"Study on New Trends in Globalisation in Shipbuilding and Marine Supplies – Consequences for European Industrial and Trade Policy"

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Abbreviations and symbols

~	circa
> <	greater or less than
AHT/S	Anchor Handling Tug Supply
BAL	BALance Technology Consulting
Balance TC	BALance Technology Consulting
bn	billion
CAGR	Compound Annual Growth Rate
CANSI	Chinese Association of National Shipbuilding Industry
CF	Cohesion Fund
CGT / cGT	compensated gross tonnage
Cons	construction
cu m(etre)	cubic metre
DTIB	Defence Technological and Industrial Base
DWT	Deadweight tonnage
EAFRD	European Agricultural Fund for Regional Development
EIB	European Investment Bank
EMFF	European Maritime and Fisheries Fund
ERA	European maritime research area
ERDF	European Regional and Structural Development Fund
ESF	European Social Fund
EU	European Union
EU 28	European Union, 28 countries
EUR	Euro
Expl	exploration
FDI	Foreign Direct Investment
FLNG	Floating LNG
FP	Framework Programme
FPSO	Floating Production & Storage Operations
FSRU	Floating Storage & Regassification Units
GBP	Pound sterling
GDP	Gross Domestic Product
GT	Gross tonnage
H2020	Horizon 2020
IMO	International Maritime Organisation
IoT	Internet of Things
IPR	Intellectual Property Right
KOSHIPA	Korean Offshore & Shipbuilding Association
k cu m	1000 cubic metre
kDWT	1000 DWT
KRW	Korean Republic Won
LNG	Liquefied natural gas
LPG	Liquefied petroleum gas
m cGT	Million compensated Gross Tonnage
mGT	Million Gross Tonnage
mDWT	Million Deadweight Tonnage
mTEU	Million Twenty-foot equivalent unit
M&A	Mergers & Acquisitions
NACE	“General Industrial Classification of Economic Activities within the European Communities”

NCCV	Non-cargo carrying vessels
NOK	Norwegian krone
OECD	Organisation for Economic Co-operation and Development
OF	Offshore vessel
OSV	Offshore support vessel
pa	per annum
PPP	Public Private Partnership project
PAX/PX	Passenger
R&D	Research and development
RDI	Research, Development and Innovation
RoRo	Roll On Roll Off
RoW	Rest of World
RTD	Research Technology & Development
SAJ	Shipbuilders' Association of Japan
SHE	Shipyard Economics
SEK	Swedish crown
SME	Small and medium enterprise
SWOT	Strength, Weaknesses, Opportunities and Threats analysis
TEU	Twenty-foot equivalent unit
TLP	Tension Leg Platform
TRL	Technology Readiness Levels
trn	trillion
UK	United Kingdom
UoM	unit of measure
US	United States
USD	US dollar
WTO	World Trade Organisation
yrs	years

0 Executive Summary – General Evaluation and Recommendations

In the ten years after the financial crisis of 2007/2008, the global shipbuilding supply chain has gone through alternating phases of dramatic downturn and improving market conditions. Continuous economic growth and related seaborne transport trends alongside positive trends in the offshore industry (due to attractive oil prices) have contributed to the positive trends and have encouraged the Chinese and South Korean shipbuilders, in particular, to extend, maintain and utilise their capacities to the full extent possible. However, towards the end of this decade, we see slowing economic growth, falling oil prices (to a critical level) and fleet overcapacity in many fleets, which lead to another fundamental crisis of world shipbuilding and also the marine industries in general.

Although it seems that a long-term demand for shipbuilding is still forecast, the market study in this report shows that for the near to mid-term, 2016-2025, the need for new orders for the commodity ship-types will remain very low. However, it should be noted that the level of global shipbuilding production that is now considered problematic, is equivalent to that of 2006 production at which time it was regarded as a healthy level. It is the balance between supply and demand that gives rise to the global shipbuilding crisis of today, and the change has been in the supply rather than the demand side. Unprecedented and speculative demand growth in the shipping sector, gave rise to expansion of shipbuilding production capacity, particularly in China and South Korea, and hence the supply-demand imbalance, despite the restructuring, closure or failure of many yards. It is not yet clear who will be the winners and losers in this situation and which yards will prevail in todays' battle for survival.

The analysis in the study leads to the conclusion that the European (EU 28) maritime technology industry, namely shipbuilders together with 1st and 2nd tier suppliers in Europe, is the leading global region in terms of aggregated *production value* of shipbuilding and ship-systems production, even though its physical level of shipbuilding production (in terms of gros tons (GT) and deadweight tons (dwt)) is low. With a calculated value of EUR 112.5 billion, the EU 28 countries represent 23.3% of the global production value for maritime technology of EUR 482,5 billion (annual average for 2010-2014). The position is even stronger, if Norway and Turkey are added to the EU 28 group. As individual nations, Germany follow Korea, China, USA and Japan in 5th position followed by Norway in 6th. United Kingdom, Italy and France follow in 8th, 9th and 10th position respectively. However, the position of Europe as whole, is only a virtual one, despite these figures, whilst there is no clear targeted European shipbuilding policy in place to offer an integrated and unified approach the international competition.

During 2015-2016, the ordering of commodity ships and offshore vessels has seen a dramatic reduction, which has affected the big shipbuilding nations in Asia, in particular, and put large parts of their industry at stake. Europe, in contrast to the global competition, in the last three years has moved into a more comfortable position when looking at the value of their shipbuilding orderbook because of its concentration on special high-tech and high value ships.

Although the European equipment industry benefits from this situation in Europe, they however also suffer from a decreasing demand from the Far East and other parts of the world, as a result of the lack of orders in these regions.

It is anticipated that the European shipbuilding market for special high-tech and high value ships, predominantly cruise ships, will come under more and more pressure over time. In the absence of an imminent improvement of the market situation for the major commodity ship-types, the market sectors for special high-tech and high value ships will face more competition. China is preparing to enter this market sector as a political objective and is keen to build-up critical capacities to serve a wider range of marine supply needs. This is not only a threat to their Asian competitors, but even

more so to the European shipyards and marine suppliers. With this mid-term prognosis, the maritime technology industry in Europe cannot feel safe or be complacent and needs to take action now. The next 10 years are likely to determine whether the European shipbuilding and marine supply chain industry can survive and grow or will decline and fail.

In comparison to the Asian competition with their targeted national shipbuilding strategies in place, the individual European shipbuilding nations seem to be too small and weak to counter these. It is therefore an utmost priority that Europe's policy, supports and maintains their marine industries' competitive advantage in high-tech shipbuilding, systems and component manufacture and sophisticated service provision. In this context, it is felt that currently there is more 'a patchwork' of differing political programmes and strategies for innovation, research, clusters, financing etc. in the EU (and individual Member States), rather than a strong and visible joint EU maritime/shipbuilding policy. This integrated approach is seen as the key to the industry's survival.

In a changing geo-political scenario, the control of the maritime domain is of the utmost importance to guarantee the defence and security of Europe. It is therefore recommended that Europe capitalizes on its current strong position, in particular, the high-tech segments and uses the next 10 years to consolidate this position for the future.

Recognising this, the study recommends deploying an overall, holistic and coherent industrial strategy specifically designed for the maritime technology industry, accompanied by truly integrated maritime policies aimed at supporting industrial growth by concrete measures. To implement such a maritime strategy, it is proposed that a political "European Maritime Co-ordinator" be nominated by the European Commission to act across the Commission programmes and services. A European maritime industrial strategy should become a key driver for the creation of a specific implementation pathway covering maritime issues and the shipbuilding supply chain - in the context of the "Juncker Action Plan". This should, in particular, target the following four points, whilst not losing sight of the other 6 action points.

- **New Stimulus for Jobs, Growth and Investment** – To enable the maritime supply chain to improve the co-operation and integration with a specific focus on SMEs. To make better use of the common EU budget and of EU financial instruments, such as the European Investment Bank (EIB), to employ those public funds available at EU level to stimulate private investment in the real maritime economy.
- **A Connected Digital Single Market** – To enable maritime industries to participate in the digitization era, maritime infrastructures need to be established covering the Economic Exclusive Zones (EEZ) of the EU Member States and also to empower networks addressing the "Internet-of-Things" of the industrial supply chains.
- **A Resilient Energy Union with a Forward-Looking Climate Change Policy** – To facilitate maritime renewable energy strategies, with their high potential to contribute to the reform of the new European Energy Union, and thereby also creating demand for new and innovative products in the shipbuilding supply chain.
- **A Deeper and Fairer Internal Market with a Strengthened Industrial Base** - To maintain and reinforce a strong and high-performing maritime industrial base for our internal market. To contribute to the "re-industrialization" of Europe and maintain global leadership in strategic sectors. Maritime technology sectors should be regarded at the same level of importance as automotive, aeronautics, engineering, space, chemicals and pharmaceutical industries. In order to achieve this for the maritime sectors it is needed to stimulate investment in new technologies, improve the business environment, ease access to markets and to finance, particularly for SMEs, and ensure that workers have the skills maritime industry needs.

In order to implement a practical, comprehensive European maritime policy, all relevant policy topics for the EU should be covered. From the list of 34 policy topics identified by the EU currently [1], policies on Enterprise, Transport, Maritime Affairs and Fishery, Foreign & Security Policy, Regional Policy and Research and Innovation all address the maritime issues with policy lines and programmes. In addition to improving and strengthening these policies, there are other important EU policies that have the potential to be more specifically aligned with the needs and contributions of the maritime industry. Without ruling other policies out, the following list give important examples:

- Trade – Building a fair and open playing field is at the heart of trade policy. Specific consideration of issues related to the maritime technology industry under the WTO and free trade agreements, has the potential to improve boundary conditions and optimise open and fair interactions between countries. This, is of particular importance, in the light of increasing national protectionism and supporting measures for the industry that have become evident in China and South Korea.
- Climate action – the contributions of maritime technologies to cut emissions and improve energy efficiency towards a low-carbon economy and 2050. In the event of unavoidable climate change, the maritime technologies will play an important role in protecting coastal areas and flood prevention.
- Environment – the contributions of maritime technologies to protect the environment and generate green growth. These include solutions to address global challenges such as to clean-up or keep clean the oceans and other water resources.
- Digital economy & society – the maritime technology industry is, like other industries, closely exploring the potential of digital technologies for their products and production. To optimise the policy objective to “drive economic growth”, it is of the utmost importance that the maritime sector becomes an integral and specific part of those measures and programmes targeting the transformation of Europe’s industrial sector and the creation of new products & services. In the digitisation of Europe’s EEZ, the marine sector should be at an equal level as respective land based initiatives.
- Space – communication and surveillance are of increasing importance for the maritime industry, when it comes to e-navigation, ship-to-shore business applications, search & rescue, autonomous ships and offshore applications, maritime traffic management, environmental surveillance of the oceans and more safety and security applications. Specific maritime application, in the context of space programmes, would be beneficial to explore and implement maritime solutions.

The alignment of policies to specific needs and potential contributions of the maritime technology industry is a complex task. To support the work of the proposed European Maritime Co-ordinator it is recommended that existing instruments such as “Leadership” be employed and their scope enhanced accordingly. Furthermore, consideration should be given to re-establishing the European Maritime Industries Forum (MIF), which ceased operation in 2011. In conjunction with industry, this may help to support the establishment of cross-over policies and effectively utilise the available EU programmes to address current industrial challenges such as digitisation, environmental friendly and sustainable shipping and to create a broader strategy for Blue Growth markets.

Based on a SWOT analysis for the industry and to complement the above, the following additional recommendations are made, targeting not only policy but also industry.

- **Framework conditions are the cornerstones for a successful marine supply chain industry globally**. Infrastructure, access to finance, skilled personnel, a multi-industry

[1] https://europa.eu/european-union/topics_en

economy with access to advanced technological developments, strong and reliable partners in the supply chain and political support are the key issues to be-addressed.

- Strengthen the policy dialogue from the administration perspective and create favourable conditions for the above-mentioned issues
- Generate and support structural improvements in the European maritime industry, i.e. stronger associations and the economic focus of maritime clusters
- To raise the knowledge base, through enhanced education and training, to the level needed to facilitate preparation and implementation of technology driven innovation in products and processes (e.g. Internet of Things, Maritime 4.0).
- Align work on regulations and research to create markets based on innovation in a time-co-ordinated fashion
- Motivate a larger group of maritime industry stakeholders to participate in the EU co-ordinated efforts

- **Access to international markets** is of crucial importance for the European maritime technology industry, which is by nature globally oriented, export-driven and at the core of international production networks.
  - Create and integrate maritime sectoral agreements into trade agreements with third countries to ensure new market opportunities for the European maritime technology industry
  - Ensure transparency of regulations and government measures in third countries, with robust IPR protection enforcement regimes as well as effective reciprocity in the treatment of investments and public procurement
  - Establish cross-over joint industry groups to enhance system capabilities
  - Agree on joint European initiatives to strengthen extra EU-28 export activities and to facilitate access to new emerging markets
  - Support regulation-driven innovative markets
  - Support emerging “Blue Growth” markets - generate reference markets
- **Integrated supply chain management** and mastering inter-related production logistics between shipyard and suppliers, are key success factors in building complex high-value vessels.
  - Maintenance and vitalization of European maritime supply markets including markets in important European regions and focused especially on subcontractors
  - Improve competitiveness in value chains – strengthen the competitive integration of suppliers into the supply chain of their customers
  - Create programme framework conditions for “Internet of things / Industry 4.0 strategies and implementation measures for industrial supply chains
  - Focus maritime cluster strategies on the enabling of industrial supply chains
- **Research and innovation** is a centre-piece of the European maritime sector triggering the capacity of EU companies to: develop new ship concepts and system technologies; implement game-changing technologies onboard; and support continuous improvement of processes.
  - Continued and expanded financial support for investments in RDI through existing and future European and regional instruments and framework programmes.
  - Open-up possibilities for more “lighthouse”-projects addressing multi technical challenges covering the wide variety of shipboard systems and ship integration challenges
  - Blue Growth research topics should be strengthened and aligned with industrial growth aspects

- Refocus large PPP projects on top-down initiatives and align them with social needs and building industrial leadership
- Think about a dedicated European maritime research area (ERA) for industrial research more specifically in combination with enhanced cluster strategies
- Move programme research objectives from lower Technology Readiness Levels (TRL) towards innovation activities by ensuring a high market uptake and impact of results.
- Support and enhance the role of “first-movers” and SMEs by continuing to strive to reduce the administration associated with applying for funding and managing existing grants.
- Create opportunities for cross-fertilisation between civil and military technologies
- Preparation of the next (9th) Framework Programme with a stronger strategic focus on the needs and requirements of the European maritime industry

1 Introduction - Objectives and approach

The objective of this study is to create an overview of the global shipbuilding supply chain industry, covering basic economic and company characteristics, and including available products and services. It evaluates national competitive market positions and tries to identify new trends in globalisation and the consequences for European Industrial and Trade Policy. The study also makes some recommendations for the support of the industrial sector. Finally, it identifies a number of global players in the shipbuilding supply chain and describes their activities and position in the supply chain.

As a basis for analysing shipbuilding supply chains, the authors define the elements and players of such a structure and describe the principle of co-operation. The study builds on a harmonised structure for systems, equipment components, materials and services as that used by the authors in a previous study, thus providing the basis for statistical analysis, extrapolation and evaluation.

At the outset, this report provides a dedicated forecast for the shipbuilding market covering 21 different ship types for the next 10 years, i.e. covering the period 2016-2025. This forecast builds on a multi-dimensional analysis of the existing fleet size and growth forecasts for each different ship type and discusses individual market trends for these. It further compares the existing orderbook with the projected market requirement per ship type and the expected market ordering activities for the next 10 years. Based on this, the study identifies the projected value-added by the shipyards and the related purchasing volumes per trade and ship type. It identifies which countries create the strongest purchasing demand in relation to ship types and which countries are the major providers of equipment and services.

In order to provide a comprehensive retrospective overview on the development of the industry, the study makes use of averaged statistical data for industrial groups available in different public databases, i.e. Eurostat, OECD, national statistics etc. This is supplemented with information provided by suppliers, industrial associations, customers and classification societies. Since no single data source alone can create comprehensive and reliable results, these different sources and approaches to data collection are used in conjunction with one another. In this fashion, this report provides an updated retrospective view on the economic performance of the shipbuilding supply chain, i.e. shipbuilding, boatbuilding repair and related supply industry and services. This retrospective view on the economic performance mainly covers the period of 2010 to 2014 and gives average values for major shipbuilding countries.

With regard to the consolidation of industrial players in the shipbuilding supply chain, the study identifies a representative selection of individual companies which actively apply globalisation practices, e.g. by M&A activities or establishing global networks for their production and services.

This said, it should be recognised that the current critical situation in the shipbuilding industry as a whole, but especially in Asia and for all commodity ship types, means that it is not easy to collect information or to generate stable results. The situation changes rapidly and it is never possible to forecast when it will stabilise again. Inevitably this will affect the global shipbuilding scenario for the next 10 years. Whilst the current situation for commodity ship-types shows an extremely difficult situation in respect of ordering activity, European shipbuilding sees a more favourable position - at least with regard to those specific ship types which comprise the high value market sector. However, in the mid-term (i.e. 10 years +) this may also come under threat since Asian competition (in particular China) has dynamic plans to try to enter into these remaining market segments.

2 The shipbuilding supply chain

2.1 Shipbuilding Markets in the supply chain

Shipbuilding supply chain industries comprise shipyards, boatyards, system and component suppliers and many different kinds of subcontracts and services. The major markets at the top end of the shipbuilding value chain and those creating the purchasing demand can be identified as follows:

- Newbuilding of merchant ships and offshore ships (shipyards, boatyards and shipping companies)
- Ship repair and conversion of merchant ships (shipyards, boatyards and shipping companies)
- Retrofitting - a special refit and conversion market for ships, typically following new regulations (shipyards, boatyards and shipping companies)
- Offshore platforms, jack-ups etc. for oil and gas (offshore yards and shipyards, oil and gas companies/operators)
- Offshore facilities, plants for offshore wind applications (offshore yards and shipyards, offshore wind operators and wind farm developers)
- Naval shipbuilding, maintenance and repair (shipyards and governments)
- Boatbuilding (boatyards, shipyards)
- Other marine and maritime markets, e.g. underwater services, traffic and environmental surveillance, safety and security markets, harbour technologies, shipyard equipment, special polar markets and (governments, ship/offshore operators, port developer etc.) – these markets are not considered in the course of this study

Although these markets as such can be identified quite well, the customer bases for them overlap to a certain extend. Some parts of the supply chain also appear at different times along the life cycle of products, e.g. when equipment has to be replaced. Other, like retrofitting may only apply for certain time periods (when new regulation requires special conversion) and are probably difficult to distinguish from the normal repair and conversion markets, driven by regular operational needs.

When it comes down to the building of major yachts or smaller specialized vessels, the distinction between boatbuilding and shipbuilding become fuzzy, especially when shipyards/boatyards are operating in both markets. For suppliers, it is also often necessary to serve both the builder of the final product (ship, offshore unit) and at the same time at the owner of the product, since decisions with regard to major outfitting systems and components may be taken by the owners.

Additional Note: Data on purchasing values by shipyards and boatyards in public statistics do not solely include end-product related equipment, systems and many different kinds of subcontracts and services, but also the energy, equipment and services which are needed to operate the manufacturing site. This type of supply is however not regarded as part of the supply chain for the building or maintaining of ships, boats and offshore products and hence is not part of the study and so it will not be further discussed. In the statistical analysis, further down in the report, purchasing values taken from statistics have been corrected to take this element into account.

2.2 Structure and patterns of the shipbuilding supply chain

The shipbuilding industry and related marine supplies industry is a comparably fragmented industry. At the top end of the shipbuilding supply chain there are numerous shipyards and boatyards which cover a wide range of company sizes ranging from small privately-owned boatyards with only a few employees up to global operating companies with many thousand employees. However, they all work according to the same principle by purchasing raw materials and equipment from different national and international sources and then by adding a certain amount to the value of production by themselves or through sub-contractors.

The suppliers themselves may serve the shipyards and boatyards in their national markets, but also other national markets such as the shipowners, navies offshore operators directly and foreign shipyards / boatyards. So, in addition to domestic production, they provide products and services for the international market through export sales. *Figure 1* below shows this diagrammatically.

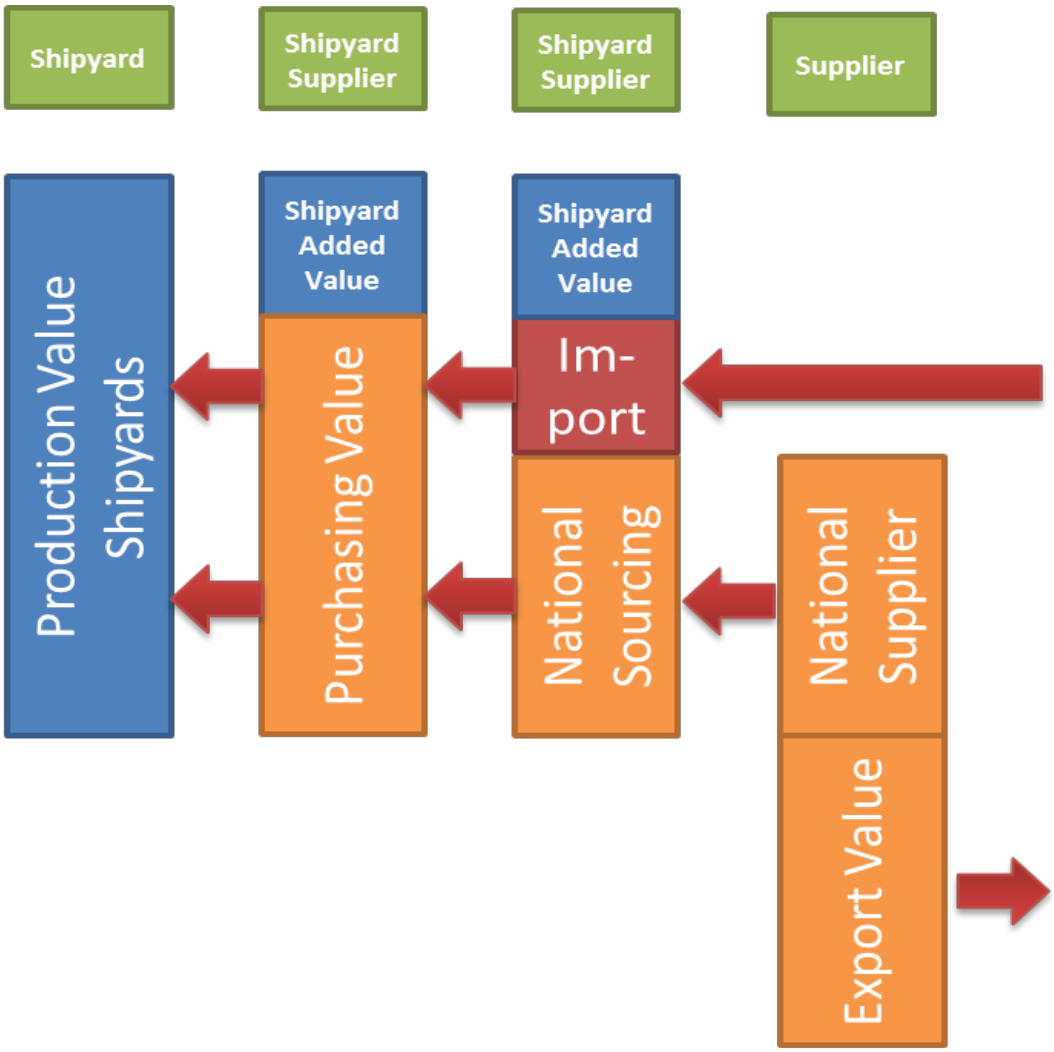


Figure 1: Horizontal and vertical co-operation between shipyards and suppliers, [Source: BALance TC]

Figure 2 provides a more complex illustration of the supply chain. This highlights the involvement of 1st and 2nd tier suppliers within the value chain and distinguishes further import and export markets with Europe and the rest of the world respectively.

These principles have been used to analyse and extrapolate existing statistical data to compile the country portfolios (*see chapter 4*).

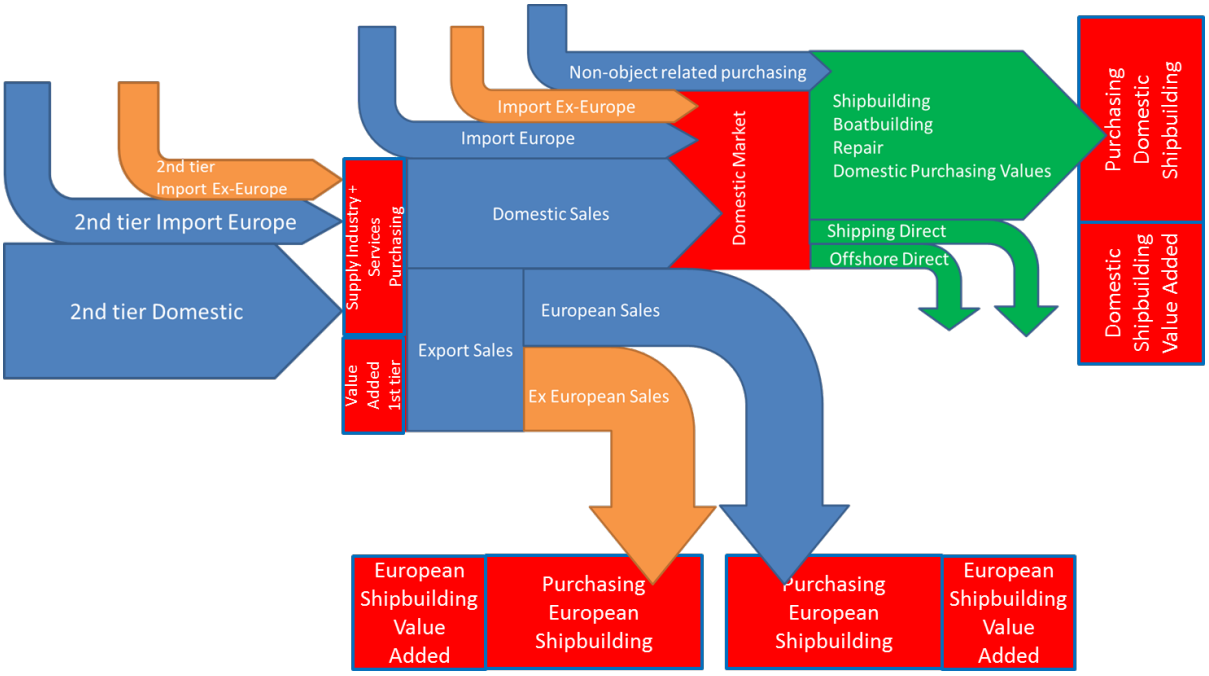


Figure 2: Value chain model for statistical evaluation
[Source: BALance 2015]

For suppliers, we further distinguish between suppliers of material, components and systems on the one hand and subcontractors on the other hand. Specifically, the following definitions have been used to distinguish between marine suppliers and subcontractors:

A. Marine suppliers are characterised by the fact that they develop functions or systems according to their own patents and techniques and they operate by respecting the specifications and terms of references defined by the customer for complete products or subassemblies. Marine suppliers can be found as “system suppliers”, “component suppliers” and “material suppliers”. These companies in most cases also serve customers from non-maritime industry sectors.

B. Marine subcontracting happens when the customer participates in the conceptual development of the product, by (even partially) providing specifications to the manufacturer, potentially ranging from detailed technical plans down to looser specifications. Marine subcontractors are subdivided between in those offering services for “manufacturing and assembly” and those offering services in the areas of “engineering, design and consulting”. The latter applies to all shipyards employing classification societies, model basins, naval architects and any other kind of engineering services, whereas the former relate to the overall building philosophy of shipyards and the extent to which they have applied outsourcing strategies for trades, which historically were undertaken in-house.

NOTE: Labour contracting which forms part of purchased material, systems and components cannot be identified separately and hence a grey zone exists between category A and B of the suppliers.

In relation to suppliers in particular, there are some companies which are major players in their technological fields of systems and components such as marine equipment and systems manufacturers which serve several marine markets often internationally and regionally as well as domestically. These specialised marine equipment and systems manufacturers can often be identified by the fact that they have type approvals with one or more classification societies.

We can also identify a very large number of suppliers, which tend to serve only domestic or localised cross-border markets and seldom serve more distant regional markets. During the 1990s many such companies were created following extensive outsourcing by shipyards. This decreased the level of value added by the shipyards themselves and at the same time increased their relative purchasing value, (as shown in the statistical analysis in this report). These suppliers are heavily dependent on the national or localised regional economic development of maritime markets.

From a globalised market perspective, the shipbuilding and offshore system and equipment supplies industry can be divided into the following types of companies:

- Global (maritime) market leaders for one or more technological sub-sectors which basically serve the maritime and offshore market.
- Global technological specialist companies with significant maritime revenue shares, but also significant supplies to other industrial sectors.
- Maritime specialist companies that serve essentially only the maritime and offshore market in Europe as well as worldwide. These companies may serve either one or several maritime sub-markets.
- Industrial generalists with lower maritime revenue shares but still significant global maritime market shares.

Forms of co-operation in the supply chain

Within the shipbuilding supply chain both horizontal and vertical co-operation co-exist between shipyards and both suppliers and subcontractors. Vertical co-operation exists as a result of the high complexity and fragmentation of the products and sub-products whereas horizontal co-operation between shipyards (or comparable manufacturers of turn-key modules) exists for capacity or delivery reasons *(see Figure 3)*.

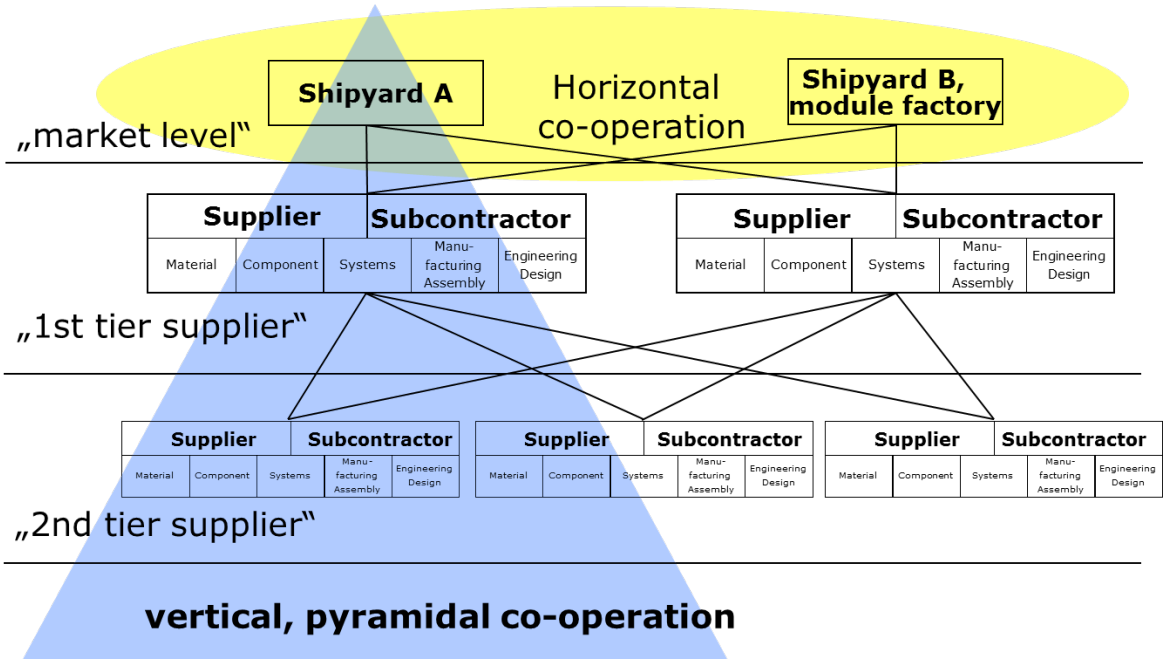


Figure 3: Horizontal and vertical co-operation between shipyards and suppliers [Source: (BALance Technology Consulting et al, 2014)]

The difference between these may be explained as follows:

Horizontal co-operation between shipyards

Horizontal co-operation in the sector by shipyards occurs to a greater extent than in other industries. Shipbuilding involves important subcontract relationships between the main contractors themselves. Hence, a main contractor, after having won an important contract, may entrust to another main contractors part of the work on that contract which his own production capacity cannot meet. Input-output statistics for the shipbuilding industry indicate that 5-10% of the reported turnover has been bought-in from the same industry sector in this fashion, i.e. artificially increasing the statistical size of the industry sector.

The sector is in fact characterised by long development phases and long manufacturing cycles (for example 12 – 24 months for merchant vessels, 24 – 36 months for passenger vessels). This can lead to alternating periods of full capacity on the one hand with periods of spare capacities on the other. Subcontracting between shipyards also helps reduce temporary over or under-capacity of labour.

Vertical co-operation

This reflects the obvious demarcation between shipyards and major system suppliers (e.g. engine manufacturers) which includes main contractors at the 2nd level and the other parties on the following levels, although, the distinction is not always easy to establish with these. The distinction between equipment suppliers (components and systems) and subcontractors can be especially difficult. Where either a technical or commercial responsibility can be identified with regard to products or components it may be better to classify the supplier as a component manufacturer rather a subcontractor.

The continuous fragmentation (e.g. through outsourcing) and also internationalisation of the supply chain results in varying distribution of production values between the different steps of the value chain. As illustrated in Figure 4, the distribution of the workload in the supply chain can be roughly assigned as: +/- 30% to the shipyards, +/- 40% to the material suppliers (including components and systems) and +/- 30% to subcontractors.

Within this work-distribution all kinds of combinations exist. The recent trend by component/system suppliers to establish remote assembly firms has increased globalisation. These manufacturing units are remotely located close to major customer markets to provide a convenient supply in close vicinity of the shipyards doing the final assembly work and at the same time may fulfil required local content values.

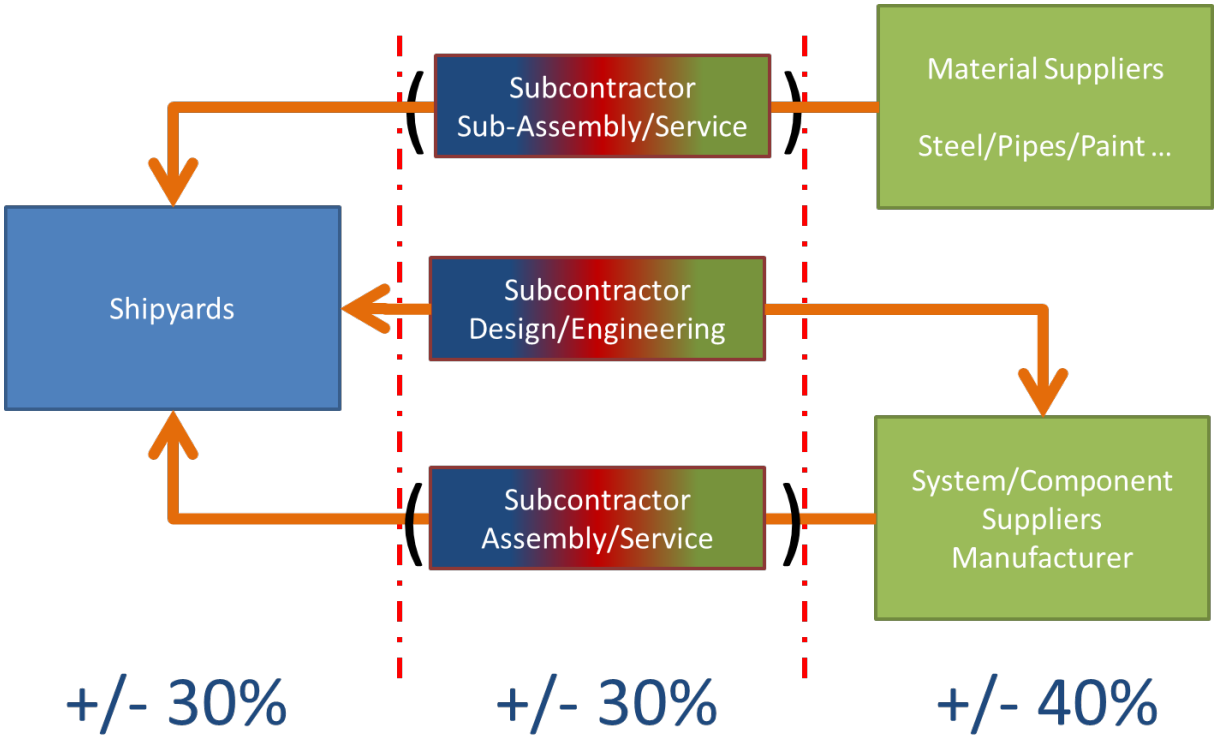


Figure 4: Value chains in shipbuilding: More fragmentation and globalisation
[Source: BALance TC]

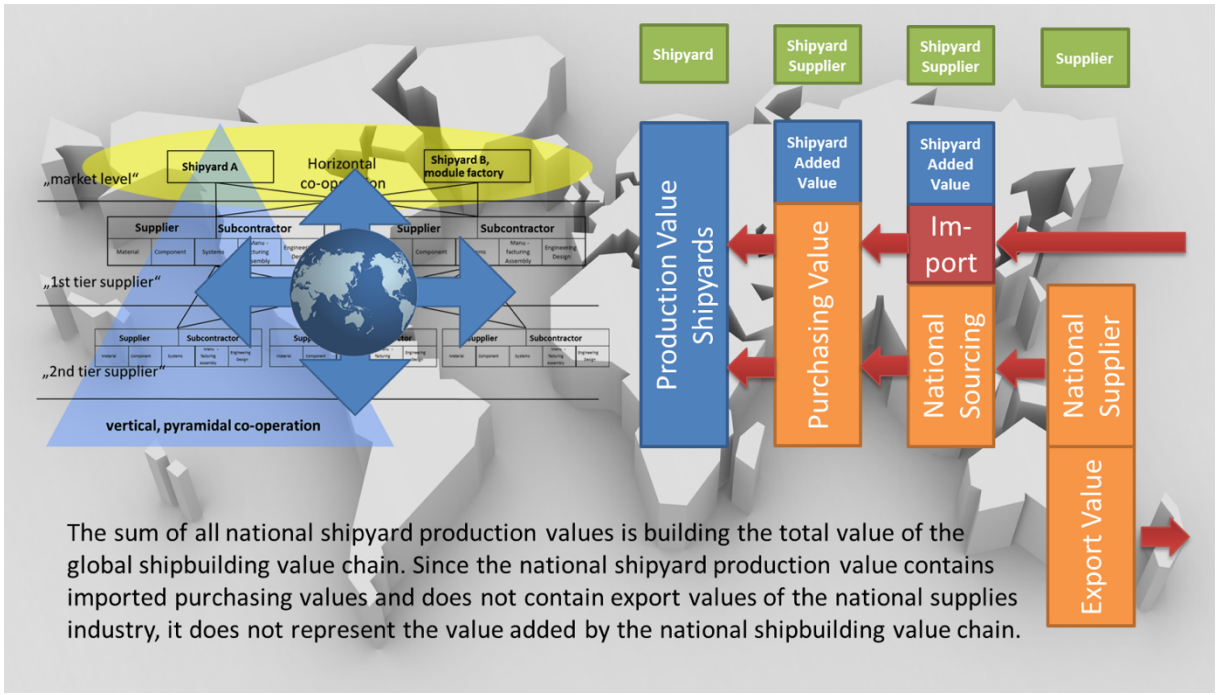


Figure 5: Major 1st tier suppliers consolidate and grow and globalise their supply chains
[Source: BALance TC]

The equipment manufacturers are affected by a similar economic cyclicality as the shipyards and their maritime customers. When a slump in orders occurs, they are all equally affected, resulting in adaption of production plans, decreases in investment and s reductions in subcontracting. However, the effects can differ between those suppliers serving global market and a wide range of marine sectors and those serving regional markets, the latter will be affected by both overall global

demand and also regional distribution (particularly European suppliers) whereas the global players are not so affected by regional variations.

When comparing the supply chain structures of the shipbuilding/marine industry with those of other industries major differences are evident in the pyramidal structure distribution. Whereas, there are still more than 50 European shipyards with 500+ employees out of 150 in total, in the automotive sector there are approximately 15 and in the aerospace industry less than 5.

Amongst the 1st tier suppliers and subcontractors the situation is similar. Whereas in automotive and aerospace industry the manufacturers progressively concentrate on “platform suppliers” with less than 500 suppliers at that level (or < 200 in Japan) the shipyards still work with a much higher number of suppliers and subcontractors directly. This can lead to between 1000 – 2500 companies in the purchasing database (depending on company size and ship-types). Products and industry specific requirements are different and supply chains for serial products are more deterministic than for shipbuilding.

There is no formal structure available which classifies the heterogeneous marine supply into dedicated categories. Those parties which try to apply a suitable categorisation adopt different solutions which reflect their own interests. Hence, all information about marine equipment and materials provided, for example, by national associations, classification societies trade fairs etc. is structured differently and so difficult to compare. Names of products and services are chosen differently, higher aggregated groupings are compiled differently and also the assignment of individual companies may be seen differently by the interested parties.

Therefore, this study is built on a harmonised structure which follows the functional or system oriented view used by the shipyards and shipowners that are the major customers. With some adjustment (especially for materials and the different areas of subcontracting) a total of 19 system groups have been identified which includes 69 sub-groups for equipment, 10 sub-groups for materials and 16 sub-groups for subcontracting.

It is recognised that this, already quite complex structure, may not cover all possible aspects of maritime systems, especially those for offshore operation (production, processing, drilling, exploration etc.) which may not be sufficiently mapped. However, this structure shows on the one hand the complexity of maritime systems and components and on the other hand provides a means to evaluate which industry sectors are involved in maritime supplies. This structure allows a mapping into the systematic statistical systems, which at least identifies those statistical industry categories including maritime supplies. In Europe, the system is called the “General Industrial Classification of Economic Activities within the European Communities” (NACE). Version NACE 1.1. applied until 2007/2008, followed by the revised NACE 2.0 since then. Unfortunately, these versions use slightly different classification keys and the data for the transition year 2008 show still some inconsistencies which are under discussion between the authors and Eurostat.

A previous study by the authors[2] provides further information regarding the application of NACE 1.1 and NACE 2.0 system groups for shipbuilding and maritime industries. including the full list of categories. Table 1 shows the logical linkages between the system groups and subgroups as applied for the marine supplies industry, which has facilitated improved industrial sectoral analysis using the statistical data of companies and industrial sectors available from national or European databases for analysis at higher aggregation levels.

[2] BALance TC: “Competitive Position and Future Opportunities of the European Marine Supplies Industry”, Study for the EU 2014

Marine Supplies "Systems Groups", "Systems"		Marine Supplies Group "Component", "Service"		Description "Component", "Service"	NACE Revision 1 4 digits		Description	NACE Revision 2 4 digits		Description
1 Propulsion Systems, Power Generating Systems		11	Dieselengine	Complete dieselengine Cylinder covers Spare parts Crank cases Camshafts Cylinder lubricating devices Tachometers Local instrument panels Special tools Turbochargers Vibration dampers	2911	Manufacture of engines and turbines, exept aircraft, vehicle and cycle engines	Dieselengines Parts of dieselengines Marine propulsion compression-ignition engines	2811 3312	Manufacture of engines and turbines, except aircraft, vehicle and cycle engines (excluding repair) Repair of machinery	Manufacture of internal combustion pstion engines for marine and railw ay Manufacture osf patrs of internal combustion pstion engines for marine and railw ay
		12	Steam turbine	Complete steam turbine Speed governors Main condensers Vacuum pumps Vacuum electors	2911	Manufacture of engines and turbines, exept aircraft, vehicle and cycle engines	Steam and other vapour turbines Steam turbines for generation of electricity Parts of vapour turbines	2811 3312	Manufacture of engines and turbines, exept aircraft, vehicle and cycle engines Repair of machinery	Steam and other vapour turbines and parts of it Hydraulic turbines, w aterw heels and regulators thereof and pats of it w ind turbines and parts of it
	1. Two Stroke Diesel Propulsion Systems 2. Four Stroke Diesel Propulsion Systems 3. Steam Turbine Propulsion Systems 4. Gas Turbine Propulsion Systems 5. Diesel-, Turbo Electric Propulsion Systems 6. POD Systems 7. CODAG Systems 8. COGES Systems	13	Gas turbine	Complete main gas turbine aggregates Pow er turbines Combustion chambers Compressor machines Starting machinery	2911	Manufacture of engines and turbines, exept aircraft, vehicle and cycle engines	Gas turbines other than turbo-jets and turbo-propellers Parts of gas turbines (excl. turbo-jets and turbo-propellers	2811 3312	Manufacture of engines and turbines, exept aircraft, vehicle and cycle engines Repair of machinery	Gas turbines other than turbo-jets and turbo-propellers Parts of gas turbines (excl. turbo-jets and turbo-propellers
		14	Gears and couplings	Turning gear Starting gear Complete main reduction gears Main reduction gear casings, foundations, bolts Central gear plants Central gears Central gear couplings	2914	Manufacture of bearings, gears, gearing and driving elements	Gears Gear boxes and other speed chargers Clutches and shaft couplings	2815 3312	Manufacture of bearings, gears, gearing and driving elements Repair of machinery	Gears Gear boxes and other speed chargers Clutches and shaft couplings
		15	Propeller	Propulsion propellers Controllable pitch propellers Propeller nuts Rope guards Propeller blades	2875	Manufacture of other fabricated metal products n.e.c.	Ships' or boats' propellers and blades therefor	2571 3311	Manufacture of other fabricated metal products Repair of fabricated metal products	Ships' or boats' propellers and blades therefor
		16	Shafts and bearings	Thrust shafts/bearings Turbine shafts Turbine main/trust bearings Propeller shafts Shaft bearings Shaft seals Gear w heels, shafts, bearings	2914	Manufacture of bearings, gears, gearing and driving elements	Ball bearings Roller bearings Cranks and crankshafts Other transmission shafts Bearing housings Other transmission elements Parts of ball or roller bearings Parts of bearing housings	2815 3312	Manufacture of bearings, gears, gearing and driving elements Repair of machinery	Roller bearings and Roller bearings and parts of Cranks and crankshafts Bearing housings and parts of Other transmission shafts Other transmission elements
		~~31~~ 17	Electrical Engines	Propulsion el. motors Gyropropeller el. Motors POD Sets	3110	Manufacture of electric motors, generators and transformers	DC motors and generators AC motors and generators	2711 3314	Manufacture of electric motors, generators and transformers Repair of electrical equipment	DC motors and generators AC motors and generators AC/DC Repair and maintenance of electrical motors
		18	Alternate Propulsors	Water Jets	2912	Manufacture of pumps and compressors		2813 3312	Manufacture of pumps and compressors 	Non-hydraulic equipment; except repair Repair of machinery

Table 1: Marine supplies industry structure (Example)
[Source: (BALance Technology Consulting et al, 2014)

The defined structure of system groups, however, has been regarded as too complex for market analysis purposes, especially when it comes down to single ship-types and the likelihood of obtain in such detailed data from shipyards or owners. Therefore, this study has applied the same simplified structure used by the previous study, which identifies 3 classes (services/subcontracts, materials, systems/equipment) and 10 system groups of marine supplies for the evaluation of market volumes, focussed on the ship newbuilding market.

The list below summarises these by the examples shown in brackets:

1. **External services and subcontracts** - only engineering, design and consulting services are covered, because subcontracts for manufacturing or assembly in most cases are integrated in post-calculation data of material supplies or system/ equipment supplies, i.e. these are included in the following subcategories.
2. **Materials – Steel** (half raw materials, subassemblies)
3. **Materials – Pipes and ducts** (half raw materials, subassemblies)
4. **Materials – Paint, coating** (paints, painting services)
5. **Systems / Equipment – Ship operation** (steering gear, anchor, deck machinery, lifesaving equipment, MARPOL equipment, general outfitting components)
6. **Systems / Equipment - Cargo handling equipment and special cargo plants** (cranes, sucker, conveyors, cargo lift, hatch covers, Ro-Ro doors and ramps, trailerlifts, cargohold outfitting and fittings, HVAC for cargo holds, LNG/LPG plants, fishing vessel equipment, special equipment for dredgers, offshore ships equipment - production, processing, drilling, exploration, etc.)

7. **Systems / Equipment – Accommodation** (pre-prepared cabins, doors, windows, walls, ceilings, coverings, floor coverings, carpets, staircases, railings, lifts, sanitary rooms, swimming pool equipment, accessories, equipment for pantry, bar, restaurant, food storage, laundry, furniture and decoration etc.)
8. **Systems / Equipment - Propulsion, power generation** (diesel engines, boiler, steam turbines, gas turbines, gears and couplings, propeller, shaft and bearings, accessories, auxiliary engines (diesel), auxiliary boilers, etc.)
9. **Systems / /Equipment - Auxiliary systems, apparatus & accessories for engine operation, ship operation, cargo handling, accommodation** (seawater cooling, fresh water cooling, fuel systems, lub oil systems, exhaust system, engine starting system, steam systems, heating systems, ballast water, firefighting, deck washing, pressurized air, tank heating, cargo hold heating and cooling, cargo pumps, inert gas plants, tank cleaning, tank heating, drinking water, sanitation hot/cold-water/sewage, HVAC, waste disposal, swimming pool technology, general engine room outfitting, roll-damping, anti-heeling systems, active stabilizers, etc.)
10. **Systems / Equipment - Electrical plants and electronic systems** (main plants, generators, batteries, cable trays, cables, fittings, e-engines, lighting (all rooms and decks), electrical heating, alarm and control systems (ship automation, remote engine control, monitoring, heating, cargo control, communication systems, nautical equipment (compass, radar, log, sat receiver, ECDIS, weather plotter), navigational lighting, entertainment systems (audio, video, cinema, theatre, meeting rooms, hotel management, clocks))

Utilising this simplified structure, the authors have applied ship cost models for 21 ship-types, based on a number of built ships and further information from shipyards and publications. These cost models are used to evaluate the relative values of ship supplies per ship-type based on the orderbook/forecast scenario as outlined later in the study.

3 Market forecast shipbuilding supply chain 2016 – 2025

3.1 Summary of market values for maritime supply chains 2016-2025

Earlier studies and analytical work[3] suggest that the expected combined global production value of maritime end producers (shipyards, boatyards, system integrators, maritime infrastructure integrators etc.) and suppliers of all kinds generate an average annual value of more than USD 365 billion annually (period 2013-2017). *Figure 6* shows how this splits between these two main categories.

Within these figures shipbuilding of merchant ships over 500 GT accounts for an average annual production value of USD 82 billion (42% of USD 197 billion) and the related marine supplies industry for a value of USD 50.4 billion (30% of USD 169 billion). Both these major sectors serve end user markets such as shipping companies, offshore operators, ports, administrations etc. However, neither of these figures includes values for their second-tier suppliers, which may add an additional total production value of USD 100-120 billion and boost the overall figure of aggregated production volumes to about USD 475 billion.

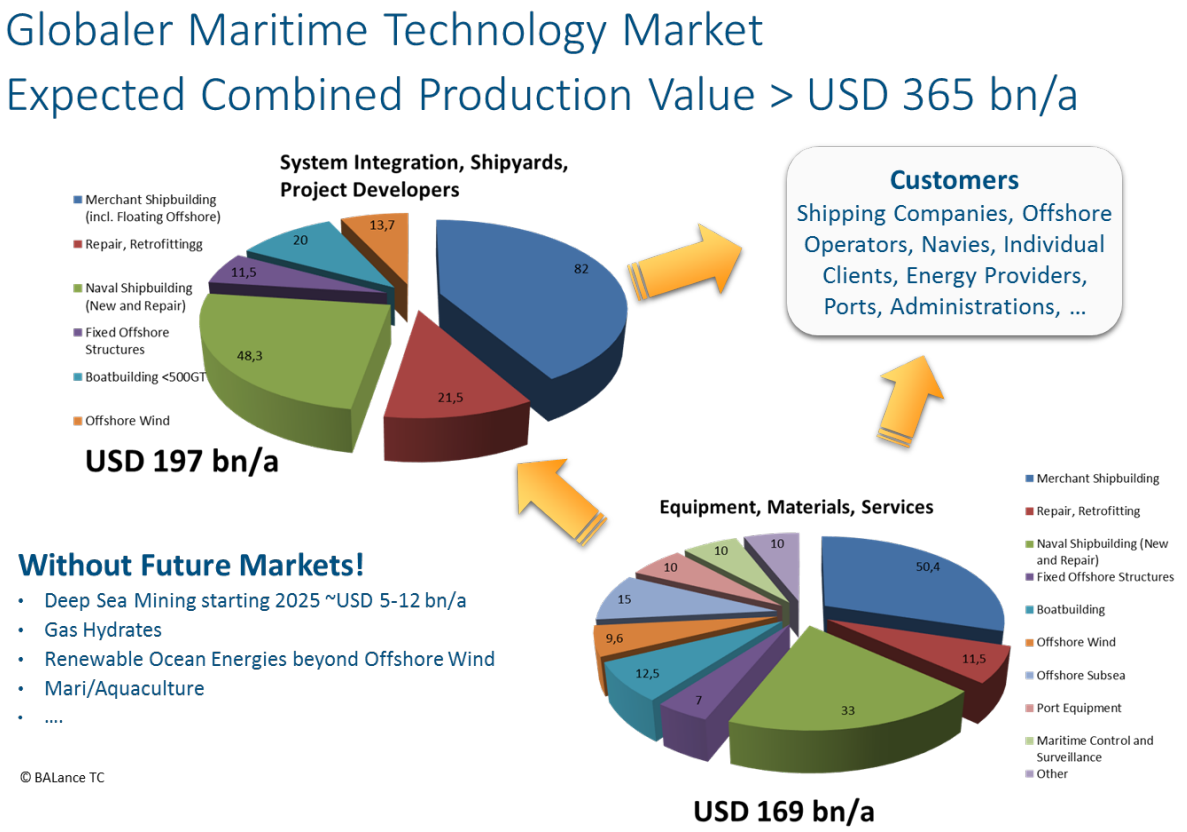


Figure 6: Global Maritime Technology Market (average annual forecast 2013-2017) [Source BALance TC]

Within this study, the merchant shipbuilding figures and related supplies have been re-valued and an updated overall forecast for the period 2016-2025 has been generated which is outlined in the following subchapters. The outcome of this, it should be noted, is an updated overall demand

[3] BALance TC: "Competitive Position and Future Opportunities of the European Marine Supplies Industry", Study for the EU 2014 and Analytics for the German National Masterplan on maritime Technologies

forecast comprising a lower number of average demand in terms of DWT and GT (approx. -10%), but a higher demand in terms of number of ships and monetary value.

This arises from a different demand mix in terms of the ship-type portfolio with less commodity ships (tankers, container, bulk carrier) and more smaller and high technology ships.

This updated forecast results in an overall increase in shipbuilding expected value to USD 91 billion (plus ~11%) and a 12.5% increase of the related marine supplies value to USD 56.7 billion/a. This value increase reflects the trend towards more technically demanding ship-types, of higher specific value and which generate demand/forecast figures for marine supplies which are proportionally higher in market value terms. These results are further outlined in the following sub-chapters.

Maritime markets outside the merchant shipbuilding market would need further analysis in order to justify the other figures as given in the above analysis. However, it is expected that these figures can still be used as a reference, although some markets actually show some weakening due to the general market situation (especially offshore oil and gas). Due to the importance of naval vessels for the European maritime technology industry, we have included under chapter 3.7 a discussion on this market

3.2 Baseline - Economic drivers GDP and seaborne transport

The primary driver for creating demand for ships and marine supplies remains the global development of GDP in the developed countries and also, if not more important nowadays, the GDP development in emerging economies and non-OECD countries, such as China, India, Brazil etc. The development of world seaborne trade has to be seen in direct relation to the development of GDP, but is also influenced by some geographical relocation of major maritime routes.

After years of strong global growth until 2007, averaging approx. 5% growth rates, the financial crisis in 2008 caused a major drawback of economic developments in 2008 and 2009 with a decline of the average global growth rates to 0%, with the advanced economies (USA, Euro-Zone and Japan) on average even dropping into a recession. However, in 2010 world GDP growth showed a surprisingly strong revitalization to about 5%, in our view this was also to compensate for some of the draw-backs from 2008 and 2009 *(Figure 7)*. In the future years and also related to latest forecast scenarios by World Bank and International Monetary Fund, the world GDP will show continuous growth in the average range of 3-4%, still very much driven by the sustained upturn of the emerging economies, driven by general development dynamics, long term population growth and positive consumer climate. The relative GDP growth for the advanced economies remains at a stable low level, but contributes to the positive trend in absolute figures. See the two figures *(*Figure 7, *Figure 8, Figure 9)* below on GDP growth, one offering a timely forecast until 2018, the other a geographical view on the GDP growth expectations.

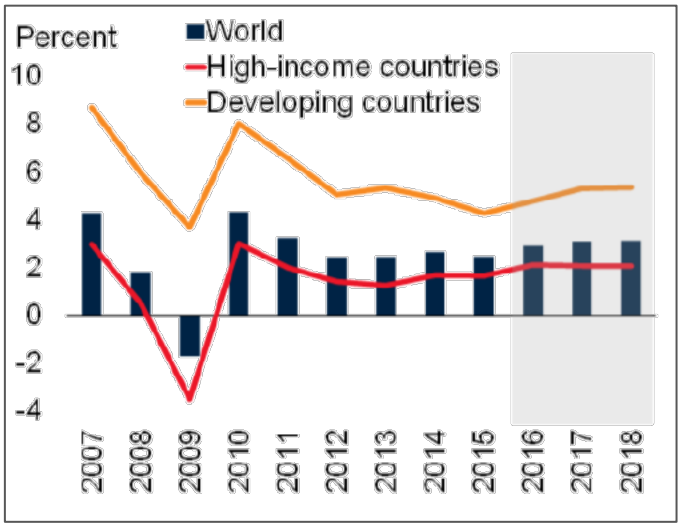
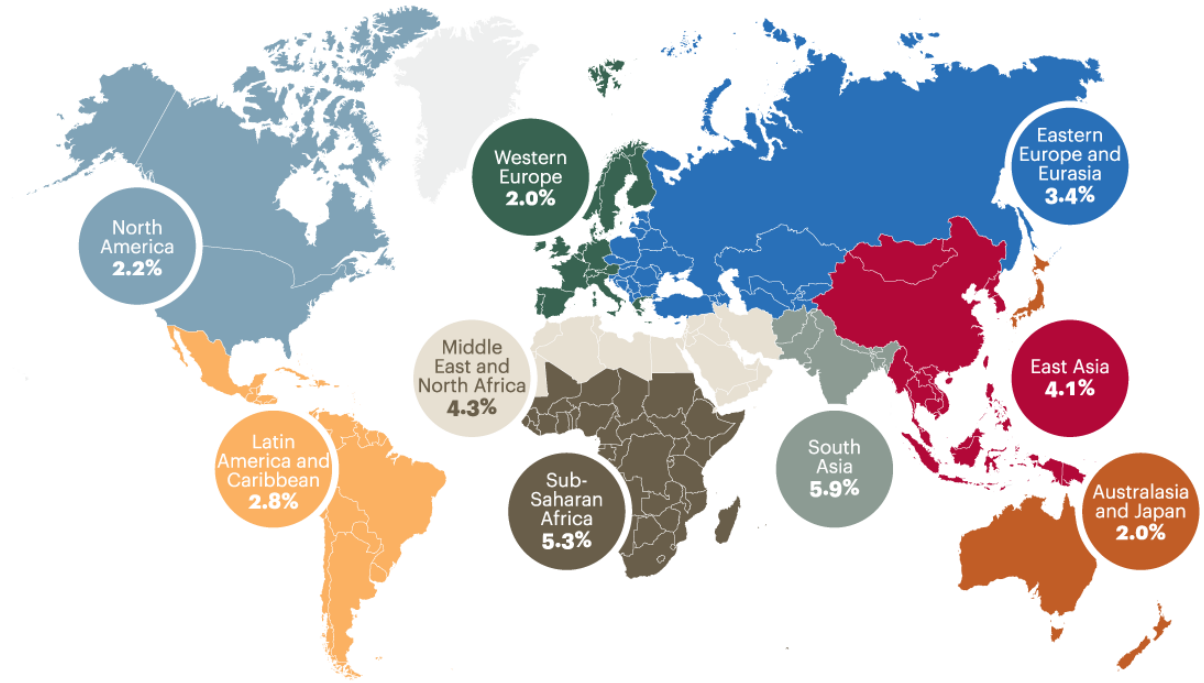


Figure 7: Global Economic Prospects
[Source: (Lloyd's Register, 2013)]

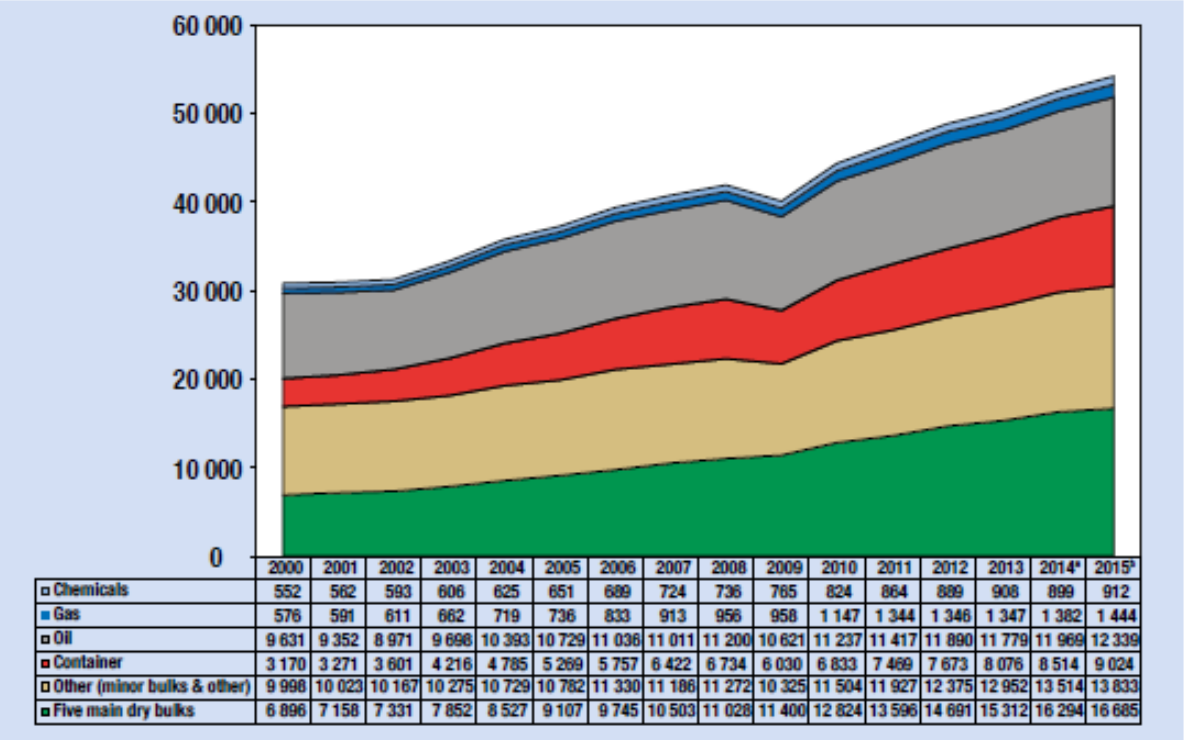
Regional growth rates vary, with South Asia and Sub-Saharan Africa leading the pack

Real GDP growth
%, 2016–2020 annual average



Notes: GDP figures are the unweighted average of the forecast annual growth rates of the economies within each region between 2016 and 2020. GDP growth is measured at constant prices.
Sources: International Monetary Fund World Economic Outlook (October 2015 and January 2016); A.T. Kearney analysis

Figure 8: GDP growth forecast 2013
[Source: (International Monetary Fund - IMF, 2013)]



	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014[a]	2015[b]
Chemicals	552	562	593	606	625	651	689	724	736	765	824	864	889	908	899	912
Gas	576	591	611	662	719	736	833	913	956	958	1 147	1 344	1 346	1 347	1 382	1 444
Oil	9 631	9 352	8 971	9 698	10 393	10 729	11 036	11 011	11 200	10 621	11 237	11 417	11 890	11 779	11 969	12 339
Container	3 170	3 271	3 601	4 216	4 785	5 269	5 757	6 422	6 734	6 030	6 833	7 469	7 673	8 076	8 514	9 024
Other (minor bulks & other)	9 998	10 023	10 167	10 275	10 729	10 782	11 330	11 186	11 272	10 325	11 504	11 927	12 375	12 952	13 514	13 833
Five main dry bulks	6 896	7 158	7 331	7 852	8 527	9 107	9 745	10 503	11 028	11 400	12 824	13 596	14 691	15 312	16 294	16 685

Figure 9: World seaborne trade
[Source: (UNCTAD, 2013)]

Following the development of GDP over time, world seaborne trade showed a major decline in 2009 by about 4.5% (10% for container shipping only), but picked-up again in 2010 showing continuous growth until 2014 and 2015 (*Figure 10*). However, observation over a longer timely period shows that the continuous average growth of seaborne trade is in line with the long-term pattern of the economic growth. The related development and forecast for the world fleet growth by "LR Global Maritime Outlook 2030" suggests annual CAGR factors of 3.5% as average figures, which is in line with other long-term forecasts. The study says "World fleet grew on average 7.4% per year during 2004-2011, compared with world seaborne trade growth of 3.9% over the same period. Although world fleet growth is expected to slow down to approximately 3.5% per year up to 2020, world seaborne trade will still grow at a similar rate of 3.7%."

The effect of the economic crisis is that in the transition from 2008 to 2009 the capacity demand from seaborne trade dropped whilst the capacity of the world fleet increased. This effect of tonnage overcapacity is still in place and is further increasing due to the delivery of the huge shipbuilding orderbook existing at the end of 2007 for deliveries until 2012 and even until 2015 in some cases. Therefore, the overcapacity in available tonnage continues to create pressure on the shipping market and slowed down the ordering activity for new ships. This resulted in an extreme low of ordering activities in late 2015/early 2016 in many sectors which still continues now, but is not necessarily true for all ship-types. The shipbuilding forecast in the following chapter builds on forecasts for the demand of specific ship-types in order to provide a more detailed picture on the demand situation. Individual growth factors have been assigned for each individual ship-type (and where appropriate size range), which depend on more parameters than just the fleet under/overcapacity, the scrapping pattern etc. It can be in general anticipated that the overall ratio of world fleet capacity to tonnage demand ratio will for the foreseeable future be over 100%. This means that ordering activity for new ships, especially for standard commodity vessels like bulkers, tankers, containers etc. will remain moderate to slow.

Following strong ordering activity in the last few years for offshore ships, LNG and LPG tankers and due to the oil price crisis, this trend now also affects these ship-types. As a result, shipbuilding

will remain a buyer's market for the foreseeable future as long as the major shipyard overcapacities in the market exist. Some promising ordering trends are related to the heterogeneous group of non-cargo-carrying vessels (NCCV) and the cruise industry which is driven by a general market upturn and SE Asian consumers are creating a new geographical market.

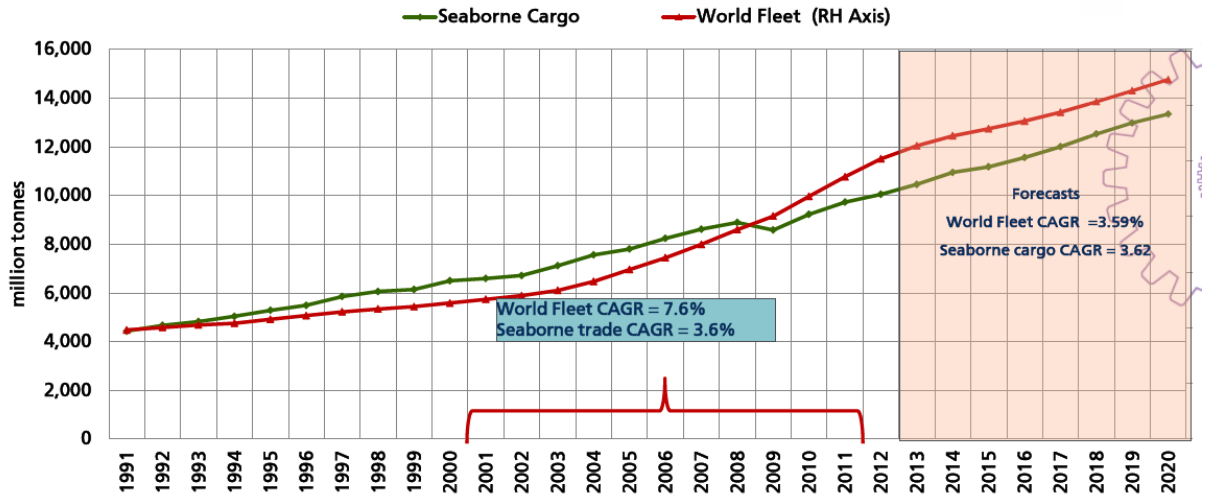


Figure 10: World seaborne trade
[Source: (Lloyd's Register, 2013)]

Just to add some other aspects to the discussion and taking a view on the long-term development again, it is likely that some emerging economies are overtaking established economies in their economic power. In the 2013 study from Lloyd's Register on „Global Marine Trends 2030" they apply a scenario based approach and as a result from the base case calculation (the so-called „status quo scenario") China, Brazil, India, Russia and Indonesia catch up and outperform established economies not only in GDP growth, but absolute size of economies.

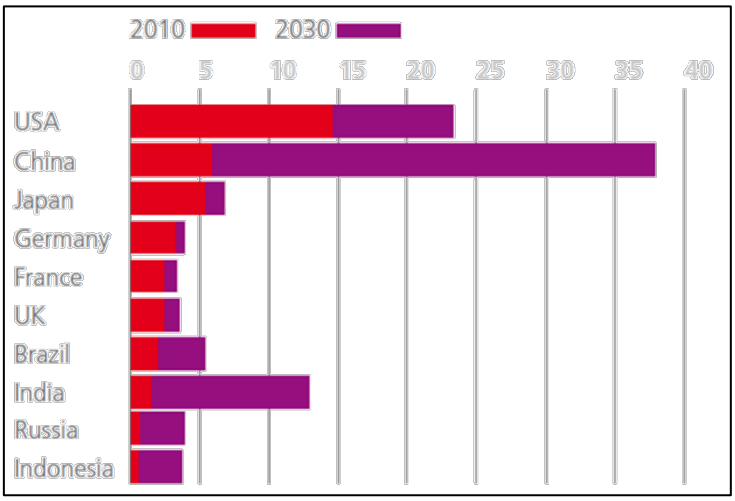


Figure 11: GDP Projection 2030 base case
[Source: (Lloyd's Register, Qinetiq and University of Strathclyde, 2013) (International Monetary Fund - IMF, 2013)]

As a consequence of this GDP growth and absolute economic power, we will see a change from the Atlantic centred economic world with a major trade route across the Atlantic today to a Sino-Pacific centred world. See below the artist impression with oversized country representation in proportion to their GDP. This scenario is not new, but it has to be considered that the expected

relocation of major trade routes due to the geographical changes of the global economic centres of gravity will have a major impact on the maritime markets.

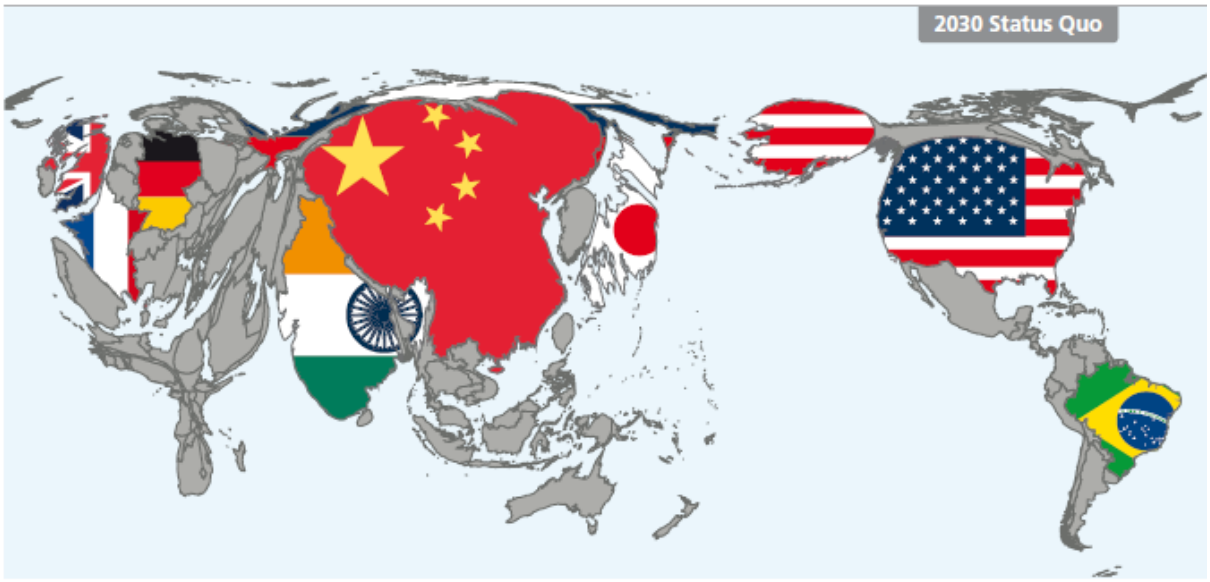


Figure 12: The world changed towards a Sino-Pacific centred global economy [Source: (Lloyd's Register, Qinetiq and University of Strathclyde, 2013)]

This global development will also have major impacts on the geography of global trade. We will see an increase of traffic between the bigger Asian economies, an increase in Arabic Gulf to Asia traffic, major increase of traffic on the classical Europe to Asia routes, and also major increase of Pacific trade to the US West coast, but also to South America, basically to Brazil through the newly extended Suez Canal. The political agreement from China with Nicaragua to build a second "Panama Canal" under control of China supports this kind of a long-term scenario very much. The following figure illustrates this scenario for the container trade. Similar mappings with even more dramatic changes for oil, gas, coal, grain etc. are available in the LR report.

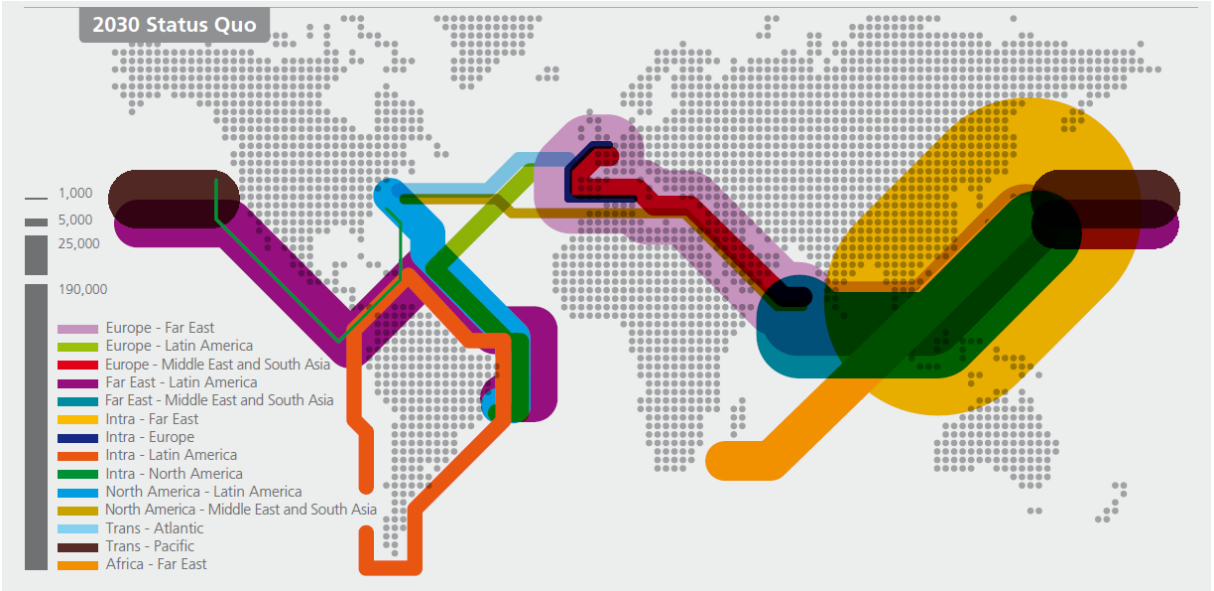


Figure 13: The world changed towards a Sino-Pacific centred global economy [Source: (Lloyd's Register, Qinetiq and University of Strathclyde, 2013)

Other current developments may have an impact to the deviation of shipping routes or the overall volume for seaborne volume. To be mentioned is here the increasingly ice-free northern maritime routes, i.e. North-East-Passage and North-West-Passage, which may have an impact through shortening the distance between Asia and Europe and between Asia and East Canada and US. Another notable development concerns the so called new Silk Road which brings container transport on trains from Asia to different destination's in Western Europe (*Figure 14*). The authors are of the opinion that these developments will be very slow in the next ten years and therefore will only have very minor effects on the newbuilding demand in the foreseeable future.

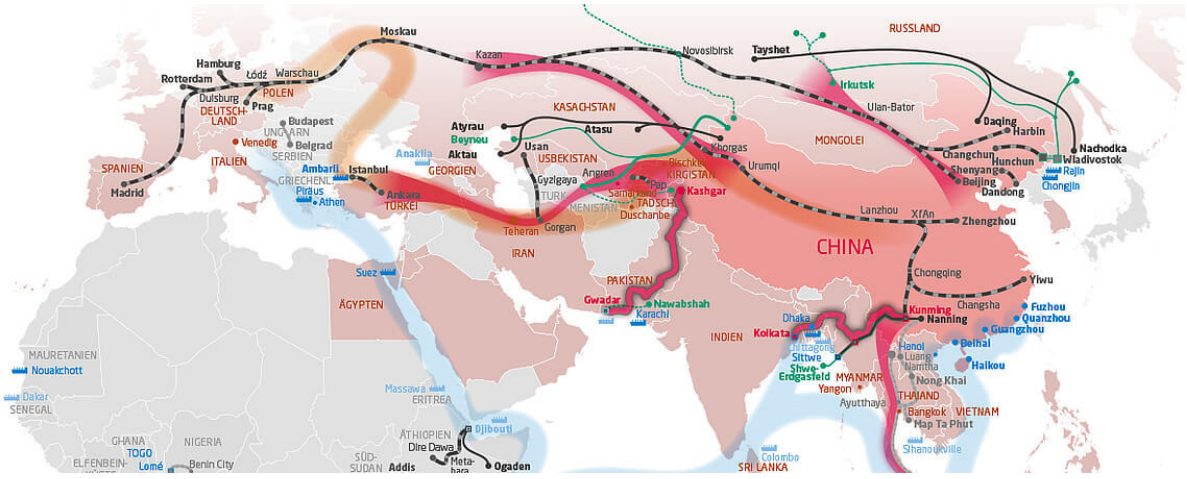


Figure 14: The new silk road
[Source: (Mercator Institute for China Studies, 2017)]

International Development of Market Shares

As additional parameter to get an idea on the geographical distribution of the market in the next 10 years, the orderbook situation at the end of 2015 has been taken as a basis. Although it might be discussed that market shares potentially swap between major shipbuilding regions the authors felt reasonably comfortable to use the actual orderbook as a basis, because it is still large and running for some ship-types over a longer period. In order to justify the situation for some ship-types, an evaluation of the geographical delivery of ships per type has been made. This also provides some interesting insight in the competition between the three major Asian shipbuilding countries and may answer some questions on the developments we see today.

The overall delivery trend in world shipbuilding 2006-2011 shows the steep increase of China's market shares until 2011 with a moderate decline after that until 2015. China capitalised on the huge orderbook they have gathered before the financial crisis and this data shows the result. Whereas South Korea maintained a market share on a very high level effectively over the whole period 2006-2015, Japan and Europe suffered most by losing more than 20% market share in the period until 2010, but stabilising after that. Rest of the World (RoW) showed a slight increase in deliveries after 2011.

The orderbook situation at the end of 2015 basically confirms the stable trend as seen for the period 2011-2015. However, slight advantages have to be seen here for China again and decreasing shares for South Korea. Japan and RoW are almost stable with Europe showing some positive trends compared to the average delivery in period 2011-2015.

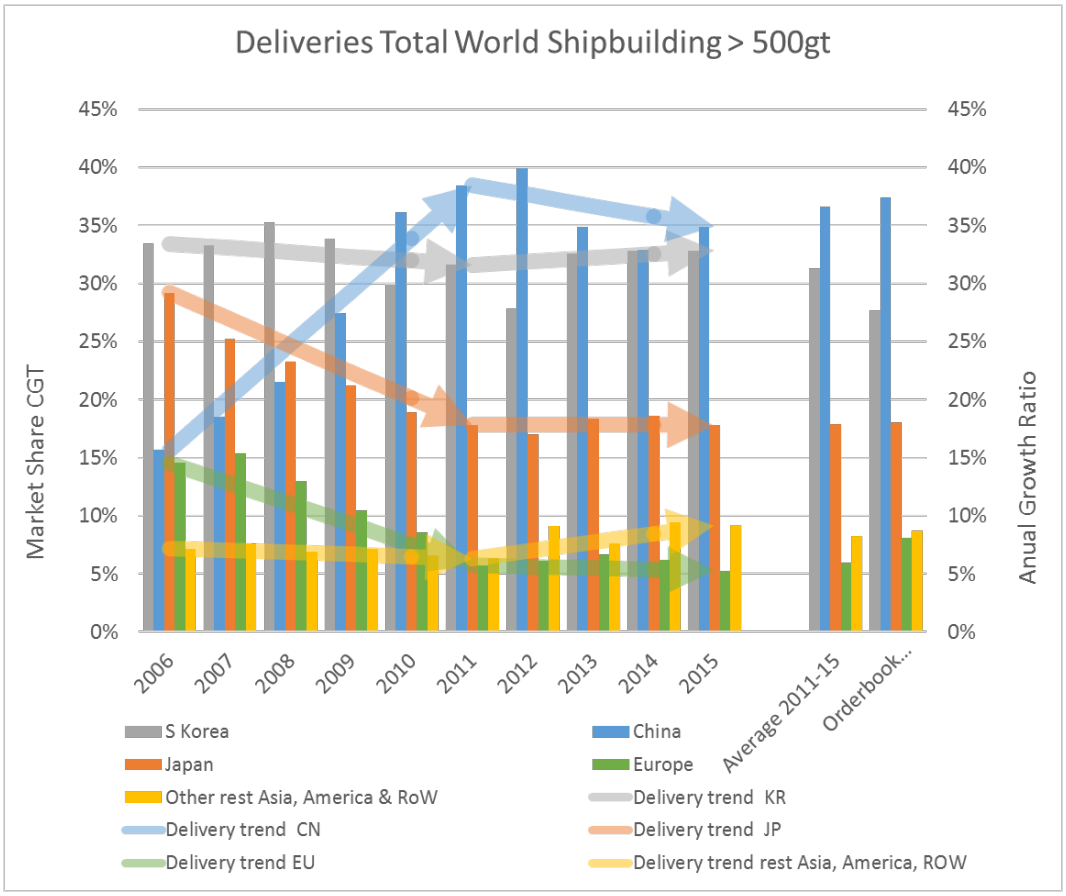
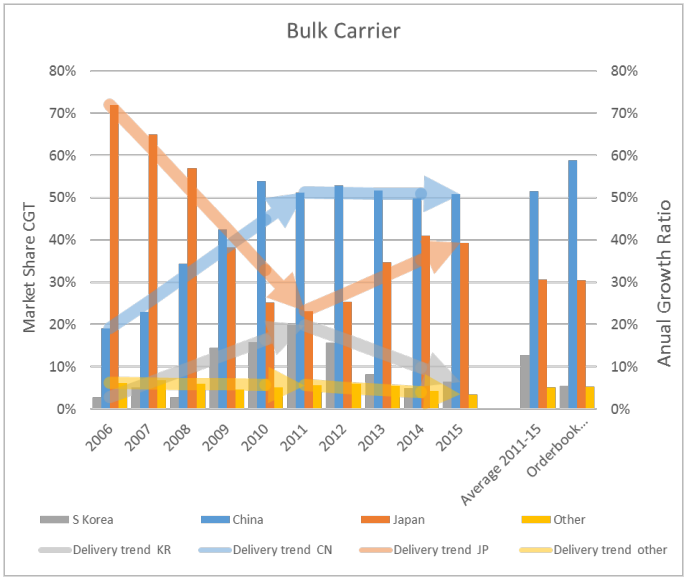
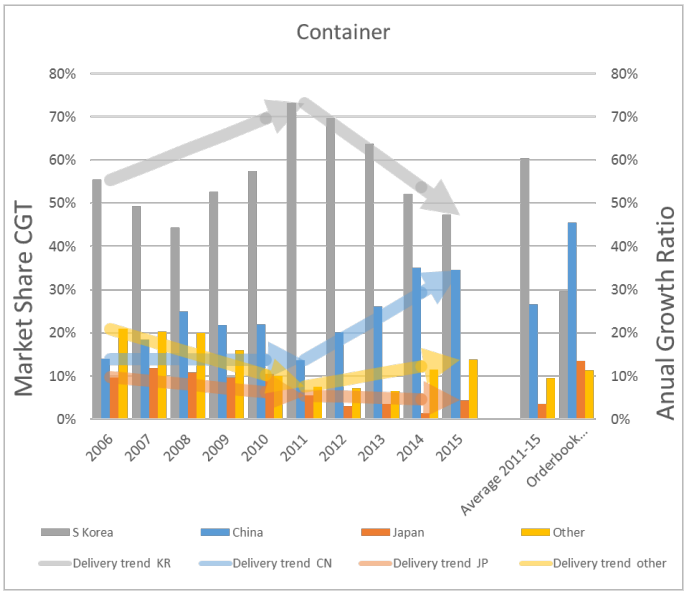
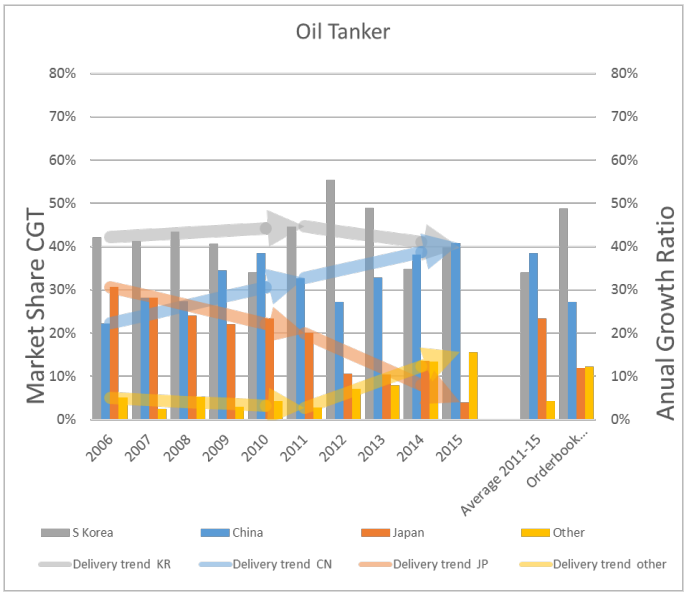
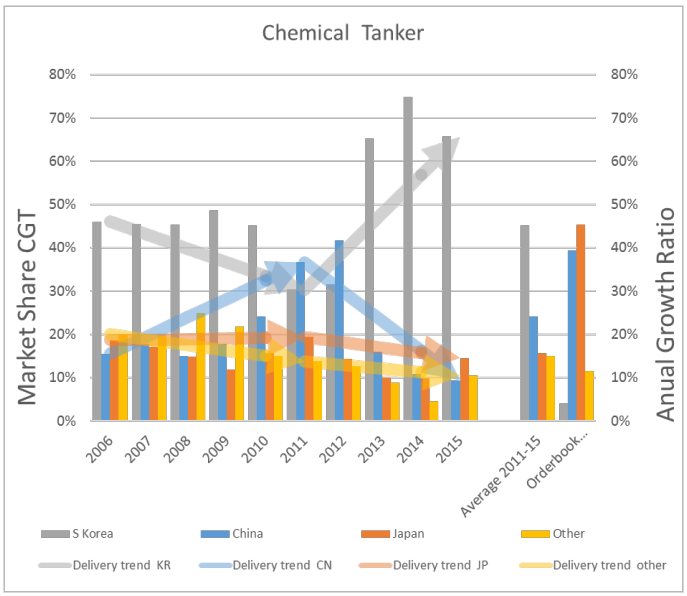


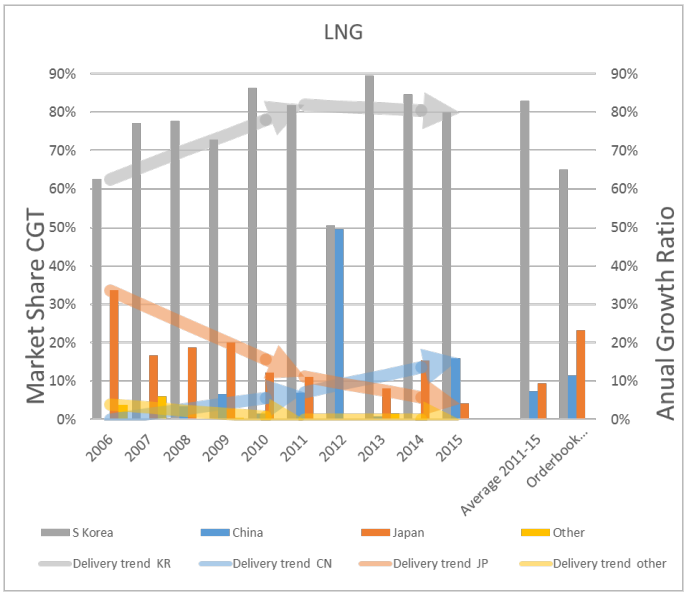
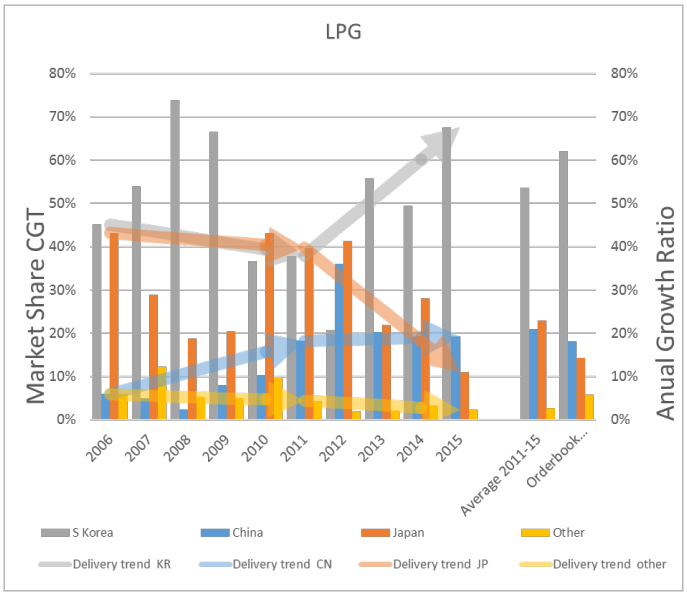
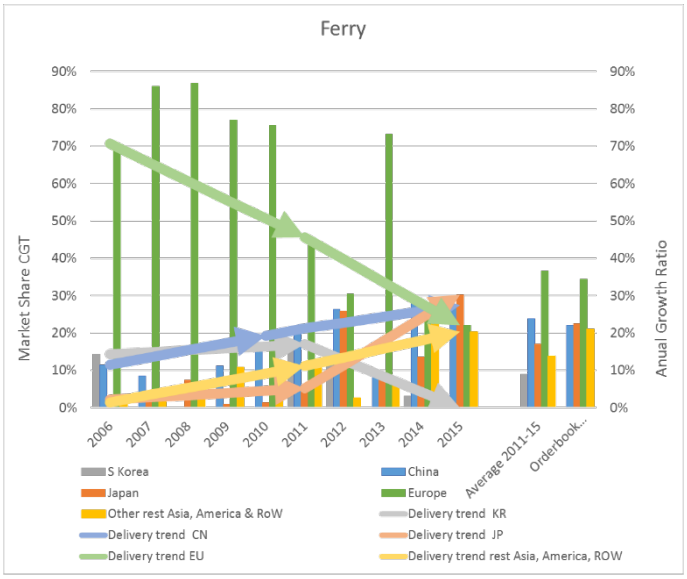
Figure 15: Delivery totals world shipbuilding >500 GT
[Source: Shipyard Economics and BALance TC calculations]

In comparison to the deliveries for total world shipbuilding, the development in deliveries for some specific ship-types shows remarkable changes.

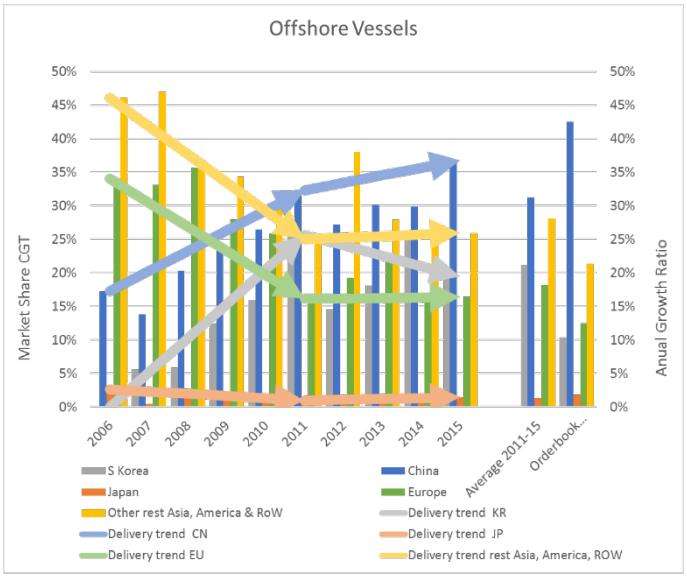


China gained substantial market shares in the period 2006 to 2011. This has been consolidated up to 2015 and also materialises in a solid orderbook. South Korea grew more slowly up to 2011, but by 2015 had lost all the ground gained and also has virtually no substantial orderbook. In contrast Japan lost 50% market share up to 2011, but gained 20% back by 2015 and consolidated an orderbook at that level.

	South Korea started with an extremely high market share of 50% of deliveries and increased that to 70% by 2011. Most of that gain was lost again by 2015 to China which gained market share strongly. This trend continues with the orderbook where China is gaining even more ground against South Korea. All others, including Japan, struggle to maintain a market share in the range of 10%.
	South Korea has maintained a constant high market share in oil tanker delivery over the whole period 2006 to 2015. They also hold a market share in the orderbook at the same level. Over the same time, China doubled their market share with 40% to the level of South Korea at the cost of Japan. Japan basically lost the oil tanker market over these ten years. Other countries gained some ground in the period 2011 to 2015. The orderbook however is dominated by South Korea with a market share of 50%.
	In the chemical tanker market, South Korea and China competed for the market lead over the full period. China won market share from South Korea and by in 2011 they were equal. However, from 2011 to 2015 South Korea outpaced China again and doubled their market share to a dominating 60%. China again lost all their gains and fell back to 10%. Japan was stable over the period at around 20%. The end 2015 orderbook again shows a big backlog for China and Japan with South Korea virtually non-existent.

	LNG has been and still is the market of South Korea. Increasing market share up to 80% in 2011 and levelling out at that level to demonstrate their dominance. The orderbook shows a comparably strong position. China is the best of the rest with increasing market shares up to 15% in 2015 and Japan lost almost all of the market by 2015. Japan however has gained some ground again with an improved orderbook.
	In LPG, South Korea has developed by 2015 into the unrivalled leading building country with 65% of deliveries and an orderbook in the same range. Japan fell from 40% in 2006 to 10% market share in 2015 and has not gained back any shares in that market. China saw a growing delivery record to 20% in 2010, but could only level out at that level up to 2015 and has an orderbook at the same level.
	Ferries, very interestingly, showed a declining delivery record for Europe losing market share from 70% in 2006 down to 20% in 2015. Over the same period China, Japan and RoW equally gained market shares of up to 20% each. With regard to the orderbook this seems to be a battle field for the coming years between China, Japan and RoW all on the same level and Europe in the lead with a 10%. It seems that ferries are seen as a kind of bridge market to cruise ships where countries hope to build up experience.

There is no other significant market for passenger ships other than cruise ships as the dominant sector. Europe is the dominant market leader with 90+% of both deliveries and orderbook for the foreseeable future - this is the last bastion of European shipbuilding. Nevertheless, as it is an interesting and valuable market segment, competition from the Far East may target this market with high investment.



Offshore vessels are the only market where the Americas play a major role as part of the RoW group. However, RoW and Europe lost 30% market shares each in the period 2006 to 2011 and levelled out at 25% and 15% market share respectively by 2015. China and South Korea inherited all those lost market shares and stand at the end of that period with a market share of 35% and 20% respectively. With regard to the orderbook China has the largest share with >40% but is also struggling with deliveries because of generally depressed market situation.

Figure 16: Development of deliveries for some specific ship-types
[Source: Shipyard Economics and BALance TC calculations]

Additional parameters to be taken into account for future market forecasts

Other factors concern market pressure from regulations (e.g. ballast water, EEDI, ECA) and technological developments with potential major impact on ship operations (e.g. smart ship, autonomous ship). Where retrofitting of existing ships is commercially not viable, these developments may create early scrapping scenarios for some ship-types and thereby create a higher demand for newbuildings. The impact of all these new developments is quite complex and difficult to predict. It may need some further investigations to enable dedicated market forecasts on that basis. For autonomous / unmanned ships, it is not expected that first ocean going vessels would enter into operation before 2025[4].

Beyond the economic parameters mentioned previously, individual parameters for scrapping and CAGR have been taken into account for each of the individual ship-types. The parameters chosen

[4] Interview Rolls Royce: Smart Ships Are Coming! World Maritime News 04-2017

are listed in the detailed information on the forecast in Annex 1 – Detailed shipbuilding forecast 2016-2025 by ship-type.

3.3 Market forecast shipbuilding 2016 – 2025

This report provides a merchant shipbuilding forecast for the 10-year period 2016 to 2025. It has been built on data, estimates and own calculation from the study team (mainly Shipyard Economics) supplemented by shipping sector expertise from Drewry Consultants and fleet data from Fairplay/IHS Markit. Besides the previously mentioned general economic parameters, the reference points for the analysis are fleet composition, size and shipbuilding orderbook at end 2015 and fleet trends at beginning of 2016.

The markets have been discussed and calculated on the basis of 28 different ship categories and within this different size bands or even further division of specific ship-types as shown in the following chapters.

For the forecast period 2016-2025, the aggregated figures show an annual average delivery of 2 475 ships, representing 52.1 mDWT, 40.1 mGT and 28.9 m cGT. By using price trends from the last ten years, the overall annual average market value has been calculated to USD 91.6 billion. However, this is not necessarily evenly distributed over the coming 10 years.

The time development of these markets may therefore not be linear over the 10-year period. and he forecast demand for most ship-types is lower in the first five-year period than in the second five-year period. This reflects various factors including current under-utilisation, especially in some fleets, varying age profiles and scrapping age as well as forecast demand growth rates.

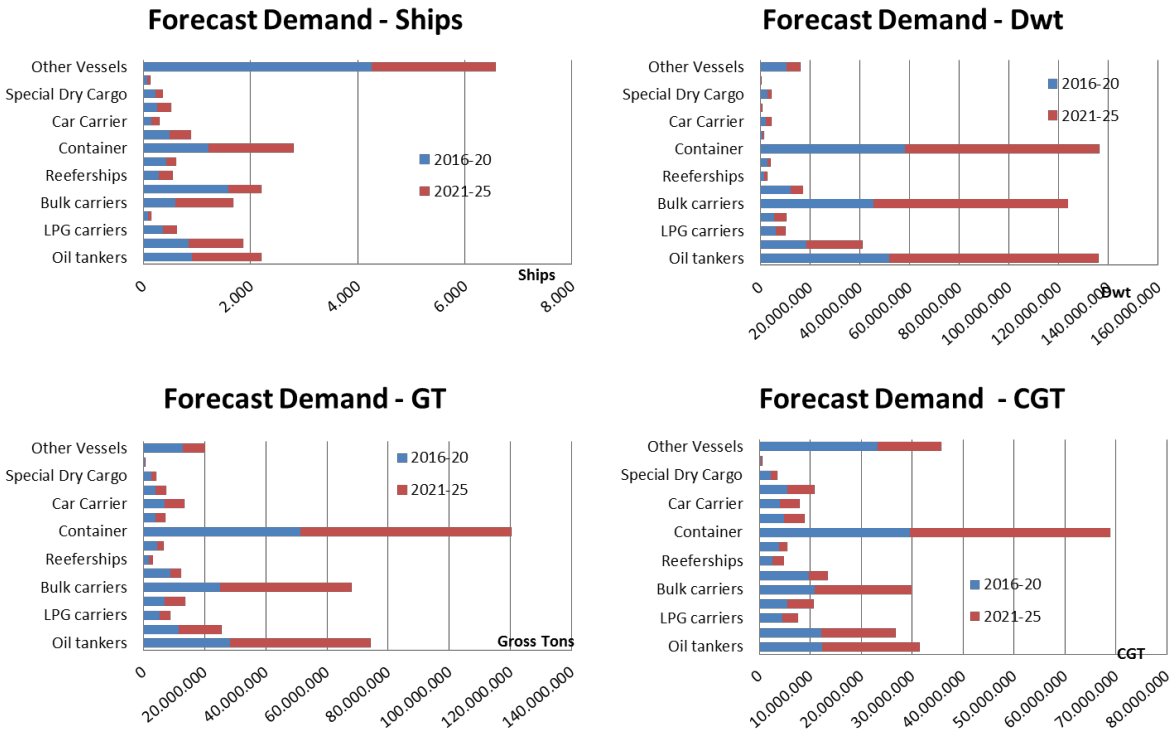


Figure 17: Timely development of forecasts per ship-types in two periods (20016-2020 and 2021-2025) [Source: Shipyard Economics and BALance TC calculations]

The overall market forecast has also been divided in four sub-markets, comprising (1) bulker and container ships, (2) all types of tankers, (3) special cargo ship categories and minor fleets (reefer, RoRo, general cargo, car carrier, special cargo) and (4) non-cargo carrying vessels (NCCV), passenger vessels and offshore vessels. This categorisation clearly shows that although by far the biggest market in size (88% in DWT and 78% in GT) categories (1) + (2) represent only 38% of the market value in USD. In comparison to this category (4) represents about 52% of the market value in USD, but only about 12% of the forecast in GT. Compared to the forecast 2009-2013 from the previous study[5], this trend has continued to develop in favour of the ship-types in sub-market 4.

The following table and graphs are giving a detailed overview on the results of the market forecast. Further detailed results are given in Annex 1 of this study.

[5] "COMPETITIVE POSITION AND FUTURE OPPORTUNITIES OF THE EUROPEAN MARINE SUPPLIES INDUSTRY", Funded by the European Commission DG Enterprise and Industry (Contract No. SI2.630862), accomplished by BALance Technology Consulting GmbH with Shipyard Economics and MC Marketing

Summary of Shipbuilding Forecast 2016- 2025

Shiptype	Ships	DWT	GT	CGT	Total USD
Bulk Carrier	1.671	123.697.556	67.985.154	29.849.987	49.330.208.362
Container	2.813	136.383.967	120.431.589	68.982.252	123.738.767.199
Subtotal	4.484	260.081.523	188.416.743	98.832.239	173.068.975.560
Average per year	448	26.008.152	18.841.674	9.883.224	17.306.897.556

Shiptype	Ships	DWT	GT	CGT	Total USD
Oil Tankers (Crude + Products)	2.209	136.246.480	74.272.364	31.524.430	77.131.373.345
Chemical Tankers	1.869	41.217.882	25.561.749	26.872.379	49.898.696.560
LNG	144	10.771.557	13.573.697	10.685.028	26.612.215.718
LPG	628	10.296.455	8.890.445	7.667.692	20.955.752.738
Special Tanker	148	1.435.340	1.082.673	1.471.184	2.942.367.999
Subtotal	4.998	199.967.714	123.380.927	78.220.714	177.540.406.359
Average per year	500	19.996.771	12.338.093	7.822.071	17.754.040.636

Shiptype	Ships	DWT	GT	CGT	Total USD
General Cargo incl. MP	2.206	17.341.073	12.368.411	13.549.389	27.098.777.700
Car Carriers (PCC & PCTC)	296	4.653.440	13.520.551	7.889.575	14.990.191.723
Reefer	541	2.965.496	3.073.047	4.850.351	13.306.170.344
RoRo	607	4.193.077	6.545.917	5.578.346	16.618.149.706
Special Cargo	457	6.877.909	6.155.499	4.761.722	19.046.888.759
Subtotal	4.107	36.030.995	41.663.426	36.629.383	91.060.178.233
Average per year	411	3.603.099	4.166.343	3.662.938	9.106.017.823

Shiptype	Ships	DWT	GT	CGT	Total USD
Passenger Cruise	97	804.843	10.556.547	10.632.230	63.793.382.414
Passenger Ferry	896	1.792.790	7.188.982	8.993.912	44.969.558.819
Passenger Yacht	240	96.476	651.127	2.142.189	13.924.230.690
MH & Fast Pax	315	87.593	689.289	2.334.979	11.674.896.176
Passenger Other	76	75.781	237.100	684.055	2.052.165.153
NCCV Dredger	398	2.821.471	2.430.495	3.674.117	16.518.829.503
NCCV Fishery	1.639	1.469.390	2.692.707	7.343.580	38.083.808.187
NCCV Tug	482	330.146	521.851	1.624.078	10.787.127.059
NCCV Service	893	1.903.417	3.842.317	6.500.147	44.929.018.095
NCCV Other	187	1.458.877	1.923.005	2.336.246	24.236.218.226
Offshore AHTS	1.391	3.026.203	3.727.373	8.263.410	49.580.462.215
Offshore OSV	1.487	5.754.936	6.602.435	11.816.829	76.809.386.574
Offshore Production	90	4.455.661	4.084.697	3.130.656	43.829.178.543
Offshore Construction	44	574.623	991.120	952.708	7.621.666.435
Offshore Research	51	204.254	381.734	540.731	7.570.232.725
<500 GT	2.878	498.332	883.197	4.411.449	17.645.796.227
Subtotal	11.162	25.354.793	47.403.973	75.381.318	474.025.957.040
Average per year	1.116	2.535.479	4.740.397	7.538.132	47.402.595.704

Total overall	24.750	521.435.025	400.865.069	289.063.653	915.695.517.192
Average per year	2.475	52.143.503	40.086.507	28.906.365	91.569.551.719

Table 2: Ship newbuilding demand forecast
[Source: Shipyard Economics and BALance TC calculations]

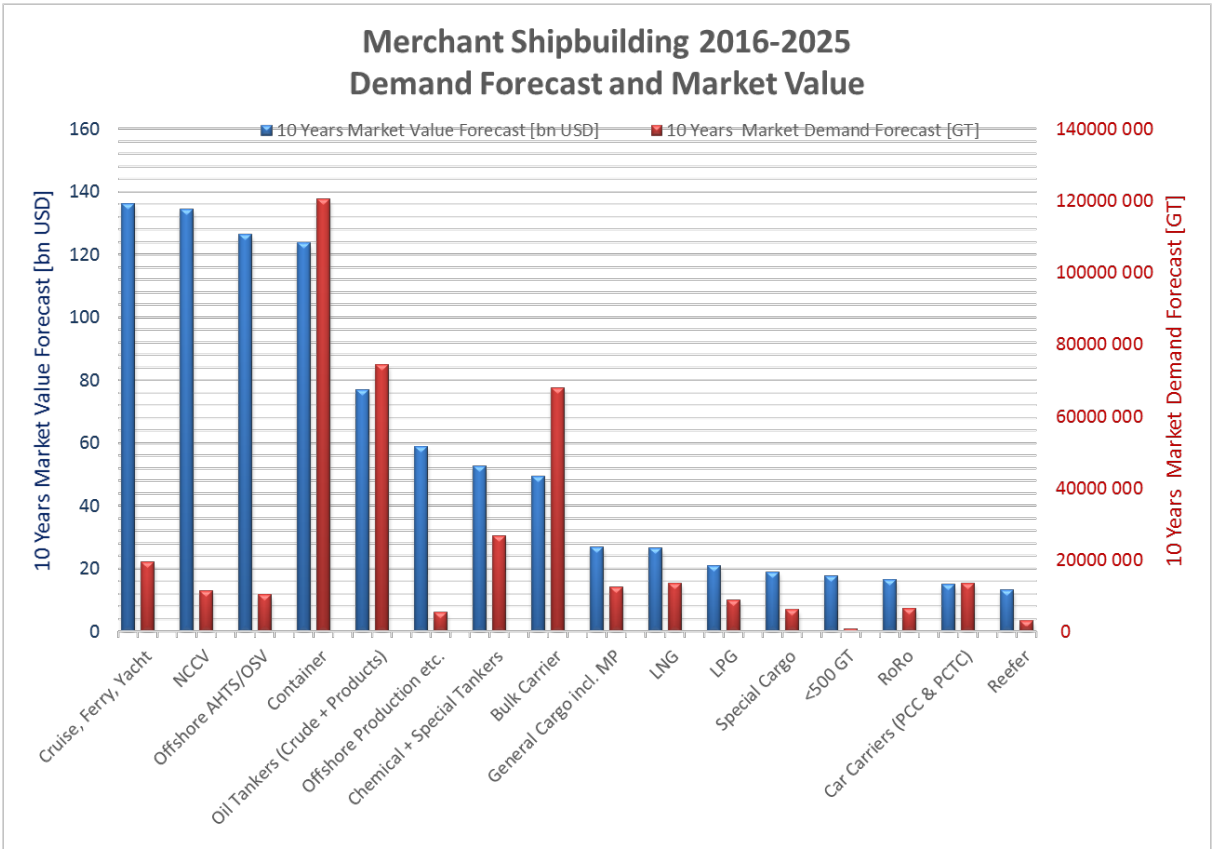


Figure 18: Shipbuilding forecast 2016-2025),
[Source: Shipyard Economics and BALance TC calculations]

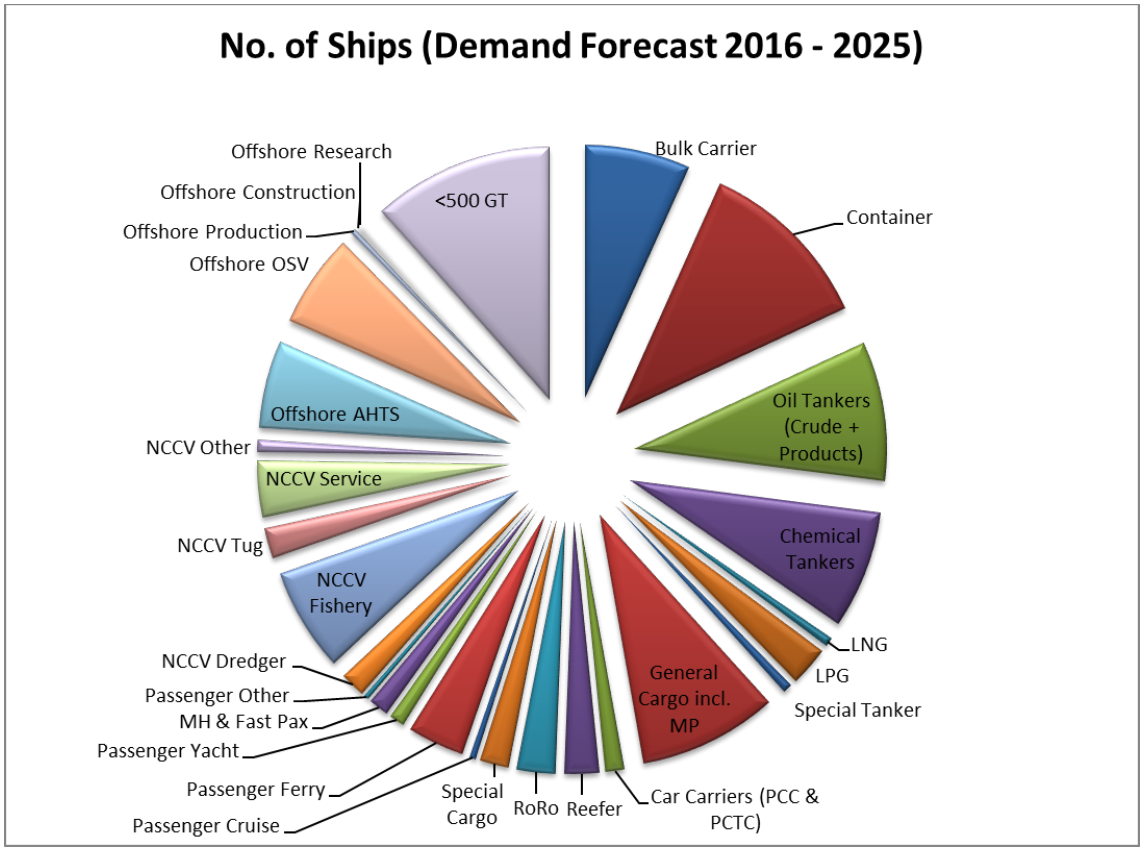


Figure 19: Ships (forecast 2016-2025),
[Source: Shipyard Economics and BALance TC calculations]

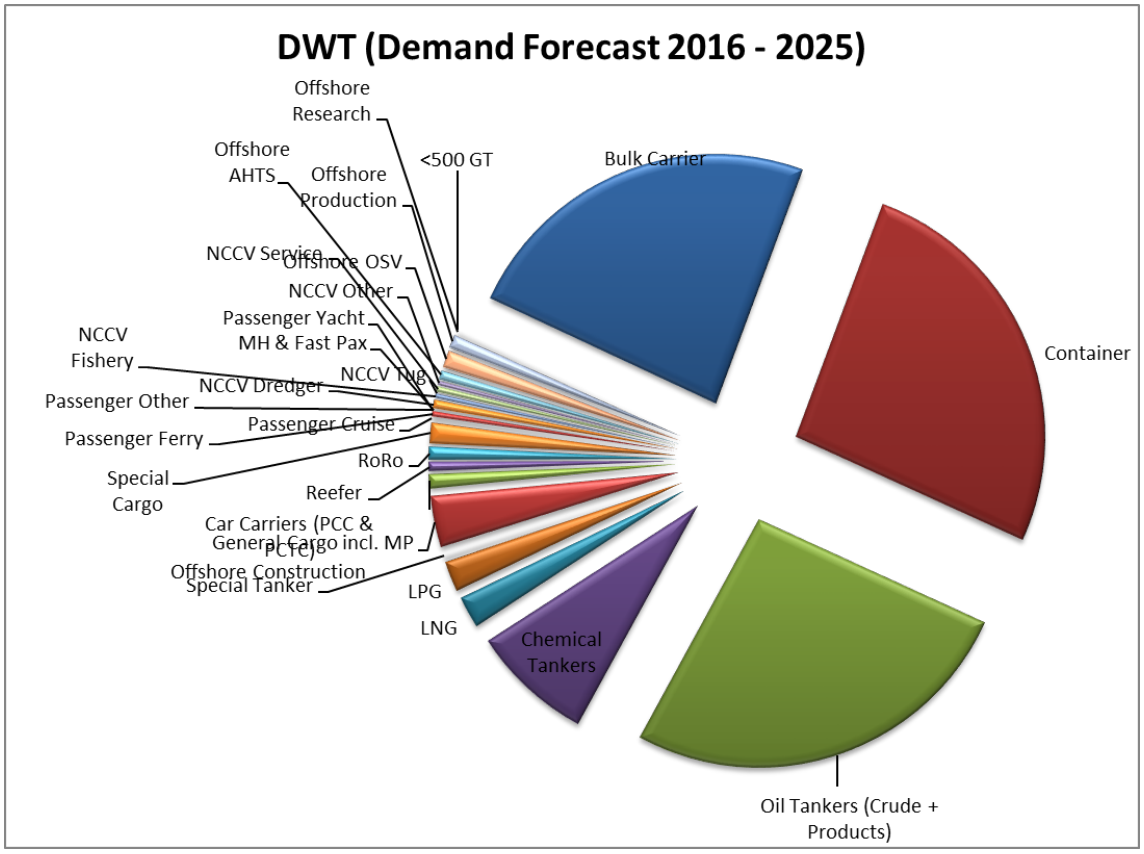


Figure 20: DWT (forecast 2016-2025),
[Source: Shipyard Economics and BALance TC calculations]

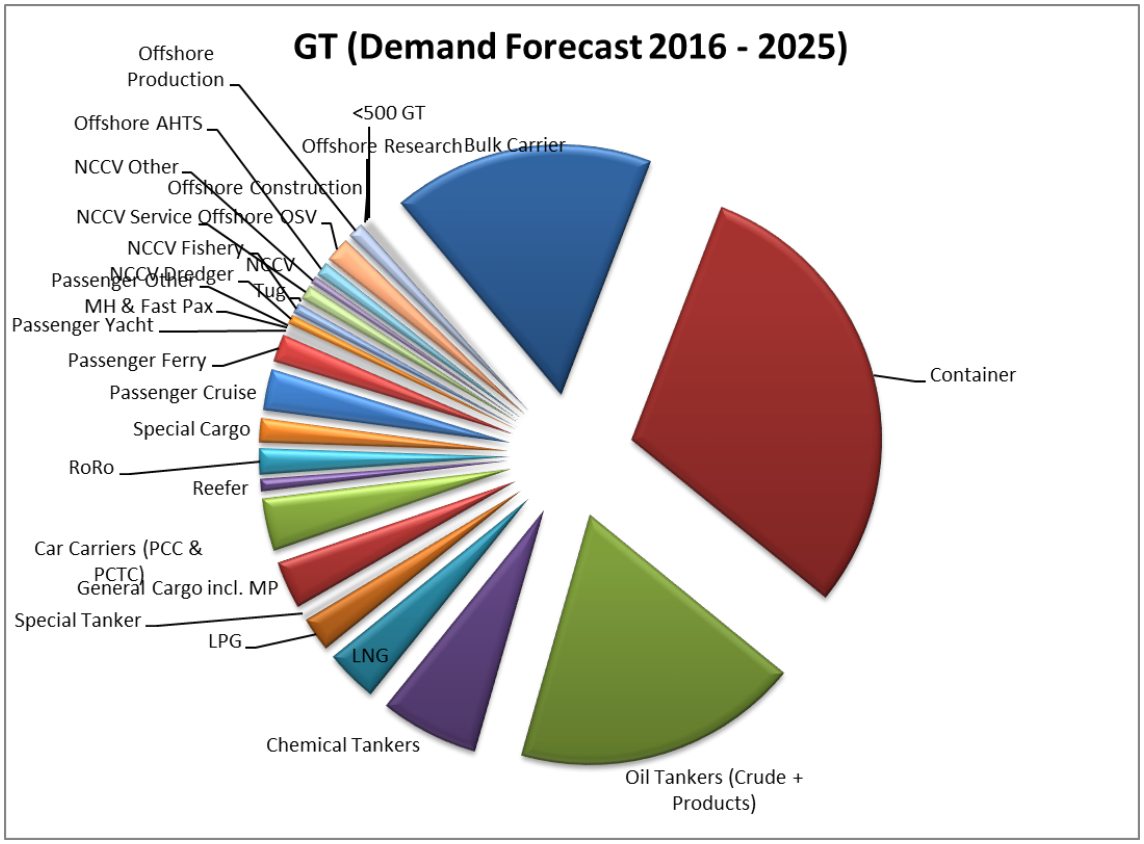


Figure 21: GT (forecast 2016-2025),
[Source: Shipyard Economics and BALance TC calculations]

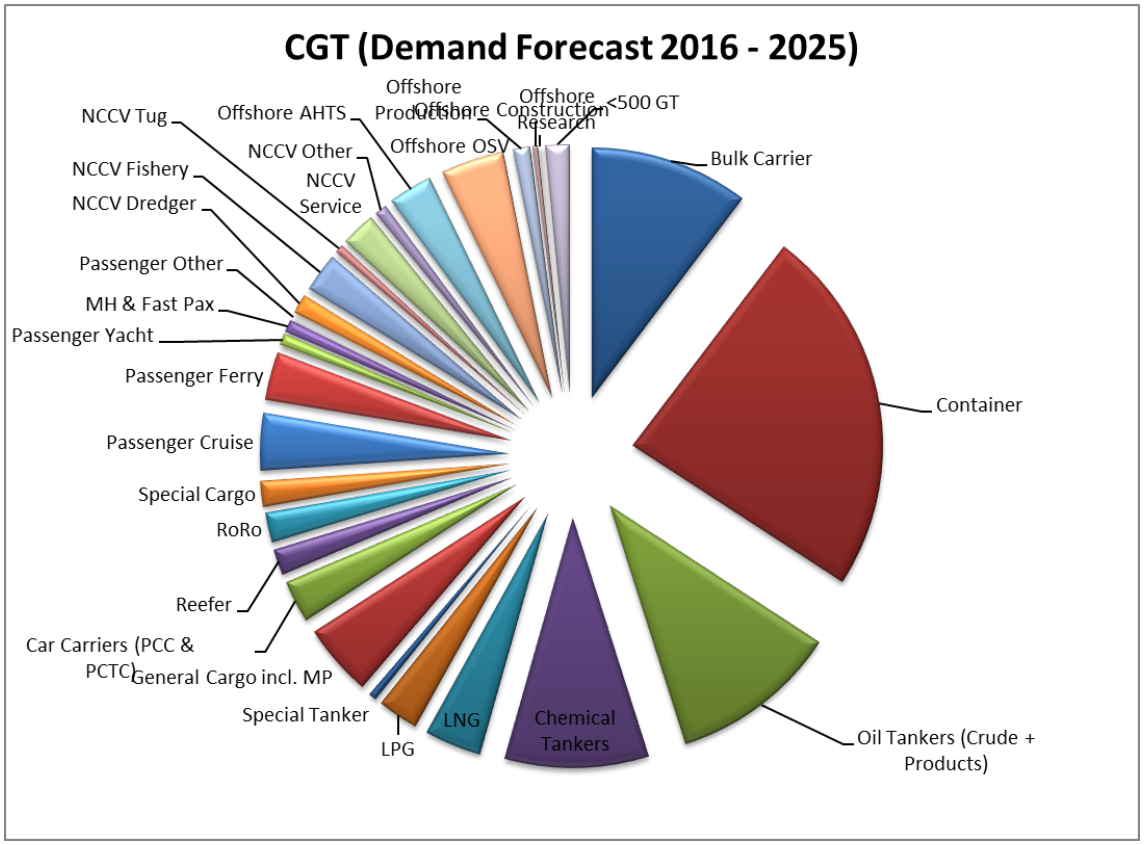


Figure 22: cGT (forecast 2016-2025),
[Source: Shipyard Economics and BALance TC calculations]

In comparison to two earlier analysis by the authors[6] based on the record high orderbook 03/2008 (5 years delivery schedule, 100% yard-capacity utilisation for 3.5 years, annual delivery in average 45-50 m cGT) and the forecast 2013-2017 (5-year delivery schedule, yard capacity utilisation <70%, annual delivery in average <30 m cGT), the actual orderbook/forecast 2016-2025 shows significant differences. Although both previous market evaluations represent a monetary volume of over USD 80 billion/a, the other parameters are quite different as shown in the following table. It demonstrates that the comparable shipbuilding volume will be increasing in terms of value in USD, number of ships and cGT, but will decrease in average GT and DWT.

	3/2008 Orderbook 5 years	2013-2017 5-year forecast	Comparison 1	2016-2025 10-year forecast	Comparison 2
No. of Ships	9422	10157	108%	24750	122%
DWT	517 mDWT	293 mDWT	57%	521 mDWT	89%
GT	336 mGT	218 mGT	65%	401 mGT	92%
cGT	181 mc GT	138 mc GT	76%	289 m cGT	105%
USD	USD 406 bn	USD 410 bn	100%	USD 916 bn	112%

Table 3: Comparison1 orderbook 03/2008 and forecast 2013-2017 and comparison 2 to forecast 2016-2025
[Source: Shipyard Economics and BALance TC calculations]

[6] BALance TC: "Competitive Position and Future Opportunities of the European Marine Supplies Industry", Study for the EU 2014 and Marine Solutions Market Study (for US Manufacturer) 2008

This comparison shows that the orderbook has further moved away from major steel intensive ship-types (tankers, bulkers, container) towards more sophisticated and outfitting intensive ship-types (passenger, offshore, NCCV). This is to certain degree good news for many shipyards and marine suppliers. Although the shipbuilding demand forecast has been declining in terms of ship physical measures (GT, DWT), the monetary market value per ship has increased due to different ship-type portfolio. Hence, it seems that the effect is more positive for shipyards with sophisticated ship-system integration capabilities and marine suppliers, since the relative value of components and systems has increased in comparison to the share of value added by the shipyards.

To get an idea on the ordering activity which can be expected in the near future, the existing orderbook has been discussed against the demand forecast as given above. It shows that for a substantial number of ship-types the existing orderbook already satisfies a significant part of the demand forecast for the next ten years, accounting for 40%+ and one sector even exceeds the forecast requirements for the entire 10 years forecast period. Although the orderbook in some cases might be seen as very vulnerable to potential cancellations, it is obvious that new ordering activities will remain at a very low level.

This is especially true for steel-intensive commodity ships. It can be seen that the situation seems to be worst for LNG and LPG tankers and bulk carriers with an orderbook volume which is close to or even exceeding the 10 years' demand forecast. Although the forecast does not consider the possibility of speculative orders (shipbuilding markets have tendency to that) the "overbooking" of this ship-type makes cancellations or longer postponements likely. Also for some other ship-types, the market prospects for new orders seems to be low. The following two diagrams show the overall situation, indicating the ship-types with "overbooking" (orderbook >60% of 10 years forecast) in the red area, "orderbook meets mid-term demand (30-60%)" in the yellow area and "good prospects for new orders" in the green area (<30%).

Looking into the second half of the forecasting period, i.e. after 2020, it is likely that the major fleets (bulker and tankers in some parts of the fleet) will continue to suffer from oversupply also in that period. This combined with a normalized ordering activity for ships and normal scrapping scenarios will keep the pressure on the shipping market high. In combination with underutilization of yard capacities the shipbuilding market in general will remain a buyer's market. This might be different for specialized vessels and minor fleets with high tech profiles. For these vessels, the demand drivers are not necessarily seaborne trade, but energy demand in combination with high energy prices, sustainability or increasing consumer interest in seaborne leisure.

The following two figures illustrate the situation and put the market demand forecast into context with the existing orderbook. It clearly illustrates the situation for which ship-types ordering activities will remain low in the foreseeable future or for which ship-types continuous ordering activities may be expected.

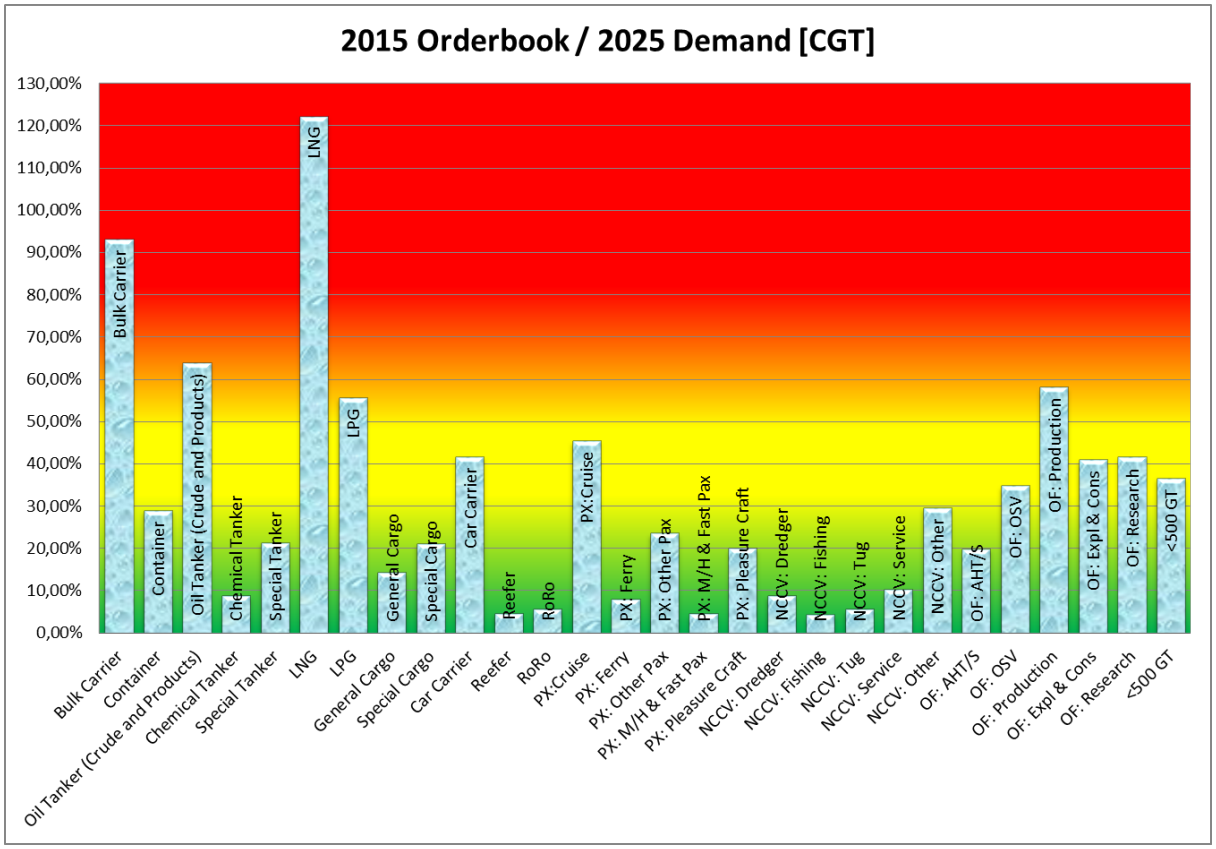


Figure 23: Orderbook/demand ratio
[Source: BALance TC calculations]

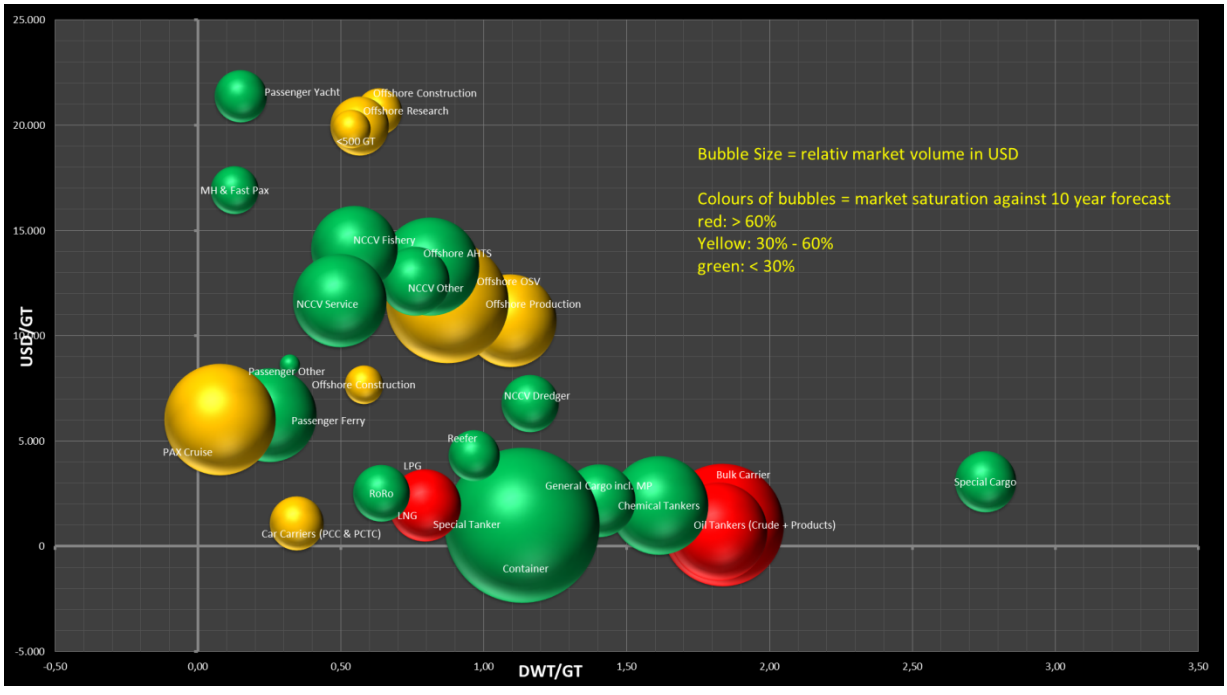


Figure 24: Shipbuilding market forecast 2016-2025
[Source: BALance TC calculations]

3.4 Discussion of current orderbook trends 2016

As outlined previously, the core analysis for this report is predominantly based on the fleet status and a 10-year shipbuilding forecast for the period 2016-2025. The reference points for these are fleet composition, size and shipbuilding orderbook at end 2015 and fleet trends at beginning of 2016. Inevitably, the marine markets are dynamic and eternally changing and this section therefore provides an update on the key market movements during 2016 up to the end of Quarter 3.

Table A: Shipbuilding Orderbook Development				
Sector/Sub-sector	**UoM**	**2016Q3**	**2015Q4**	**Change**
Bulk Carrier	DWT	93 206 359	117 970 221	-21.0%
Container	TEU	2 682 881	3 226 489	-16.8%
Oil Tanker	DWT	78 376 343	91 813 178	-14.6%
Chemical Tanker	DWT	4 980 535	3 582 899	39.0%
General Cargo	DWT	2 717 997	2 886 318	-5.8%
LNG Carrier	GT	14 828 691	16 983 792	-12.7%
LPG Carrier	GT	4 391 261	6 038 730	-27.3%
Car Carrier	GT	4 383 207	6 067 124	-27.8%
RoRo	DWT	366 239	200 011	83.1%
Reefer	DWT	131 690	135 910	-3.1%
Special Cargo	DWT	1 524 452	1 494 366	2.0%
Special Tanker	DWT	475 152	327 582	45.0%
Offshore Vessel	GT	5 414 900	5 977 693	-9.4%
OF: AHT/S	GT	677 988	739 824	-8.4%
OF: Explor & Constr.	GT	226 372	405 458	-44.2%
OF:	GT	2 141 463	2 300 438	-6.9%
OF: Production	GT	2 271 533	2 373 232	-4.3%
OF: Research	GT	97 544	158 741	-38.6%
Passenger	GT	7 113 279	5 566 712	27.8%
PX: Cruise	GT	5 945 954	4 788 284	24.2%
PX: Ferry	GT	955 346	544 101	75.6%
PX: MH & Fast Pax	GT	41 223	44 701	-7.8%
PX: Other Pax	GT	18 251	59 292	-69.2%
PX: Pleasure	GT	152 505	130 334	17.0%
NCCV	GT	1 033 870	1 401 739	-26.2%
NCCV1: Dredger	GT	179 399	229 021	-21.7%
NCCV2: Fishing	GT	124 346	127 731	-2.7%
NCCV3: Tug	GT	33 043	26 021	27.0%
NCCV4: Service	GT	489 587	395 849	23.7%
NCCV5: Other	GT	207 495	623 117	-66.7%
Total	**Ships**	**4 577**	**5 264**	**-13.1%**
Total	**CGT**	**95 614 177**	**111 219 268**	**-14.0%**
Total	**GT**	**174 112 103**	**206 442 813**	**-15.7%**
Total	**DWT**	**241 901 037**	**291 228 045**	**-16.9%**

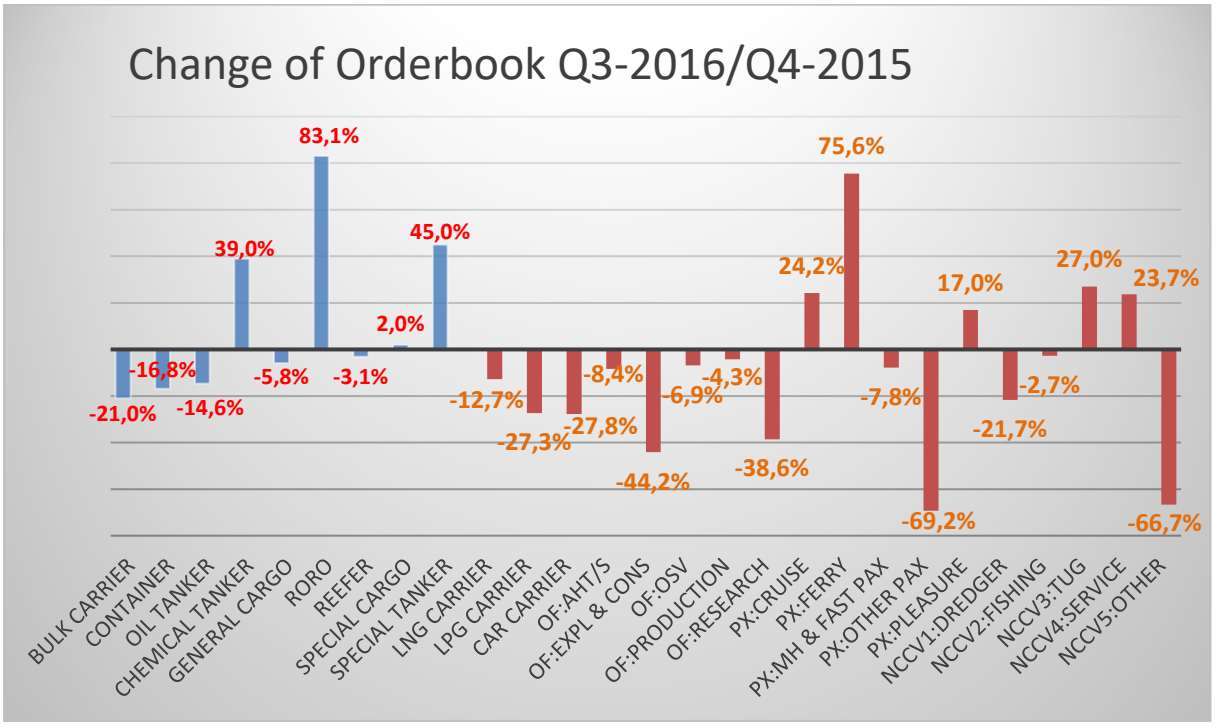
Table 4: Shipbuilding Orderbook Development
[Source: Shipyard Economics]

During 2016 (to end of Quarter 3) the size of the shipbuilding orderbook, has reduced by between 13 - 17% (depending on the parameter used) which means that deliveries have generally exceeded new ordering activity. Table 4 shows the change in the orderbook and Table 5 summaries the new ordering activity.

Table B: New Orders placed in 2016 YTD				
Sector / sub-sector	Ships	CGT	GT	DWT
Bulk Carrier	47	1 652 422	6 035 450	11 805 550
Chemical Tanker	27	256 699	200 932	333 300
Container	64	1 321 847	2 341 052	2 612 420
General Cargo	26	147 976	117 642	171 871
LNG Carrier	4	356 559	465 880	346 000
LPG Carrier	12	119 823	150 394	143 610
Offshore Vessel	23	235 026	152 581	139 385
OF: AHT/S	4	29 813	15 900	11 500
OF: OSV	19	205 213	136 681	127 885
Oil Tanker	72	977 825	2 361 577	4 298 411
Passenger	46	2 559 608	2 539 033	282 642
PX: Cruise	23	2 150 018	2 150 041	184 002
PX: Ferry	18	377 259	380 750	97 460
PX: MH & Fast Pax	2	7 514	1 300	560
PX: Other Pax	1	13 756	4 510	620
PX: Pleasure	2	11 061	2 432	0
Reefer	1	7 728	4 100	4 100
RoRo	15	230 291	312 484	135 624
Special Cargo	11	112 474	127 950	132 524
Special Tanker	12	122 880	85 697	119 040
NCCV	33	209 745	104 109	80 265
NCCV1: Dredger	2	23 118	18 508	22 112
NCCV2: Fishing	15	92 411	38 513	26 430
NCCV3: Tug	2	5 290	1 400	0
NCCV4: Service	12	63 805	28 688	14 923
NCCV5: Other	2	25 120	17 000	16 800
Grand Total	**393**	**8 310 903**	**14 942 112**	**20 604 742**

Table 5: New order placed in 2016 (year-to-date)
[Source: Shipyard Economics]

Inevitably there are sectoral variations, with some sectors or sub-sectors recording an increase as demonstrated in the following *Figure 25*.



Edit Note for Figure 25 - Bars in Blue % change measured in DWT & Bars in Red % Change measured in GT

Figure 25: Change of orderbook in 2016
[Source: Shipyard Economics and BALance TC calculations]

Of particular note in the mainstream ship-types are:

- Bulk carriers: a significantly higher drop in the capacity on order, with 424 ships delivered in 2016 so far but only 47 ordered.
- Chemical tankers: a significant increase in the capacity on order, predominantly due to the designation of IMO chemical capability on ships with the potential to carry chemicals or oils
- Passenger vessels: where significant increases in the capacity on order are seen for cruise ships -where 23 ships have been ordered against 8 delivered so far, this year - and ferries where the orders placed are for much larger vessels than those delivered.

Large percentage variations, in some of the very small sectors, such as RoRo, can be the result of the specific details of the vessels on order and not, therefore considered to be an indication of a sector trend.

Slippage is still occurring in the orderbook with order deliveries dates being missed or put back. The orderbook at end 2015 includes a significant volume of deliveries still slated for delivery in 2015, and whilst some of these are due to late reporting, there was still a considerable volume that slipped back into 2016. The projected deliveries for 2017 (comprising those already delivered plus those shown for delivery this year) would indicate a considerable increase in the capacity delivered compared with deliveries in 2015, however it seems almost inevitable that some of the orderbook due for delivery this year will either slip back into subsequent periods or be cancelled.

Table C: Shipbuilding Trends					
Change	**UoM**	**2015 Act**	**2016 Act**	**2016 Act+OBk**	**10 yr F'cast Ave**
Bulk Carrier	DWT	48 600 865	34 636 788	74 141 562	12 369 756
Container	TEU	1 350 406	522 242	984 157	974 224
Oil Tanker	DWT	11 773 094	16 717 606	37 842 998	13 624 648
Chemical Tanker	DWT	7 630 262	5 205 594	7 029 856	4 121 788
General Cargo	DWT	912 336	908 365	2 071 038	1 734 107
LNG Carrier	GT	3 020 568	1 875 207	4 345 663	1 357 370
LPG Carrier	GT	2 205 265	2 215 710	3 343 374	889 045
Car Carrier	GT	1 379 815	1 010 736	1 728 693	1 352 055
RoRo	DWT	420 543	47 799	113 995	419 308
Reefer	DWT	11 789	16 294	45 394	296 550
Special Cargo	DWT	532 192	182 979	769 269	687 791
Special Tanker	DWT	76 588	68 842	188 553	143 534
Offshore Vessel	GT	1 913 000	721 562	2 961 153	1 578 736
Passenger	GT	977 022	1 122 439	1 729 356	1 932 305
NCCV	GT	374 575	357 554	762 788	1 141 038
Total	**Ships**	**2 119**	**1 697**	**3 535**	**2 187**
Total	**CGT**	**38 075 605**	**25 542 307**	**53 460 768**	**28 353 082**
Total	**GT**	**67 080 164**	**46 391 845**	**95 834 133**	**39 783 378**
Total	**DWT**	**96 391 648**	**70 301 215**	**146 566 976**	**52 093 669**

Table 6: Shipbuilding Trends
[Source: Shipyard Economics]

Table 6 demonstrates this potential volatility in the orderbook phasing, which reflects an insecure market situation, from which it can be seen how the projected outturn figures for 2016 are not only much higher than those for 2015, but are disproportionately high compared with the year-to-date actual deliveries.

The table also compares recent trends with the average yearly volumes forecast for the period 2016-2025 from which it can be seen that the current levels of production are much higher in certain sectors - in particular Bulk Carriers and LPG and to a lesser degree Oil Tankers. Continued production at the current rates, runs the risk of significant fleet overcapacity or the drying-up of ordering activities in these sectors in order to restore the supply demand balance.

3.5 Benchmarking of shipbuilding demand forecasts with forecasts from major associations

In this sub-chapter, the authors compare the results of their market forecast as given above with available forecasts from global associations representing the shipbuilding industry from different major shipbuilding countries. Available forecasts consist of information provided at different international meetings of the branch, i.e. JECKU (Annual Shipbuilding Meeting of Japan, Europe,

China, South Korea and US) and ISFEM (Annual International Shipbuilding Forecast meeting). The associations involved are Shipbuilding Association of Japan (SAJ), European Ships and Marine Equipment Association (SEA Europe), Chinese Association of Shipbuilding (CANSI) and Korean Shipbuilding Association (KOSHIPA).

The basis or this comparison are the most recent forecasts presented by the major shipbuilding countries at the ISFEM 2016 meeting held in Xian, China in May 2016.

In the following sub-sections, we endeavour to compare the forecasts of SAJ, CANSI, KOSHIPA, Sea Europe (and any others provided) with each other for each major ship-type sector and also with the 10-year shipbuilding forecast summarized in Section 3.3 which forms a key element of the underpinning analysis of supply chains.

Typically, not all ISFEM participants produce forecast for all sectors, and some tend to work in different units of measure to others. The Table 7 below gives an overview of the documentation sources used for this review.

Sector	Balance/SHE	SAJ	KOSHIPA	SEA Europe	CANSI
Oil Tankers	x	x		x	x
Chemical Tankers	x				
Special Tankers	x				
Bulk Carriers	x	x		x	x
Container Ships	x	x	x		
LNG	x	x	x	x	
LPG	x	x			
General Cargo	x				
Special Cargo	x				
Reefer	x				
RoRo	x				
Car Carriers	x				
Offshore Vessels	x			x	
OSVs					x
Offshore Structures					x
Passenger	x				
Pax excluding Cruise	x			x	
Cruise	x			x	
Ferry	x				
Other Vessel Type					
Fishing	x			x	
Research					
Dredgers	x			x	
Tugs	x				
Service	x				
Artic Vessels				x	
Other NCCV	x				
Overall SB Demand	x	x		x	

Table 7: Benchmarking of shipbuilding demand forecasts, overview of documentation sources

The key conclusions out of the comparisons of forecasts are:

- At the level of overall newbuilding demand (for vessels of 500 GT+) the BAL/SHE forecast was slightly higher than that of the SAJ and similar to that of SEA Europe but notably lower than that of CANSI.
- However as is often the case, considerable differences exist, at sectoral level between the forecasts of different parties.

- The BAL/SHE forecast undertaken for this study covers more sectors individually than those of any of the other major shipbuilders. There appeared to be a general trend for the shipbuilding majors to focus only on the sectors that are most relevant to them.
- In particular, the BAL/SHE forecast covered sectors such as chemical tankers, general cargo, reefers, RoRo vessels which are all significant cargo carrying sectors, which were not covered by any of the shipbuilding majors as independent sectors.
- The BAL/SHE forecast included sector sub-division based on size bands for cargo vessels and main vessel sub-types for other sectors.
- Comparison of forecasts for 'Other non-cargo' vessel types are further complicated by the deferring details of the sub-division.
- Small timescale differences sometimes account for some significant differences - for example when the forecast demand of one forecaster anticipates a slightly earlier or later demand which then falls into a different time period.

For more detailed comparisons, presentations on forecast Overall Newbuilding Requirement were provided by SAJ, SEA Europe and CANSI. These forecasts vary in format, with:

- SAJ presented in graphical and tabular formats in CGT and GT and with 7 major sub-sector divisions
- SEA Europe forecast presented in graphical (rather than tabular) format in CGT only with no sub-sector breakdown
- CANSI presented in graphical format but with quantified notes, in CGT, but without any sector breakdown.

The BAL/SHE forecast which covered a shorter period, is provided in tabular format, in CGT, GT, DWT, ships and other cargo measures, covering 15 sub-sector divisions for ships of 500 GT and above. It therefore does not cover the element for vessels of under 500 GT and experience indicates that most of the newbuilding forecasts do not cover such small vessels.

BAL/SHE		CGT	GT	DWT	Ships
2016-2025	per year	28.4	39.8	52.1	2 187

SAJ		CGT	GT	DWT	Ships
2014-2020H1	per year	22.2	34.1		
2020-2025H1	per year	29.3	51.4		
2025H2-2030H1	per year	38.1	69.9		
2030H2-2035H1	per year	45.7	83.0		
2014-2035H1	per year	33.0	57.7		

SEA Europe		CGT	GT	DWT	Ships
2015-2020	per year	27.5			
2020-2025	per year	30.0			
2025-2030	per year	42.0			
2030-2035	per year	40.4			
2016-2035	per year	35.0			

Values read from graphs

CANSI		CGT	GT	DWT	Ships
2016-2020	per year	32.0			
2021-2025	per year	44.0			
2026-2030	per year	44.0			
2016-2030	per year	40.0			

Table 8: Comparisons of forecasts
[Source:]

In light of the differences in timescale, format and sub-division, the potential for comparison is limited, however the following observations are made:

- The SAJ presentation forecasts an average demand of 33.0 million CGT p.a. (59 million GT p.a.) over the 21-year period 2014-2035, which is broken down over time periods as 22.2 million CGT (2014-20), 29.3 million CGT (2020-25), 38.1 million CGT (2025-30) and 45.7 million CGT (2030-35).
- The SEA Europe presentation forecasts the demand over the 20-year period, 2015-34 which shows a fluctuating requirement over this period which, when scaled off their graph, seems to average approximately 35m CGT p.a.
- The CANSI forecasts covers the 15-year period 2015-2030, with 32 million CGT p.a. forecast requirements for the first 5-years rising to 44 million CGT p.a. for years 6 - 10.
- The BAL/SHE forecast covers the 10-year period 2016-2025, with forecast requirement in CGT of 28.4 million CGT p.a. and in GT 39.8 million GT p.a. over that timescale.
- Over first 10 years of their forecasts (from 2015/2016 as appropriate), the SAJ averages 25.8 million CGT p.a., SEA Europe averages approx. 28.8 million CGT p-a- (by scaling off graphs) and CANSI averages 38.0 million CGT p.a.. The BAL/SHE forecast is therefore slightly higher than that of the SAJ, similar to that of SEA Europe and significantly lower than that of CANSI.
- SEA Europe issued an updated shipbuilding forecast in March 2017. Their forecast for overall shipbuilding demand in this update was shown graphically, and indicated a slight increase in the average demand for the period 2016-2035 from 35 million CGT per year to 35.6 million CGT per year. This increase is mainly driven by a more optimistic demand for the period 2026-2030, although the forecast for the earlier years is also marginally higher than previously forecast.

More detailed comparisons have been made by different ship-types. This comparison is included in Annex 1, where also the shipbuilding demand forecast as presented in chapter 3.3. is given in more detail.

3.6 Market forecast for shipbuilding supplies 2016 – 2025

The authors have calculated the market for marine supplies created by shipbuilding in the period 2016-2025 based on the shipbuilding forecast as outlined in the previous chapter. Calculations are based on individual cost models per ship-type and ship size, suggesting relative values of marine supply trades in relation to the overall value of the vessel. In addition, the geographical distribution of the shipbuilding demand/orderbook projection gives an indication on where the demand for marine supplies is created. The following description gives an overview on the forecasted demand for marine supplies by supply trade, ship-type and region.

On the basis of the shipbuilding market forecast as given above predicting an approx. USD 915 billion market for 26 different ship categories over the period of the next 10 years, the marine supplies forecast adds up to USD 567 billion (62% of shipbuilding market). This figure can be subdivided into approx. USD 132 billion for materials (steel plates, profiles, pipes, ducts, paint, 14.4% of the shipbuilding market) and into approx. USD 397 billion for marine equipment (systems and components, approx. 43.4% of the shipbuilding market). Both figures include supplier services for pre-manufacturing and assembly on board.

The following figures show a more detailed analysis of the marine supplies forecast 2016-2025. The different figures analyse the purchasing demand from different perspectives. The first perspective is the demand distribution over the different trades. It clearly shows that power generation creates the biggest value over all with about USD 100 billion over a ten-year period. This is followed by four areas creating between USD 60 billion and USD 80 billion over the ten-year period, namely steel, cargo handling, auxiliary systems and electrical plants and electronics.

A second analysis is creating an impression where the demand for equipment is coming from. Not surprisingly China is at the top of the global regions, but unexpectedly EU 28 is the runner-up followed by South Korea and Japan. The latter two Asian countries have lower ranking in comparison to earlier forecasts.

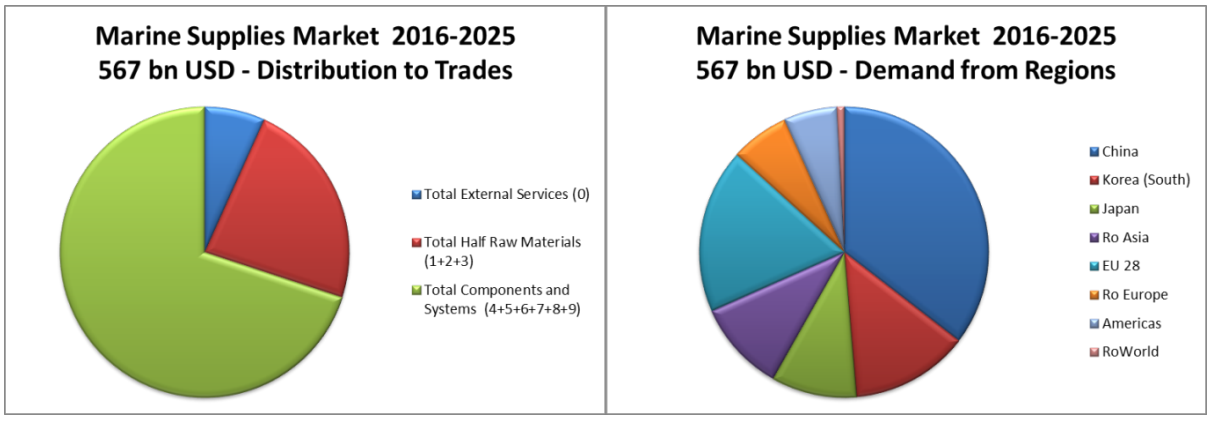


Figure 26: Marine Supplies Market 2016-2025
[Source Shipyard Economics and BALance TC calculations:]

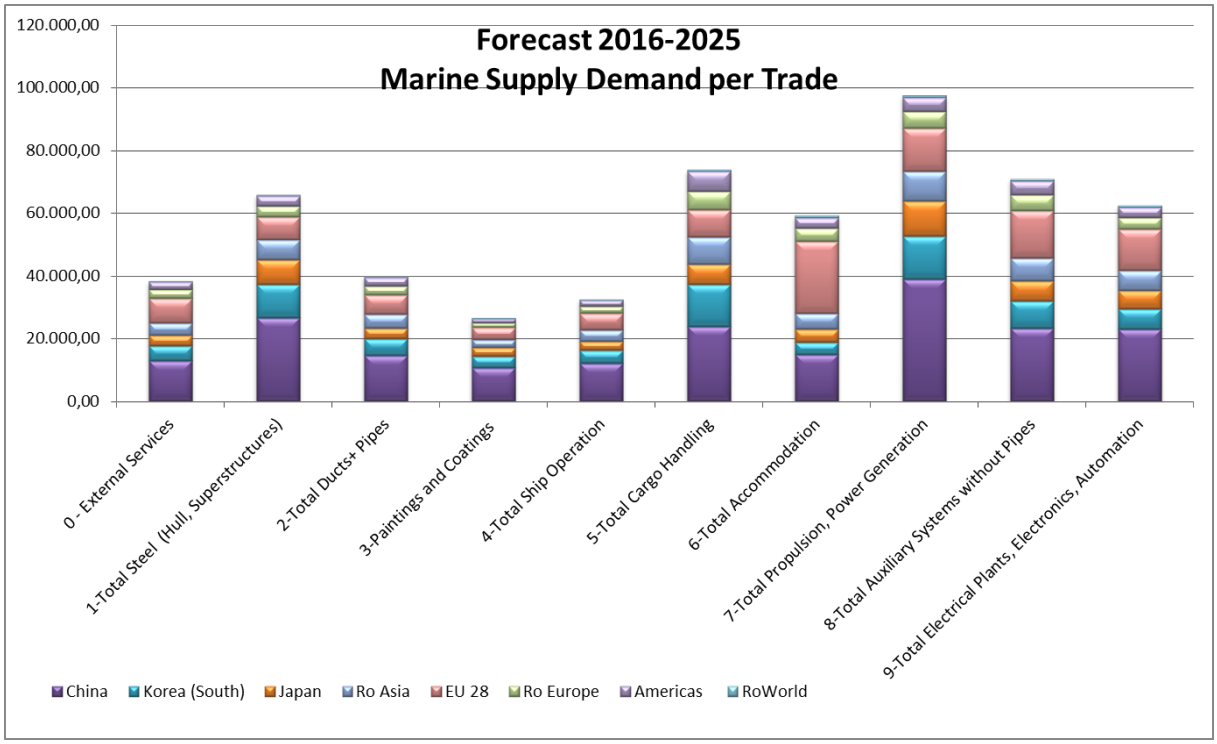


Figure 27: Forecast 2016-2025 marine supply demand per trade
[Source: Shipyard Economics and BALance TC calculations]

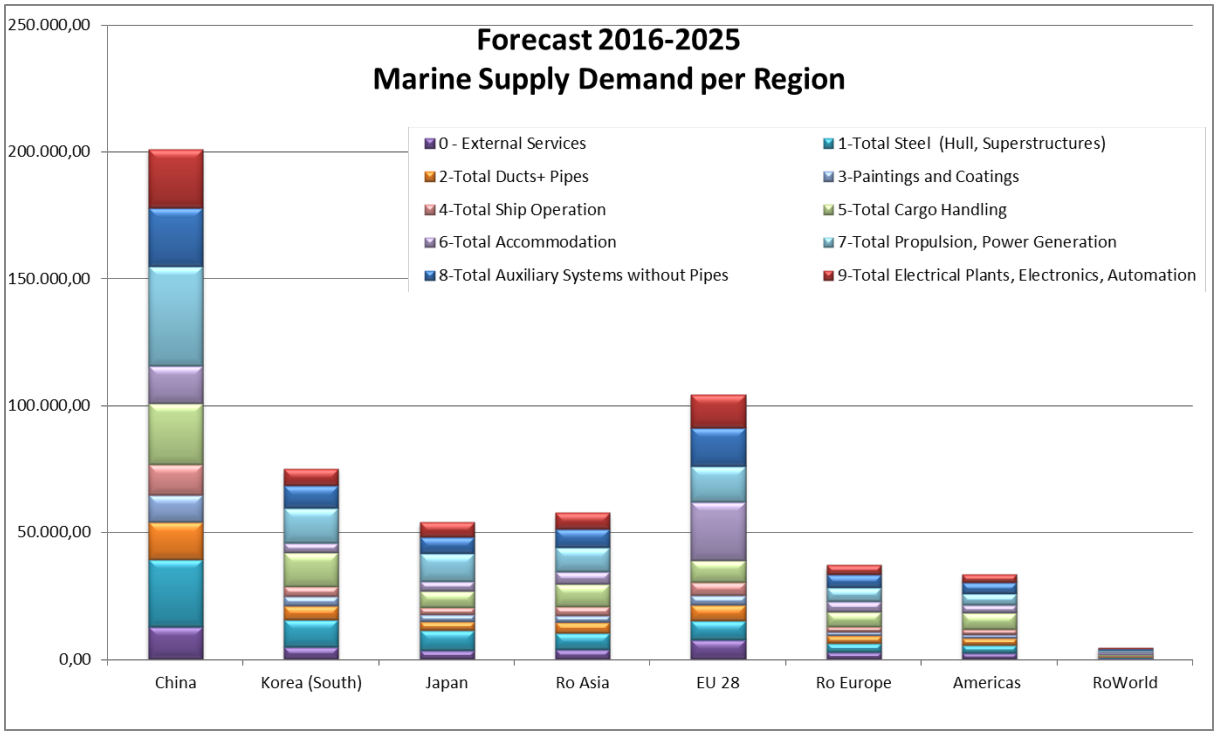


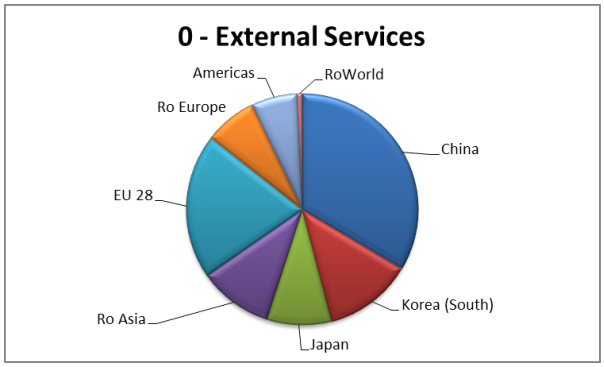
Figure 28: Forecast 2016-2025 Marine supply demand per region
[Source: Shipyard Economics and BALance TC calculations]

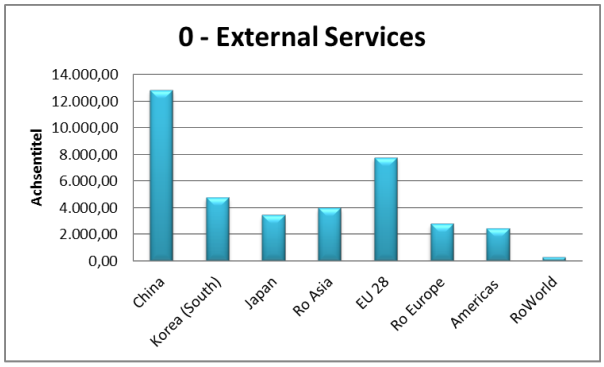
Looking into further details of the different trades shows that due to the size of the overall orderbook China is leading in the creation of demand in all trades except one. This is “accommodation” where EU 28 with their exceptional orderbook and forecast for cruise ships and mega yachts create the by far biggest demand. In all other trades except cargo handling EU 28 is the runner-up. For cargo

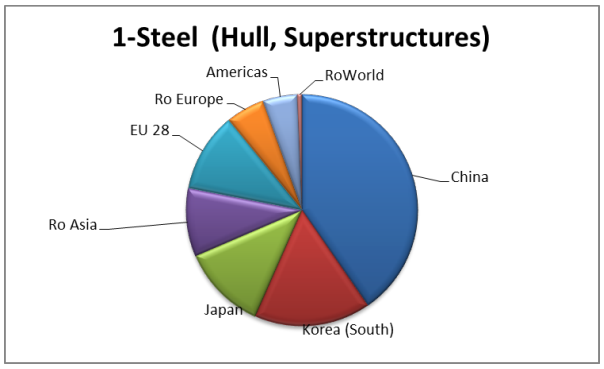
handling South Korea still creates a high demand driven by the orderbook and forecast for the offshore sector.

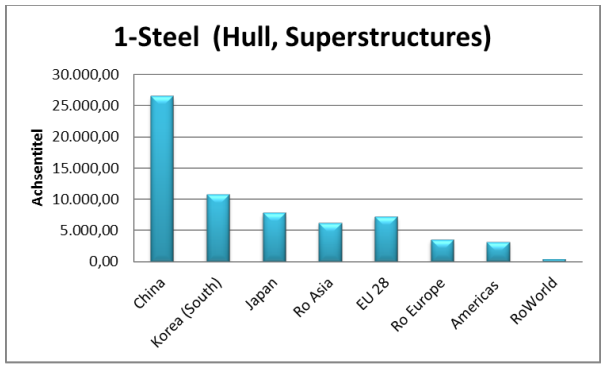
In relation to ship-types it is the container ship sector which is leading the pack in creating demand for supplies, well ahead of offshore AHTS, tankers, cruise ships and other NCCV.

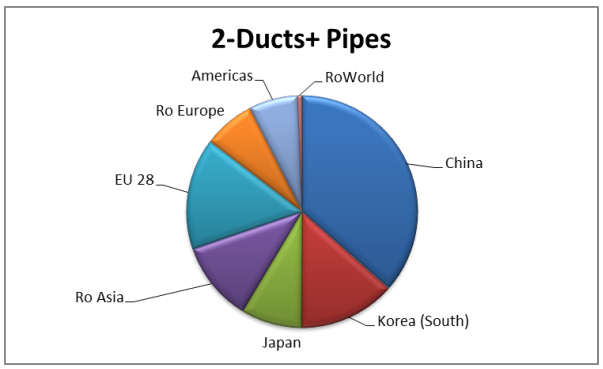
For the evaluation of the value creation in the shipbuilding supply chain the information on fleet ownership, building country per ship-type and origin country of demand creation for supplies are important criteria.

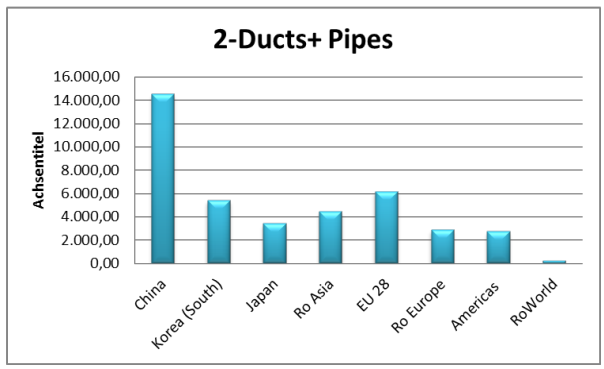


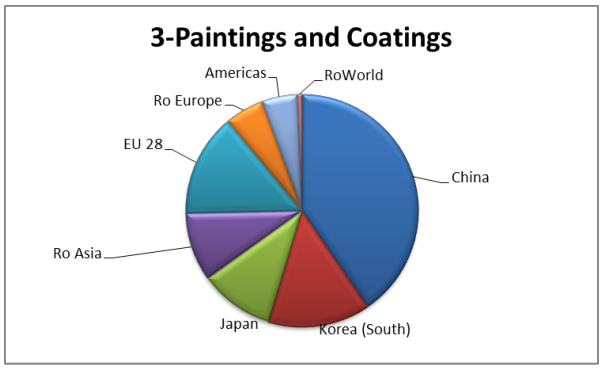


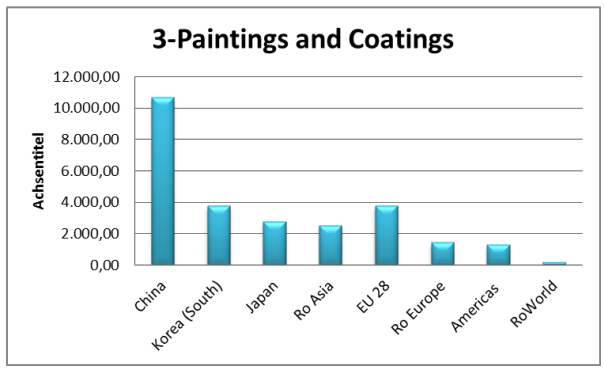


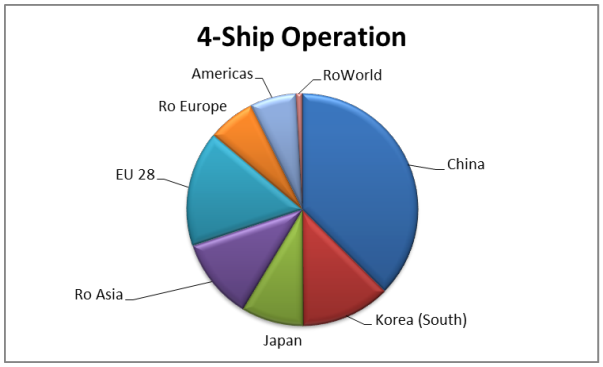


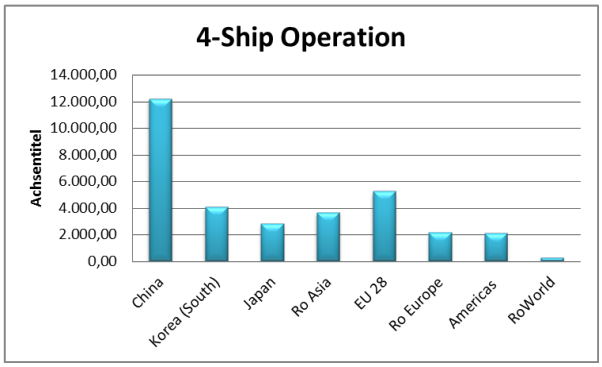









4-Ship Operation
Americas
RoWorld
Ro Europe
China
EU 28
Ro Asia
Korea (South)
Japan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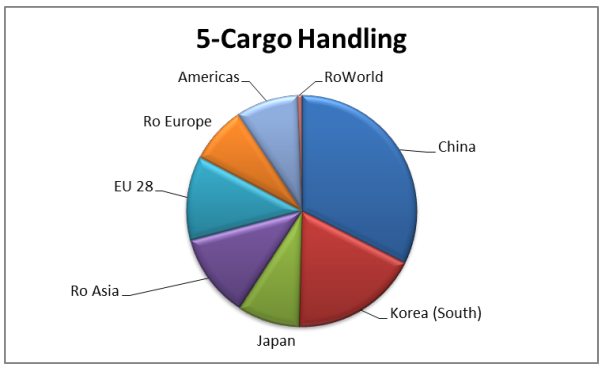
EU 28
Ro Europe
Americas
RoWorld


5-Cargo Handling
Americas
RoWorld
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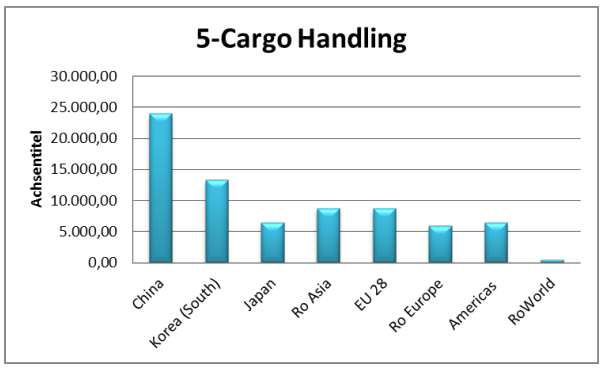
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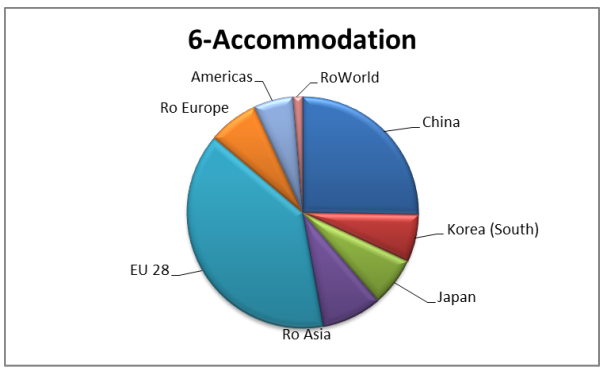
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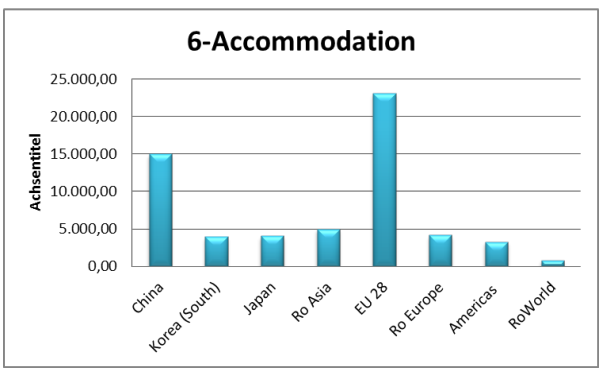
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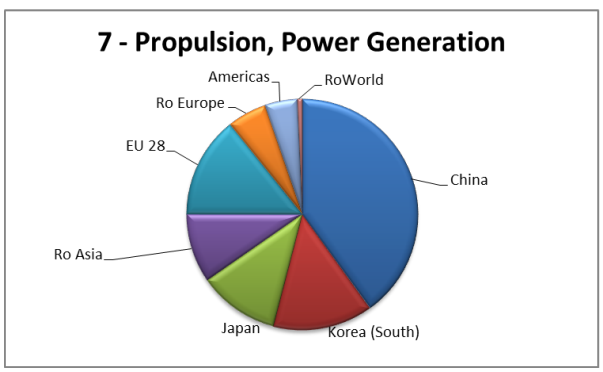
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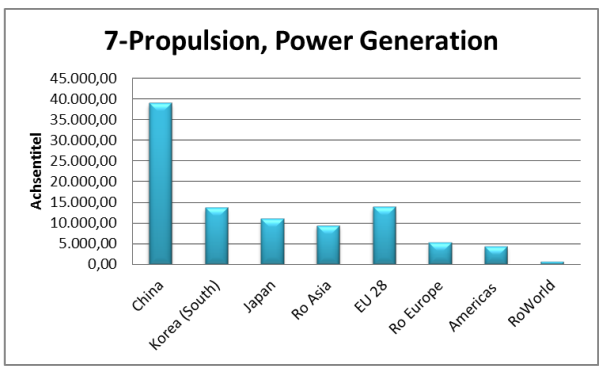
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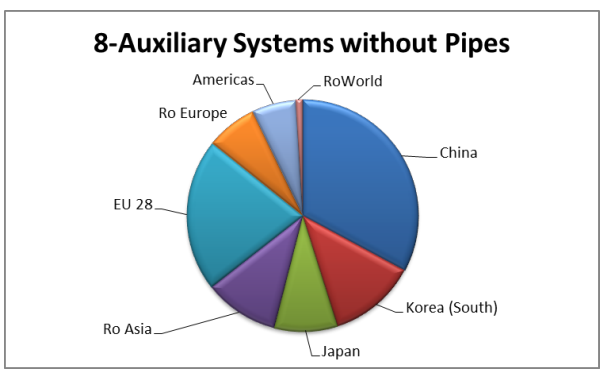
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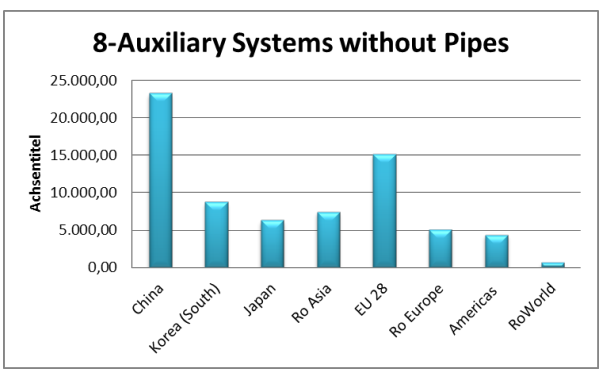
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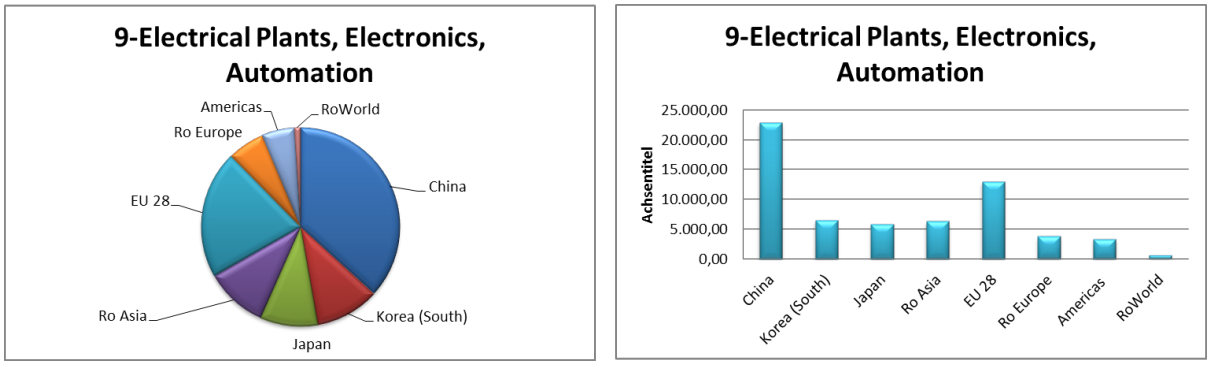


Figure 29: Forecast for different trades
[Source: Shipyard Economics and BALance TC calculations]

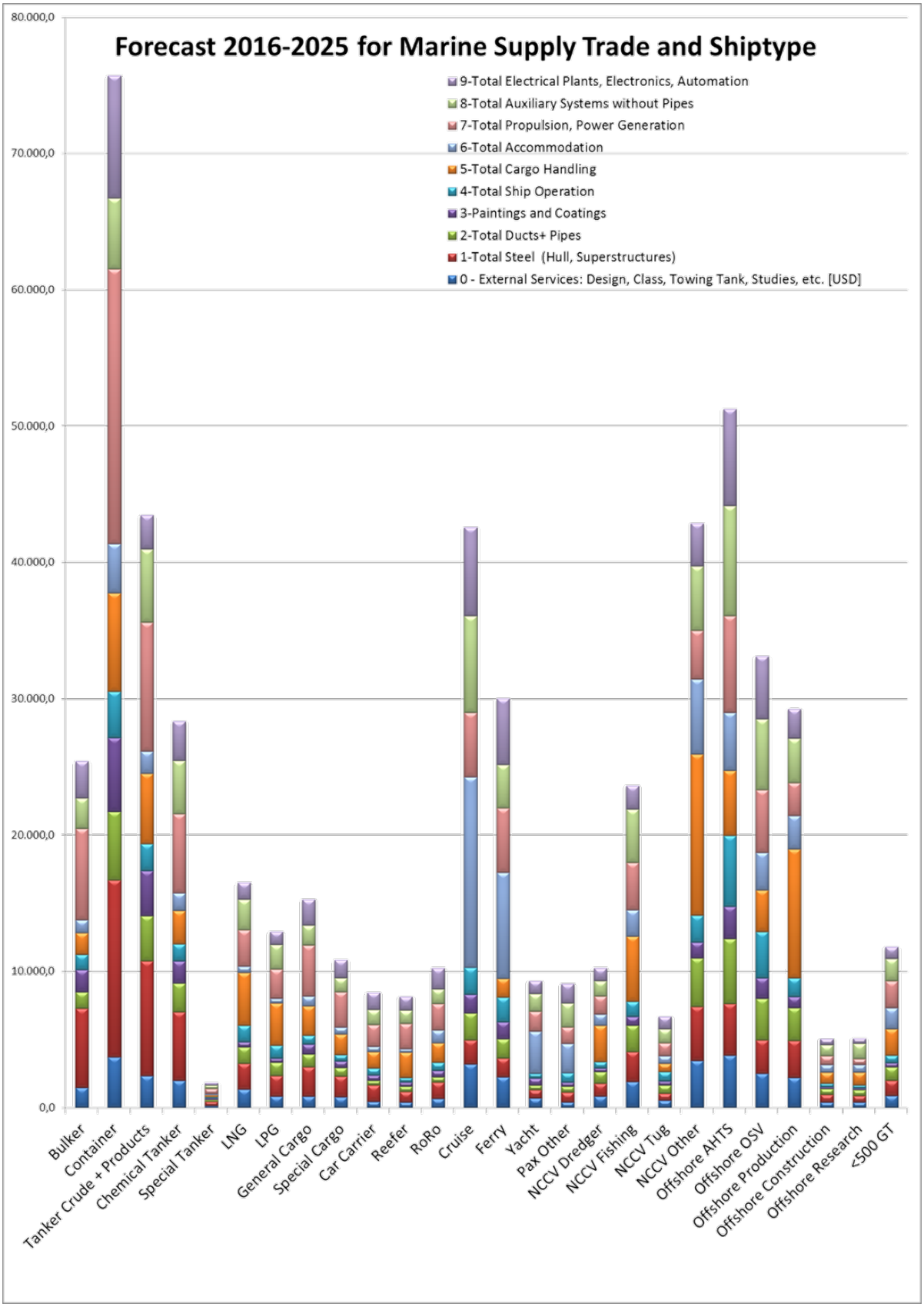


Figure 30: Forecast 2016-2025 for marine supply trade and ship-type
[Source: Shipyard Economics and BALance TC calculations]

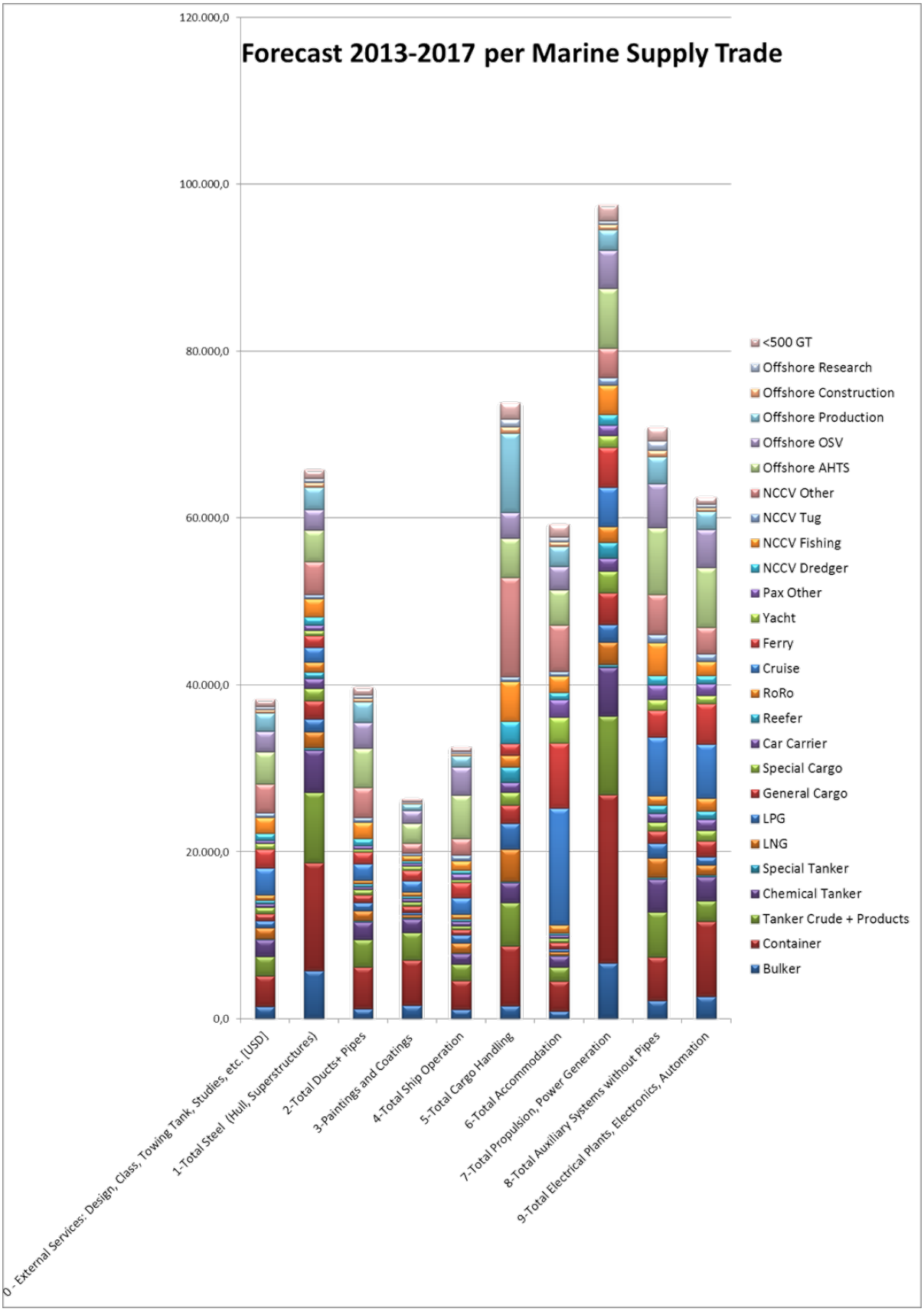


Figure 31: Forecast 2016-2025 per Marine supply trade
[Source: Shipyard Economics and BALance TC calculations]

3.7 Naval Market

Although not part of the original focus of the study, naval shipbuilding is discussed because of its characteristic as a high-end shipbuilding segment of particular importance to the European maritime technology industry, namely the shipyards and high-end equipment suppliers.

Detailed data for this market is difficult to find and hence it can only be evaluated at a general level and the following analysis should be regarded as a best estimate.

The development of world and regional naval markets is generally aligned with growth rates for GDP, representing the economic power of nations to build-up strong defence forces. This, however, is augmented by other influences like politics, strategic interest, access to the sea, seaborne economic interest, global and regional strength and potential naval responsibilities in international missions (e.g. anti-piracy). Additionally, it should be recognised that naval systems are heavily influenced by innovation in technology, especially by information technology and electronics, as naval ships evolve increasingly towards automated and autonomous systems rather than labour intensive, manned, ships. In this they may also become part of more complex and integrated technical products which are also integrated with other mission forces.

Naval products can be regarded in some respects as frontrunners for innovation with subsequent spin-offs into civilian markets. Super yachts are a particularly good example of this, with examples of comparable propulsion systems and levels of complexity. Therefore, for more reasons than just size, the world market for naval ships is significantly important to the world shipbuilding industry. *Figure 32* summarises the global naval market forecast by AMI International, which projects USD 838 billion (on circa 3 900 ships) over a period of 20 years; this contributes an average of USD 37 billion annually to the overall market forecast of shipbuilding. Compared to an earlier 20 years forecast this represents an increase in the market forecast value of 12%. More than 20% of this forecast is assigned to non-US NATO countries, which basically represents Europe. Information from Sea Europe on the global naval orderbook in mid-2015 values this at USD 445 billion. Given that naval projects have long lead times of 10 years or longer, this orderbook value corroborates the size of the naval market forecast.

World Naval Market Summary Table, 2013-2032

Global Naval Market Forecast (2013-2032)	In Progress (Building)		Planned (Near-Term Targets)		Projected (Rock-Kicking)		Totals	
Vessel Type	*# Hulls*	*US$B*	*# Hulls*	*US$B*	*# Hulls*	*US$B*	***# Hulls***	***US$B***
Aircraft Carrier	9	49.8	2	4.0	2	3.0	***13***	***56.8***
Amphibious	129	29.5	204	33.9	33	3.4	***366***	***66.8***
Auxiliary	57	8.1	112	40.1	16	3.1	***185***	***51.3***
Corvette	51	7.1	43	13.1	23	5.8	***117***	***26.0***
Cruiser	2	2.6	6	3.6			***8***	***6.2***
Destroyer	55	55.3	90	113.8	3	2.9	***148***	***172.0***
FAC	147	5.5	45	3.5	34	2.8	***226***	***11.8***
Frigate	193	68.8	75	42.4	44	17.0	***312***	***128.2***
MCMV	28	4.5	71	6.4	28	2.6	***127***	***13.5***
OPV	121	12.5	139	16.7	31	3.1	***291***	***32.3***
Patrol Craft	1121	9.7	482	7.5	157	1.6	***1760***	***18.8***
Submarine	154	142.3	142	100.7	27	11.5	***323***	***254.5***
Totals	***2067***	***395.7***	***1411***	***385.7***	***398***	***56.8***	***3876***	***838.2***

Figure 32: AMI World naval market summary 2013-2032,
[Source: (AMI International, 2013)]

According to the AMI study the world market will continue to grow despite shrinking naval budgets in Europe and the US, which might change again in the future. However, despite significant growth rates in South East Asia - especially China, India and South Korea - the US market remains by far the single biggest market, representing almost 40% of the market projection. On the other hand, South East Asia is overtaking European NATO countries in overall market size over the forecast period. This world naval market overview reflects the demand side of the market. On the supply side it should be noted that, for the time being, the United States and major Asian countries (China, Japan, partially Korea) basically build naval ships for their own use and only export limited numbers, whereas the major export builders comprise a limited number of European global players, as outlined in the following Figure 33: World naval export market overview,

[Source: (AMI International, 2013)]*Figure 33*. On average Europe's naval industry had an average share of more than 60% of the global export market over the period 2005-2014. This underlines the importance of this sector for the European maritime technology industry.

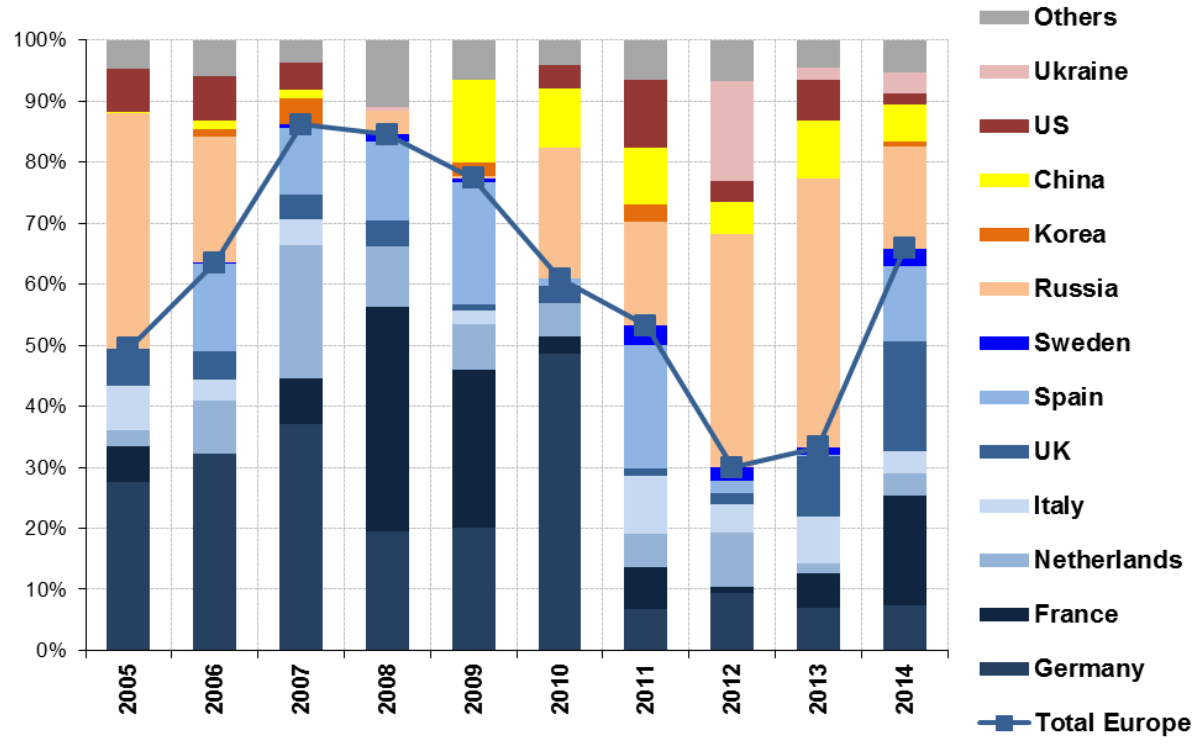


Figure 33: World naval export market overview,
[Source: (AMI International, 2013)]

In addition to the naval newbuilding market, the global naval vessel maintenance, repair and operations market was conservatively estimated to have an average annual production value, at shipyards, of USD 6 billion[7] Between them the average annual production volume for naval shipbuilding and repair totals circa USD 48 billion which represents a share of approximately 22% of the overall production value of shipbuilding (as calculated by the statistical analysis in Chapter 4).

With regard to the cost for supplies, i.e. materials and equipment, literature provides the following cost model in which labour accounts for 32 per cent of the 'end cost' of a surface combatant project, equipment 57% and material 11%[8]. As with all models, the complexities are hidden in the detail –

[7] (based on Irish consultants Research and Markets report "The Global Naval Vessels MRO Market 2012-2022").

[8] (Australia Defence SA Advisory Board, 2010, RAND Corporation, 2006)

in this model, the labour category is defined only as shipyard labour, with labour costs being fully burdened (i.e. including direct and overhead costs) and covering all types of labour (e.g., engineering, support, manufacturing). In this model, material includes basic items used in shipbuilding such as steel, paint, electrical cable, and insulation; and equipment includes major manufactured items such as systems for navigation, command and control, and machinery such as elevators, pumps, air conditioning and electrical distribution. To that end the structure of the model complies with the basic model applied in this study for merchant shipbuilding.

Given the basis of USD 48 billion, for the annual average production volume at shipyards, the related figure for equipment and materials totals an average annual production volume from 1st tier suppliers of USD 33 billion, which represents about 20% of the total production volume of global 1st tier suppliers.

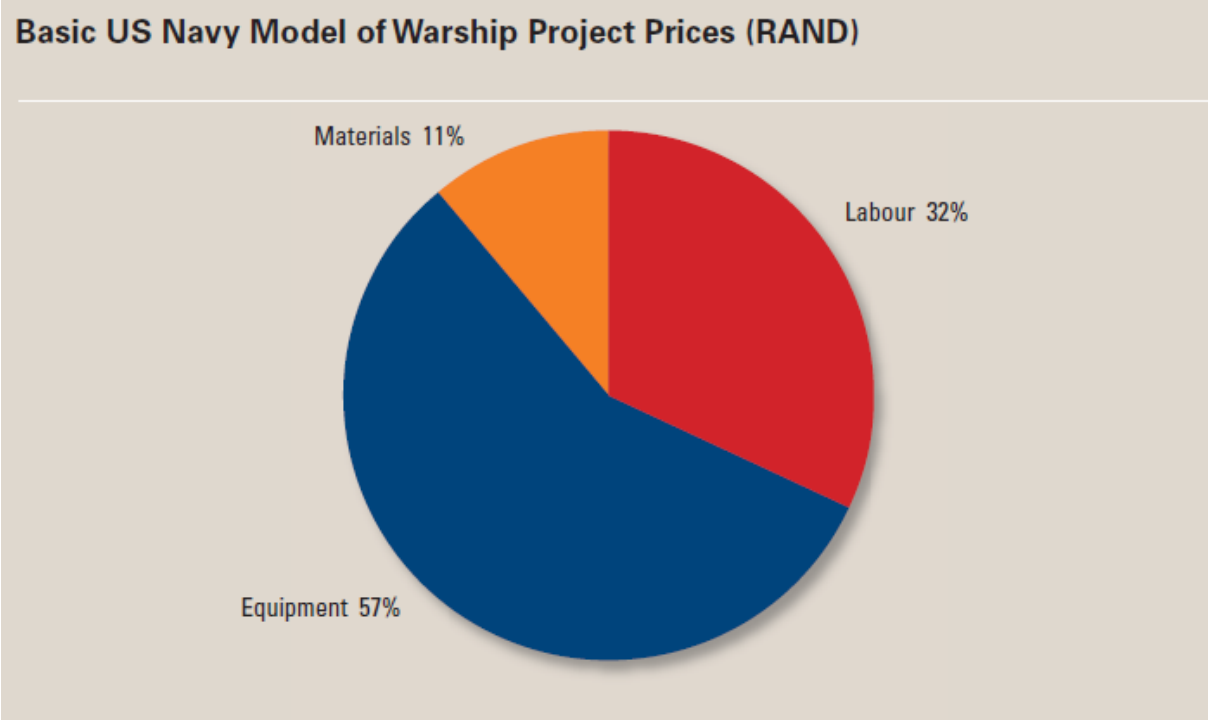


Figure 34: Basic navy model of warship project prices,
[Source: (RAND, 2006) (DefenceSA Advisory Board, 2011)]

With these figures in mind it is evident that the production value of naval shipbuilding, for Europe's shipbuilding industry and related supply industry, is relatively higher than that in other major shipbuilding countries. Europe's share falls in the range of 25-30% of the total production value and is only higher in the US, where naval production value exceeds 60% of the total industry production value. This shows the strategic importance of naval shipbuilding for Europe's shipyards and suppliers. Taken in combination with the merchant high-end ships built in Europe, it provides a powerful basis to continuously innovate, maintain knowledge and to strengthen supply chains. It should also be noted that smart knowledge in design, engineering, testing, running integrated supply chains and managing the entire life cycles of sophisticated ships and fleets deserves special consideration both now and in the future.

4 Shipbuilding supply chain analytics – The country's perspective

4.1 Global shipbuilding and marine supplies – A statistical view on the supply chain

The size of the shipbuilding supply chain has been estimated based on available national studies and the following official statistical data sources:

- Eurostat SBS – Structural Business Statistics
- OECD STAN Database
- Input / Output Tables from OECD

Where necessary, the project team has made appropriate assumptions and suitable inter- and extrapolations. The starting points for the analysis of the shipbuilding supply chain are the "production value" and "value added" indicators of the official statistics for NACE classes "shipbuilding"," boatbuilding" and "repair of ships and boats". These statistical classes contain ship newbuilding, repair, naval shipbuilding, boatbuilding, offshore vessels and platforms and ship scrapping. The difference between "production value" and "value added" determines the "purchasing-value".

The "purchasing value" comprises all goods and services procured by the yards, including energy, food and other non-marine supplies products and services. Therefore, the purchasing value has been corrected for "shipyard and energy cost". A further correction has been made for "purchasing-values" relating to customers other than shipyards. Whereas the newbuilding costs for ships, naval vessels and offshore platforms are contained in the purchase value, those for maintenance and repair directly performed by the marine supplies industry and the shipping and offshore companies are not covered. Therefore, the purchasing values of shipping companies and, as far as possible, also for offshore companies have been considered as well.

In a second step, the calculated purchase values have been divided into imported and domestic purchase values based on country specific OECD Input Output tables in order to reflect the level of internationalisation of the maritime supply chain in each country. Furthermore, the "value added", "domestic purchase value" and "imported purchase value" indicators for several NACE industry classes representing the maritime supplies industry have been gathered and analysed from Eurostat. In particular, the "domestic value added" of each supply chain tier gives a good indication of the socio-economic impact of the maritime supply chain in Europe.

By applying this approach on a global scale, reliable and appropriate data has been found in the statistics for the OECD countries. For new shipbuilding nations, which are not OECD countries, at first for China, but also for countries like Philippines, Viet Nam, Brazil, Indonesia, Singapore, Malaysia etc. data has been obtained from secondary sources and has been based on qualified evaluations.

Average size of the global shipbuilding supply chain 2010-2014

The size analysis of the global shipbuilding supply chain has been generated using a combination of data from different sources. In some countries, where we have to accept a lack of data, necessary estimates have been made. The core of the data is coming from Eurostat for the EU, the OECD STAN database and national publications from various national bureaus of statistics or national industry associations.

On this basis, the average size of the global shipbuilding supply chain has been calculated as an average figure based on the period 2010 to 2014. Preliminary results for the global production value are calculated at a total amount of EUR 211 398 billion (~ USD 230 339 billion), which represents

the total value of the complete global shipbuilding supply chain. *Figure 35* depicts the production values of the world major shipbuilding nations.

Since these global production values are based on the available data, further research in this field is envisaged in order to validate the preliminary results and to enlarge upon the analysis. Furthermore, other marine markets like direct purchases from offshore and shipping industries and as well as by governments may have been underestimated.

World market leaders in terms of production value are China, South Korea and Japan, thanks to their strong focus on merchant shipbuilding. The aggregated EU-28 production value exceeds other maritime countries like Japan or USA and maintains a strong market share (~19%). High market values for the USA, Norway and UK are predominantly caused by navy and offshore markets, whereas Italy is characterised by cruise-shipbuilding and a very strong boatbuilding market. Germany and France build on strong cruise-shipbuilding. Overall, the presented estimation of the world production value provides a fair idea on the average size for the period 2010-2014.

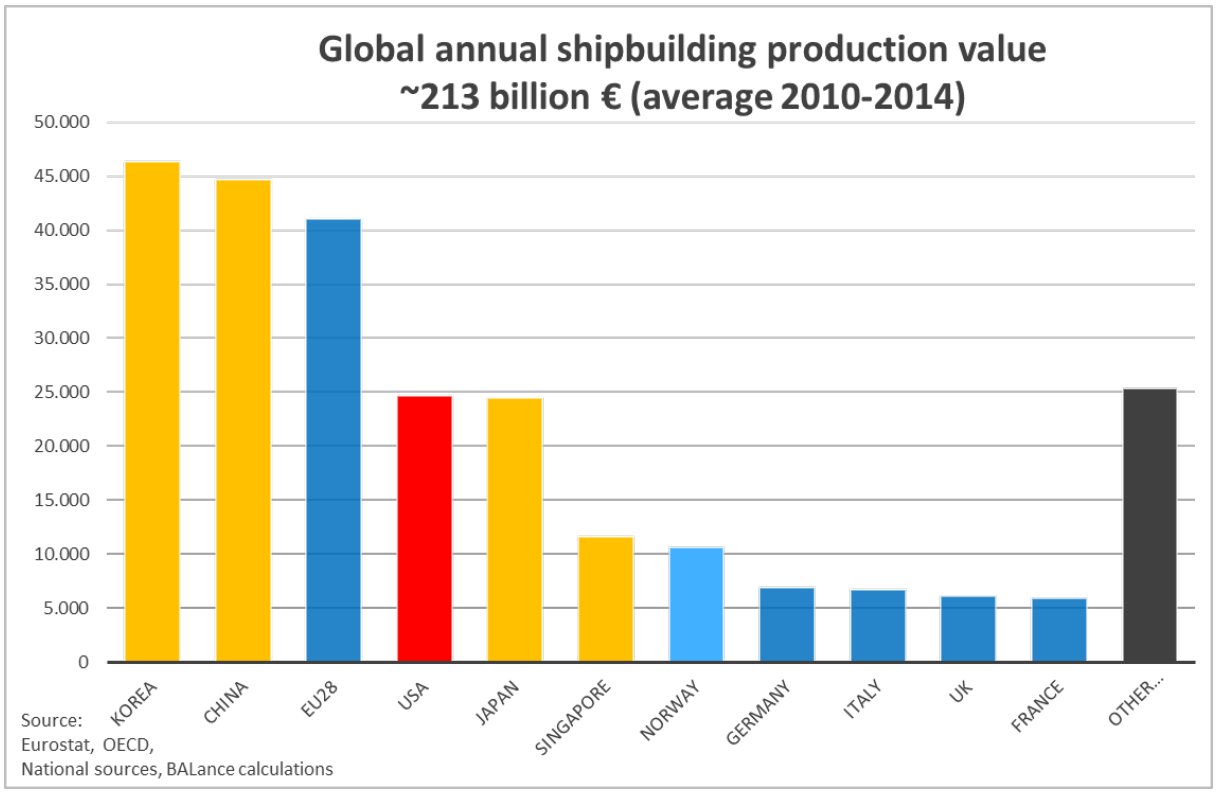


Figure 35: Regional distribution of the world shipbuilding production values for shipbuilding [million EUR] [Sources: (OECD), (Eurostat), BALance TC calculations, 2017]

Developments in shipbuilding production values show a rapid increase, especially in China, South Korea and Japan in the time frame under consideration. While the European shipbuilding countries face a slowly stagnating decline after the production value peak in 2008, the major shipbuilding countries of China, South Korea and Japan are characterised by enormous growth rates in terms of produced CGT (see *Figure 36*) and the associated production value up until 2011. In the following years, the production volumes have shrunken massively. Consequently, the average values for the timeframe 2010 – 2014 include the peak in production value that leads to high average values. As a result, the production value gap (in physical figures such as DWT, GT and CGT) between China, South Korea and the EU 28 has increased significantly. Moreover, other regions such as Brazil and the USA have generated substantial growth of their shipbuilding industry during the timeframe under investigation.

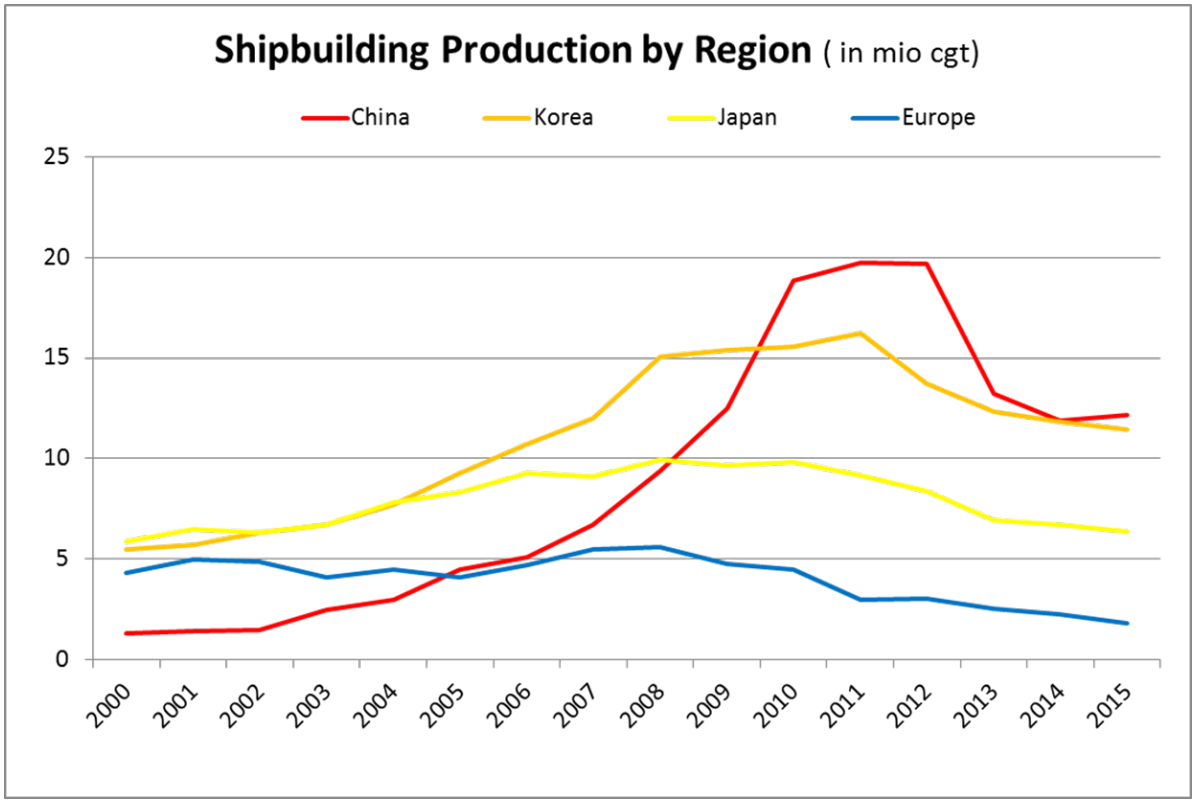


Figure 36: Shipbuilding production by Region in mill. CGT, [Source: Shipyard Economics]

In a next step, the overall size of the world market for marine supplies has been projected from the global production values of shipbuilding in combination with identified patterns of the shipbuilding delivery structure. On that basis, the overall value of global marine supplies summarizes to approximately EUR 150 billion annual average for the period 2010-2014. Approximately EUR 14 billion of this is represented by non-object purchases from shipyards for general operational purposes. Object oriented purchases (i.e. those directly relating to the production of ships) total EUR 136 billion and breaks down into the basic supply classes “system and components” (~72%), “material” (~21%) and “external services” (~8%). Following this, the Asian market for marine supplies created an average annual demand of EUR 84 billion, equal to 62% of the global market, for Europe an amount of EUR 35 billion, which equals 25% of the global market and for the rest of the world an amount of EUR 17 billion of marine supplies that equals to 12,7%.

The purchase value share of the total shipbuilding production value is an important indicator for the supply chain analysis. In the 1990s, we have seen major outsourcing strategies by shipyards, which materialised statistically as increasing purchase/production ratios. Since the trend towards more outsourcing at shipyards continued, present levels of total purchasing values arrive at ratios between 65% to 85% in 2013. Outsourcing strategies initially have been followed to reduce cost and to slim down production in shipyards. In the boom years before the financial crisis with increasing shipbuilding activities (2002-2005), purchasing ratios had further increased in order to compensate for lack of production capacity and supplement in-house capacity using external sources.

After the financial crises, differing trends can be identified (see *Figure 37*). While South Korea increased its purchase values ratio, China maintains a stable purchase value ratio. In other countries, like Italy, Germany or France, a high variation of the purchase ratio can be seen. The timeline is characterised by a decline in the production value after 2009. Consequently, the European ship- and boatbuilding industry had to adapt their production capacities. In this process, purchase values can be adjusted quicker, while the adaption of production facilities and employees

is carried out with a more slowly. As a result, several European countries as well as the aggregated values for EU 28 have a significantly lower purchase value shares of the production value after 2009 (see *Figure 56*). In the years 2010 and onward, the decline in production value has stagnated and after 2011 there is even a small growth and the share of the purchase value in relation to the production value increases back to the level of 2008.

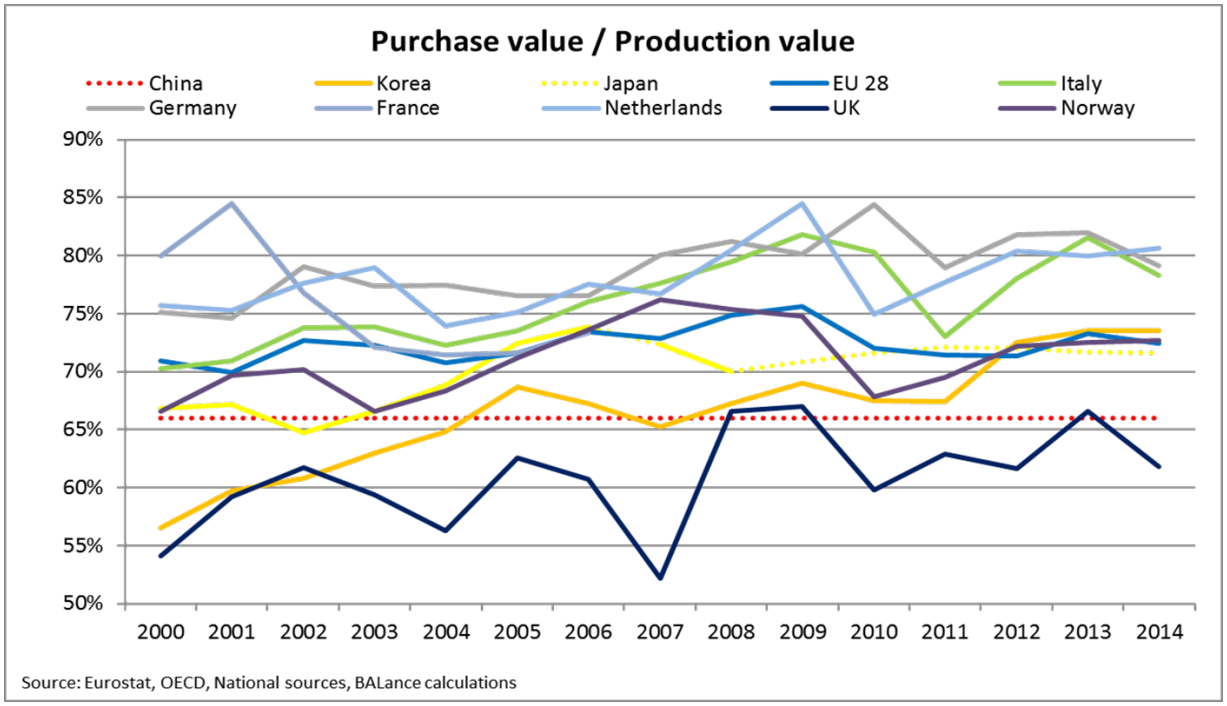


Figure 37: Ratio purchase value / production value
[Sources: (OECD) (Eurostat), BALance TC calculations, 2016]

4.2 Overall shipbuilding supply chain portfolios

The production and purchasing values of the shipbuilding- and boatbuilding industries are the first step in the analysis of the shipbuilding supply chain. In the second steps, the 1st and 2nd tier suppliers of the shipbuilding supply chain have been analysed in terms of value added, imported and domestic purchase values as well as domestic and international sales. In this manner, the analysis has been performed for individual countries taking account of their respective statistical import/export ratios available from Eurostat, national statistical offices and Input-Output tables provided by the OECD. Additional information was derived from national studies performed by some of the EU Member States. The result of this statistical analysis has been summarised in National portfolios, as depicted in *Figure 38,* which are provided in Annex 2 (*"Country Portfolios of Shipbuilding Supply Chains"*) for EU 28, Norway and Turkey. Based on the statistical production value, the value added and the domestic and imported purchase value, the number of full time-equivalent employees and the number of enterprises have been estimated by using the statistical figures available from Eurostat for the average turnover/employee and the average number of employees per enterprise.

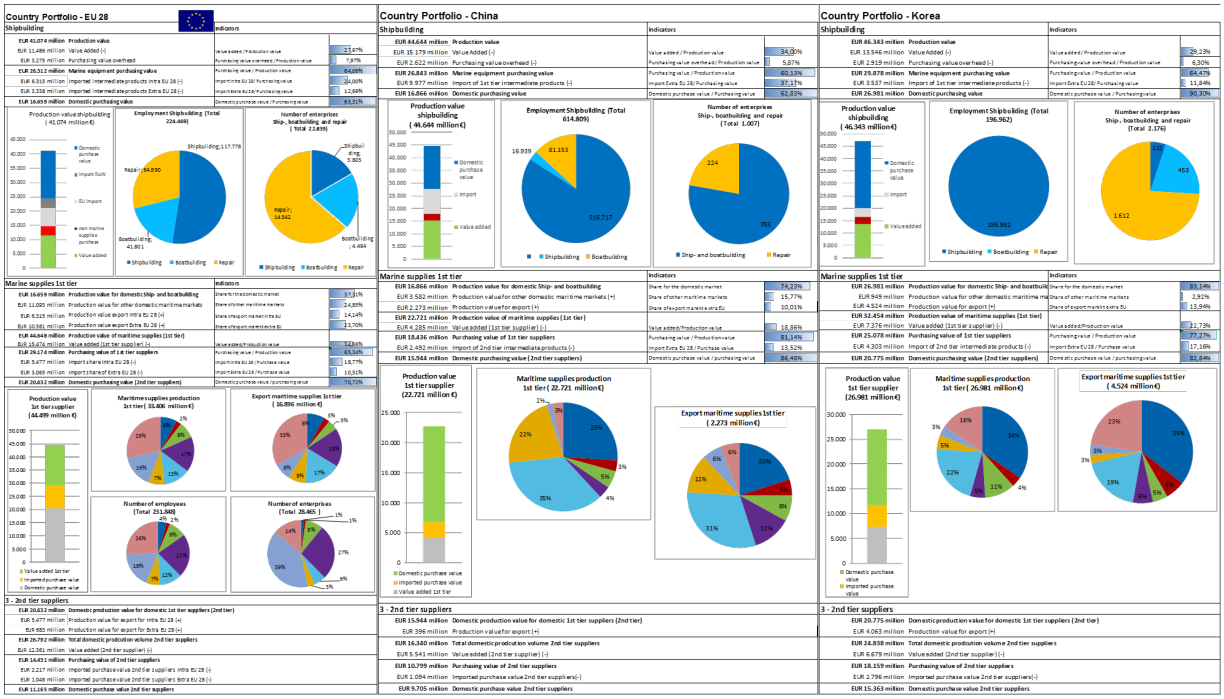


Figure 38: National portfolios
[Source: BALance TC, 2017]

The analysis of the 1st and 2nd tier supplier distinguishes between the following 8 categories of marine supplies according to the structure available from input output statistics:

1. External services, subcontracts (Engineering)
2. Material – Steel, pipes and non-ferro materials
3. Material – Coatings
4. Goods – Steel products
5. Goods – Engines
6. Goods – Mechanical engineering
7. Goods – Electrical engineering, electronics
8. Goods – Others

It should be noted that due to the variances of statistical calculations, the accuracy of the national portfolios is likely to be stronger for those countries with bigger production values than for those which have marginal production values, such as Luxembourg and Ireland. Variances may occur through corrections for markets other than the purchasing market of shipyards. Corrections have been made for purchasing by shipping companies and offshore companies directly, which are not included in production values of the shipyards. Further corrections would have been necessary for direct purchasing of the navy for maintenance and repair, but these could not be performed due to a lack of data. As a result, the overall result is potentially slightly underestimated.

Based on reasonably reliable data, the results of the national statistical analysis of EU Member States have been aggregated into an overall European (EU 28) Portfolio *(Figure 40)* with average data for the period 2010-2014.

Shipbuilding generates an overall production value of EUR 41 billion, employing 225 000 people in more than 22 000 companies. With an overall production volume of EUR 44.5 billion p.a., the 1st tier of the shipbuilding supply chain reaches an even higher production value building on their high production values for export. While goods and services worth of EUR 6.3 billion are exported intra

EU 28, a production value of EUR 10.5 billion is exported outside the EU 28 countries (extra EU export). Consequently, the 1st tier of the shipbuilding supply chain engages more than 231 000 employees in more than 28 000 enterprises across Europe.

The economic strength of the 1st tier suppliers within European shipbuilding supply chain in combination with the distinct intra-European trade is responsible for a powerful group of sub-suppliers in the 2nd tier of shipbuilding supply chain. The analysis estimates a total production value of EUR 26.8 billion for the 2nd tier suppliers and additional 109 000 employees.

Country Portfolio - EU 28

Shipbuilding		Indicators	
EUR 41.074 million	**Production value**		
EUR 11.486 million	Value Added (-)	Value added / Prodcution value	27,97%
EUR 3.275 million	Purchasing value overhead	Purchasing value overhead / Production value	7,97%
EUR 26.312 million	**Marine equipment purchasing value**	Purchasing value / Production value	64,06%
EUR 6.315 million	Imported intermediate products Intra EU 28 (-)	Import Intra EU 28/ Purchasing value	24,00%
EUR 3.338 million	Imported intermediate products Extra EU 28 (-)	Import Extra EU 28/ Purchasing value	12,69%
EUR 16.659 million	**Domestic purchasing value**	Domestic purchase value / Purchasing value	63,31%

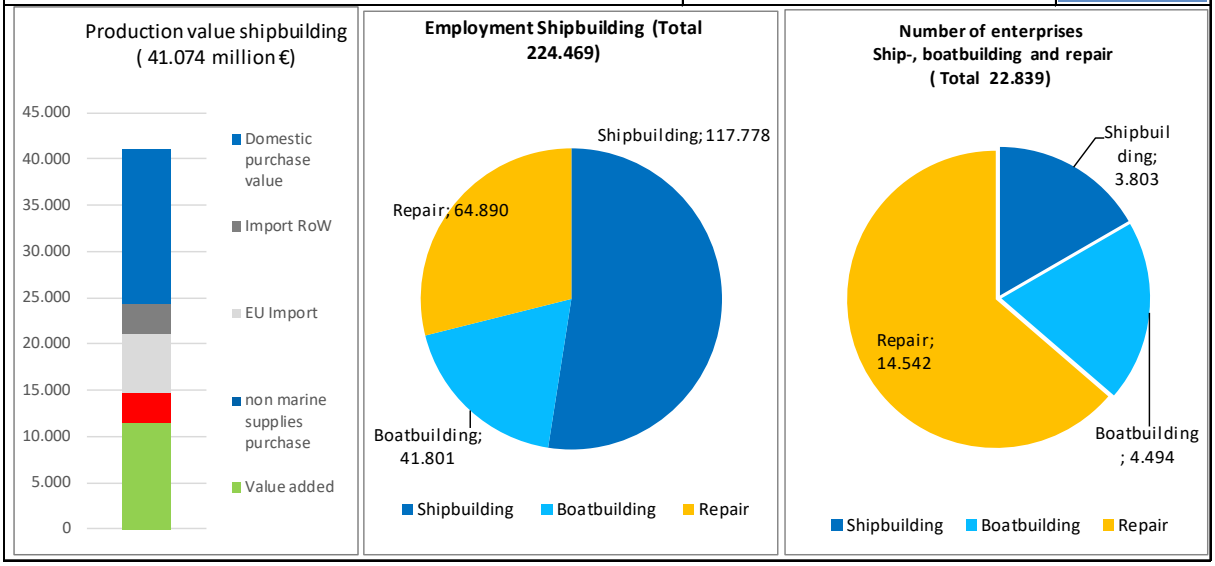
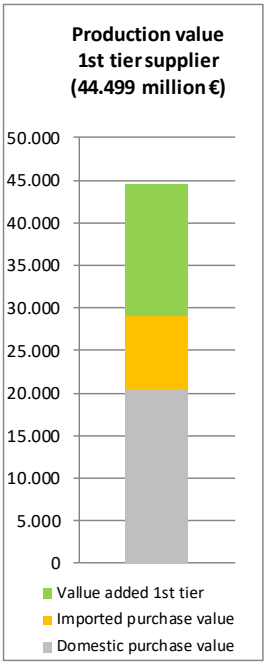
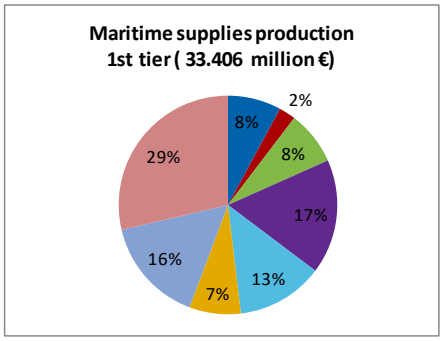
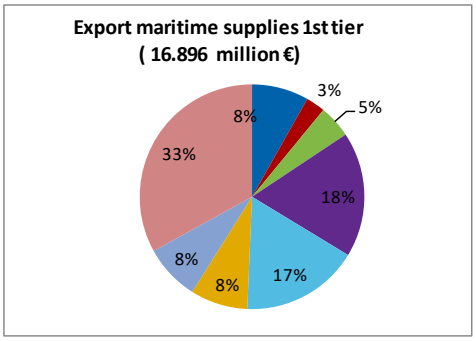


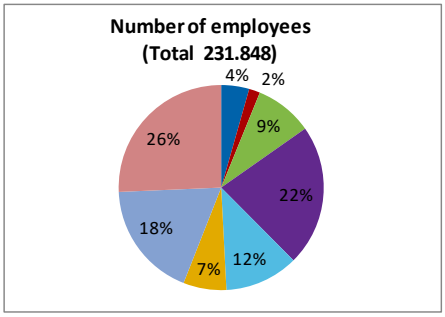
Figure 39: Aggregated member states portfolios EU 28: Part 1,
[Source: (Eurostat) and BALance TC calculations 2017]

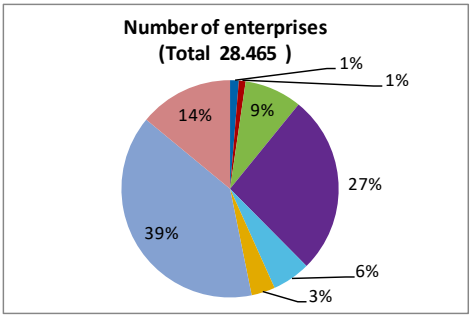
Marine supplies 1st tier		Indicators	
EUR 16.659 million	**Production value for domestic Ship- and boatbuilding**	Share for the domestic market	37,31%
EUR 11.093 million	Production value for other domestic maritime markets	Share of other maritime markets	24,85%
EUR 6.315 million	Production value export Intra EU 28 (+)	Share of export market intra EU	14,14%
EUR 10.581 million	Production value export Extra EU 28 (+)	Share of export marekt extra EU	23,70%
EUR 44.648 million	**Production value of maritime supplies (1st tier)**		
EUR 15.474 million	Value added (1st tier supplier) (-)	Value added/Production value	34,66%
EUR 29.174 million	**Purchasing value of 1st tier suppliers**	Purchasing value / Production value	65,34%
EUR 5.477 million	Import share Intra EU 28 (-)	Import Intra EU 28 / Purchase value	18,77%
EUR 3.065 million	Import share of Extra EU 28 (-)	Import Extra EU 28 / Purchase value	10,51%
EUR 20.632 million	**Domestic purchasing value (2nd tier suppliers)**	Domestic purchase value / purchasing value	70,72%











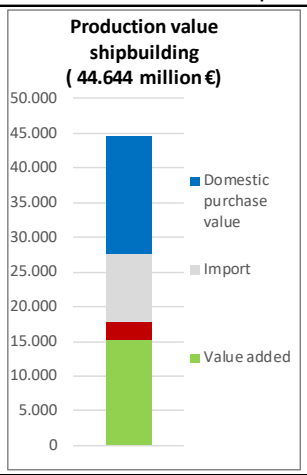
3 - 2nd tier suppliers	
EUR 20.632 million	**Domestic production value for domestic 1st tier suppliers (2nd tier)**
EUR 5.477 million	Production value for export for Intra EU 28 (+)
EUR 683 million	Production value for export for Extra EU 28 (+)
EUR 26.792 million	**Total domestic prodcution volume 2nd tier suppliers**
EUR 12.361 million	Value added (2nd tier supplier) (-)
EUR 14.431 million	**Purchasing value of 2nd tier suppliers**
EUR 2.217 million	Imported purchase value 2nd tier suppliers Intra EU 28 (-)
EUR 1.049 million	Imported purchase value 2nd tier suppliers Extra EU 28 (-)
EUR 11.165 million	**Domestic purchase value 2nd tier suppliers**

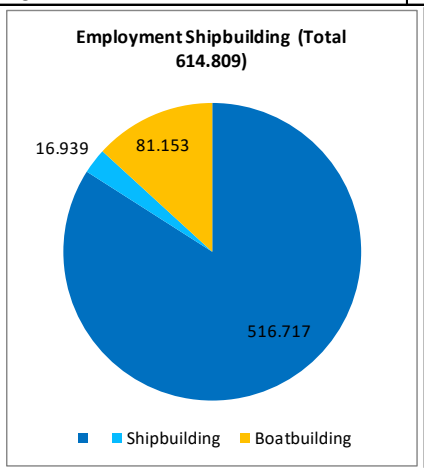
Figure 40: Aggregated member states portfolios EU-28, Part 2
[Source: (Eurostat) and BALance TC calculations 2017]

Comparable portfolios have been generated for other major shipbuilding countries in the world. However, available data sources are OECD and national sources, which do not report at the same level of detail or accuracy as Eurostat. The following tables show analysis for China, South Korea and Japan.

Country Portfolio - China

Shipbuilding		Indicators	
EUR 44.644 million	**Production value**		
EUR 15.179 million	Value Added (-)	Value added / Prodcution value	34,00%
EUR 2.622 million	Purchasing value overhead (-)	Purchasing value overhead / Production value	5,87%
EUR 26.843 million	**Marine equipment purchasing value**	Purchasing value / Production value	60,13%
EUR 9.977 million	Import of 1st tier intermediate products (-)	Import Extra EU 28/ Purchasing value	37,17%
EUR 16.866 million	**Domestic purchasing value**	Domestic purchase value / Purchasing value	62,83%





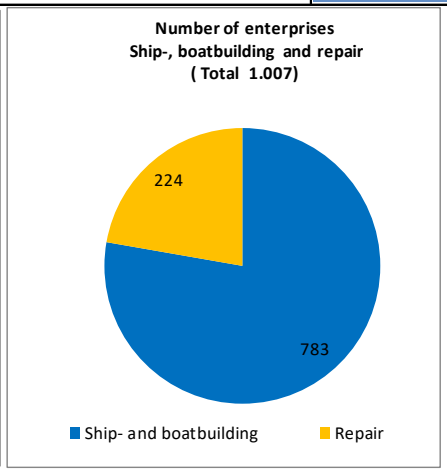
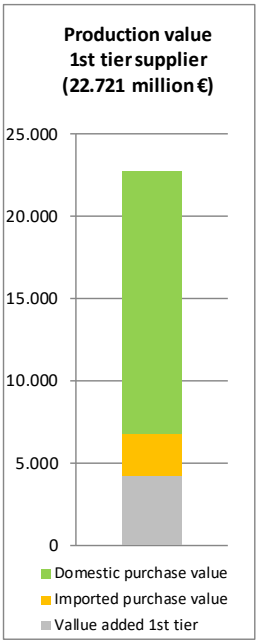
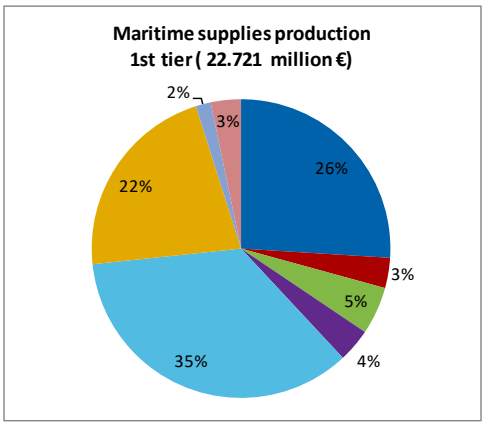
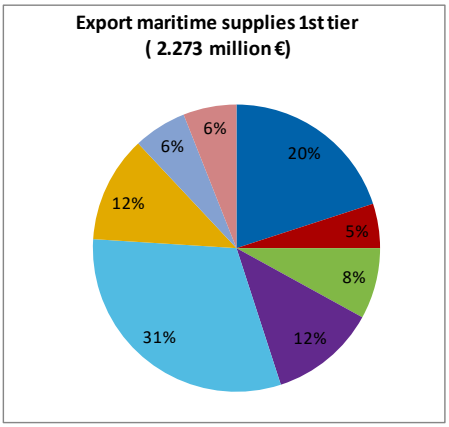


Figure 41: Aggregated member states portfolios China: Part 1,
[Source: China Statistics and BALance TC calculations 2017]

Marine supplies 1st tier		Indicators	
EUR 16.866 million	**Production value for domestic Ship- and boatbuilding**	Share for the domestic market	74,23%
EUR 3.582 million	Production value for other domestic maritime markets (+)	Share of other maritime markets	15,77%
EUR 2.273 million	Production value for export (+)	Share of export marekt extra EU	10,01%
EUR 22.721 million	**Production value of maritime supplies (1st tier)**		
EUR 4.285 million	Value added (1st tier supplier) (-)	Value added/Production value	18,86%
EUR 18.436 million	**Purchasing value of 1st tier suppliers**	Purchasing value / Production value	81,14%
EUR 2.492 million	Import of 2nd tier intermediate products (-)	Import Extra EU 28 / Purchase value	13,52%
EUR 15.944 million	**Domestic purchasing value (2nd tier suppliers)**	Domestic purchase value / purchasing value	86,48%





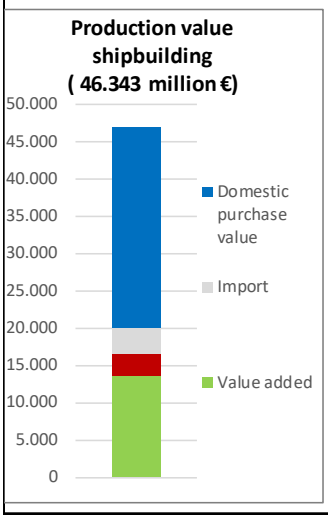


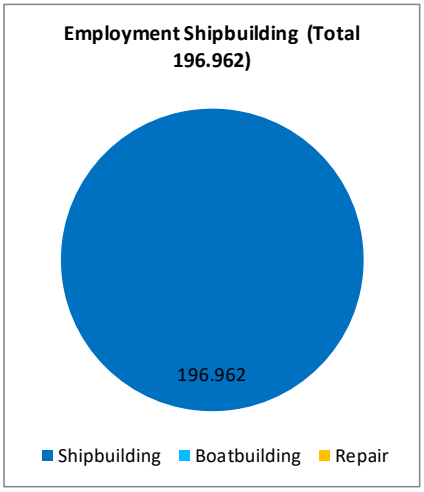
3 - 2nd tier suppliers		
EUR 15.944 million	**Domestic production value for domestic 1st tier suppliers (2nd tier)**	
EUR 396 million	Production value for export (+)	
EUR 16.340 million	**Total domestic prodcution volume 2nd tier suppliers**	
EUR 5.541 million	Value added (2nd tier supplier) (-)	
EUR 10.799 million	**Purchasing value of 2nd tier suppliers**	
EUR 1.094 million	Imported purchase value 2nd tier suppliers(-)	
EUR 9.705 million	**Domestic purchase value 2nd tier suppliers**	

Figure 42: Aggregated member states portfolios China, Part 2
[Source: (Eurostat) and BALance TC calculations 2017]

Country Portfolio - Korea

Shipbuilding		Indicators	
EUR 46.343 million	**Production value**		
EUR 13.546 million	Value Added (-)	Value added / Prodcution value	29,23%
EUR 2.919 million	Purchasing value overhead (-)	Purchasing value overhead / Production value	6,30%
EUR 29.878 million	**Marine equipment purchasing value**	Purchasing value / Production value	64,47%
EUR 3.537 million	Import of 1st tier intermediate products (-)	Import Extra EU 28/ Purchasing value	11,84%
EUR 26.981 million	**Domestic purchasing value**	Domestic purchase value / Purchasing value	90,30%





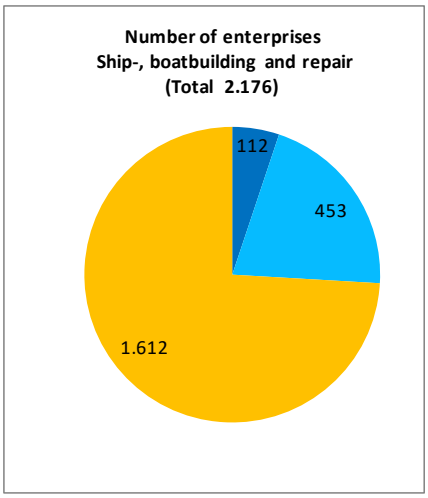
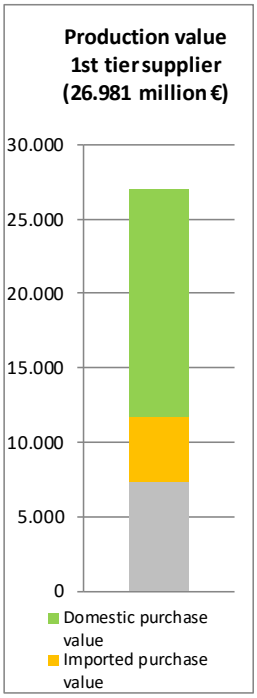
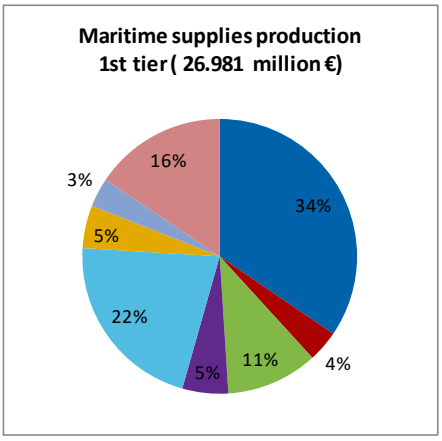
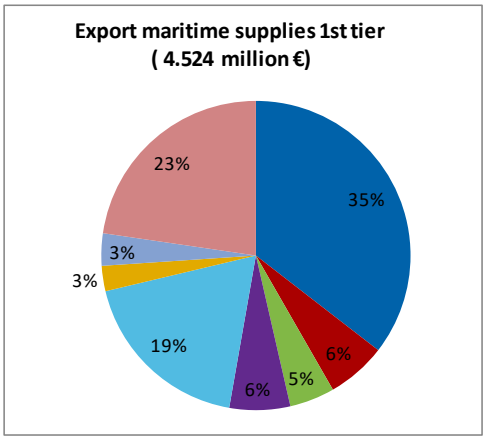


Figure 43: Aggregated member states portfolios South Korea: Part 1, [Source: (OECD) and BALance TC calculations 2017]

Marine supplies 1st tier		Indicators	
EUR 26.981 million	**Production value for domestic Ship- and boatbuild**	Share for the domestic market	83,14%
EUR 949 million	Production value for other domestic maritime ma	Share of other maritime markets	2,92%
EUR 4.524 million	Production value for export (+)	Share of export marekt extra EU	13,94%
EUR 32.454 million	**Production value of maritime supplies (1st tier)**		
EUR 7.376 million	Value added (1st tier supplier) (-)	Value added/Production value	22,73%
EUR 25.078 million	**Purchasing value of 1st tier suppliers**	Purchasing value / Production value	77,27%
EUR 4.303 million	Import of 2nd tier intermediate products (-)	Import Extra EU 28 / Purchase value	17,16%
EUR 20.775 million	**Domestic purchasing value (2nd tier suppliers)**	Domestic purchase value / purchasing value	82,84%





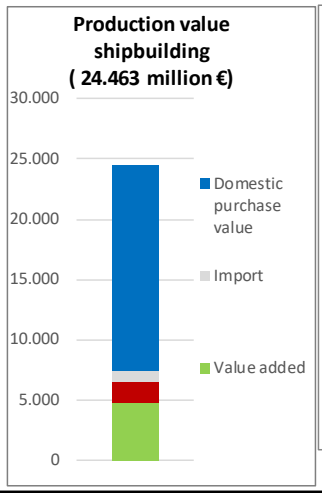


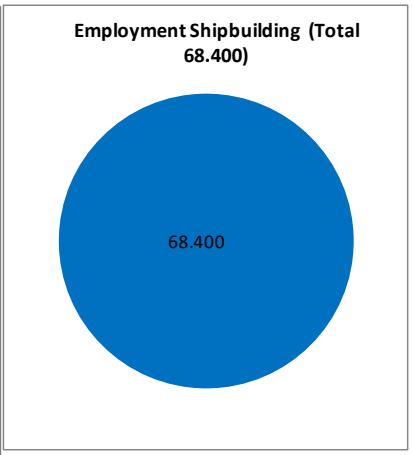
3 - 2nd tier suppliers	
EUR 20.775 million	**Domestic production value for domestic 1st tier suppliers (2nd tier)**
EUR 4.063 million	Production value for export (+)
EUR 24.838 million	**Total domestic prodcution volume 2nd tier suppliers**
EUR 6.679 million	Value added (2nd tier supplier) (-)
EUR 18.159 million	**Purchasing value of 2nd tier suppliers**
EUR 2.796 million	Imported purchase value 2nd tier suppliers(-)
EUR 15.363 million	**Domestic purchase value 2nd tier suppliers**

Figure 44: Aggregated member states portfolios South Korea, Part 2
[Source: (OECD) and BALance TC calculations 2017]

Country Portfolio - Japan

Shipbuilding		Indicators	
EUR 24.463 million	**Production value**		
EUR 4.800 million	Value Added (-)	Value added / Prodcution value	19,62%
EUR 1.750 million	Purchasing value overhead (-)	Purchasing value overhead / Production value	7,15%
EUR 17.913 million	**Marine equipment purchasing value**	Purchasing value / Production value	73,23%
EUR 870 million	Import of 1st tier intermediate products (-)	Import Extra EU 28/ Purchasing value	4,86%
EUR 17.043 million	**Domestic purchasing value**	Domestic purchase value / Purchasing value	95,14%





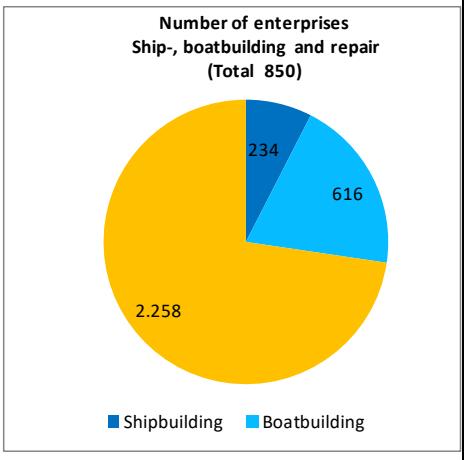
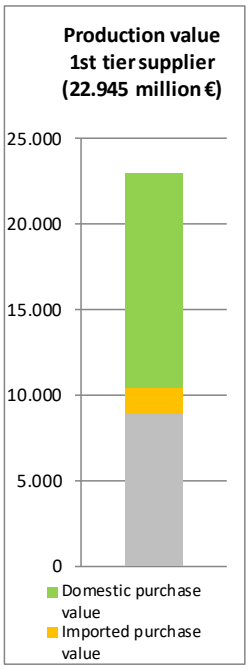
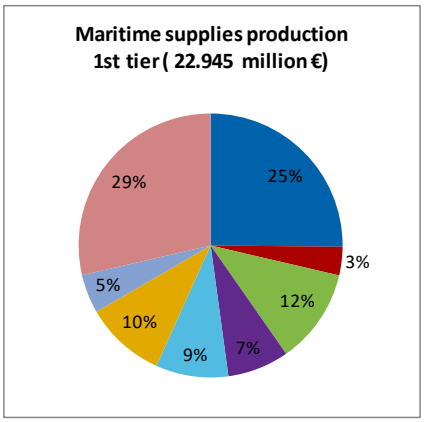
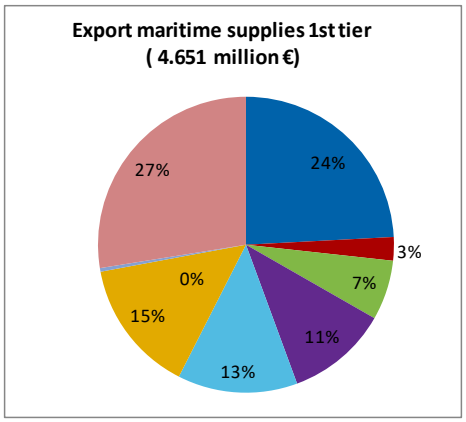


Figure 45: Aggregated member states portfolios Japan: Part 1,
[Source: (OECD) and BALance TC calculations 2017]

Marine supplies 1st tier		Indicators	
EUR 17.043 million	**Production value for domestic Ship- and boatbuilding**	Share for the domestic market	74,28%
EUR 1.251 million	Production value for other domestic maritime market	Share of other maritime markets	5,45%
EUR 4.651 million	Production value for export (+)	Share of export marekt extra EU	20,27%
EUR 22.945 million	**Production value of maritime supplies (1st tier)**		
EUR 8.932 million	Value added (1st tier supplier) (-)	Value added/Production value	38,93%
EUR 14.013 million	**Purchasing value of 1st tier suppliers**	Purchasing value / Production value	61,07%
EUR 1.466 million	Import of 2nd tier intermediate products (-)	Import Extra EU 28 / Purchase value	10,46%
EUR 12.547 million	**Domestic purchasing value (2nd tier suppliers)**	Domestic purchase value / purchasing value	89,54%







3 - 2nd tier suppliers	
EUR 12.547 million	**Domestic production value for domestic 1st tier suppliers (2nd tier)**
EUR 1.072 million	Production value for export (+)
EUR 13.619 million	**Total domestic prodcution volume 2nd tier suppliers**
EUR 7.119 million	Value added (2nd tier supplier) (-)
EUR 6.500 million	**Purchasing value of 2nd tier suppliers**
EUR 799 million	Imported purchase value 2nd tier suppliers(-)
EUR 5.702 million	**Domestic purchase value 2nd tier suppliers**

Figure 46: Aggregated member states portfolios Japan, Part 2
[Source: (OECD) and BALance TC calculations 2017]

The following figures summarise the main results from the statistical analysis.

Production value of the shipbuilding supply chain.

The production values for the shipbuilding and boatbuilding industries and their 1st and 2nd tier suppliers have been analysed for each of the 28 EU member states, for Norway, Turkey and the major shipbuilding regions in the world (*Figure 47*).

The top 10 maritime nations alone stand for about 86% of the total world production volume of 482,5 billion Euro. Europe's share in total world production volume is 23,3%.

The top 10 trailing nations stand for another 12,5% of the total world production volume (*Figure 47*). The remaining nations gather the remaining 1,5% (*Figure 47*).

It should be also noted that some nations with noteworthy maritime technology production are still missing in this evaluation. Namely Russia, India, Canada, Australia, Indonesia, Vietnam. It is expected that these nations would add a considerable amount of production value to the evaluation, but could not be included, because the availability or quality of data was not sufficient. This might be subject to a later exercise.

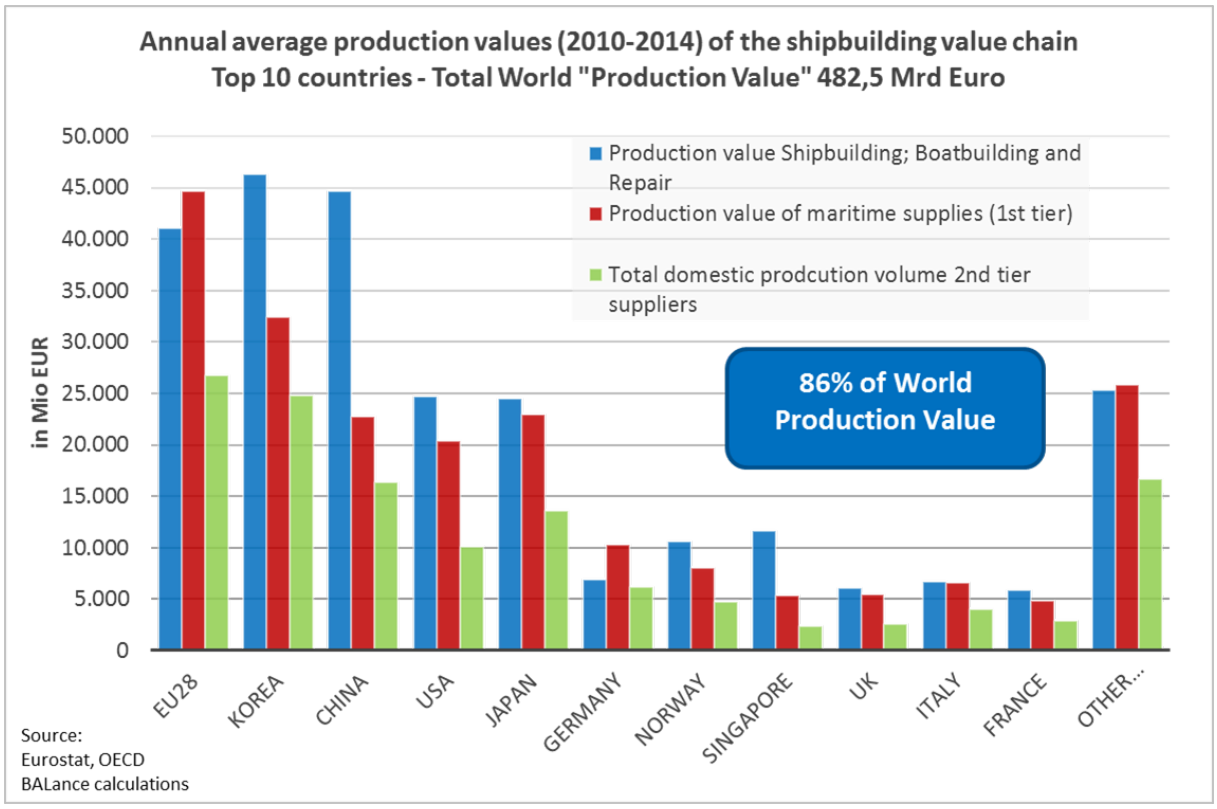


Figure 47: Global Production values of the shipbuilding supply chain in million EUR (average 2010-2014) [Source: (Eurostat), (OECD), National statistics and BALance TC calculations, 2017]

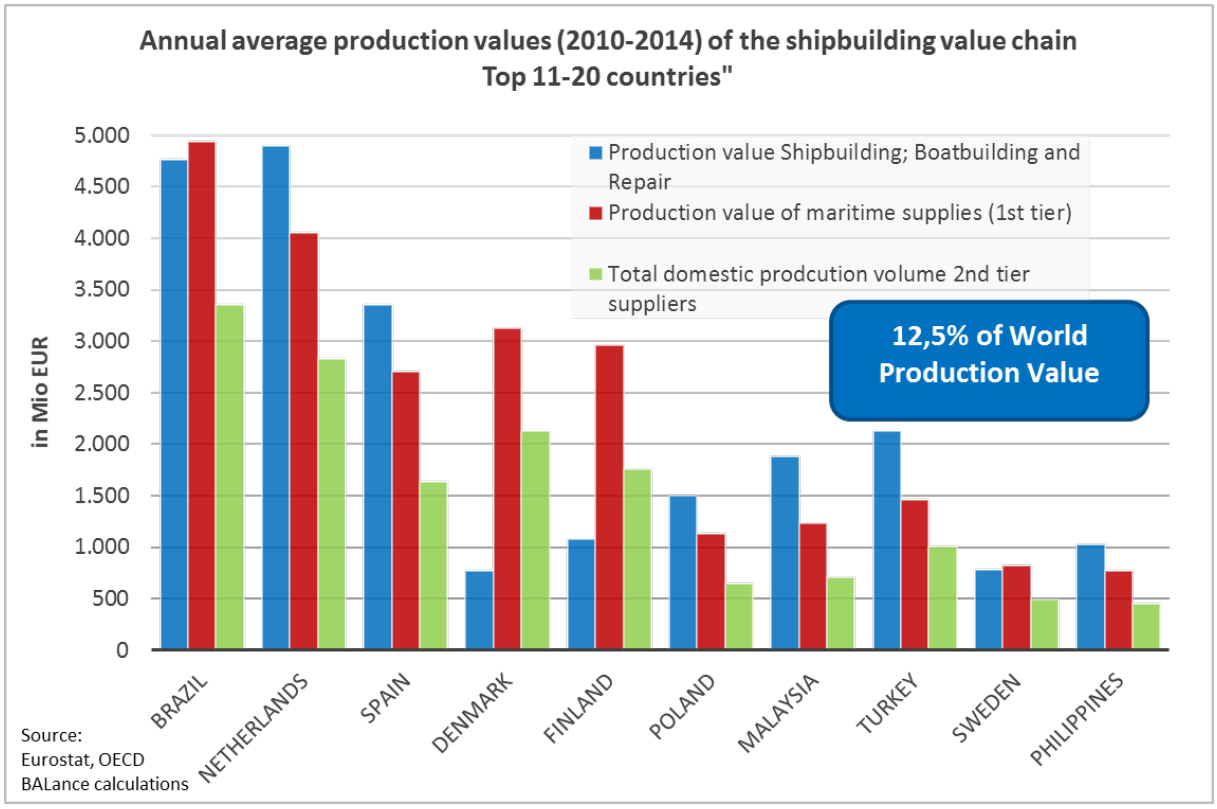


Figure 48: Global Production values of the shipbuilding supply chain in million EUR (average 2010-2014) [Source: (Eurostat), (OECD), National statistics and BALance TC calculations, 2017]

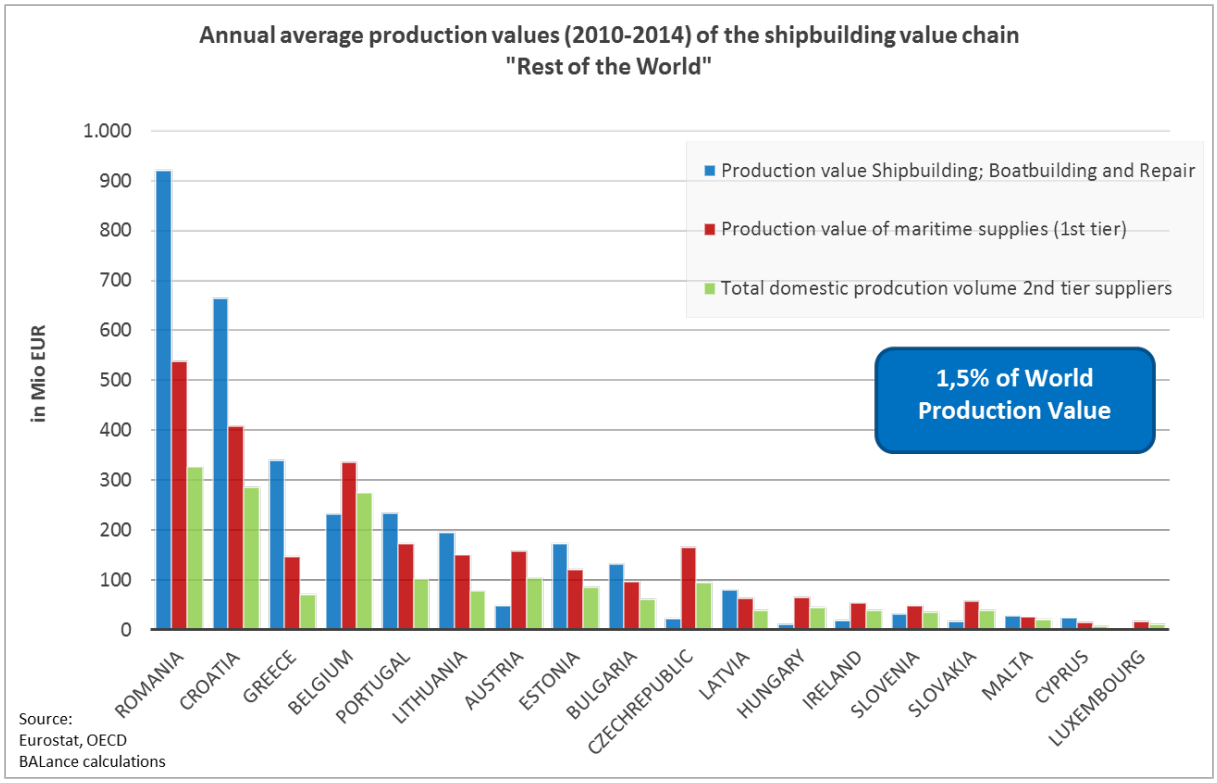


Figure 49: Global Production values of the shipbuilding supply chain in million EUR (average 2010-2014) [Source: (Eurostat), (OECD), National statistics and BALance TC calculations, 2017]

Value added by the shipbuilding supply chain

A slightly different pattern appears, if we aggregate the value added (rather than the production values) of the industry, i.e. summing up the value added by ship- and boatbuilding industry and the 1st and 2nd tier suppliers. *Figure 50*: Value added shipbuilding supply chain depicts these results for the major shipbuilding regions, EU 28 (aggregated), Norway and leading EU countries individually. It is interesting to see the different distribution of the value added through the supply chain elements in the various countries. The added value created in countries with high export rates for marine supplies is significantly higher than those which have a strong shipbuilding industry, but are importing marine supplies to a large extent.

Figure 50: Value added shipbuilding supply chain ("EU 28" show aggregated results of all 28 EU countries – "Other countries" include all countries not displayed in this figure)
[Source: (Eurostat), (OECD), National statistics and BALance TC calculations, 2017]

Export value for marine supplies:

The export values have been analysed for the 1st and 2nd tier of the shipbuilding supply chain (see Figure 51), which have a high impact on the total production value of the supply chain. It should be noted that for EU 28, only exports to non-EU 28 countries has been included.

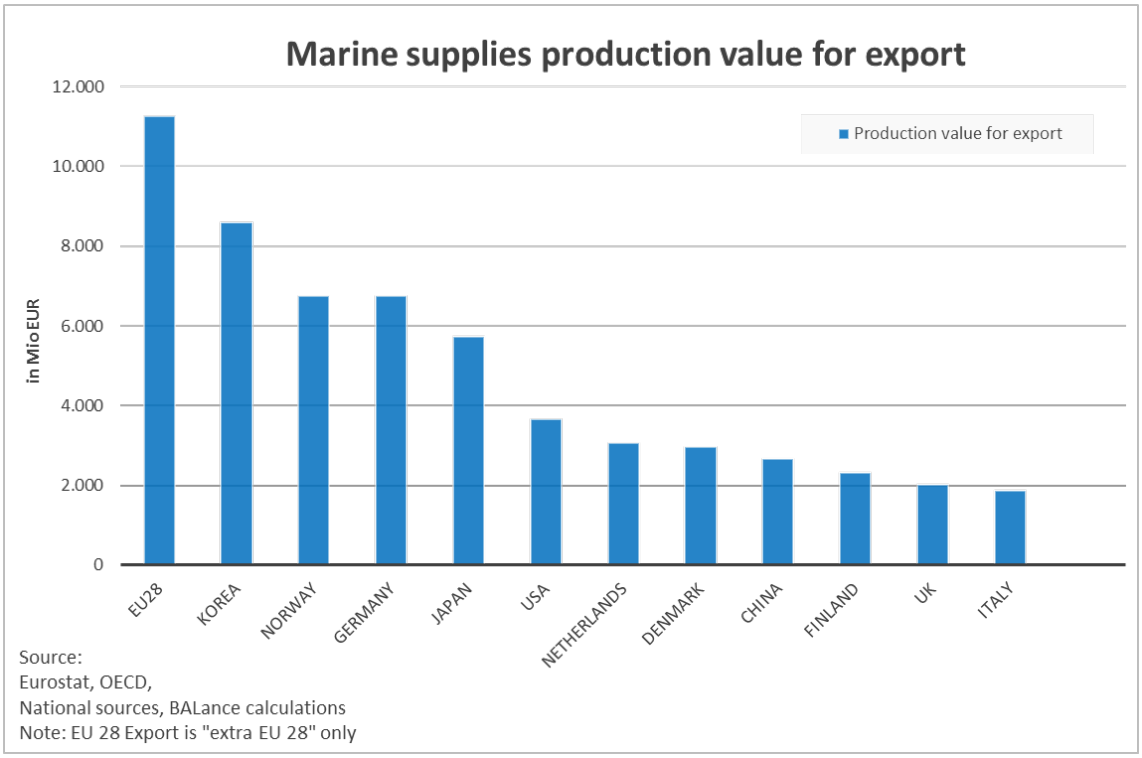


Figure 51: EU-28 - Export value in million EUR (average 2010-2014)
[Source: (Eurostat), (OECD), National statistics and BALance TC calculations, 2017]

Trade balance for marine supplies:

In order to get a better impression on the strength of the supply industry, the trade balance has been calculated for world regions including EU 28 (*see Figure 47).*, *Figure 48* presents the results at a country level for the major maritime nations.

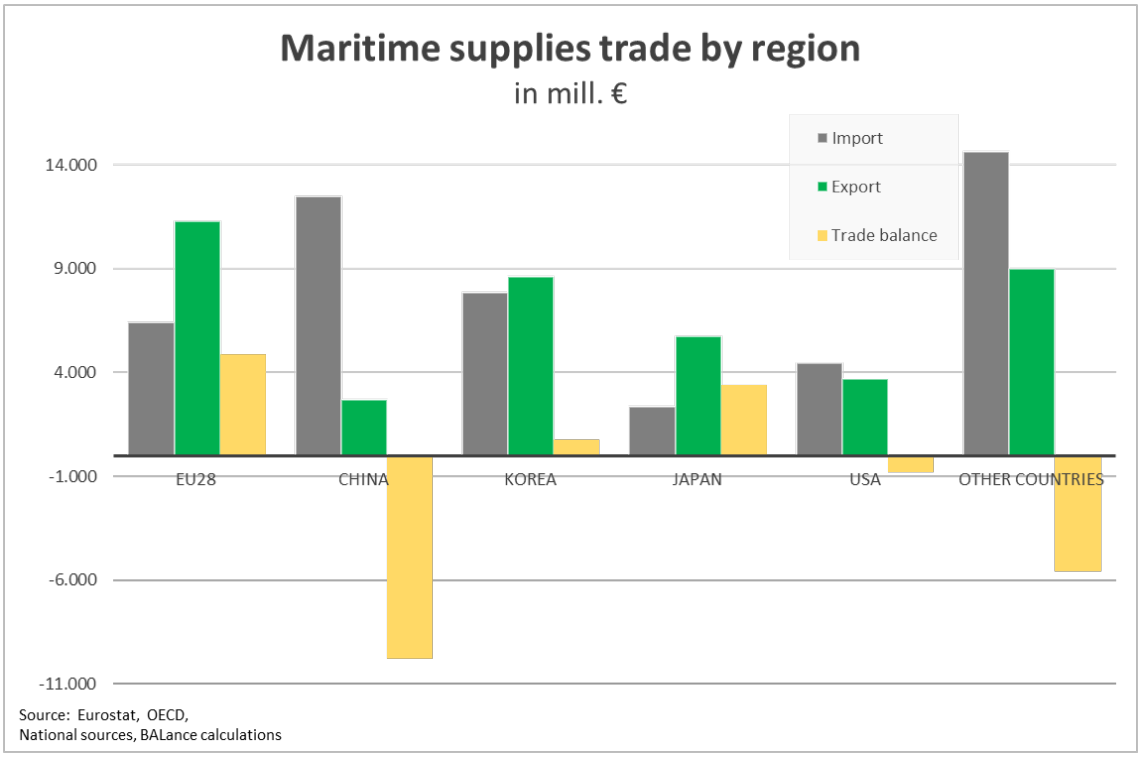


Figure 52: Trade balance maritime countries (average 2010-2014)
[Source: (Eurostat), (OECD), National statistics and BALance TC calculations, 2017]

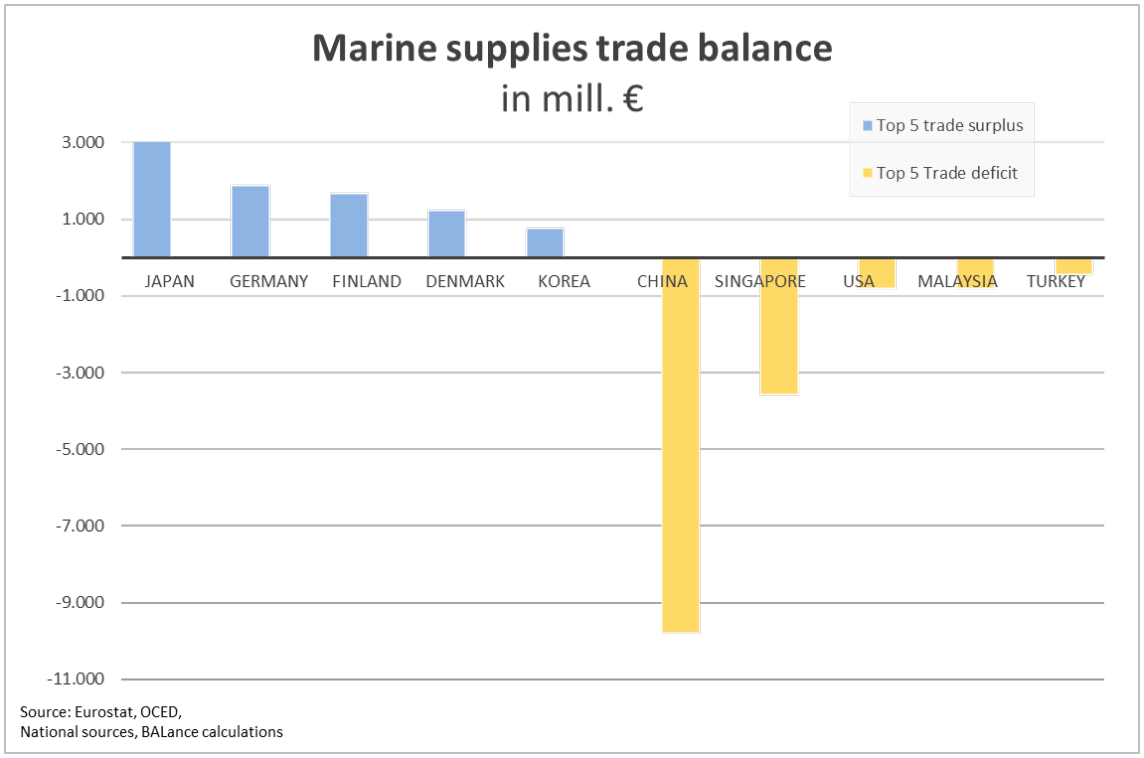


Figure 53: Trade balance maritime countries (average 2010-2014)
[Source: (Eurostat), (OECD), National statistics and BALance TC calculations, 2017]

Employment:

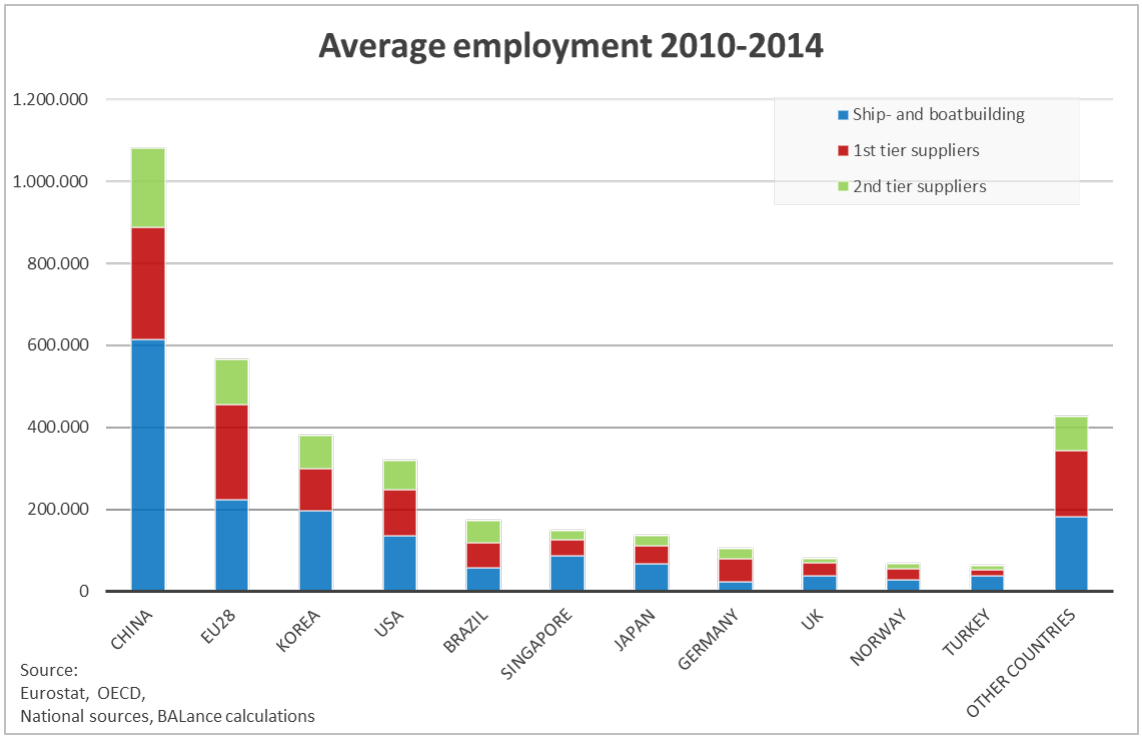


Figure 54: Number of employees in shipbuilding supply chain per country (1st and 2nd tier), ("EU 28" show aggregated results of all 28 EU countries – "Other countries" include all countries not displayed in this figure)
[Source: (Eurostat), (OECD), National statistics and BALance TC calculations, 2017]

Number of enterprises:

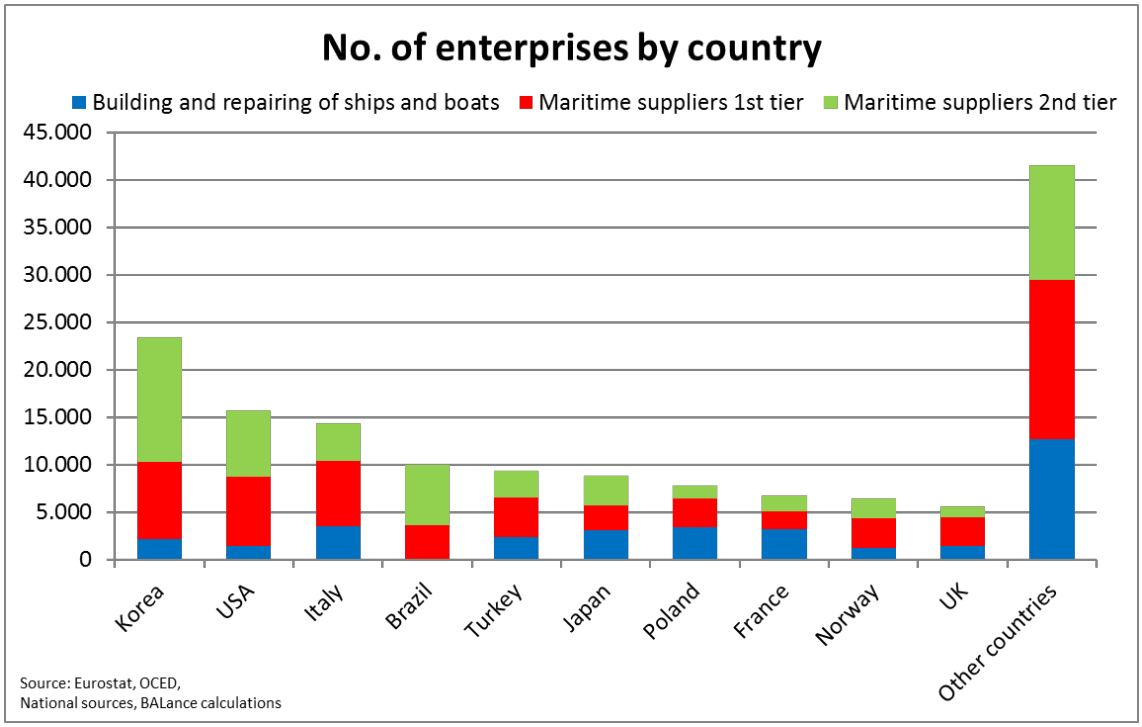


Figure 55: EU-28 Number of enterprises per country and size
[Source: (Eurostat), (OECD), National statistics and BALance TC calculations, 2017]

4.3 The European shipbuilding supply chain - Development over time

For the European Member States, a more detailed analysis has been performed based on the more comprehensive data provided by Eurostat. Firstly, we have collected, combined and, where necessary, inter- or extrapolated the available statistical data over the time period 1995 to 2014. For the years 2008-2014, the conversion from the industrial classification system NACE1.1 to NACE 2.0 was necessary; with help of the colleagues from Eurostat, we have tried to minimise any inconsistencies arising from this. *Figure 56* presents the development of the production value for shipbuilding, boatbuilding and repair of ships and boats for the period 1995 to 2014.

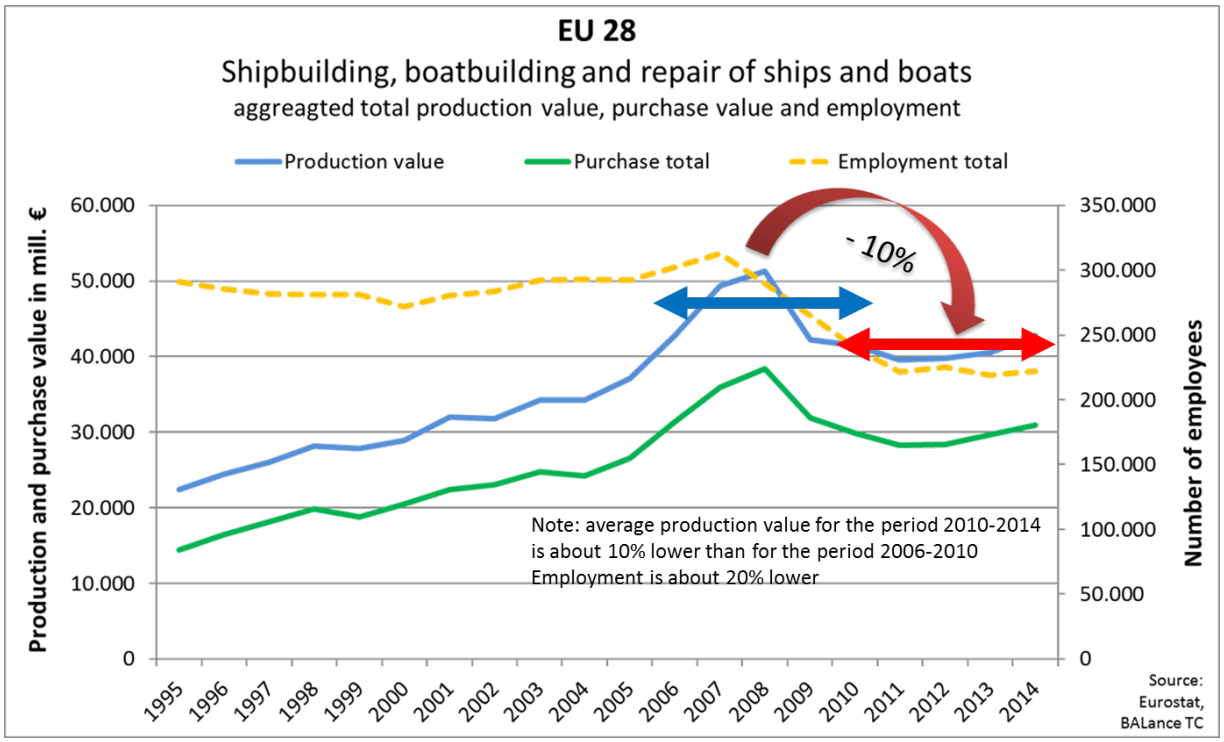


Figure 56: Shipbuilding, boatbuilding and repair of ships and boats - EU-28, [Sources: (Eurostat), BALance TC calculations, 2016]

The 20-year time series for the EU 28 shows a continuous growth of the production value up until 2008, whereas the total number of employees remained relatively stable. After the peak in 2008, with a total production value of more than EUR 50 billion, the European ship- and boatbuilding industry faced a substantial drop in 2009 (-17.7% for EU 28). Comparing the averages for the period 2006-2010 with the period 2010-2014 shows the production value fell by 10%. After 2009, the European shipbuilding industry has managed to stabilise at a level higher than that in 2006. However, employment levels have declined noticeably after 2008 (-13.1% in 2014 compared to 2008).

Building on that, *Figure 57* shows the related timeline for purchasing values created by the three sectors. Comparing the purchasing averages for period 2006-2010 with period 2010-2014 indicates that purchasing values fell by 13%. This is slightly higher than the overall production value and might be explained through an increase of value added by the shipyards themselves.

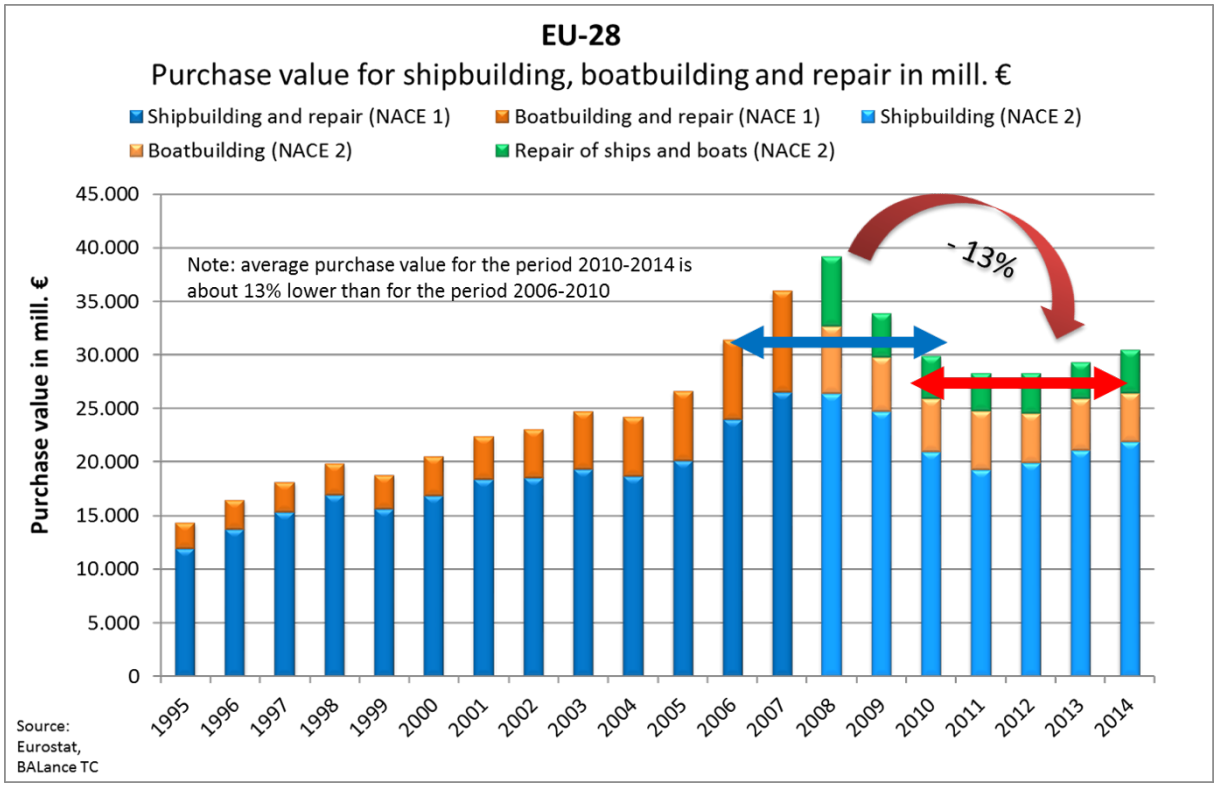


Figure 57: Purchase value for ship- and boatbuilding per country in million EUR, [Source: (Eurostat), BALance TC calculations, 2017]

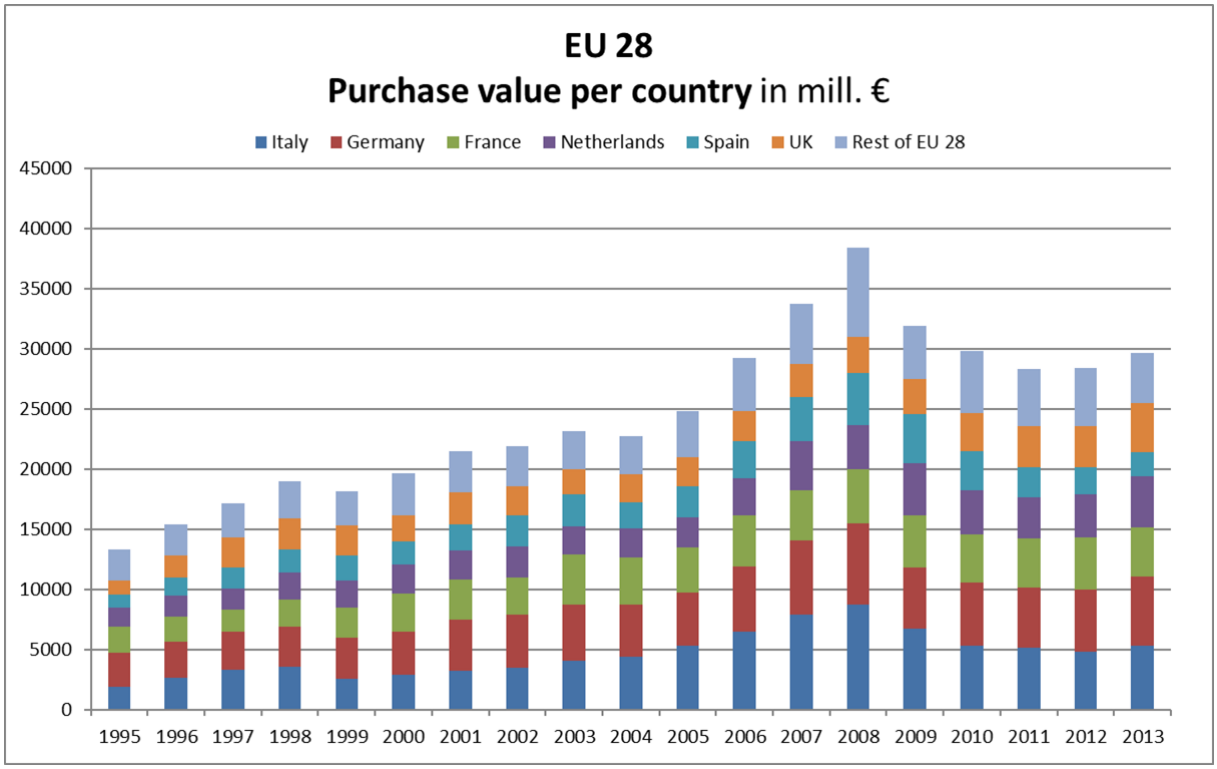


Figure 58: Production value by country created through shipbuilding, boatbuilding and repair in million EUR [Source: (Eurostat), BALance TC calculations, 2016]

A country specific analysis of the purchase values for EU 28 countries demonstrates the high impact of five major shipbuilding countries. As shown in *Figure 58*, six countries - Italy, Germany,

France, Netherlands, Spain and United Kingdom - are responsible for more than 80% of the total purchase value in EU 28 according to the statistical analysis.

4.4 Discussion of statistical developments of production values in specific countries

As discussed above, the general development of the ship- and boatbuilding industry during the period2008-2014 is characterised by a slowing down of the downward production value trend post 2008. Overall, the EU 28 - production value for ship-, boatbuilding and repair declined from EUR 42 215 billion in 2009 to EUR 40 428 billion in 2013, which translates to an average annual decline of -4,65 %. However, the general development in the maritime industry did not affect all maritime economies equally. Analysis of the production value and related purchase value, using a trend analysis, for eight countries with a high involvement in the global shipbuilding supply chain, leads to some noticeable results (*see Figure 59 and Figure 60*).

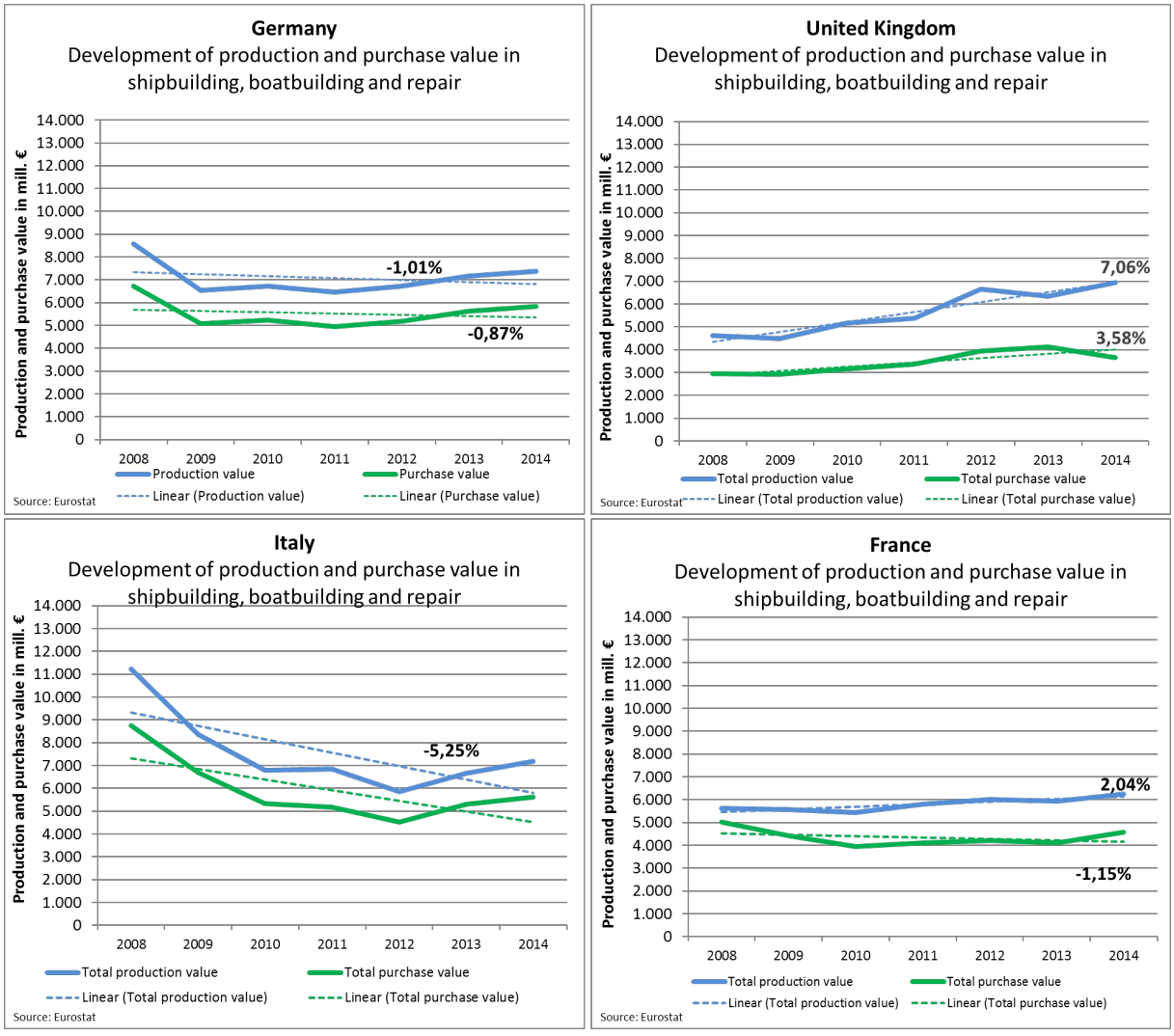


Figure 59: Development of production and purchase value in shipbuilding, boatbuilding and repair Germany, United Kingdom, Italy, France
[Source: (Eurostat), BALance TC calculations, 2017]

After the economic crisis in 2007/2008 the development of the maritime economy in individual countries can be categorised into three major groups. The first group represents those countries where, after suffering a decline in 2008/2009, the situation has stabilised and which continue production on a stable level or with moderate growth. Countries in this group comprise Germany, France, Netherlands, Finland and UK which all realised an annual growth in the range of 3-7%. The second group comprises countries where the decline continued up to the present day. The example in this category is Spain which has suffered an average decline in the shipbuilding supply chain economy of more than 10%, with no particular signs of improvement. The third group also suffered an initial decline lasting until 2010 (for Norway) or 2012 (for Italy), but has experienced from substantial growth since then.

What we cannot yet tell, from the available statistics, is the effect of developments during2015 and 2016. It can be speculated that Germany, Italy and France will show continuous positive trends in shipbuilding due to increasing orderbooks for cruise ships, which may last for a long period (at least until 2024). In Italy, we can see this already from 2013 onwards. In contrast Norway and, to some extent, The Netherlands may suffer from continuous decline as a result of the recent oil price fall which has a major impact on the offshore industry. This trend is already evident for these countries in the available data for 2014. Despite also being affected by the offshore crisis, the UK may on the other hand benefit from developments in both the naval defence and offshore wind sectors.

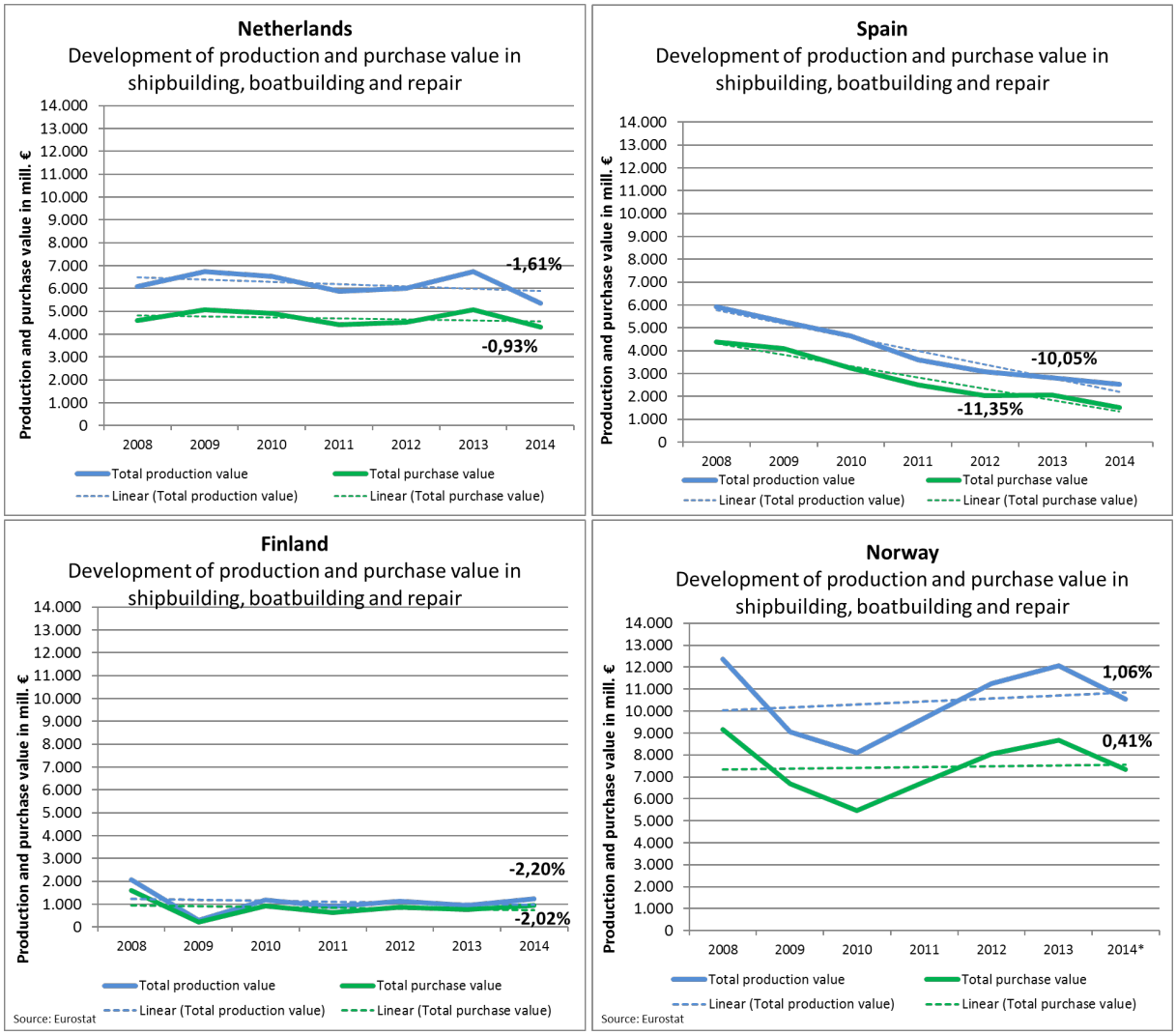


Figure 60: Development of production and purchase value in shipbuilding, boatbuilding and repair Spain, Netherlands, Finland, Norway [
Source: (Eurostat), BALance TC calculations, 2017]

These statistical representations provide only partial insight into the shipbuilding and boatbuilding situation and their related purchasing values in these countries. An evaluation of the suppliers' situation is more difficult and can only be discussed qualitatively. It is clear that the supply industry, which is significant and export oriented in many European countries, is suffering substantially from the worldwide downturn in commodity shipbuilding and the offshore crisis. Capacities established during the shipbuilding boom period are now increasingly idle or underutilised, often resulting in financial difficulties. The result of this is an increasing trend towards market consolidation.

In comparison, the development in Japan, South Korea and China is varied. Japan, for instance, experienced some growth in terms of production values up to 2012, but has faced a major downturn since then with a decline of 50%. South Korea, in contrast maintained a stable level of production value over the period 2008 until 2014 but is obviously facing a major downturn from 2015 onwards. This is not yet evident the available statistical data, but is obvious from the recent economic figures published for their shipbuilding industry. China, however, has seen sustained growth, although this has slowed since 2012 and then slumped since 2014. The absolute figures on production values in China are, however, very difficult to confirm. Whilst China has reported a fairly constant level of delivered shipbuilding tonnage, the production value is reported to have nearly doubled, which seems doubtful given the mix of ship-types built. This apparent inconsistency has not been explained and it is argued that there may be double counting of production values.

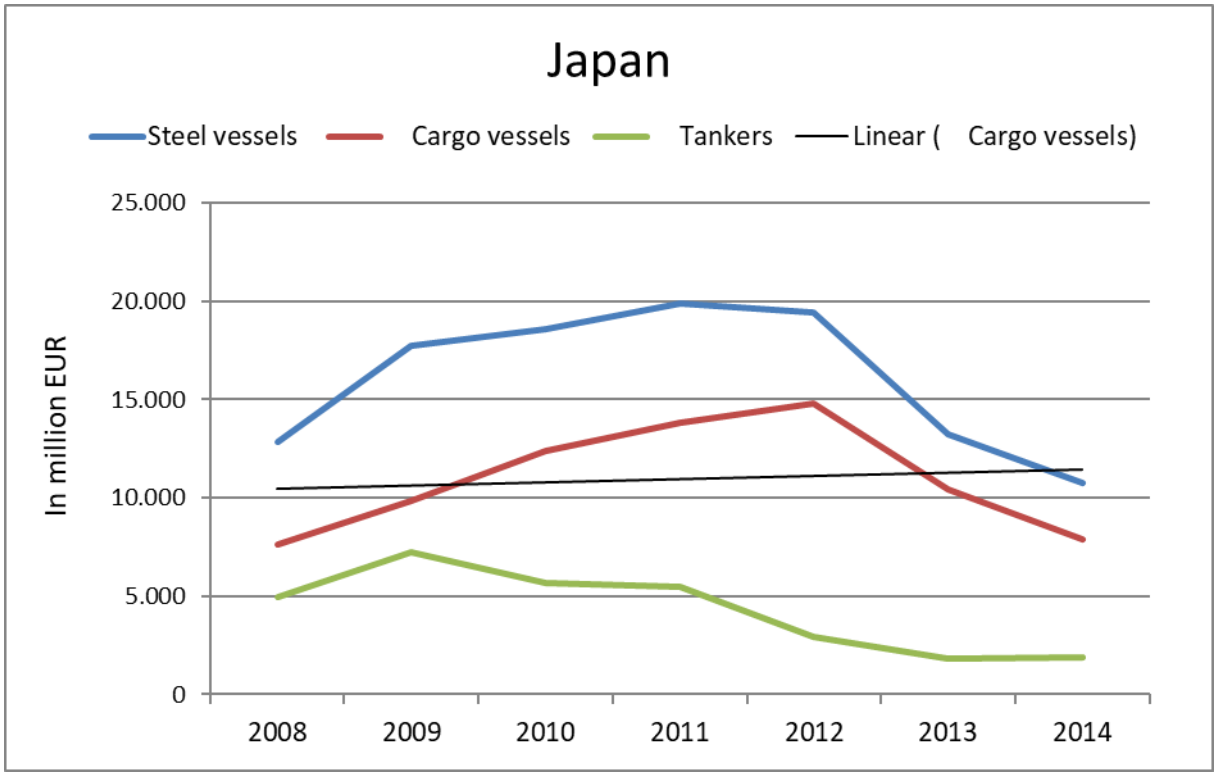


Figure 61: Development of production and purchase value in shipbuilding, boatbuilding and repair; Japan [Source: (OECD), Japan National Statistics, BALance TC calculations, 2017]

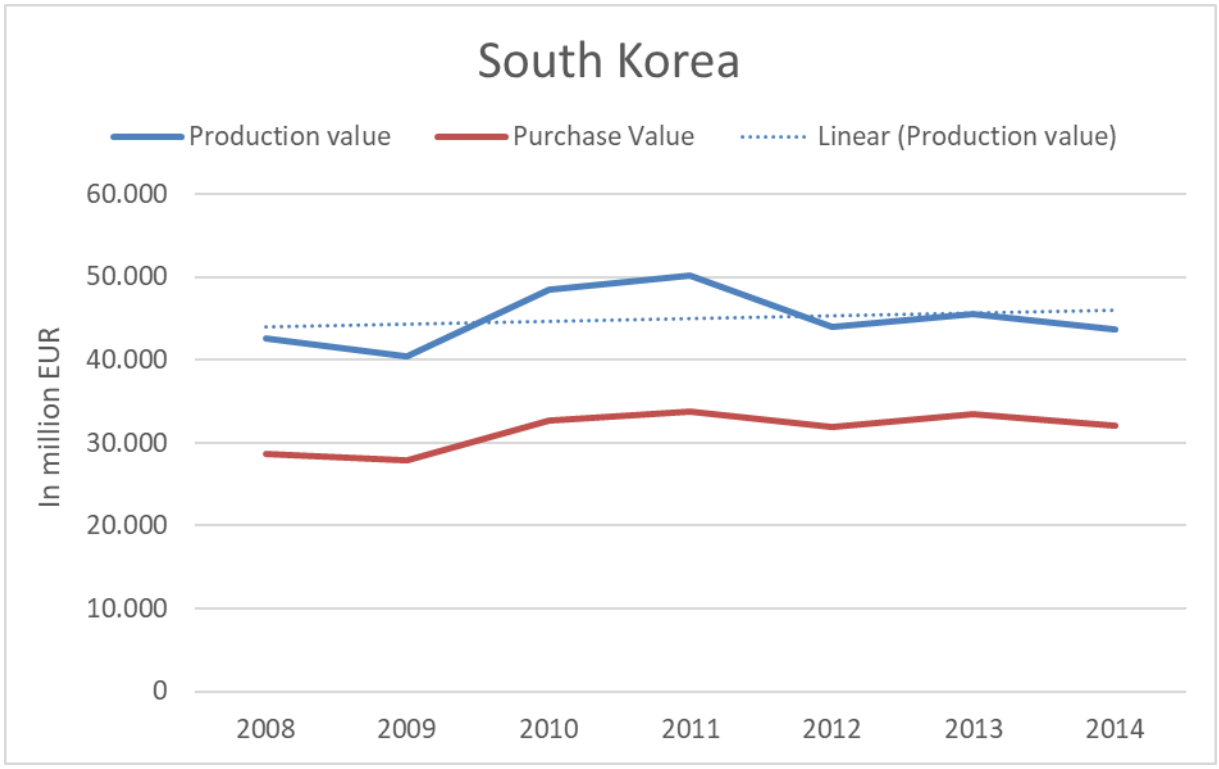


Figure 62: Development of production and purchase value in shipbuilding, boatbuilding and repair: South Korea [Source: (OECD), S.Korean National Statistics, BALance TC calculations, 2017]

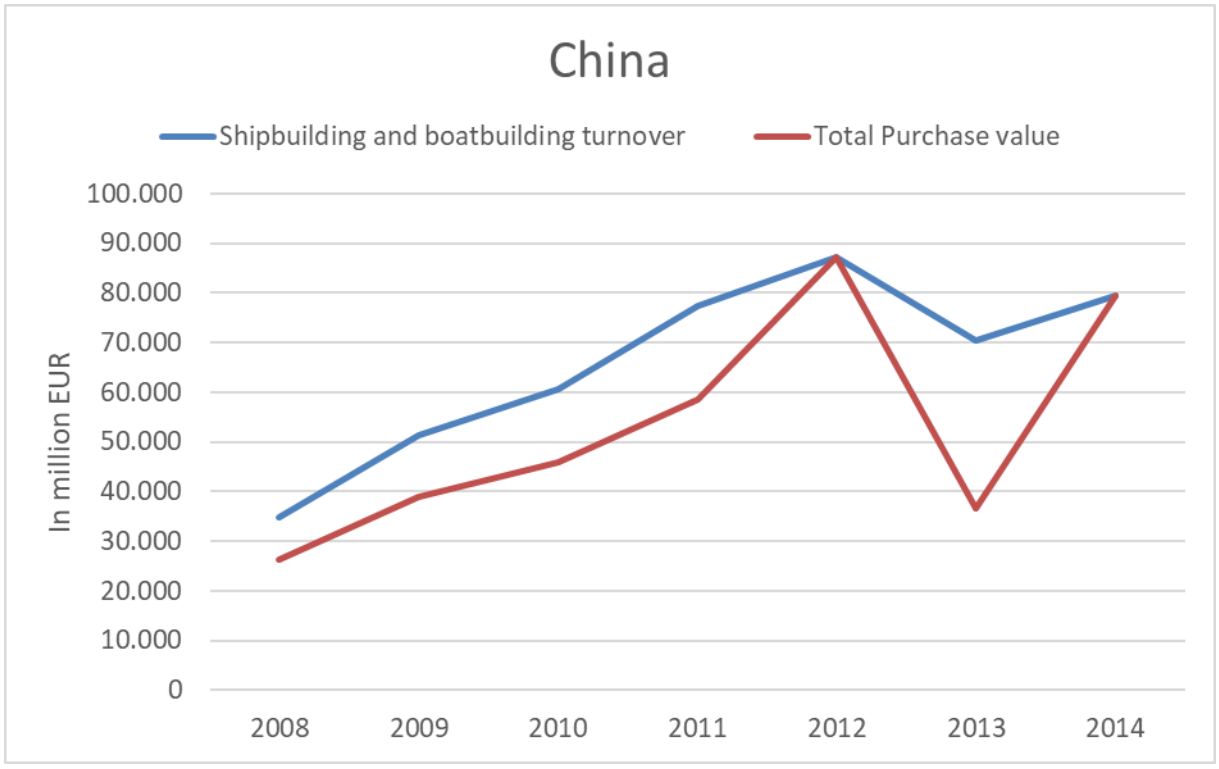


Figure 63: Development of production and purchase value in shipbuilding, boatbuilding and repair; China [Source: (OECD), Chinese National Statistics, BALance TC calculations, 2017]

4.5 Country Strategies on shipbuilding and marine supplies industries

With regard to shipbuilding and marine supplies industry related strategies, it transpires that after the financial crisis in 2007/2008 that interest in investing into maritime industries has slowed down. This is particularly true for countries like India, Indonesia and Malaysia who hoped to take advantage of the shipbuilding boom by building their own capacities and preparing to play a bigger role in the future global market. In the light of decreasing market activity following the financial crisis, these countries have suffered from limited interest in capital investments both from within their own countries and abroad.

Although also affected by the market decline, South Korea and Japan were sitting on a huge orderbooks for ships still to be delivered for the period up to 2010/2012, which has contributed to the major fleet surpluses for some ship-types. Positive market developments in the offshore sector, allowed South Korea and Singapore, in particular, to utilise and extend some of their shipyard capacities for this sector. However, after the collapse of the oil price in the middle of 2014, the offshore sector decline contributed to the crisis in the maritime sector, through the demand collapse of both commodity ships and offshore units. Brazil, which had built up capacity to exploit the offshore sector, found its production virtually eliminated as a result of the collapse of that market.

The three major shipbuilding countries, China, South Korea and Japan, hence entered into a deepening crisis which by the end of 2016 put large parts of their industry at risk. The way in which these countries have adapted their national industrial strategies to deal with this situation is summarised below.

Japan:

At the time of the crisis in 2007, Japan was already adapting to the diminished ordering activity and decline in their shipbuilding output. Japan was adopting strategies to invest in other countries like China, Brazil and Philippines to build and maintain shipbuilding capacities in those regions. Following the recent market developments, Japan faces another major industrial restructuring. At this time, it seems that this will involve the restructuring of three Japanese shipbuilding groups:

- MHI separating its shipbuilding activity and combining this with those of Imabari, Oshima and Namura to create the biggest shipbuilding group in the world
- JMU – Japan Marine United Group has been created through the combination of NKK, IHI and Hitachi Zosen
- Kawasaki, Mitsui, Sumitomo, Tsuneishi are to remain as individual yards for the time being but concentrating on their overseas activities (for example Kawasaki which, jointly with COSCO, operates two yards in China)

Whereas in the first case, each looks to build to a large extend on own engineering capacities, the JMU initiative looks likely to see a concentration of all design and research activities into two centralised operations, namely the NMRI - National Maritime Research Institute (operational) and JSTRA – Japan Ship Technology Research Association.

Major objectives of these institutions with regard to innovation are similar to EU, but it seems that they are implemented more focussed to the needs of the industry. (including Internet of Things (IoT), Environment, Performance etc.). Example projects are

- Smart Ship Application Platform 2 (SSAP2)
- NYK Super Eco Ship 2030 – Zero Emission Container Vessel as example for a serious realisation path

The Japanese government is expected to support this process to the extent of approximately USD 200 million.

South Korea:

The South Korean shipbuilding industry has experienced massive losses in the last couple of years, as a result of the global slowdown and contracting drop and this continues into 2017. Following the reported attempts of the industry itself to find solutions to this difficult situation, the country's top three shipbuilders have established self-rescue programs worth about USD 10 billion to cope with the downturn and mounting losses stemming from delays in the construction of offshore facilities.

As this seems to insufficient to save the country's shipbuilding industry, the South Korean Government is now also taking steps to support the industry with massive financial aid. As part of this strategy, the sector's restructuring plan is aimed at downsizing and promoting higher value-added technologies.

- The shipyards will cut their workforces by 24 percent and reduce their combined docks by 43 percent by 2018, while they will invest a total of KRW 180 billion (USD 154.3 million) into research and development on new ship-making technologies and services.
- The government will order two warships worth a combined USD 1.3 billion in 2017 to help shipbuilders tackle a fall in ship orders, with a combined USD 3.3 billion funds to be created.
- The South Korean Ministry of Trade, Industry & Energy (MOTIE) of Korea furthermore announced in February 2017 that it has launched a project to support the five regions concentrated on shipbuilding businesses with an amount of USD 13 billion by 2020 (including KRW 4trn 2017) for making private investment

Recently the decision was made to try to save Daewoo Shipbuilding & Marine Engineering (DSME) by raising capital and/or swapping debt into equity, from shareholders and South Korean state-owned banks. These and other measures prompted Europe and Japan to ask for details about this at OECD level and with a view to potential counter measures.

China:

China, with its enormous shipbuilding capacity built up in the last 15 years, does not seem willing to give-up its major share in world shipbuilding and, most strategically of all the Asian countries, has established far reaching industrial programmes to defend this position. At the beginning of 2017 the Chinese Ministry of Industry and Information Technology (MIIT) updated the five-year Shipbuilding Action Plan (2016-2020). The updated plan outlines the principles of "***innovation-driven - deepen integration - optimize the structure"*** *as key elements* and formulates major objectives and framework measures for the industry.

The major development goals are:

- Deepen the Structural Adjustment of Shipbuilding Industry,
- Speed up Transformation and Upgrading
- Market Share Increase 5% Shipbuilding
- Market Share Marine Engineering Equipment 35-40%
- Innovation ability in the world - R & D investment is at least 2.5% of sales revenue.
- Structural transformation is significant. - the top 10 shipbuilding companies will complete more than 70% of the newbuilding output - the average ratio of local equipment for the three

major ship types of bulk carriers, oil tankers, container ships is targeted to reach 80%, 60% and 40% respectively

- Quality and efficiency to be greatly improved. The backbone of the shipyard is to establish a comprehensive lean manufacturing system, with automation, digitalisation and education levels being significantly improved.

These development goals in themselves are threatening to their major competitors in Asia, but through the objective of also targeting the higher value ship sector and targeting increased domestic content for marine equipment, this will also pose a threat to the European supply chain industry.

The Shipbuilding Action Plan (2016-2020) formulates the following key tasks (translation from Chinese):

- ***to enhance scientific and technological innovation lead***
    - ***Strengthen basic and cutting-edge technology research.*** *Research and system revision; to increase the intelligent ship, deep sea equipment, polar technology and equipment in areas such as research efforts, to strengthen the forward-looking layout, enhance the source of supply, to promote scientific and technological innovation to the "parallel" "lead" change.*
    - ***Construction of high-level innovation centre.*** *Build a number of international level laboratory and engineering centre. Encourage the platform to open up the various types of resources, to provide professional services for the community, the establishment of resource-rich, innovative and active, efficient coordination of the "double" new ecology.*
- ***to enhance scientific and technological innovation lead***
    - ***The implementation of major special projects****. Speed up the launch of major scientific and technological projects in deep-sea space station, organize the implementation of large cruise ships, intelligent ships, marine slow-speed engine, seventh-generation deep-water drilling platform and a number of major innovation projects and special projects, research collaboration with the key areas of technology, Product design and manufacture of key technology research, key systems and equipment development, as well as the development of standards and norms*
- ***Adjust and optimize the industrial structure***
    - *efforts to resolve excess capacity.*
    - *Strong support of strong enterprises*
    - *Actively cultivate new economic growth points - To meet the domestic cruise yachts and other traditional high-end consumer potential to accelerate the realization of cruise independent design and construction, to develop small and medium-sized yacht and new yacht design and manufacturing. We will actively develop and apply deep-sea fishery breeding equipment, renewable energy development equipment, deep-sea mineral resources development equipment, marine space development and utilization equipment, and polar technology and equipment.*
- ***development of advanced and efficient manufacturing***
    - *Vigorously promote intelligent manufacturing.*
    - *Positive development of "Internet +" and service-oriented*
    - *Full implementation of green manufacturing*

- ***deep integration of military and civilian development***
    - *Promote military and civilian coordination and innovation*
    - *Promote the sharing of military and civilian resources*
- ***promote all-round opening up and cooperation***
    - *Accelerate the pace of "externalisation "*
    - *promote the ship and marine engineering equipment, international production capacity and equipment manufacturing. Support oil and gas development enterprises, shipbuilding and marine engineering equipment manufacturing enterprises, financial institutions to strengthen strategic cooperation, joint development of global oil and gas resources development and operations.*
    - ***Encourage backbone enterprises to actively carry out overseas mergers and acquisitions**, **overseas investment and construction**, the establishment of overseas research and development centres, experimental base and global marketing and after-sales service system. Actively participate in international shipbuilding rules and regulations to amend and improve the international shipbuilding standards to develop the depth and breadth of participation.*
- ***Safeguard measures***
    - *Increase financial support. Encourage and guide the financial institutions to implement differentiated credit policies for the shipbuilding industry according to the actual situation; increase the direct financing support to the shipping enterprises and support the listing and financing of the shipping enterprises in line with the conditions; Financial institutions and shipbuilding enterprises to actively use full-calibre export macro-prudent management of export financing policies, to improve the export financing environment for the shipbuilding industry, to encourage financial institutions to support the shipbuilding industry mergers and reorganization and international capacity cooperation.*

To complement the Shipbuilding Action Plan (2016-2020), at the end of 2016 MIIT launched a five-year action plan specially dedicated at **"Boosting Capabilities of Marine Equipment"**, which formulates the following specific strategies as:

- *The R&D Investment of marine equipment shall be promoted. The necessary national development centres or national laboratories for marine equipment shall be established and set-up*
- *Different financial support measures as import taxes, newbuilding credit, development finance and insurance shall be mobilized for the development of marine equipment*
- *Merging of activities shall be promoted to boost the capabilities and productivity of manufacturers in their production and marketing.*
- *A global service network shall be promoted.*

4.6 Trends in Foreign Direct Investments (FDI) in shipbuilding and marine supplies industries including major success stories – a global overview

To identify trends in foreign direct investment in shipbuilding and marine supplies industries, a two-step approach was adopted. Firstly, available FDI statistics have been gathered from sources such as national statistics offices, national central banks and international organisations such as OECD or UNCTAD and then analysed. During the gathering process, the heterogeneous level of detail in the FDI statistics became evident; this ranged from detailed FDI stock for specific industries through to more general FDI stock statistics for manufacturing. Secondly, specific case studies of foreign direct investment in the shipbuilding and marine supplies industries have been analysed, with particular emphasis on the motivation and justification of the FDI decision. Examples of these are included in chapter 5.

Despite the detail variances of these statistics, a general trend was observed of overall vastly increasing FDI stock together with a high volatility. *Figure 64* demonstrates this for the NACE-class C 30 “Other transport equipment”, which comprises railroad, aircraft and shipbuilding. Whilst in 2009 and 2010 the EU 28 reports an outward FDI surplus, in 2011 and 2012 the results show an overall FDI inward surplus as a result of proportionately greater falls in the outward stock levels.

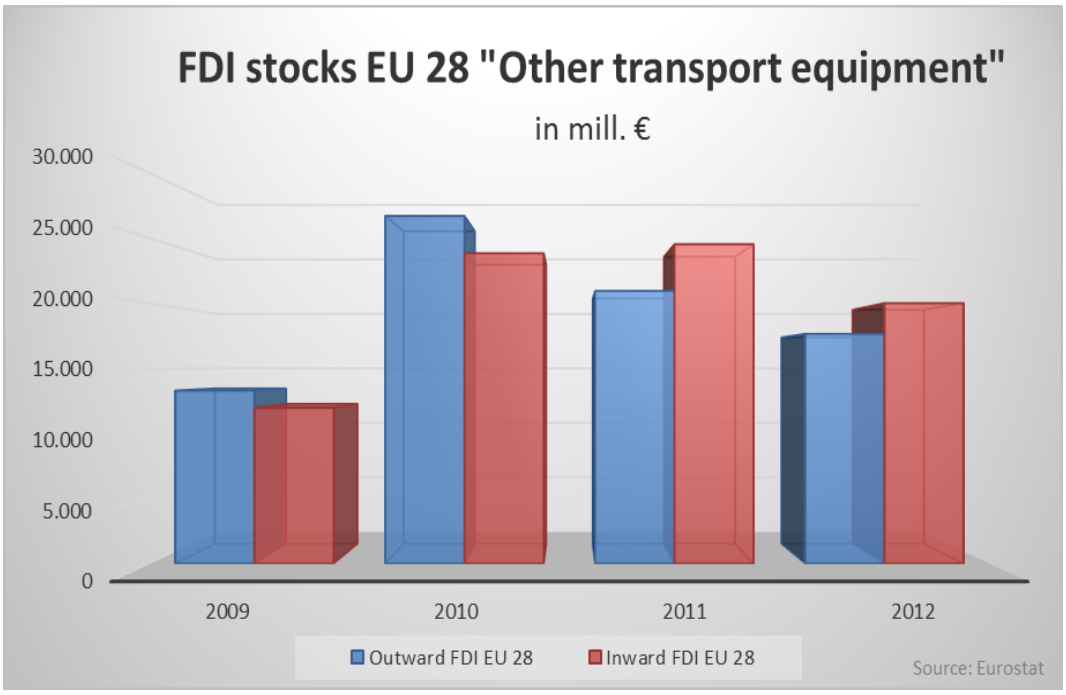


Figure 64: EU 28 FDI stocks for “Other transport equipment” [Source: (Eurostat)]

Very few countries were found to provide more detailed FDI statistics, even down to the level of NACE-class C 301 “Building of ships- and boats”. In Germany, the statistics of the national central bank demonstrate a substantial FDI inward surplus, as illustrated in *Figure 65*, indicating it to be an attractive shipbuilding location due to existing production capacities for complex ship types like cruise ships or offshore vessels in combination with the associated employee know-how.

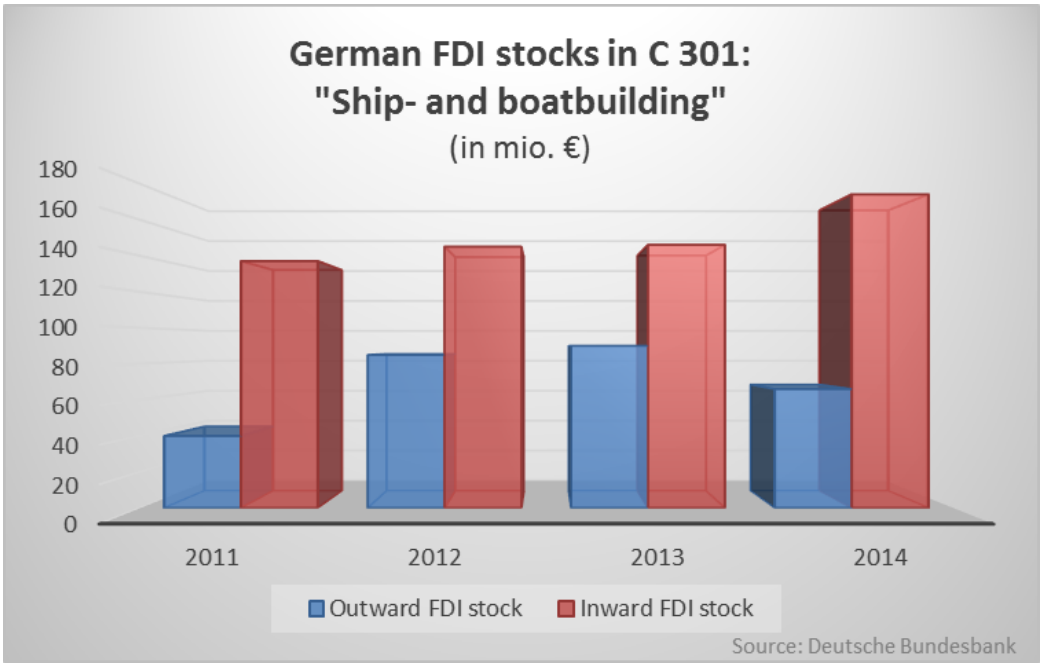


Figure 65: German FDI stocks for NACE-class C 301: "Building of ships and boats" [Source: (Eurostat)]

In Germany, the turnover of enterprises with inward FDI has developed very strongly up to 2013 (NB data for 2014 is preliminary). The difference in turnover between outward and inward FDI funded enterprises represents the FDI inward surplus for the German shipbuilding industry.

The employment of inward FDI funded shipbuilding enterprises in Germany increased to 5 000 employees which represents 39.6% of the total employment in German shipbuilding (according to EUROSTAT). German shipbuilding outward FDIs lead to substantially decreased turnover and employment with 4 000 employees in 2013. The employment difference between inward and outward FDI enterprises is not as great as the difference in terms of turnover, since the labour productivity in Germany is relatively high in global terms.

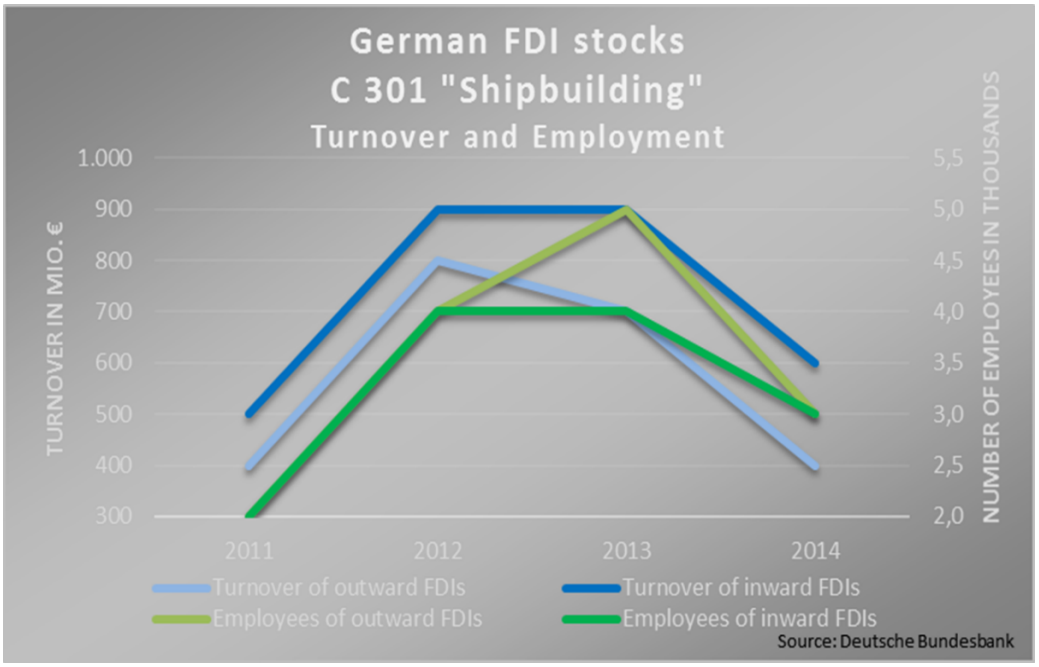


Figure 66: Turnover and employment related to German FDI position in Ship- and Boatbuilding [Source: Deutsche Bundesbank]

Based on the available official statistics, FDI activities of specific NACE-classes that also include marine supplies have been analysed and documented. This indicates that industrial countries tend to report a FDI outward surplus in these classes as illustrated in *Figure 67* for the Netherlands.

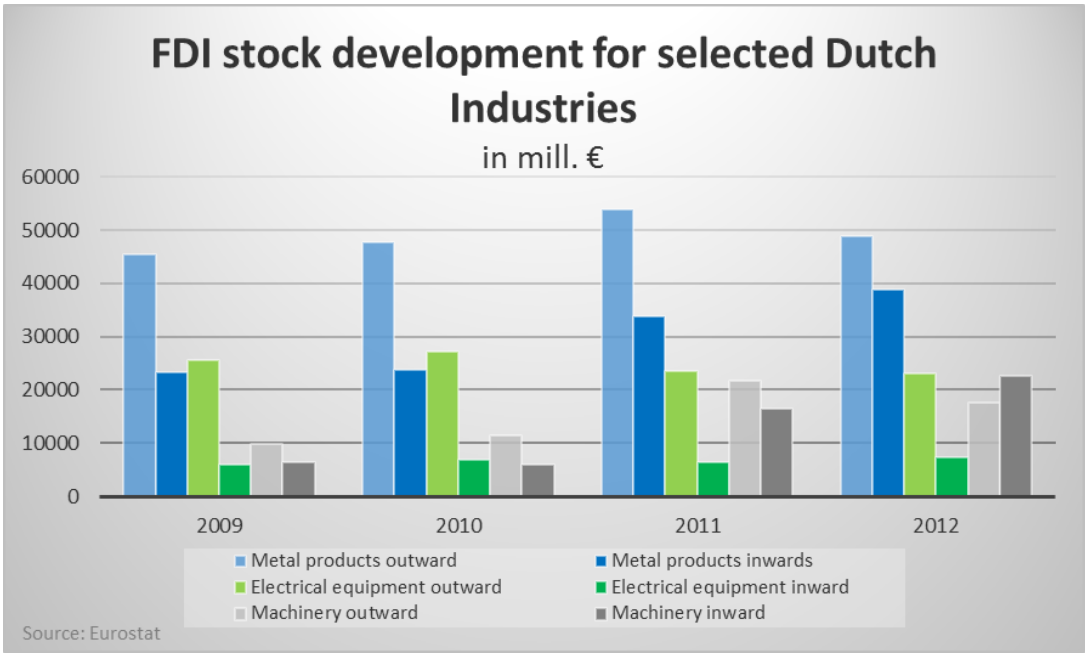


Figure 67: FDI stock development for selected Dutch industries [Source: (Eurostat)]

Other countries report considerably different FDI positions. In Singapore for example, the available FDI statistics for the manufacturing sector indicate a structural inward FDI surplus (*see Figure 68*) that initiates additional production capacities and generates employment. This FDI inward surplus can be considered to be a result of a simple regulatory system, political stability, a very good telecommunication and transport infrastructure, together with a strategic location at the crossroads of maritime routes and proximity to major markets. Moreover, the Singapore government actively offer incentives to attract inward FDI by offering tax advantages.

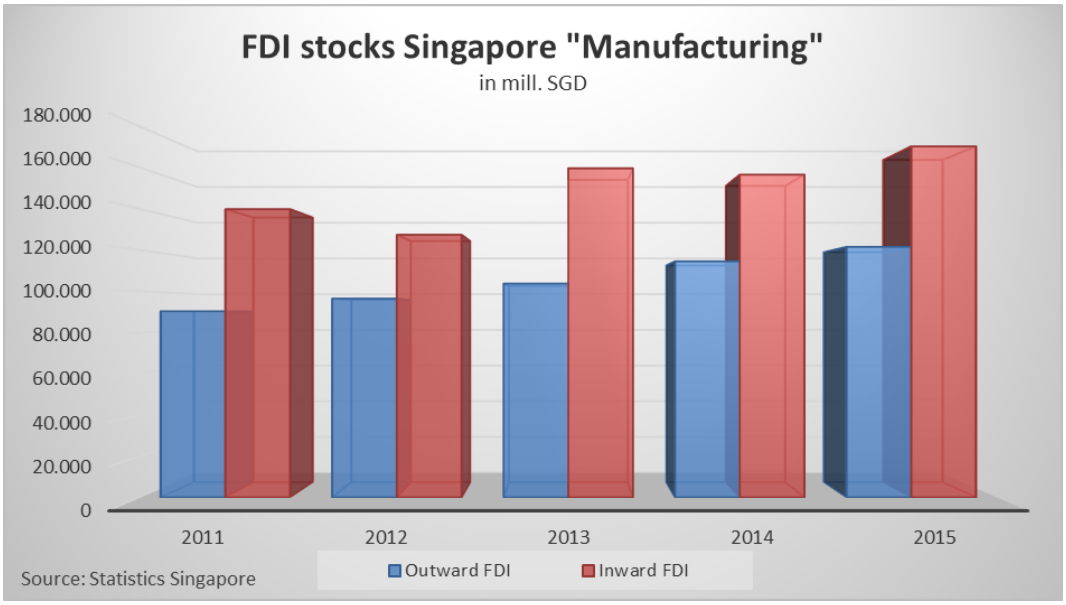


Figure 68: FDI stock development for Singapore in the manufacturing sector [Source: (Maritime and Port Authority of Singapore, 2017)]

In contrast to Singapore, the FDI stock position for “Other transport equipment” of South Korea reports a substantial FDI outward surplus. Whilst the outward FDI stock grows throughout the timeframe under consideration, the inward FDI stock has stagnated at the same level as depicted in *Figure 69*. In general, inward FDIs in South Korea are limited by restrictive regulatory frameworks, comparatively high cost of manpower, expensive real estate and unique industry standards [*Source:* (Banco Santander, S.A)].

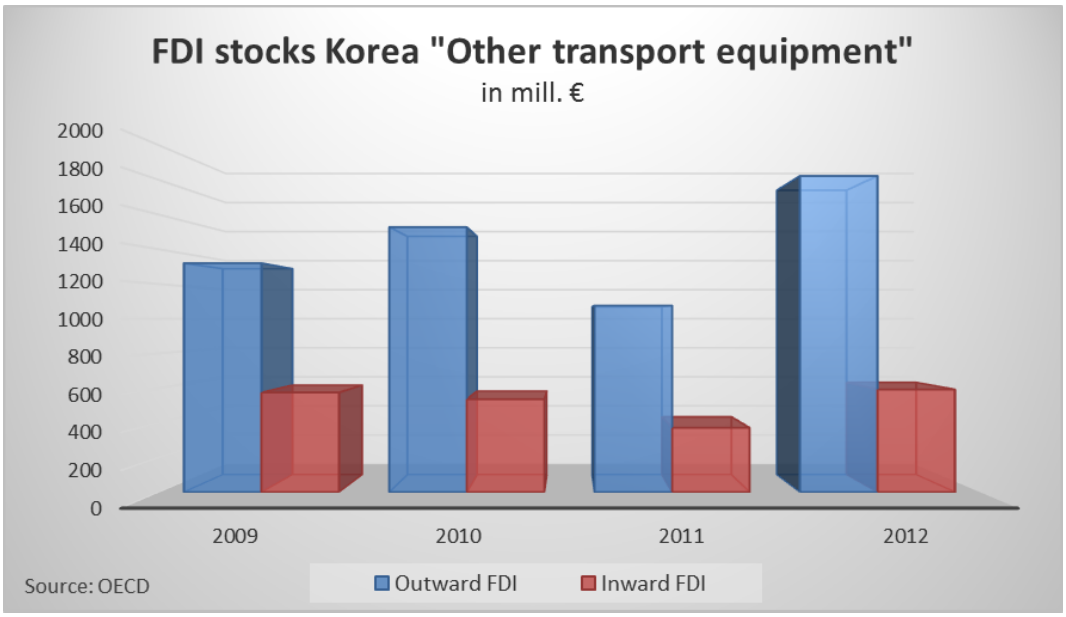


Figure 69: FDI stock development Korean “Other transport equipment”
[Source: (OECD - WORKING PARTY ON SHIPBUILDING, 2015)]

The republic of China was the third biggest recipient of foreign direct investments in 2015 *[Source:* (UNCTAD, 2016)*]*. The main reasons for this are direct access to the world´s biggest market which is still dynamically growing and with comparatively low labour costs. The annual FDI inward flows increased significantly after the financial crisis in 2010 and remain on a high level (*see Figure 70*). The government of China encourages investments in the high technology industry, production of equipment or new materials, the service sector, recycling, clean production, the use of renewable energies and environmental protection. On the other hand, the government's foreign investment guide points out that investments in sectors or Chinese companies that already have a relatively strong production capacity and use advanced technologies will not be encouraged [*Source:* (Banco Santander, S.A)*]*.

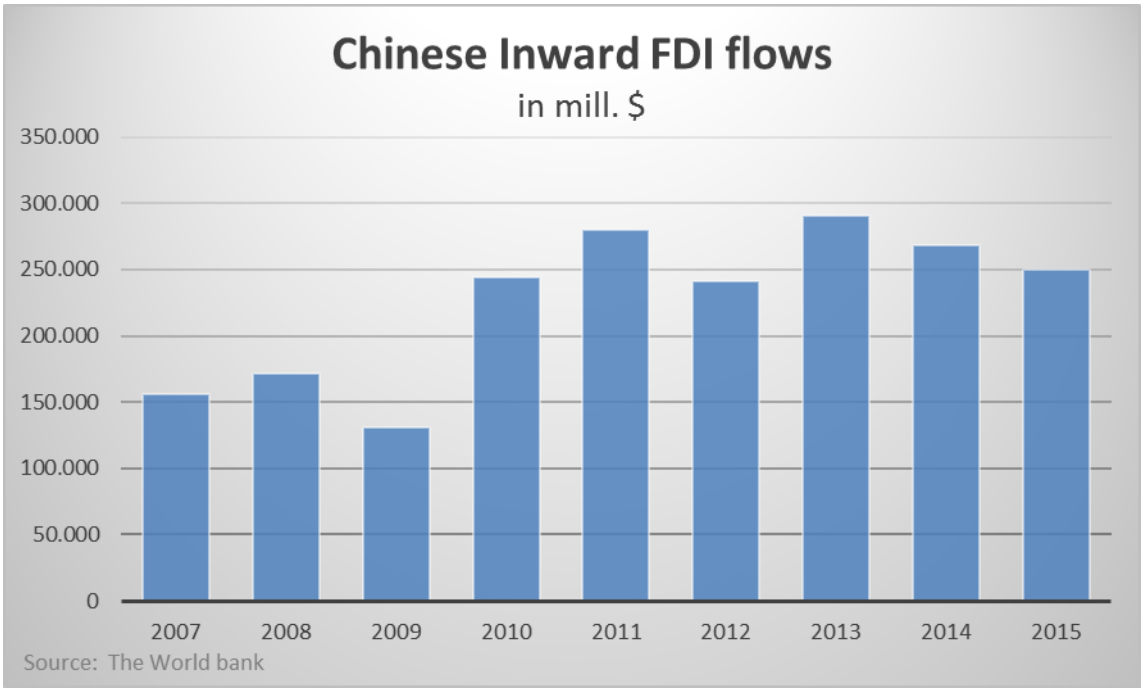


Figure 70: Chinese inward FDI flows
[Source: World Bank]

As a general observation, it can be said that:

- The investment boom into Brazil is over. Due to the oil price recession, investments into local content manufacturing have been written-off by many companies, e.g. Mitsubishi which cancelled co-operation with local shipyards.
- China and Singapore continuing being hotspots for foreign investments. This is especially true for shipyards seeking co-operative partners such as Tsuneshi and Kawasaki which has built a strong joint venture with Cosco.
- European investors are seeking co-operation in China to get closer to the shipbuilding market and to comply with (indirect) local content requirements. This is the case for engine manufacturers (Wärtsilä and MTU), but also for some manufacturers of other equipment. China is supporting these activities through governmental action plans to attract more added value creation into the country.
- Some European shipbuilding groups, from Italy and The Netherlands which seek to develop a global industrial base, have also been very active internationally. Surprisingly so, for the high-end sector, Asian investments are seen in Germany to be about shipbuilding capacity development for cruise shipbuilding, but also about buying into German mechanical engineering and electrical engineering companies. This development must be monitored in the coming years with the given the background of Chinese strategic activities to channel the transfer of know-how in order to develop their own supply industry.

5 Shipbuilding supply chain analytics – Portfolios of major global industrial players[9]

5.1 Background of the European shipbuilding supply chain

After the decline following the financial crisis in 2008/2009, the production value and employment of the European shipbuilding supply chain industry stabilised at the level of 2006.

Over this period, the shipbuilding market experienced a dramatic decline in terms of commodity vessels. The composition of the orderbook changed from steel-intensive standard ships to smaller, outfit-intensive complex vessels. This to a large extent came about through a concentration the offshore sector. This offset some of the difficulties arising from over- ordering of commodity ships, especially bulk carriers.

The forecast (see Chapter 3) demonstrates that the problem with commodity ships is likely to continue and is likely to affect not only bulk carrier, but also oil tankers with LNG, LPG tankers and offshore floating production structures also vulnerable. For these ship types the orderbook is already well above 60% of the 10-year requirement forecast, which means ordering activities are likely to remain extremely low and with a higher risk of cancellations.

Although the global seaborne trade forecast remains at a level of 3-4% annual growth, actual growth has dropped to below 2%. This results in the continuing underutilisation of the existing fleet and may depress further ordering of new ships.

The very low crude oil price has weakened the offshore market which has seen the cancellation or deferral of capital expenditures for larger offshore projects. This has led to a drop in the orders plus some cancellations for offshore ships and platforms, which has created a major problem for some Asian shipyards. As well as the domestic effect, this has also affected the foreign activities of these shipbuilding companies which has led to withdrawal from overseas investments in the marine sector, e.g. in Brazil.

Looking to the longer term, however continued growth is anticipated in both the shipping and oil & gas sectors. The ordering boom by of shipowners and oil & gas firms together with build-up of shipbuilding capacity has left a legacy of problems and it is not possible to predict the full extent to which we will see the withdrawal of shipyards and suppliers from the market as a result.

Conversely, we see a boost in orders for cruise ships and some other high value niche products, which is likely to favour European shipyards with a positive knock-on effect for the marine supply industry.

The cruise sector continues to grow at a steady pace. The Cruise Lines International Association forecasts the commissioning of 97 new cruise ships between 2017 and 2026 representing a total investment of about USD 53 billion.

Our demand forecast supports this trend and analysis shows that high value offshore ships, passenger ships and the fragmented group of NCCV account for about 50% of the market volume in the next 10 years.

The ship repair business is still suffering from the slow growth in maritime transport and financial difficulties of the shipping companies. Increasingly the new ships coming into the market have a

[9] The selection of companies referred to in this chapter represents major players in the industry, not necessarily meaning that all relevant stakeholders in the market have been identified. In this sense these are only exemplary, but representative companies. Information provided on maritime companies include main fields of activities, revenues, employees, joint ventures, shareholders, M&A activities, aspects of globalisation and internationalisation of production. This information has been assembled from public company information (e.g. company websites, annual reports), maritime branch magazines and commercial databases.

reduced repair and maintenance requirement (as a result of increased time between dockings). In some sectors, increased scrapping is lowering the average age of the fleet, with a consequent drop in shiprepair need.

Although impacted by the low oil price, retrofitting has been identified as a promising market with high potential, following new regulations on energy efficiency of ships and emission reductions. But this market is emerging very slowly and is unlikely to materialise quickly enough to make a substantial contribution in the near term.

As a consequence of the changing security situation, naval and defence sectors are forecasted to grow, particularly in Asia. However naval projects boost the orderbook situation with, European and USA shipyards taking a leading position in the overall world market by value[10].

The consumer oriented yacht– and boatbuilding industry is still suffering from the post financial crisis effects and has seen declines of about 50%. Italy is the market leader for luxury yachts and boats with a length between 30 m and 50 m and many of the market leading companies are to be found there. The Italian sector association UCINA reported a total turnover of about EUR 2.4 billion for 2013 with an export share of 67%. However, 78% of this export share was produced for customer markets outside the EU.

The three largest yacht and boat yards worldwide are based in Italy. The Azimut Benetti Group has an annual turnover of more than EUR 700 million and is the world's largest luxury yacht builder with a global market share of about 9%. Sanlorenzo and the Ferretti Group (including CRN Yachts) are two other major Italian yards. The larger mega-yacht projects seem to be untouched by economic trendsand still continue to grow.

Optimism remains in the offshore industries, where in oil & gas the development of new fields in more demanding environments and related CAPEX are expected to return in the near future and in the offshore wind industry where the development pace is still high in some European countries (e.g. UK, Germany, Denmark, Netherlands). However, this is still vulnerable and depends on the further development of the world economy (especially emerging economies), the level of the oil price and willingness of countries to work on an energy change and towards more environmental friendly technologies.

How does this situation affect the suppliers as such? After the initial decline of new ship orders, the industry experienced a slight growth in sales from 2009 to 2013. But the situation in the marine supplies industry is more variable. Some companies reported growth in 2012 and up to 2015, however other suppliers report a decline in sales. In particular, those suppliers with greater dependence on the shipbuilding business and certain commodity ship types have been affected by a continuous sales declines. On the other hand, supplier companies with a broader market base and especially those with advanced and innovative products have benefited from the current market situation.

However, since 2016 some main global maritime specialist companies have reported serious and significant decreases in both their turnover as well as new orders. As a result of continuing weaknesses in the international maritime supplier market some of these companies announced restructuring programmes for their marine business portfolios in 2016. These include both cost reduction initiatives and some employment reductions in their maritime business.

The sectors expect to remain in an ailing market situation for some time and for commodity shipbuilding and offshore the next few years is likely to remain very difficult. At the same time global competition is intensifying, from ship suppliers in other regions in the world. But promising areas

[10] According SeaEurope Market Monitoring Report 2016

for European marine suppliers include technology for energy- and cost-saving and environment-friendly operation of ships and offshore plant.

The marine supplies industry comprises all products, systems and services supplied for the building, service and maintenance of ships, and offshore structures. From the previous study, the shipbuilding and offshore (oil & gas, offshore wind, other offshore renewables) supplier industry in Europe comprises about 7 000 companies, the vast majority of which are small and medium-sized enterprises. Whereas the export rate of individual EU countries lies in the range 20% – 70%, the export share of the aggregated EU 28 region to non-EU countries is still high and equates to about 33% of the total production value.

Table 9 provides an overview of about 40 selected major players in the shipbuilding and offshore supply chains, which demonstrate the consolidation and globalisation process within the maritime sector. Many of these companies have applied globalisation strategies and have built their economic success on the basis of a distributed workforce, which has also given them good access to the globalised market. This reflects ongoing globalisation trends of companies looking for production cost reductions or to meet local content requirements.

Company	Headquarter Country	Merchant Shipbuilding	Naval Shipbuilding	Offshore Platforms, Large Offshore Ships	Ship Repair and Conversion	Services, Design, Classification, Model Basin, Consulting	Steel, Half Raw Materials, Subassemblies	Paintings/ Coatings	Ship Operation	Cargo Handling Equipment	Special Cargo Plants incl. Offshore Systems	Accommodation	Propulsion/ Power Generation	Auxiliary Systems, Apparatus & Accessories	Electric/ Electronics/ Nautical Equipment/ Communication
Damen Group	Netherlands	■	■	■	■				■					■	
Fincantieri Group	Italy	■	■	■	■	■						■	■	■	■
Meyer Group	Germany	■	■	■		■						■			
DCNS Group	France	■	■		■	■									■
BAE Systems	UK	■	■			■									
ThyssenKrupp Marine Systems	Germany	■	■			■									
Navantia	Spain	■	■	■	■										
MV WERFTEN (Genting Group)	Germany/ HKG	■			■										
STX Offshore & Shipbuilding	South Korea	■	■	■	■								■		
Mitsubishi	Japan	■	■	■	■	■							■		■
Hyundai HI	South Korea	■	■	■											
Sembcorp Marine	Singapore	■		■	■										
Bureau Veritas	France					■									
DNV GL	Norway					■									
ABB Marine	Finland, Norway						■				■		■	■	■
AkzoNobel Corp.	Netherlands							■							
Akastor	Norway										■			■	
Aker Solutions	Norway										■			■	
Alfa Laval	Sweden								■		■			■	
Bosch Rexroth	Germany								■	■	■		■	■	
Cargotec	Finland								■	■					
Brunvoll Holding	Norway								■	■					

Company		Headquarter Country	Merchant Shipbuilding	Naval Shipbuilding	Offshore Platforms, Large Offshore Ships	Ship Repair and Conversion	Services, Design, Classification, Model Basin, Consulting	Steel, Half Raw Materials, Subassemblies	Paintings/ Coatings	Ship Operation	Cargo Handling Equipment	Special Cargo Plants incl. Offshore Systems	Accommodation	Propulsion/ Power Generation	Auxiliary Systems, Apparatus & Accessories	Electric/ Electronics/ Nautical Equipment/ Communication
Caterpillar Marine Power Systems		Germany												■	■	
Central Industry Group		Netherlands						■		■	■					
GEA Group		Germany								■					■	
GE Power Conversion	Marine	France												■	■	■
	Oil & Gas	France										■		■		
Hempel		Denmark							■							
Hyundai Heavy Industries Engine & Machinery Division		South Korea												■	■	
Inmarsat		UK														■
Jotun Group		Norway							■							
KAEFER		Germany								■		■			■	
Kongsberg Maritime		Norway								■		■			■	■
Liebherr		Germany									■	■				
MAN Diesel & Turbo		Germany												■	■	
Raytheon Anschütz		Germany														■
Rolls-Royce Marine		UK					■			■	■			■	■	
Saipem SpA		Italy										■				
Schneider Electric		France												■		■
Siemens	Marine Solutions	Germany												■	■	■
	Oil & Gas	Germany									■	■				
Schottel		Germany												■		
Technip		France										■				
TTS Group		Norway								■	■	■				
Viking Life-Saving Equipment		Denmark								■						
Wärtsilä		Finland					■			■		■		■	■	■
ZF Friedrichshafen AG Marine Propulsion Systems		Germany												■	■	

Table 9: Selected major players out of the shipbuilding supply chains
[Source: Company Background Information, BALance TC)]

The shipbuilding and offshore supplies industry can be divided into the following categories, on the basis of their maritime turnover share, from which differing company types can be identified:

- **Regional maritime specialist** companies that serve essentially only the maritime and offshore market in Europe as well as worldwide. These companies operate either only one or several maritime sub-markets. Examples of this category are the following highly-specialised companies:

  - Life-saving equipment (Viking Life-Saving Equipment, Denmark; Palfinger, Austria; Survitec Group, UK)
  - Propulsion systems (e.g. Schottel, Germany; Mecklenburger Metallguss, Germany; Voith Schneider Propulsion, Germany; Becker Marine, Germany; Reintjes, Germany)
  - Electric/Electronics/Nautical Equipment (e.g. SAM Electronics, Germany; Consilium, Sweden; Raytheon Anschütz, Germany; Kelvin Hughes, UK; Transas, Russia/UK; Raytheon Anschütz, Germany)
- **Global market leaders** for one or more sub-sectors that cover also mainly the maritime and offshore market. Examples include Technip (France), Saipem (Italy) and leading Norwegian companies Kongsberg Maritime, Aker Solutions and Akastor.
- **Global maritime specialist** companies with significant maritime revenue shares, but also with supplies to other industrial sectors. Examples include:
  - Steel (e.g. Central Industry Group, Netherlands; Scana Industrier, Norway)
  - Paintings and coatings (e.g. Hempel, Denmark; Jotun, Norway; Muehlhan, Germany)
  - Ship operation (e.g. Bosch Rexroth, Germany; Glamox Global Marine & Offshore Lighting, Norway)
  - Cargo handling equipment (e.g. Cargotec, Finland; TTS Group, Norway)
  - Special cargo plants (e.g. Saacke, Germany; Baader, Germany)
  - Propulsion/Power generation (e.g. Wärtsilä, Finland; MAN, Germany with the subsidiary Renk, Germany; Rolls Royce, UK with the subsidiary Tognum, Germany; GE Power Conversion, France; Caterpillar Marine Power Systems, Germany; ZF Marine, Germany; Volvo Penta, Sweden)
  - Auxiliary systems (e.g. Hamworthy, UK; Autronica Fire & Security, Norway)
  - Satellite communication (e.g. Inmarsat, UK; EADS/Astrium, France; Telenor Satellite Broadcasting, Norway; Cobham SATCOM, UK)
- **Industrial generalists** with lower maritime revenue shares but still significant global maritime turnover such as ABB and Liebherr from Switzerland; Bosch, Siemens and Alfa Laval from Sweden; Schneider Electric from France and AkzoNobel from the Netherlands.

Driven by the economic crisis but with positive future market trends, a number of general developments can be seen in the structure of the European marine supplies industry. These include market consolidation through ongoing mergers and acquisitions, the development of component manufacturers to companies offering complex systems and trends towards globalisation of manufacturing in order to reduce cost and to follow the markets to the physical place of manufacture.

5.2 Opportunities and risks for European marine supplies industry

The European marine supplies industry is split into two different groups. On the one hand, there are global players who are active in one or more marine markets and one or more supply trades - typically represented by the top 100 companies in the sector (i.e. a few large or medium sized companies). On the other hand, the vast majority of companies which are dependent on regional maritime markets or even on single maritime customers- (i.e. a large number of small and medium

sized enterprises) often also located in the close proximity of shipyards or in localities (including cross border) with intensive maritime activities.

These two groups face different risks and challenges, but also have different opportunities for accessing market and for co-operation with their customers. The marine market is an example of a truly global market. It is difficult, nigh impossible, to identify with any degree of confidence any part of the market that can be considered an 'EU share'. EU suppliers, like shipyards, have to compete in all sectors on the world market. No longer are there any safe havens - either by virtue of EU ownership or build record of ships. While there may be natural tendencies to source from the EU for both EU owners and EU builders, the final decision is technical ("Does the equipment meet the technical specification?") and maybe more important, commercial ("Is the product at the right price?").

Global players:

Europe's strong position in the global marine supplies market relies on a relatively limited number of companies with leading market positions in one or more segments. These companies are dependent on the market development on a global scale and serve the whole shipbuilding market including those ship-types with systems, equipment and services, which are no longer built in European yards. The majority of these companies come from Northern Europe, building their strength in machine building, technical services or the traditionally strong maritime market. These companies are also very active in M&A activities, extending their position as system suppliers or benefitting from global distribution of manufacturing.

Originating from the financial crisis this already resulted in a strengthening of their market position, a trend that is likely to continue in the foreseeable future. The products of these companies are at the forefront of technical performance including high level of reliability and quality. Continuous innovation and competitive cost levels are the keys for maintaining this market position, especially as the growing demand for energy efficient and environmentally friendly vessel opens up the market for many sophisticated systems with a high performance. Not only is innovation critical for success with such new applications, but also a powerful and well distributed service network is essential in order to convince shipping companies to rely on their products through offering a global service network to minimise ship downtime.

As the commodity shipbuilding market is moving more and more to Asia and the position of European shipping companies weakens in the international arena, there is a risk of continuous loss of market share to the developing Asian marine suppliers; especially as some Asian countries implement strategies to improve their market position. In light of the critical situation in the major Asian shipbuilding countries, it remains to be seen how this may also affect their supply industry.

The sharp increase in obtaining type approvals for marine equipment by Asian manufacturers is a clear indication that there is a strategic will to cover more shares of the supplies sector. Although risky with regard to IPR protection, European marine suppliers are teaming up with Asian companies in order to avoid losing markets to Asian competitors with which they have no involvement. This materialises in differing forms of co-operations, including license agreements, joint ventures and localised production sites. Eventually this may negatively affect European employment in the sector, as the well-known example of slow speed engines demonstrates.

European regional suppliers

The second group of European marine suppliers represents more typically the SME group of companies. Here again we can distinguish service providers and equipment suppliers, which have a specific market position defined by their products. This can include some internationally active companies, however, due mainly to the size of their businesses, most of them operate regionally, nationally or localised cross border European. Particularly in subcontracting (for manufacturing and

assembly) we find either companies, which had historically been shipyard functions (i.e. joinery, accommodation specialists, pipeshops, sheetmetal shops, plate shops etc.) or companies which specialise in assembly work for some specific ship systems. The latter are very often subsidiaries of larger system or component suppliers.

These companies live or die by the health of their regional maritime economy - a major risk which is normally outside their control. When their associated shipbuilding industry in the region is suffering or disappearing, these suppliers are directly affected. Teaming up with shipyards to improve the competitiveness of the supply chain by means of smart integrated production processes and low cost is probably the only chance they have to influence the situation. The only way to address this risk is by trying to broaden the business basis, i.e. open up to serve other industries and/or try to broaden the geographical customer basis. In conjunction with continuous innovation this strategy can improve the chances of survival.

5.3 M&A, market consolidation

Since 2013 those suppliers exclusively focused on the shipbuilding industry have been greatly concerned by the global downturn. The boom in shipbuilding has uncovered the strategic and operational deficiencies of many suppliers which had been concealed by the unusually long boom cycle. Above all, those European suppliers with a strong and export-oriented turnover (global players) have reacted prompt but differently.

The need to counter the threat from decline in sale has increased the pressure to improve profitability. It has forced many enterprises to enter into strategic mergers and acquisitions. Some companies had to undertake on restructuring programmes for their marine business portfolios, combined in part with cost reduction initiatives and some reductions of employees in the maritime business.

The main acquisition objectives are:

- the improvement of the system competence (especially for the suppliers of components),
- overcoming technology deficits,
- reducing of production and selling costs (by increasing outsourcing or re-re-locating production),
- complementing of the product and service portfolio by different business segments providing improved sales opportunities
- optimization of the regional structure of the own production facilities or distribution channels (securing of the market access to growth markets, in particular in Asia, or meeting the growing demands for local content).

The reactions of the European manufacturers to these challenges, which are mainly relevant for globally active companies, have established the trend of the market consolidation and can be demonstrated by the following examples of M&A, joint venture and investment activities:

- **Cargotec, Finland** is a cargo handling solutions provider and acts as global player. With its brands MacGregor, Kalmar and Hiab, Cargotec offers cargo handling equipment, solutions and products. MacGregor offers integrated cargo flow solutions for maritime transportation and offshore industries, Kalmar a wide range of cargo handling solutions and services to ports, terminals, distribution centres and to heavy industry and Hiab on-road load handling solutions.

- In 2013: Cargotec acquired Hatlapa, a leading German marine equipment manufacturer of air and water-cooled compressors, steering gears and a wide range of deck machinery.
- In 2013 Cargotec has bought the Aker mooring and loading systems business.
- In 2016 Cargotec acquired the German company Interschalt maritime systems.
- In 2016: The Cargotec subsidiary MacGregor and China State Shipbuilding Corporation's (CSSC) Nanjing Luzhou Machi Co Ltd (LMC) have signed an agreement for a new joint venture with the Chinese partner to hold the majority of shares. As a first step, the joint venture will cover the transfer of Hatlapa marine air compressor technology over a two-year period. CSSC Luzhou MacGregor Machine Co Ltd will be located in Nanjing and will have exclusive sales rights for the air compressors in China.

- **Wärtsilä, Finland** is a global leader in advanced technologies and complete lifecycle solutions for the marine and energy markets. Wärtsilä is a market leader in medium-speed main engines. It is the world's second largest supplier of ship engines and world market leader for 4-stroke engines (medium-speed).

  In the last few years Wärtsilä bought a number of international marine companies such as:

  - 2008: Acquisition of the global ship design group Vik-Sandvik
  - 2008: Acquisition of Conan Wu & Associates Pte Ltd (CWA), a naval architecture and ship design company headquartered in Singapore.
  - 2011: Acquisition of the Swedish Cedervall, one of the leading manufacturers of shaft seal and bearing systems for the marine industry
  - 2012: Acquisition of Hamworthy headquartered in Poole, UK. Hamworthy employed around 1150 people worldwide and operates design, manufacture and sale of equipment facilities in the UK, Norway, Denmark, Germany, Singapore, and a modern assembly plant in China.
  - 2012: Acquisition of MMI Boiler Management Pte Ltd., a Singapore-based company specialising in the service and maintenance of boilers for marine and industrial applications.
  - 2015: Acquisition of L-3 Marine Systems International with the companies SAM Electronics et al from L-3 Communication Holdings Inc. (USA).
  - 2016: Acquisition of Eniram, a Finnish-based technology company providing the marine industry with energy management and analytics solutions. Eniram provides the maritime industry with energy management technology to reduce fuel consumption and emissions.
  - 2016: Acquisition of the USA and Canada based company Weir American Hydro from the Weir Group plc. American Hydro is a leading supplier and installer of large equipment upgrades and servicing for the hydroelectric and water distribution industries, specializing in consultancy, design and precision performance enhancements for hydro-turbines and pumps.

- **Rolls-Royce Marine, UK** has a leading range of capabilities in the marine market, encompassing the design, supply and support of power and propulsion systems. Rolls-Royce has strong positions in the offshore, naval and merchant and naval sectors.

  - In 2009: the global marine headquarters of Rolls-Royce moved to Singapore.
  - In 2011: Rolls Royce together with Daimler/Germany acquired the German engine manufacturer Tognum AG. The strategic objective is to integrate the Rolls Royce

Bergen Diesel engines (medium-speed diesel and gas engines) with the Tognum engines (high-speed diesel engines).
  - 2013: Acquisition of Tognum AG from Daimler.
  - 2016: Rolls-Royce is looking to invest millions of euros in its azimuth thruster production facility in Rauma, Finland, consolidating assembly and test capability and modernising the operation to position the business for future growth opportunities. Rauma produces a wide range of mechanical azimuth thrusters for use on a wide range of applications including semi-submersible drilling rigs and drillships, tugs and offshore vessels. Rauma also produces thrusters for specialist vessels such as icebreakers and polar research ships.

- **Alfa Laval Group, Sweden** runs 32 major production units and 102 service centres worldwide. The group realizes yearly revenues of about SEK 24.7 billion (2010) with a very diverse product portfolio and a relatively small maritime share.

  - In the last few years (2008-2012) Alfa Laval acquired 23 different companies with combined sales volume of SEK 7 565 million. In order to strengthen the maritime portfolio and market position in shipbuilding and offshore Alfa Laval bought the Danish Aalborg Industries in 2011.
  - Alfa Laval Aalborg (former: Aalborg Industries) is a leading equipment and service supplier in the marine sector and a supplier of industrial products to selected key markets. It is the world's leading marine boiler engineering company. The revenue before the takeover amounted to SEK 3.1 billion.
    Aalborg Industries is the biggest acquisition for Alfa Laval so far.

  - 2014: Acquisition of Frank Mohn (Framo)

- **Inmarsat, UK** is the one of the leaders in global mobile satellite communications. Thousands of vessels rely on the end-to-end service availability and coverage for operational communications and safety services.

  - In 2016: Singapore Telecommunications Limited (Singtel) and Inmarsat entered into a strategic partnership to enhance maritime cyber security using Trustwave's Unified Threat Management (UTM) solution. Trustwave, the cyber security arm of Singtel, will provide the software based UTM service to be integrated with Inmarsat hardware onboard ships, to protect data and reduce cyber risk for maritime companies.
  - In 2016: Marlink announced in June that it had signed a strategic alliance with Inmarsat, which will see Inmarsat's new Fleet Xpress service integrated into Marlink's existing service portfolio. Through the agreement, Marlink will bring more than two thousand vessels to Inmarsat's new Fleet Xpress service over a five-year period. Fleet Xpress, the Global Xpress maritime solution, sets a new standard in broadband maritime communications, delivering the highest levels of reliable high-speed broadband connectivity and exceptional performance across all of the world's oceans as well as facilitating innovative 'Connected Ship' applications.

5.4 System suppliers (from component suppliers to system suppliers)

Table 9: Selected major players out of the shipbuilding supply chains provides an overview on major global market players in the main shipbuilding and offshore sub-sectors. It is evident that many of these companies now cover not only one sub-sector, but develop into system providers covering three or more subsectors. In other words; they are players within the supply chain covering different functions.

The trend for the development from components to system supplier continues. This is accompanied by the formation of larger company structures within Europe and beyond by stronger integration in international networks or even through international M&A activities. The following examples describe some important global system suppliers in the global shipbuilding and offshore market:

Total propulsion systems and flow, gas & environmental solutions

The Finnish-based Wärtsilä is the most important company in this respect. Already by 2011 Wärtsilä was one of the most important global suppliers of complete propulsion systems. With the acquisition of Hamworthy, a UK-based global player and provider of fluid handling equipment and services for marine, oil & gas and industrial sectors, in 2011 Wärtsilä became a global system supplier for total propulsion systems and flow gas & environmental solutions. Wärtsilä Hamworthy is now a global system supplier with total offering for automation, power drives, power distribution, communication and control, engines, seal & bearings, propulsion, flow & gas solutions, environmental solutions, ship design and service agreements.

Complete electric/ electronics/ navigation solutions

The most important European global system suppliers in this sector are:

- Siemens, Germany (including overall company's industry market coverage)
- ABB, Finland, Norway and Switzerland (including overall company's industry market coverage)
- Kongsberg Maritime, Norway (including a strong offshore business)
- Wärtsilä including the acquisition of L-3 Marine Systems International with the companies SAM Electronics et al.
- Raytheon Anschütz, Germany
- Schneider Electric, France.

Complete propulsion systems

The most important European global system suppliers in this sector are:

- MAN, Germany (and other European countries)
- Rolls-Royce, UK (and other European countries) especially in connection with the acquisition of Tognum in Germany)
- Wärtsilä, Finland (and other European countries) especially in connection with the recent acquisition of L3 Marine (SAM Electronics et al)
- Caterpillar Marine Power Systems, Germany

  Caterpillar Marine Power Systems was established and headquartered in Hamburg/ Germany by the US based Caterpillar Inc as part of a strategic realignment of Caterpillar's marine activities. This organization carries the responsibility for all sales and service operations involving the Cat and MaK brand marine products of Caterpillar.

Paint and coatings

The most important European suppliers in this sector are:

- AkzoNobel, Netherlands
- Hempel, Denmark
- Jotun, Norway.

Cargo handling equipment

The most important European suppliers in this sector are:

- Cargotec, Finland
- Liebherr, Switzerland

Satellite communication

The most important European suppliers in this sector are**:**

- Inmarsat, UK
- EADS/Astrium, France
- Telenor Satellite Broadcasting, Norway
- Cobham SATCOM, UK.

Offshore drilling

In the ever-growing offshore oil & gas market, complete offshore drilling solutions have become more and more important the shipyard suppliers too.

The most important European system suppliers in this sector are:

- Technip, France
- Saipem, Italy
- Norwegian-based Aker Solutions Group which was divided in the two separate groups Aker Solutions and Akastor in 2014.

5.5 Shipbuilding suppliers following markets - Examples for internationalisation and diversification of production

A steadily increasing share of the global shipbuilding production has moved to Asian countries. As a result, innumerable European ship suppliers run their own facilities in Asia, mainly in China, but also in other Asian countries. Examples include:

Steel

- The Central Industry Group from the Netherlands operates in China through the Shanghai Ship Equipment Centre for machinery & equipment.

Paint/ coatings

- In 2009, Hempel of Denmark acquired full ownership of Hempel-Hai Hong which was subsequently renamed Hempel (China) Ltd. With its headquarters in Hong Kong, there are three production facilities, ten sales offices located in Beijing, Dalian, Qingdao, Shanghai, Chengdu, Guangzhou, Shenzhen, Wuhan, Chongqing and Tianjin, and eleven stock points strategically located in China. The was originally founded in 1992 as a joint venture with China Merchants Holdings (International) Co Ltd.
- Jotun Paints of Norway has joint ventures in China, Indonesia, Thailand, India and South Korea.
- Akzo Nobel of the Netherlands, a leading manufacturer of paints and coatings produces marine paints and coatings in China.

Ship operation

- TTS Group, Norway runs selected joint ventures and production facilities in Asia and has a long history of successful business in China with respect to joint ventures with CSSC) and Dalian New Shipbuilding Heavy Industry Co. (part of CSIC). Together, TTS and these partners own three companies that operate within the markets of cargo access, deck equipment and offshore handling equipment. TTS claims to be the Norwegian company with the largest operation in China.

Cargo handling equipment

- Cargotec from Finland established their joint venture Rainbow-Cargotec Industries Co Ltd (RCI) with Jiangsu Rainbow Heavy Industries Co., Ltd. to strengthen presence in China in 2011. RCI will build a new facility to Taicang that will increase Cargotec's delivery capacity.
- Acquisition of the German company Interschalt maritime systems in 2015.
- Liebherr from Switzerland operates different joint ventures as e.g.:
    - Liebherr Machine Tools India Private Limited (Bangalore, India): The joint venture company produces gear cutting machines in Bangalore that are intended for sale on the Asian market in particular.
    - Xuzhou Liebherr Concrete Machinery Co., Ltd. (Xuzhou, China): The joint venture company produces concrete batching plant and recycling plant for the Chinese market
    - Zhejiang Liebherr Zhongche Transportation Systems Co., Ltd. (Zhuji, China)
- Leading international companies with a special focus on offshore oil&gas: e.g. Technip, France, Saipem, Italy and the Norwegian companies Aker Solutions and Akastor.

Propulsion/ power generation

- Wärtsilä from Finland has established
    - a joint venture with Hyundai Heavy Industries for the production of Wärtsilä Dual Fuel Engines (DF) in South Korea (WHEC) in 2007,
    - a joint venture with Jiangsu CuiXing Marine Offshore Engineering Co. Ltd. for the production of Wärtsilä 26 and 32 medium-speed engines in Nantong/China for the Chinese market in 2011 (production start planned for early 2013) and
    - agreed on another joint venture with Yuchai Marine Power Co. Ltd. (YCMP) for the production of medium-speed marine engines to serve the increasingly dominant

Chinese shipbuilding industry. Production started in 2014. The UK-based Hamworthy, a Wärtsilä company since 2013, runs selected joint ventures and production facilities in Asia:

- Wärtsilä Suzhou Ltd., China
- Wärtsilä Hamworthy Korea Ltd
- Wärtsilä Hamworthy India
- Wärtsilä Pumps Pte. Ltd., Singapore

  - Wärtsilä from Finland is to set up a new fully-owned manufacturing facility in Brazil to meet the increasing market demand, particularly in the offshore market.
  - 2015: Acquisition of L-3 Marine Systems International with the companies SAM Electronics et al in 2015.

- Rolls-Royce, UK
  - moved its global Marine headquarters from London to Singapore in 2009.
  - started a joint development project for a medium-speed engine with Hyundai Heavy Industries in South Korea in 2001.
  - Since 2006 the subsidiary Rolls-Royce Marine Manufacturing (Shanghai) Limited manufactures and supplies marine equipment and runs marine aftermarket support services.
- MAN Diesel & Turbo from Germany runs the following maritime joint ventures and production facilities in Asia:
  - MAN Turbocharger China is the leading supplier of turbochargers for marine diesel-engine manufacturers in China. A facility was already established in Shanghai in 2002. Initially acting as an assembly workshop for axial turbochargers, MAN subsequently localized component production over the years. In time, the Shanghai factory became too small and, in 2011, the turbocharger workshop was moved to the current plant in Changzhou.
  - MAN runs a production facility and an engineering centre for four-stroke engines In Aurangabad, India.
- Caterpillar
  - Plant for the production of MaK engines in Guangdong, China.
  - Joint venture with Chinese Anqing CSSC Diesel Engine Company, Ltd., to manufacture MaK brand medium-speed marine engines for China and the Asia Pacific region.
  - Caterpillar has enlarged the facility in Piracicaba, Brazil to package 3500C series engines, generator sets and diesel electric propulsion systems for marine and offshore applications.
- Schottel, Germany, a global player in the area of propeller and pod propulsion production, manufactures propulsion components in Suzhou, China
- ZF Friedrichshafen AG - Marine Propulsion Systems

Auxiliary systems (e.g. ballast water, firefighting)

- Alfa Laval Aalborg from Denmark operates engineering major factories are located in China, Brazil and Vietnam. Selected joint ventures are:

    - Aalborg Industries Ltd., Qingdao, China (Manufacturing of marine boilers, heat exchangers, and inert gas systems since 1974)
    - Alfa Laval Hai Phong Co. Ltd., Hai Phong, Vietnam (Manufacturing of marine boilers since 2006) Aalborg Industries Vietnam Co. Ltd. was established in 2004 as a joint venture between VINASHIN (Vietnam Shipbuilding Industry Corp.) and Aalborg Industries A/S. In 2009, after mutual agreement the Aalborg Industries Group became the sole owner of Aalborg Industries Co. Ltd., Vietnam

Electric/ electronics/ nautical equipment

- Kongsberg Maritime from Norway has a manufacturing location in Zhenjiang (China) which is focuses on the delivery of electrical control & distribution units to the marine industry.

Cargo handling/ special cargo plants (offshore oil & gas)

- The Norwegian Aker Solutions opened a new plant in Paraná that will double the company's subsea production capacity in Brazil.
- Wärtsilä from Finland is to set up a new fully owned manufacturing facility in Brazil to meet the increasing market demand, particularly in the offshore market. Wärtsilä's investment in the new facilities is approximately EUR 20 million. The manufacturing premises will be based on a multi-product factory concept for the assembly and testing of Wärtsilä generating sets and propulsion products.
- Activities from the leading international offshore companies as e.g. Technip, France, Saipem, Italy and the Norwegian company Akastor.

Auxiliary systems

- Alfa Laval Aalborg from Denmark has operated a factory in Brazil for marine and industrial boilers since 2000.

5.6 Assessment of strategic cooperation, partnerships and acquisitions, globalisation activities and consolidation programs from EU shipyards and marine suppliers

The following examples provide an overview on the motivation and recent activities of shipbuilding groups, major naval groups and also marine suppliers with regard to assessment of strategic cooperation, partnerships and acquisitions, globalisation activities and consolidation programs.

5.6.1 Shipbuilding Groups

Typically, two or more companies form a strategic partnership when each possesses one or more business assets or have expertise that will help the other by enhancing their businesses. Strategic partnerships can develop in outsourcing relationships where the parties desire to achieve long-term mutual benefits and innovation based on mutual goals.

Our research has shown that strategic partnerships and co-operation are assuming greater significance in the EU shipbuilding sector. The following are some examples:

A. Fincantieri / Italy

- The Italian Fincantieri Group is now the largest shipbuilder by revenue in the Western world (meaning Europe and North America) and one of the most dynamic and diversified players in the industry, being focused on high value-added segments with high-tech content and high unit values.
- It has twenty shipyards across Europe, Americas and Asia with a workforce of 19 000 people, 60% of these outside Italy.
- It follows a clear strategy with defined action plan to seize opportunities and address the issues of shipbuilding, offshore and equipment, systems and services. There is significant development of commercial and industrial synergies with the Norwegian subsidiary for the offshore business.
- Significant development of commercial and industrial synergies is evident with its Vard group in Norway (Offshore Business).
- Fincantieri and CSSC Cruise Technology Development Co., Ltd, founded a joint venture to build two cruise ships for a cruise company joint venture established between Carnival Corporation, CSSC, and Shanghai Waigaoqiao shipyard,) for operation in the Chinese market. The contract has an assumed value of USD 1.5 billion and includes an option for four additional cruise ships. The contract aims at developing and supporting the growth of the Chinese cruise industry. Giuseppe Bono, CEO of Fincantieri, stated, “Looking at the global scenario means trying to widen one’s boundaries, laying the foundations to further boost business prospects and access more complex markets. It is not possible to maintain a competitive presence in the medium and long term without such a commitment *[Source:* (Haun, 2017)

B. Damen / Netherlands

- Damen has grown to include 32 shipyards and numerous related companies involved in the construction, maintenance and repair of ships, of which18 yards are located outside the Netherlands. Since 1969 the company has delivered over 4 000 custom-built marine vessels with export to over 117 countries.
- By the end of 2015, a total of 50 different companies represented the global presence of the Damen Group, 23 of them in the Netherlands, 27 in the rest of the world.
- Romania’s Damen Shipyards Galati (DSGa) is the largest of Damen Shipyards Group’s shipyards, repair yards and related companies worldwide. While Damen’s international sales organisation takes care of product development, self-managed DSGa has developed into a highly efficient production shipyard with a significant output.
- In 2012 Damen Shipyards Group acquired French ship repair yard Arno Dunkerque, the only operator for ship repair and conversion in Dunkerque, to expand its ship re-pair and conversion services.
- In 2015 Damen Shipyards Antalya in Turkey has added new capacity dedicated to building their popular Fast Crew Supplier 5009 design. This is12 000 m² facility and is the second development in Antalya where Damen has operated a shipyard since 2013.
- In May 2016, the Damen Shipyards Group (DSG) announced the opening of a new branch office in Houston, Texas, under the name of Damen North America, to meet the increasing demand for Damen’s unique shipbuilding concepts and repair and conversion services.

- Damen Shiprepair & Conversion took over the management of the Curaçao Droogdok Maatschappij as of February 1st, 2017. The facility will operate under the name of Damen Shiprepair Curaçao. Damen plans to invest approximately 40 million USD in a third floating dock and the yard's infrastructure and equipment.
- Damen Song Cam, a brand-new yard founded in 2014, is one of the largest in the Group and is Damen's first formal joint venture yard in Vietnam. It is a state-of-the-art shipyard applying western shipyard practices and European HSE standards into a Vietnamese environment. The yard is designed to produce around 40 ships p.a. in the first phase.
- Nakilat Damen Shipyards Qatar was established in 2010 as a joint venture between Qatar Gas Transport Company and Damen Shipyards Qatar Holding a wholly-owned subsidiary of DSG. Located in the north-eastern corner of Qatar, the yard is ideally located in the middle of the Arabian Gulf and is capable of building ships up to 170 metres in length.
- In September 2014 Damen Shipyards announces that it has established three strategic partnership agreements with major Ballast Water Treatment (BWT) system suppliers - Trojan Marinex, Bio-UV, and Evoqua Water Technologies. These systems, are included in Damen's worldwide One Stop BWT Retrofitting Service. This service gives shipowners peace of mind in complying with ballast water regulations in a time and cost-effective way. Damen has chosen to include BWT systems manufactured by its strategic retrofit partners.
- In January 2015; the Swedish defence and security company Saab and DSG signed an exclusive agreement to work together in pursuit of the potential Walrus-class submarine replacement programme for the Netherlands. They will also explore ways in which they might bid jointly on other submarine procurement programmes in the international submarine market. Through its acquisition of Kockums, Saab acquired extensive experience in the design and manufacture of submarines and surface vessels for a global customer base, integrating advanced systems and using a range of ultra-modern materials and construction techniques.
- In2016 DSG and GustoMSC announced a strategic collaboration to produce a range of self-propelled and non-self-propelled jack-up platforms for the offshore industries – the DG JACK range. The collaboration will be based on GustoMSC's strong track record in the design of jack-ups and provision of jacking systems, combined with Damen's extensive experience in shipbuilding and vessel optimisation, financing and worldwide after-sales services.
- Damen is working with its supplier base to developing new and innovative products to ensure they can offer fully integrated, compatible solutions. An example of this is the letter of intent signed with the Norwegian company TeamTec in 2016 to supply and service the AVITALISTM BWT system. The system combines filtration and a proven, eco-friendly chemical treatment solution optimized for medium-sized to large vessels in water of any salinity, turbidity or temperature. The intention is to advance to a full partnership by the end of 2016.

C. Meyer / Germany

- Meyer operates an ongoing co-operation and partnership strategy which includes the Finish maritime network in and around its Turku shipyard (acquired from STX Europe). This initiative helps them meet the growing demand for cruise ships and maintain the group's capacity to match their main competitors in Europe.

D. Navantia / Spain

- The state owned Navantia group is the largest shipbuilding company in Spain and is regarded as the fifth-biggest naval shipbuilder in the world. The company has developed

naval programs in nearly 20 different countries, and currently has own offices in Australia, Qatar, India, Turkey and Brazil.

- Navantia has established RDI agreements with major partners (Lockheed Martin, Indra, Thales, MTU etc.) as well as joint ventures with foreign shipyards to build vessels in other countries. Acciona Energía and Navantia, signed a strategic collaboration agreement on offshore wind power in July 2011, through which both companies will jointly support technological and industrial projects with various institutions.
- In October 2015 Navantia and defence and aerospace company Paramount Group signed MoU to jointly develop naval systems and vessels for South Africa and other African states.
- In 2011 Navantia established a wholly-owned Australian subsidiary, Navantia Australia to have a permanent presence in Australia.
- Navantia spent two years in Brazil preparing building a complete network of industrial partnerships and establishing a subsidiary in Brazil to meet Brazilian defence legislation on local content and to position itself for major Brazilian Navy fleet renewal contracts.
- In 2016, SAGE Automation and Navantia Australia established a joint venture to create local capability in Australia in naval automation and monitoring as part of its warship design and through-life support services.

E. MV Werften Genting Group (Hong Kong / Germany)

- Cruise ship operator Genting Group, acquired the German shipyard group MV Werften, to gain shipbuilding capacity to potentially build their own luxury cruise ships, river ships and mega yachts.
- Genting Group's is a Malaysian parent owns majority shareholdings of Star Cruises, Crystal Cruises and Norwegian Cruise Line. Encountering strong competition for available cruise ship building capacity, the group decided to acquire four German shipyards to build their 10 cruise ships (valued at EUR 3.5 billion) within their required timeframe. The workload with support the employment of the 3 000 workforce through to 2020.
- The group's FDI in Germany currently totals EUR 230 million for three shipyards and foreseen investments in a particular subassembly plant for cabins.

5.6.2 Naval shipyard groups

A. DCNS / France

- DCNS is one of the world’s leaders in the naval defence sector, and a key player in the field of marine renewable energies. Firmly established in France, the Group aims to play a key role in every move to consolidate the sector in Europe and internationally, where competition and price rivalry are becoming more and more intense.
- The reported aim of DCNS is to become the consolidator of European naval systems within ten years, with an industrial base in several locations in Europe and worldwide. A portfolio of innovative and competitive products and services will drive its profitability and growth, backed by skilled and motivated staff capable of visualising, absorbing and incorporating the technologies of the future and able to maintain the skills necessary for the sovereignty of France.

B. BAE Systems / UK

- BAE Systems is a major UK-owned multi-national defence contractor. BAE Systems is a trusted partner to the governments of a number of countries around the world and the company continues to expand its international business.
- With governments' spending, still under pressure and strong competition worldwide, BAE Systems has responded to these challenging market conditions by focusing on meeting their commitments to customers, improving efficiency, affordability and financial performance to sustain their existing market and win new business.
- Their vision is to be the premier international defence, aerospace and security company and their strategy sets out to meet the five key longer-term focus (areas as listed in the previous bullet point) to help BAE Systems achieve this.

C. ThyssenKrupp Marine Systems / Germany

- In February 2017 ThyssenKrupp, Marine Systems acquired the remaining 49% in the naval supplier Atlas Elektronik (formerly held by Airbus) thereby becoming its sole ATLAS Elektronik is an international maritime company with a global reputation for sonar systems and has been a technology partner to ThyssenKrupp Marine Systems for many years.
- In 2017 ThyssenKrupp Marine Systems was chosen as a strategic partner to the Norwegian navy following an extensive selection process by the Norwegian defence ministry. This new German-Norwegian partnership is based on the joint purchase and lifetime management of identical submarines, which are to be delivered in the second half of the period 2020-30.

  Both Atlas Elektronik and the Norwegian naval and maritime supplier Kongsberg, aim to supply submarine components as command and control systems to the Norwegian submarines that will be built by ThyssenKrupp Marine Systems.

5.6.3 Marine suppliers

Strategic cooperation, partnerships and acquisitions

A. Brunvoll Holding / Norway

The acquisition of Scana Propulsion by Brunvoll reflect its long-term plan in which it would like to participate in developing Brunvoll to serve the market with a broader product portfolio. This acquisition has two Norwegian companies both having a long tradition and expertise in the marine market domestically and internationally.

B. Inmarsat / UK

- Inmarsat provides global mobile connectivity on land, at sea and in the air. Their vision is to meet the remote and mobile connectivity needs of their customers, giving them what they need to connect – reliably, securely and globally. Examples of initiatives include:
  - Strategic partnership in2016 with Singapore Telecommunications Ltd (Singtel) to enhance maritime cyber security using Trustwave's Unified Threat Management (UTM) solution.
  - Strategic alliance with Marlink in2016 which will see Inmarsat's new Fleet Xpress service integrated into Marlink's existing service portfolio.

C. Kongsberg Maritime, Norway

- Kongsberg Maritime and Schneider Electric signed a global partnership agreement in 2016 to further the development and delivery of KONGSBERG K-Power switchboards and related systems for offshore and maritime markets.

D. Rolls-Royce Marine / UK

- Acquisition of Tognum AG, of Germany, to supplement their technology, product and systems capabilities.

E. Technip / France

- In May 2016 Technic combined with FMC Technologies (of Houston, USA) to form TechnipFMC with the following stated strategic objectives:
    - Create a leader in subsea, surface and onshore/offshore, driven by technology and innovation.
    - Build a comprehensive and flexible offering across each market from concept to project delivery and beyond.
    - Accelerate growth: broader portfolio of solutions will increase innovation, improve execution, reduce costs and enhance customer success.
- In January 2017, the new company started operations with a combined 44 000 employees with headquarters in Houston, London and Paris.

Globalisation activities and consolidation programs

A. Cargotec / Finland

- Cargotec's updated strategy for 2015–2018 aims to secure profitable growth by focusing on services, digitalisation and people leadership. Their target is to transform Cargotec's position from a global equipment provider to the global leader in intelligent cargo handling, with a strong services and solution offering in cargo and load handling business.

  Their MacGregor brand serves the offshore and marine industries by offering world-leading engineering solutions and services with a strong brand portfolio. It will focus on its operations in China to win in its biggest market.

B. Wärtsilä / Finland

- 2014: Agreement between Wärtsilä and China State Shipbuilding Corporation (CSSC) to establish a joint venture for manufacturing medium speed and dual-fuel engines. This built upon their previous collaboration from 2004 when they formed Wärtsilä CME Zhenjiang Propeller a company producing fixed and controllable pitch ship propellers.
- 2015: Acquisition of L-3 Marine Systems International/SAM Electronics of the USA.
- 2015-2016: In 2015, Wärtsilä finalised a joint venture with CSSC, for its 2-stroke engine business - to be known as Winterthur Gas & Diesel (WinGD). with, CSSC taking 70% of the shareholding and Wärtsilä the remaining 30%. The head office of WinGD remains in Winterthur, Switzerland and the company has subsidiaries in China, South Korea and Japan. In 2016, Wartsila sold its remaining shareholding to CSSC which now owns 100% of WinGD.

  2016: Wärtsilä and CSSC established a new joint venture company focusing on China's growing market for electrical and automation solutions for marine applications. The has new production facilities located in Lingang, Shanghai.

C. MAN Diesel & Turbo / Germany

- In September 2016 engine manufacturer MAN Diesel & Turbo announced its new "Basecamp 3000+" initiative aimed at ensuring the future viability of the company. The program, titled, will tackle development of the company's strategy and portfolio, as well as optimizing internal processes and cost improvements with the aim of achieving an improvement in results of over EUR 450 million. It was anticipated that around 1 400 staff will be affected by the planned measures.
- Previous initiatives have included around EUR 100 million of savings through restructuring of its group functions and three strategic business Engine & Marine Systems, Power Plants and Turbomachinery.

D. Rolls-Royce Marine / UK

- In 2016 Rolls-Royce announced plans to accelerate the transformation of its marine business as a result of continuous weakness in the maritime market. The marine business currently employs around 4 800 people in 34 countries. Planned measures include a further simplification of the structure of the business, with a streamlining of the senior management team, and a series of cost reduction initiatives which will result in the loss of around 800 roles worldwide and result in an estimated GBP 45-50 million of annualised savings from mid-2017. Costs of this restructuring are expected to be around GBP 20 million, split between 2016 and 2017.
- This follows a series of cost reduction initiatives carried out over the past three years to improve the affordability and competitiveness of the marine business which involved a further 1 000 job losses announced in May and October 2015.

6 Assessment of European and Member States activities

6.1 Overview on main maritime policy activities and strategies from selected DGs

This overview presents the major policy guidelines from selected DGs. The most relevant areas for the maritime industry. Areas which might be of benefit for the future of these sectors are identified.

6.1.1 DG GROW (Internal Market, Industry, Entrepreneurship and SMEs)

DG GROW is responsible for developing and improving the Internal Market for goods and services, covering areas such as the Europe 2020 initiative; fostering entrepreneurship, growth and SMEs, protection and enforcement policy and delivering the EU's space policy (e.g. Copernicus & Galilea).

In the shipbuilding sector DG GROW's key initiatives include the LeaderSHIP initiative (2015 and 2020) however it also commissions specific studies and analyses on the sector. In the recreational craft sector, they centre around the Recreational Craft Directive.

- The Commission’s LeaderSHIP 2015 and LeaderSHIP 2020.
- The shipbuilding industry impacts upon various other policy areas, in particular research and innovation, intellectual property, maritime clusters, safety, and the environment. The Commission also takes further policy action in these areas, including conducting studies on key issues.
    - LeaderSHIP initiative and related policies
    - Commission Studies and Analyses on Shipbuilding and Maritime Industries

Development of a dedicated industrial policy for the maritime sector, including the marine supplies industry, would be beneficial to the sector; as would support for enhanced networking between the yards and marine suppliers.

6.1.2 DG RTD (Research and Innovation)

This defines and implements research and innovation policy. Its key flagship initiative is the Innovation Union Research funding applies to a broad range of topics. In the marine sector, it funds FP 7 and H2020 programmes and sub-chapter 6.2 provides details of recent projects.

Further emphasis on initiatives which strengthen and extend networking between the yards and the marine supply industry would be beneficial.

6.1.3 DG REGIO (Regional and Urban Policy, European Regional and Structural Development Fund (ERDF and ESF))

This DG provides financial support for the development and structural adjustment of regional economies, economic change, enhanced competitiveness as well as territorial cooperation throughout the EU.

Under the ERDF, increased regional funding for marine supplies industry clusters, particularly in Southern Europe, is considered important, together with the previously mentioned need to support improved networking between yards and the marine supplies sector.

6.1.4 DG ENER (Energy)

DG ENER is responsible for developing and implementing European energy policy and has a broad remit. Its work on energy strategy, renewable energy and the oil & gas sector have particular relevance to the marine industries. These include current initiatives on offshore energy co-operation and the development of an offshore grid linking ten countries in the North Seas region.

For the future, development of a European offshore wind energy masterplan, would help support both the yards and marine supplies industry.

6.1.5 DG ENVIRONMENT (Environment)

DG ENV is responsible for EU policy on the environment. Its environment policies cover a wide range of topics with the marine and coast policy having particular relevance to the marine sector. Many of its areas of responsibility link strongly to the work done in the marine sector to develop more environmentally-friendly ships for the future and retrofit relevant technology.

Greater political and financial support for the development of sustainable marine and environmentally-friendly technologies would be beneficial, to increase the “Made in Europe” opportunities for the region's shipbuilding industry and enhance export opportunities for both it and the supplies industries.

6.1.6 DG CONNECT (Communications Networks, Content and Technology)

DG CONNECT develops and implements policies covering the digital economy and society, culture and media and related areas of research and support for business and industry. It involvement in the Copernicus programme includes the marine sector and the EGNOS programme has particular relevance to maritime navigation.

For the future, it would be beneficial if more marine-specific objectives can be identified to support initiatives for the shipbuilding and marine supplies sectors.

6.1.7 DG MARE (Maritime Affairs and Fisheries)

DG MARE develops and carries out the Commission's policies on maritime affairs and fisheries, areas which clearly have a strong link to shipbuilding and marine supplies. Its European Union Maritime Security and its Blue Growth strategies are of particular relevance. Further detail on Blue Growth are to be found later in this chapter.

The development of more industry-oriented strategies in both these areas would be of future benefit to European shipbuilding, offshore and marine supplies sectors.

6.1.8 DG MOVE (Mobility and Transport)

DG MOVE is responsible for promoting mobility that is efficient, safe, secure and environmentally friendly and hence conditions enabling industry to be competitive. There are many aspects of their remit that have particular relevance to the marine industry including the European Maritime Safety Agency and the **Innovation & Networks Executive Agency (**successor to TEN-T). Specific maritime initiatives and projects include:

- Maritime Transport Strategy 2018
- Motorways of the Sea concept
- Studies on:

  - Completion of an EU Framework on LNG-fuelled ships and its relevant fuel provision infrastructure
  - The analysis and evolution of international and EU Shipping
  - Analysis of recent trends in EU shipping and policy support to improve the competitiveness of Short Sea Shipping in the EU
  - Evaluation of impact of Directive 2000/59/EC on port reception facilities for ship-generated waste and cargo residues
  - Study on the progress achieved in Mutual Recognition of certificates.

- Various EMSA publications including:
- Management of Ship-Generated Waste On-board Ships (2017)
- EMSA Study on the use of Fuel Cells in Shipping (2017) Summary Overview of Marine Casualties and Incidents 2011-2015(
- EMSA Outlook 2017

Further detail on many of some of these aspects is provided later in this chapter.

6.1.9 DG JRC (Joint Research Centre)

The Joint Research Centre is the Commission's science and knowledge service, which recently developed a long-term strategy for how the organisation should evolve in the next 15 years.

A greater definition of how this strategy impacts the maritime industry and more specific initiatives to take this forward would be beneficial, to increase the focus of our diversified industry.

6.1.10 DG COMM (Communication)

DG COMM's responsibilities cover a broad range of areas relating to the Commission's corporate image including media communication and tools, co-ordination of projects with other institutions and national governments, reporting on political developments and providing its Spokesperson Service.

It has been highlighted in this report that the EU shipbuilding industry still suffers, to some extent, from a negative historical image (subsidy, low-value, dirty industry). Positive initiatives to communicate the present-day reality of high-tech manufacturing (e.g. cruise and defence) and services, would be beneficial both within the EU and worldwide.

6.1.11 DG COMP (Competition)

DG COMP is responsible for establishing and implementing a coherent competition policy.

Comments are made elsewhere in this report, regarding recent trends of competitor shipbuilding countries providing direct support initiatives to their industries. Where this can be verified, it is considered important that the EU invokes, through OECD and similar, appropriate tariffs and counter-measures to avoid damage to its industry.

6.1.12 DG DEVCO (International Cooperation and Development)

DG DEVCO is responsible for European international co-operation and development policy and delivering aid throughout the world.

Specific initiatives and projects relevant to the maritime sector include:

- Capacity building for climate mitigation in the maritime shipping industry (2016)
- EU provision ofEUR37 million to fight piracy in Eastern and Southern Africa (2015)

6.1.13 DG TRADE (Trade)

DG Trade develops and implements the EU's trade policy in order to help secure prosperity, solidarity and security in Europe and around the globe.

6.2 Assessment of EU regional and structural funding, research and innovation policy towards Foreign Direct Investments

The following table gives an overview on available EU instruments and programmes which might be employed to support industry strategies and initiatives. This chapter describes the scope and basic objectives of these programmes. It should be noted that co-ordination of these programmes for one industry branch problematic. It would be potentially beneficial if a sectoral industry policy approach could address this co-ordination for the future.

Responsible DG or institution	**Funding and innovation instruments**	**Main maritime content**
Innovation and Networks Executive Agency (INEA)	Connecting Europe Facility (CEF)	CEF Transport is the funding instrument to realize European transport infrastructure policy. It aims at supporting investments in building new transport infrastructure in Europe. CEF Transport focuses on cross-border projects and projects aiming at removing bottle-necks or bridging missing links in various sections of the Core Network and on the Comprehensive Network (link), as well as for horizontal priorities such as traffic management systems. The total budget for CEF Transport is EUR 24.05 billion for the period 2014-2020. Motorways of the Sea (MoS), a horizontal priority of the (EF, aims to promote green, viable, attractive and efficient sea-based transport links integrated in the entire transport chain.
DG GROWTH		The Commission is addressing issues affecting the shipbuilding industry through a variety of policy measures, in particular LeaderSHIP 2015 and LeaderSHIP 2020.
DG RTD	H2020 (R&D and innovations)	Funding and support for shipbuilding and marine suppliers. This is very important for the shipbuilding and marine supplies sector.
European Investment Bank (EIB)	• Maritime transport • Energy • TEN-T • Projects in EU Member States	• Construction and rehabilitation/extension projects for ports and logistic centres; inland water transport projects such as rehabilitation/expansion of waterways or inland ports; in terms of shipping, the EIB finances the acquisition of new vessels to either extend fleet capacity or to replace older vessels. • Development and expansion of renewable energy projects to make Europe's energy supplies more sustainable, competitive and secure. • Trans-European Transport Networks • Maritime developments and projects in EU member states.

Responsible DG or institution	Funding and innovation instruments	Main maritime content
DG REGIO	European Regional and Structural Development Funds • ERDF • ESF	The ERDF contributes to the Europe 2020 Strategy for smart, sustainable and inclusive growth, it has to focus on the priorities specified in this strategy. The main priorities are: • research and innovation; • information and communication technologies (ICT); • small and medium-sized enterprises (SMEs); • promotion of a low-carbon economy.
DG MARE	Blue Growth Strategy	Blue Growth is the long-term strategy to support sustainable growth in the marine and maritime sectors as a whole. Seas and oceans are drivers for the European economy and have great potential for innovation and growth. It is the maritime contribution to achieving the goals of the Europe 2020 strategy for smart, sustainable and inclusive growth.

Table 10: Assessment of the most important funding and innovation instruments of the EU

The Connecting Europe Facility (CEF) of the **Innovation and Networks Executive Agency (INEA)** is a key EU funding instrument to promote growth, jobs and competitiveness through targeted infrastructure investment at European level. The INEA is the successor of the Trans-European Transport Network Executive Agency (TEN-T EA), which was created by the European Commission in 2006 to manage the technical and financial implementation of its TEN-T programme. **INEA officially started its activities on 1 January 2014 in order to implement the CEF programme.**

It supports the development of high performing, sustainable and efficiently interconnected trans-European networks in the fields of transport, energy and digital services. CEF investments fill the missing links in Europe's energy, transport and digital backbone. The CEF benefits people across all Member States, as it makes travel easier and more sustainable, it enhances Europe's energy security while enabling wider use of renewables, and it facilitates cross-border interaction between public administrations, businesses and citizens. In addition to grants, the CEF offers financial support to projects through innovative financial instruments such as guarantees and project bonds. These instruments create significant leverage in their use of EU budget and act as a catalyst to attract further funding from the private sector and other public-sector actors. INEA implements most of the CEF programme budget, in total EUR 27.4 billion out of EUR 30.4 billion (EUR 22.4 billion for Transport, EUR 4.7 billion for Energy, and EUR 0.3 billion for Telecom).

The CEF is divided into three sectors:

CEF Transport

CEF for Transport is the funding instrument to realize European transport infrastructure policy. It aims at supporting investments in building new transport infrastructure in Europe or rehabilitating and upgrading the existing one.

TEN-T policy objectives foresee:

- completion by 2030 of the Core Network, structured around nine multi-modal Core Network Corridors.

- completion by 2050 of the Comprehensive Network in order to facilitate accessibility to all European regions

CEF Transport focuses on cross-border projects and projects aiming at removing bottle-necks or bridging missing links in various sections of the Core Network and on the Comprehensive Network (link), as well as for horizontal priorities such as traffic management systems. CEF Transport also supports innovation in the transport system in order to improve the use of infrastructure, reduce the environmental impact of transport, enhance energy efficiency and increase safety. The total budget for CEF Transport is EUR 24.05 billion for the period 2014-2020.

Motorways of the Sea (MoS), a horizontal priority of the CEF, aims to promote green, viable, attractive and efficient sea-based transport links integrated in the entire transport chain. Their implementation should help to rebalance the EU transport system. MoS are considered the maritime pillar of the Trans-European Transport Network. They consist of short-sea routes, ports, associated maritime infrastructure and equipment, facilities as well as simplified administrative formalities enabling Short Sea Shipping or sea-river services between at least two maritime ports, including hinterland connections. They contribute towards the achievement of a European Maritime Transport Space without barriers, connect Core Network Corridors by integrating the maritime leg and also facilitate maritime freight transport with neighbouring countries. The MoS concept builds on the EU's goal of achieving a clean, safe and efficient transport system by transforming shipping into a genuine alternative to overcrowded land transport. MoS aim at introducing new intermodal maritime-based logistics chains to bring about a structural change to transport organization: door-to-door integrated transport chains.

CEF Energy

The EU's energy infrastructure is aging and, in its current state, not suited to match future demand for energy, ensure security of supply or support large-scale deployment of energy from renewable sources. The upgrading of existing, and development of new energy transmission infrastructures of European importance will require investment of about EUR 40 billion in electricity and at least EUR 70 billion in gas.

A total budget of EUR 5.35 billion is made available for energy projects for the 2014-2020 period, of which EUR 4.7 billion in the form of grants managed by INEA.

CEF Telecom

CEF in Telecom is a key EU instrument to facilitate cross-border interaction between public administrations, businesses and citizens, by deploying digital service infrastructures (DSIs) and broadband networks. Supported projects will contribute to the creation of a European ecosystem of interoperable and interconnected digital services that sustain the Digital Single Market. A EUR 1.04 billion budget is earmarked for trans-European digital services for 2014-2020.

The EU further promotes the industry's development and addresses competitiveness issues. The sector is continuously monitored by the European Commission. Action is taken in co-operation with stakeholders to further enhance competitiveness and promote the sector's development. In this context, the Commission is addressing issues affecting the shipbuilding industry through a variety of policy measures, in particular the joint LeaderSHIP approach (DG GROWTH).

The shipbuilding industry impacts upon various other policy areas, in particular research and innovation, intellectual property, maritime clusters, safety, and the environment. The Commission also takes further policy action in these areas, including conducting studies on key issues.

- LeaderSHIP initiative and related policies
  The new LeaderSHIP 2020 initiative was adopted in 2013, in response to the effects of

the economic crisis on the shipbuilding sector. The report outlines a strategic vision for the industry that is:

- innovative;
- green;
- specialised in high tech markets;
- energy efficient;
- capable of diversifying into new markets, etc.

To make this vision a reality, the report provides a series of recommendations for the short and medium term to generate sustainable growth and high-value jobs linked to maritime technologies.

Funding and support for shipbuilding and marine suppliers RDI and innovations (DG RTD)

The Horizon 2020 funding mechanism for marine and maritime research is also very important for the shipbuilding and marine supplies sector. Some of the most important RDI and innovation projects, funded by DG RTD, are listed in Chapter 6.2.

European Investment Bank (EIB)

The EIB is the European Union's bank. This is the only bank owned by and representing the interests of the European Union Member States. The EIB works closely with other EU institutions to implement EU policy. The bank is the world's largest multilateral borrower and lender providing finance and expertise for sustainable investment projects that contribute to EU policy objectives. More than 90% of the activity is in Europe. The EIB supports projects that make a significant contribution to growth and employment in Europe with a focus on four priority areas:

- Innovation and skills
- Access to finance for smaller business
- Infrastructure
- Environment and climate.

The EIB Group consists of the EIB and the European Investment Fund (EIF), the specialist provider of risk finance to benefit SMEs and midcaps across Europe. The EIB is supporting Europe's economic recovery by implementing the European Fund for Strategic Investments (EFSI). By the end of 2016, the EIB Group had committed EUR 30.2 billion under EFSI, mobilizing total investment of EUR 163.9 billion, or 52% of the target of EUR 315 billion over three years.

The main maritime sectors and projects funded by the EIB are:

- Maritime Transport

  Construction and rehabilitation/extension projects for ports and logistic centres; inland water transport projects such as rehabilitation/expansion of waterways or inland ports; in terms of shipping, the EIB finances the acquisition of new vessels to either extend fleet capacity or to replace older vessels. Funded maritime transport projects are e.g.:

  - Green Shipping Guarantee (GSG) programme
    The aim of the Green Shipping Guarantee (GSG) programme is to accelerate the implementation of investments in greener technologies by European shipping companies. The programme will be structured as a guarantee framework with financial institutions specialised in ship financing. In order to develop and demonstrate the concept, the programme will be launched with a pilot phase with selected partner institutions with identified pilot transactions.

- Green Shipping Programme Loan
  Financing of small shipbuilding projects including new vessels, conversion and retrofitting of vessels that promote sustainable transport, TEN-T and environmental protection. The loan will be structured as a programme loan for a series of sub-loans to multiple ship owners with eligible projects to be implemented mainly in European shipyards.
- Balearia Green Fleet Renewal
  Modernization of the promoter's fleet through the acquisition of new dual-fuel vessels. The project involves the construction of two passenger ferries powered by liquefied natural gas (LNG) for the promoter's fleet. The vessels will replace two older, less fuel-efficient (therefore more polluting) vessels. The vessels will be constructed and operated to full EU and International Maritime Organization (IMO) specifications and regulations. The vessels will also be constructed to the highest EU environmental standards. The vessels will be EU flagged and registered and are expected to be operating on the promoter's Mediterranean routes between Spain and the Balearic Islands.

- Energy

  The EIB supports the development and expansion of renewable energy projects to make Europe's energy supplies more sustainable, competitive and secure. Examples of funded maritime energy projects are:

  - ENI Renewable Energy Generation
    Implementation of four new renewable energy generation projects in the vicinity of Eni's plants and areas of operation in three regions (Sardinia, Sicily, Puglia): The project supports national and EU renewable energy objectives and supports Italy in meeting its commitments with respect to greenhouse gas emission reductions.
  - Northern Offshore Wind
    Construction and operation of an offshore wind farm 22 km from the Belgian Coast with an estimated capacity of up to 370 MW. The development of offshore wind energy will support EU and national targets for renewable energy generation, and contributes to security of energy supply and environmental objectives. The project will further contribute to the Bank's priority objectives for energy-sector lending related to renewable energy sources and climate action (transversal).

- Trans-European Transport Networks (TEN-T)

  Funded maritime TEN-T projects are e.g.:

  - Belgium: Antwerp's new sea-lock - the latest of many EIB projects
  - Belgium: two locks and dredging of the river Meuse
  - France: extension of the ports of Calais, Cherbourg and Caen
  - Italy: Medium sized Italian ports programme loan
  - Ireland: infrastructure work in Dublin and the relocation of Cork's container terminal
  - Netherlands: Sealock IJmuiden, set to become the largest lock in the world
  - UK: a deep-water container port on the Thames for London, a deep-sea container terminal for Liverpool, and upgrades for the ports of Hull, Southampton and Dover
  - Antwerp's new sea-lock.

The EIB also funds maritime developments and projects in EU member states.

- France (2016)

  In 2016, a first agreement was signed between the EIB and the French Société Générale (EUR 150 million) under the Investment Plan for Europe. This agreement was made

possible by the EU guarantee under the Investment Plan for Europe – commonly known as the Juncker Plan – and the CEF. With an overall envelope of EUR 750 million, the new mechanism is intended to finance new shipbuilding projects but also the conversion and modernization of existing ships, while respecting the principles of sustainable transport and environmental protection. More specifically, it will support investment in the development of technologies to improve energy efficiency and cut harmful emissions in the European maritime transport sector.

- Italy (2012)

  The Italian shipbuilding company Fincantieri has received a EUR 140 million loan from the EIB to finance Italy's R & D shipbuilding programs. This was the first financing operation ever undertaken by the EIB in Europe to promote RDI by a company in this sector. The project focuses mainly on three areas:
  - technological solutions to improve the energy efficiency and reduce the fuel consumption of ships;
  - the optimization of ship design, during both the construction and operational stages, so as to increase the safety of vessels and reduce their environmental impact; and
  - innovative studies (also relating to design) that can reduce the size and increase the accommodation capacity of ships.

Main Funds

The five main funds work together to support economic development across all EU countries, in line with the objectives of the Europe 2020 strategy are:

- European Regional Development Fund (ERDF)
- European Social Fund (ESF)
- Cohesion Fund (CF)
- European Agricultural Fund for Rural Development (EAFRD)
- European Maritime and Fisheries Fund (EMFF).

ERDF and ESF (DG REGIO)

The ERDF was set up in 1975 and provides financial support for the development and structural adjustment of regional economies, economic change, enhanced competitiveness as well as territorial cooperation throughout the EU. Along with the ESF, CF, EAFRD and the EMFF, the ERDF is one of the five Structural and Investment Funds of the EU. For the 2014-20 period, the budget for the ERDF amounts to more than EUR 250 billion. The Fund supports projects under the 11 themed objectives for cohesion policy, and focuses in particular on four key priorities:[11]

- Strengthening research, technological development and innovation
- Enhancing access to, and use and quality of ICT
- Enhancing the competitiveness of SMEs
- Supporting the shift towards a low-carbon economy in all sectors.

The ERDF also funds cross-border, interregional and transnational projects under the European territorial cooperation objective.

[11] http://ec.europa.eu/regional_policy/en/policy/what/glossary/e/european-regional-development-fund

Key Themes

As the ERDF contributes to the Europe 2020 Strategy for smart, sustainable and inclusive growth, it has to focus on the priorities specified in this strategy. The main priorities are:

1. research and innovation;
2. information and communication technologies (ICT);
3. small and medium-sized enterprises (SMEs);
4. promotion of a low-carbon economy.

The level of concentration required varies according to the category of the regions being supported. More developed regions are required to allocate at least 80% of their ERDF resources to at least two of these priorities and at least 20% to the low-carbon economy. Transition regions are permitted to allocate at least 60% of their ERDF resources to at least two of these priorities and at least 15% to the low-carbon economy. Less developed regions are expected to allocate at least 50% of their ERDF resources to at least two of these priorities and at least 12% to the low-carbon economy.

Budget and financial rules

During the period 2014-2020 the European Union will allocate over EUR 325 billion (in 2011 prices) to its cohesion policy, including almost EUR 256 billion to two of the Structural Funds: the ERDF and the ESF. The share of this budget dedicated to the ERDF will be decided on the level of each EU Member State.[12]

ERDF and ESF				**ERDF**
Investment for growth and jobs				European territorial cooperation
Less developed regions	Transition regions	Special allocation for outermost and sparsely populated regions	More developed regions	
164 279	32 085	1 387	49 271	8 948

Table 11: Source: European Commission (in billion EUR, in 2011 prices)

The level of co-financing required in projects financed by the ERDF is geared to the development of the regions concerned. In the less developed regions (and outermost regions) the ERDF can finance up to 85% of the cost of the project. In the transition regions, this can be up to 60% of the cost of the project, and in the more developed regions up to 50%.

The Commission's objective is to protect Europe with very strict safety rules preventing sub-standard shipping, reducing the risk of serious maritime accidents and minimizing the environmental impact of maritime transport. For Europe, maritime transport has been a catalyst for economic development and prosperity throughout its history. Maritime transport enables trade and contacts between all European nations. It ensures the security of supply of energy, food and commodities and provides the main vehicle for European imports and exports to the rest of the world. Almost 90% of the EU's external freight trade is seaborne. Short sea shipping represents 40% of intra-EU exchanges in terms of ton-kilometres.

[12] http://www.europarl.europa.eu/atyourservice/en/displayFtu.html?ftuId=FTU_5.1.2.html

The **"Motorways of the Sea"** (MoS) concept of DG MOVE aims to introduce new intermodal maritime-based logistics chains in Europe, which should improve our transport organization within the years to come. These chains will be more sustainable, and should be commercially more efficient than road-only transport. MoS will thus improve access to markets throughout Europe, and bring relief to our over-stretched European road system. For this reason, fuller use will have to be made not only of our maritime transport resources, but also our rail and inland waterways, as part of an integrated transport chain. The concept was introduced with the 2001 Transport White Paper - European transport policy for 2010: time to decide. The Commission proposed the development of MoSas a "real competitive alternative to land transport and the White Paper also defined that it should be part of the trans-European network (TEN-T) and funds should be made available for its development. The following four corridors were designated for the establishment of projects of European interest:

- Motorway of the Baltic Sea (linking the Baltic Sea Member States with Member States in Central and Western Europe, including the route through the North Sea/Baltic Sea canal) (by 2010);
- Motorway of the Sea of western Europe (leading from Portugal and Spain via the Atlantic Arc to the North Sea and the Irish Sea) (by 2010);
- Motorway of the Sea of south-east Europe (connecting the Adriatic Sea to the Ionian Sea and the Eastern Mediterranean, including Cyprus) (by 2010);
- Motorway of the Sea of south-west Europe (western Mediterranean, connecting Spain, France, Italy and including Malta and linking with the Motorway of the Sea of south-east Europe and including links to the Black Sea) (by 2010).

Europe - Blue Growth Strategy (DG Mare)

Blue Growth is the long-term strategy to support sustainable growth in the marine and maritime sectors as a whole. Seas and oceans are drivers for the European economy and have great potential for innovation and growth. It is the maritime contribution to achieving the goals of the Europe 2020 strategy for smart, sustainable and inclusive growth.

The 'blue' economy represents roughly 5.4 million jobs and generates a gross added value of almost EUR 500 billion a year. However, further growth is possible in a number of areas which are highlighted within the strategy. The strategy consists of three components:

1. Develop sectors that have a high potential for sustainable jobs and growth, such as:
    a. aquaculture
    b. coastal tourism
    c. marine biotechnology
    d. ocean energy
    e. seabed mining.
2. Essential components to provide knowledge, legal certainty and security in the blue economy
    a. marine knowledge to improve access to information about the sea;
    b. maritime spatial planning to ensure an efficient and sustainable management of activities at sea;
    c. integrated maritime surveillance to give authorities a better picture of what is happening at sea.
3. Sea basin strategies to ensure tailor-made measures and to foster cooperation between countries
    a. Adriatic and Ionian Seas
    b. Arctic Ocean

c. Atlantic Ocean
d. Baltic Sea
e. Black Sea
f. Mediterranean Sea
g. North Sea.

Integrated Maritime Policy (DG MARE)

The Integrated Maritime Policy seeks to provide a more coherent approach to maritime issues, with increased coordination between different policy areas. It focuses on:

- Issues that do not fall under a single sector-based policy e.g. "blue growth" (economic growth based on different maritime sectors).
- Issues that require the coordination of different sectors and participants e.g. marine knowledge.

Specifically, it covers these cross-cutting policies:

- Blue Growth
- Marine data and knowledge
- Maritime spatial planning
- Integrated maritime surveillance
- Sea basin strategies.

The key purpose of this policy is:

- To take account of the inter-connectedness of industries and human activities centred on the sea. Whether the issue is shipping and ports, wind energy, marine research, fishing or tourism, a decision in one area can affect all the others. For instance, an off-shore wind farm may disrupt shipping, which in turn will affect ports.
- To save time and money by encouraging authorities to share data across policy fields and to cooperate rather than working separately on different aspects of the same problem.
- To build up close cooperation between decision-makers in the different sectors at all levels of government – national maritime authorities, regional and local authorities, and international authorities, both inside and outside Europe. Many countries are recognizing this need and move towards more structured and systematic collaboration.

Marine and Maritime Agenda for Growth and Jobs - The Limassol Declaration

This was adopted on 8 October 2012 by European Ministers for maritime policy and the Commission at a conference in Limassol. Five years after the launch of the EU Integrated Maritime Policy, the Member States and the Commission reaffirmed that a dynamic and coordinated approach to maritime affairs enhances the development of the EU's 'Blue Economy' while ensuring the health of seas and oceans.

Funding opportunities

The EU provides funding for the political priorities of their Integrated Maritime Policy under Regulation 508/2014. The funding is implemented through:

- Annual work programmes with a total budget of EUR 259 million for the 2014-2020 period. EUR 29 million to be spent mainly on calls for tender and calls for proposals[13]
- EUR 71 million for the 2014-2020 period within the framework of the EMFF operational programmes[14]

6.3 Assessment of EU and Member States Research and Innovation Policy towards globalisation

EU maritime research

The 2014-20 EU funds for research and innovation are provided through a system of EU programmes including

- Horizon 2020, the largest programme, covering all research fields and fully dedicated to funding R&I activities;
- sectoral R&I programmes (nuclear energy, coal and steel, space);
- European Structural and Investment Funds, implemented at regional level.

These programmes are complemented by five other EU programmes not funding R&I activities directly, but connected to them:[15]

Overview of EU programmes funding or connected to R&I activities and their respective budgets (in million EUR)

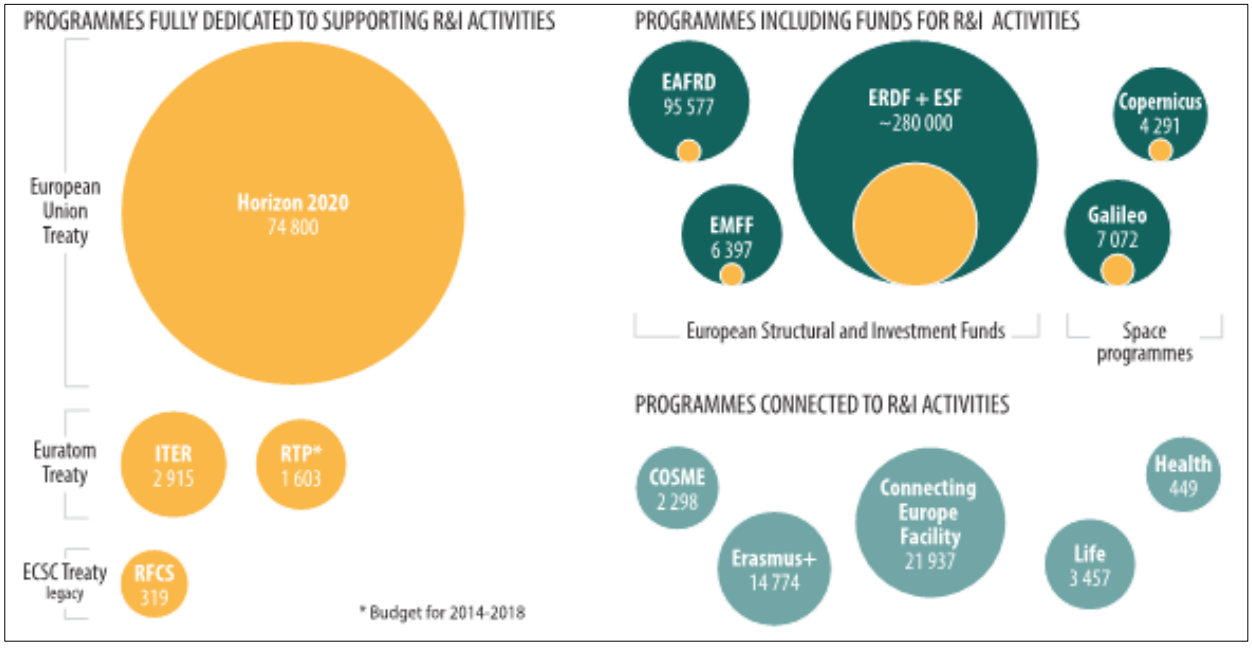


Figure 71: Overview of EU programmes funding (European Commission, 2015)

[13] European Maritime and Fisheries Fund, REGULATION (EU) No 508/2014

[14] https://ec.europa.eu/maritimeaffairs/policy_en

[15] http://www.europarl.europa.eu/RegData/etudes/BRIE/2015/568327/EPRS_BRI(2015)568327_EN.pdf

Status research Horizon 2020 (H2020)

In 2013, the Commission adopted the 2013 work programme of the 7th Research FP7. These were the last calls under FP7, a programme strongly linked to the Europe 2020 strategy for growth and jobs and a bridge to Horizon 2020, the future research and innovation programme post 2014.

Development of maritime funding in transport programmes of EU 1999-2015

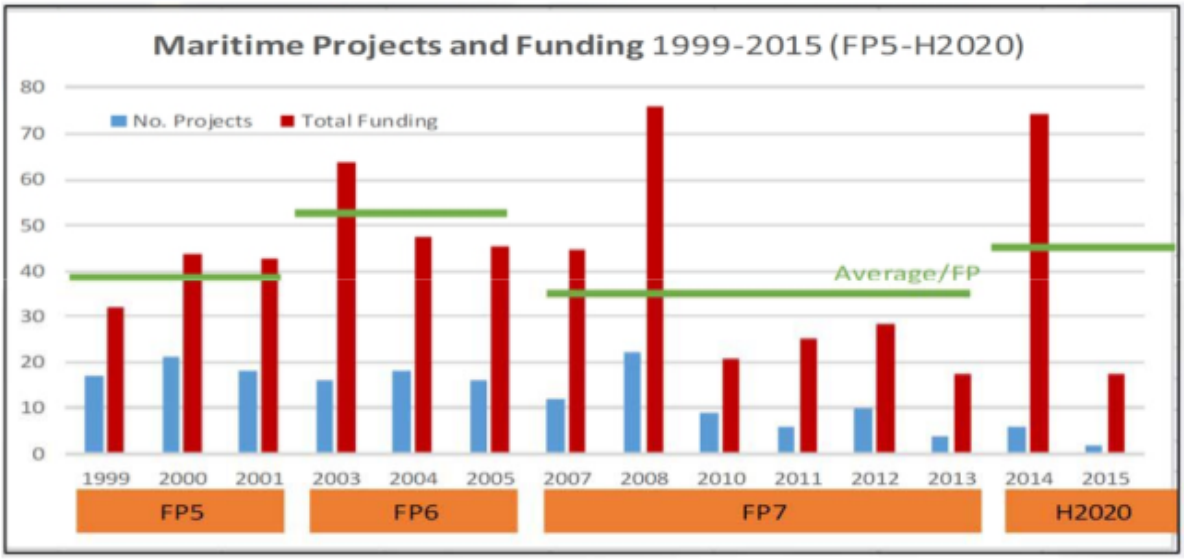


Figure 72: Maritime projects and funding 1999-2015 (FP5-H2020)
Source: Evaluation by German CMT based on FP5-H2020 Maritime Projects and Funding – FR 20160706, In: GE-01, H2020, Calls and WP, Transport, Maritime Statistics

Country examples of EU member states' national research and innovation policies

Germany

The overall objectives of the maritime strategy can be summarized as follows:

- Strengthen industrial competitiveness
- Improve structural framework conditions for future market potentials

To achieve these objectives, it uses the following instruments:

- **Innovation**

  The government initiates and funds innovation and research programs to foster innovative shipbuilding in order to secure competitive employment. The main research areas are:

  - Energy efficiency,
  - Environmental friendly technologies

  Between 2004-2014, the government planned an annual budget of EUR 32 million, in total EUR 160.3 million was expended on 98 projects and the innovation program was extended to 2017.

  The government also started a research program for the next generation of maritime technologies with a total funding of EUR 150 million for the period 2011-2015.

- **Ship finance and trade support**

  The government provides insurance for the repayment of loans linked to exports. In 2014, the value of the shipbuilding sector and marine supply industry export credit guarantees totalled EUR 5.5 billion

  - Aval guarantees of the German government
  - Commercial Interest Reference Rate: Loan with a fixed interest rate according to the agreed minimum level of OECD
  - Trade promotion.

- **Coordination activities**

  The Federal Ministry for Economic Affairs and Energy initiated the "National Masterplan Maritime Technologies" (NMMT), a multi-stakeholder platform for industry, government, coastal states, the scientific community and maritime associations to coordinate maritime issues.

France

France has a national strategy covering the security of maritime areas which was adopted by the inter-ministerial sea committee on 22 October 2015.

Figure 73: French national strategy for the security of maritime areas (French Government, inter-ministerial sea committee, 2015)

The implementation and updating of the strategy involves monitoring and regular updates to the assessment of maritime risks and threats, which will be done by a steering group, composed of representatives of the ministries and administrations contributing to it, which meets at least once a year under the chairmanship of Secretary-General for the Sea (SG Mer). Proposals for a five-yearly review of the strategy will be presented by SG Mer to the national maritime conference and the executive committee of the Coast Guard Function before being submitted to the inter-ministerial sea committee (CIMER) for decision.

SG Mer provides the coordination between the different ministries to ensure inter-ministerial maritime governance exists, based on a body of comprehensive and consistent elements. SG Mer's scope extends to include maritime economy, ecology, biodiversity and research. It invests largely in forward-thinking initiatives, the development of French maritime policy and in the strengthening of its bonds with (international) organisations such as the UN, IMO, regional fisheries organisations, in relation to the development of EU maritime policy.

In 2014, the government adopted a maritime policy in favour of employment, the environment, innovation and education intends to optimise the benefits to these through its maritime policy centred upon three objectives:

- Firstly, growth and employment, through protection of the merchant navy's competitiveness in the sectors in which it is most effective, modernisation of the major French maritime ports and improvement of their attraction through their competitiveness; successful industrial launch of marine energies; support for the shipbuilding and shipbreaking sector and devoting attention to coastal tourism.
- Secondly, protection of the marine environment and sustainable use of resources, through an objective of 20% 'Marine Protected Areas' by 2020 and the promotion of economic sectors such as fishing and aquaculture, that both protect the marine environment and guarantee socio-economic balance.
- Finally, a high-level teaching, research and innovation policy, in the field of marine science, while simultaneously reinforcing the attractiveness of maritime teaching and professional occupations, in order to maintain the French maritime sector's influence at the international level.

Italy

In Italy, there are various programs from both the government and state-owned banks (e.g. CDF, Fintecna). in addition to programmes and activities by Italian ministries and authorities such as:

- national programmes for naval ships from the Ministry of Defence
- Ministero dell'Istruzione, dell'Università e della Ricerca (MIUR) (FIRST - Fondo per gli Investimenti nella Ricerca Scientifica e Tecnologica).

The Netherlands

The Dutch government formulates its overall objectives for the Dutch maritime strategy along the following principles:

"An international sustainable leading maritime position for the Netherlands, achieved by an integral cooperation between the national government and the maritime cluster on a basis of a shared maritime strategy." [Source: (Dutch ministries of Infrastructure and the Environment, Economic Affairs, Defence, Education, Culture and Science, Finance, Foreign Affairs, Security and Justice, Social Affairs and Employment, 2015)]

In order to achieve these objectives, it focuses on the following policy areas:

- Human Capital
- Innovation
- Trade
- Accessibility
- Safety and the Environment
- Security and Stability.

On 15 January 2015, the first 'Dutch Maritime Strategy' was submitted to their House of Representatives in order to strengthen the country's international maritime position.

The government description highlighted the fact that the country has a) the largest port in Europe and b) the national inland shipping fleet has the largest European market share. The country is also the main global producer of super yachts and the Dutch offshore and hydraulics sectors ranks among the world leaders. The government believes its maritime strategy is unique, being established in collaboration with all the maritime partners, in order to preserve and strengthen their leading maritime position in the world.

The maritime strategy focuses on:

- formulating policies in 6 cluster-wide policy areas,
- emphasising the need for international co-operation: IMO, EU, CCR, ILO, NATO, UN,
- public and private collaboration between government, companies and knowledge institutions.

The strategy is composed of six themes: human capital; innovation; trade; accessibility; safety and the environment; and security threats and stability and not only involves collaboration between the national government, employers and employees, but also collaboration between decentralised local governments, educational establishments and NGOs in the field of, for example, nature, the environment and health.

The Dutch maritime innovation policy strategically concentrates on these topics

- Eliminating legal barriers for innovation
- Facilitating the use of alternative fuels
- Innovation that optimizes co-financing from the EU.

Spain

Areas where Spain feels it potentially compete globally include hi-tech naval vessels, such as those built by Navantia, and radar and communication systems, such as those Indra supplies, and the government has consolidated its efforts around these two companies.

The companies are part of the national defence industry which has 30 000 direct employees. Since 1996 around EUR 36 billion has been invested to consolidate the defence industry by the government. Despite this the sector suffers from unsatisfactory competitiveness and the public policy is directed at a step by step consolidation.

INNOVAMAR is a private not-for-profit organization, with objectives to: encourage, promote and perform actions related to the competitiveness of the maritime sector, promote increased added value and sustainable development, with particular attention to the use and exploitation of marine resources. It encourages and promotes research, technological development and innovation especially, in shipbuilding and its ancillary industry, marine industry, shipping, fisheries and aquaculture, and in general, the exploitation of marine resources.

Denmark

The Danish Maritime Fund provides financial support to initiatives and undertakings, which serve to develop and promote Danish shipping and shipbuilding industries. The fund was established in 2005 and its trust funds comprise 10% of the shares in "Danmarks Skibskredit A/S" (Danish Ship Finance Ltd.), the dividend of which comprises the main income of the Fund. Danish Maritime Days is a global platform for collaboration across the industry – shipowners, bankers and other investors, shipyards, suppliers, brokers, lawyers, ship management, insurance, ports and various service providers – as well as with regulators and other important stakeholders and opinion shapers. It

provides an opportunity to meet with stakeholders from all sectors of the industry from around the world to discuss strategic challenges and innovative solutions in a new thinking context.

Finland

The Finnish Ministry of Employment and the Economy initiated their maritime industry growth programme and has granted further financing for 2016. The goals of the growth programme are:

- 10% increase in the turnover of Finland's maritime cluster
- 10% increase in its exports (Export Finland, 2017)
- creation of 400 jobs
- three foreign investments in Finland.

The implementation of the programme is planned to cover 2015-2017. The ministry has recently granted EUR 516 000 to Finpro Oy for the implementation of the programme. The financing for the programme's first year of operation was EUR 956 000 (2017).

The target of the 'Maritime and Offshore from Finland' program is to increase the related business by at least EUR 500 million in 2015-2017. This will be achieved out by activating companies to internationalize and by helping them to get involved into major shipbuilding, oil and gas projects in international markets. The goal of the program is to network national companies and to enable a common offering, which increases the efficiency and visibility of Finnish companies internationally and the flow of investments into Finland".

Belgium[16]

Belgium provides VAT exemptions for the delivery of certain ships (which also applies to shipyards):

- Seagoing vessels which are used for the transport of passengers and goods, fishing or trade,
- Rescue boats for sea rescue,
- Naval vessels,
- Barges for commercial inland waterway transport.

Croatia

Traditionally shipbuilding has a long history in Croatia, including small and typically family craft. In 2011, modern shipbuilding industry comprised 5 large, 14 medium and 352 small shipyards.

Less than a decade ago, Croatian shipbuilding ranked fourth in the world with 69 contracted ships and capacity fully utilised for 3 years. Since then and in the lead, up to Croatia's accession to the EU, the state-owned shipyards have gone through a restructuring and privatisation phase, which has seen this capacity substantially reduced.

The main activities followed up by the Croatian government according to the programmes of restructuring were:

- investment in shipyards under restructuring over the 5 years restructuring period totalling about EUR 353 million, as eligible State Aid for restructuring emphasises;
- the issue of additional state guarantees for securing advance payments of buyers for new projects, up to a total amount of about EUR 57 million in state aid.

[16] Shipping Industry Almanac 2015, Ernst & Young, http://www.ey.com/Publica- tion/vwLUAssets/ey-shipping-industry-almanac-2015/$File/ey-shipping-industry-almanac-2015.pdf, S. 37 ff.

6.4 Example research and innovation activities from EU shipyards and marine suppliers

6.4.1 Shipyards

Damen / Netherlands

- The broad Damen product portfolio includes tugs, workboats, fishing vessels and barges, naval craft, patrol craft, customs vessels, prison vessels, cargo vessels, dredgers, mega yachts, fire boats, ferries etc. Damen's vision is to strengthen its already strong market position in the different niche markets of shipbuilding to diversify its product portfolio.
- During the last few years the company has identified and developed new ways to address growing ocean challenges, such as pioneering the world's first mobile BWT vessel (InvaSave) to operate in ports and support ship de-ballasting operations. It launched the first fully LNG-powered EcoLiner inland shipping tanker. Its EcoLiner is designed to deliver fuel savings for inland shipping operators, while at the same time cutting emissions. The design combines conventional, proven engineering with sustainable innovations, including the world's first installations of the ACES Air-Lubricated Hull, a gas-electrical shaft propulsion system and one of the first Van der Velden Flex Tunnels installations.
- A completely new solution jack-up was introduced 2016. - DG Jack - the result of a strategic collaboration between Damen and GustoMSC. It expands their portfolio targeting the offshore markets in oil & gas, renewables (like offshore wind) and civil construction.

Fincantieri / Italy, Meyer / Germany and Navantia / Spain

Table 12 shows the participation of the major European players Fincantieri, Meyer and Navantia in the shipbuilding supply chain in recently closed or ongoing EU-funded research projects

EU Programme / Funded under...	Title / Short description	Topic(s)	Total cost (EUR)	Total EU contribution (EUR)	Start date / from	End date / up to
Horizon 2020						
H2020-EU.3.4. - SOCIETAL CHALLENGES - Smart, Green and Integrated Transport	HOLISHIP HOLIstic optimisation of SHIP design and operation for life cycle	MG-4.3-2015 - System modelling and life-cycle cost optimisation for waterborne assets	11 431 746	11 431 746	2016-09-01	2020-08-31
H2020-EU.3.4. - SOCIETAL CHALLENGES - Smart, Green and Integrated Transport	LeanShips Low Energy and Near to Zero Emissions Ships	MG-4.1-2014 - Towards the energy efficient and emission-free vessels	22 992 004	16 726 364	2015-05-01	2019-04-30
FP7						
FP7-TRANSPORT	JOULES Joint Operation for Ultra Low Emission	SST.2013.1-2. - towards the Zero Emission Ship	13 937 009	8 500 000	2013-06-01	2017-05-31

EU Programme / Funded under...	Title / Short description	Topic(s)	Total cost (EUR)	Total EU contribution (EUR)	Start date / from	End date / up to
	Shipping					
FP7-TRANSPORT	MESA Maritime Europe Strategy Action - FOSTER Waterborne	SST.2013.6-1. - strengthening the research and innovation strategies of the transport industries in Europe	2 054 995	1 974 974	2013-09-01	2016-08-31
FP7-TRANSPORT	GRIP GREEN RETROFITTING THROUGH IMPROVED PROPULSION	SST.2011.1.1-1. - green retrofitting through optimization of hull-propulsion interaction	4 167 938	2 959 895	2011-11-01	2015-03-31

Table 12: Participation of the European major players Fincantieri, Meyer and Navantia in the shipbuilding supply chain in recently closed or ongoing EU-funded research projects
Source: Divers European Commission Sources

6.4.2 Marine suppliers

MAN Diesel & Turbo / Germany

Company: MAN Diesel & Turbo Headquarter/ Country: Germany						
EU Programme / Funded under...	**Title / Short description**	**Topic(s)**	**Total cost (EUR)**	**Total EU contribution (EUR)**	**Start date / from**	**End date / up to**
Horizon 2020						
H2020-EU.3.4. - SOCIETAL CHALLENGES - Smart, Green And Integrated Transport	HERCULES-2 FUEL FLEXIBLE, NEAR-ZERO EMISSIONS, ADAPTIVE PERFORMANCE MARINE ENGINE	MG-4.1-2014 - Towards the energy efficient and emission free vessel	25 108 685	16 813 400	2015-05-01	2018-04-30
FP7						
FP7-TRANSPORT	JOULES Joint Operation for Ultra Low Emission Shipping	SST.2013.1-2. - Towards the zero emission ship	13 937 009	8 500 000	2013-06-01	2017-05-31
FP7-TRANSPORT	HERCULES-C HIGHER EFFICIENCY, REDUCED EMISSIONS, INCREASED RELIABILITY AND LIFETIME, ENGINES FOR SHIPS	SST.2011.1.1-3. - Towards zero emission marine engines	17 017 584	9 397 174	2012-01-01	2014-12-31

Table 13:Participation of MAN Diesel & Turbo in shipbuilding supply chains in recently closed or ongoing EU-funded research projects
{Source: Divers European Commission Sources[

Rolls-Royce / UK

Company: Rolls-Royce Headquarter/ Country: UK						
EU Programme / Funded under...	**Title / Short description**	**Topic(s)**	**Total cost (EUR)**	**Total EU contribution (EUR)**	**Start date / from**	**End date / up to**
Horizon 2020						
H2020-EU.3.4. - SOCIETAL CHALLENGES - Smart, Green and Integrated Transport	HOLISHIP HOLIstic optimisation of SHIP design and operation for life cycle	MG-4.3-2015 - SYSTEM MODELLING AND LIFE-CYCLE COST OPTIMISATION FOR WATERBORNE ASSETS	11 431 746	11 431 746	2016-09-01	2020-08-31
H2020-EU.3.4. - SOCIETAL CHALLENGES - Smart, Green and Integrated Transport	LeanShips Low Energy and Near to zero emissions Ships	MG-4.1-2014 - TOWARDS THE ENERGY EFFICIENT AND EMISSION FREE VESSEL	22 992 004	16 726 364	2015-05-01	2019-04-30
H2020-EU.2.1.1. - INDUSTRIAL LEADERSHIP - Leadership in enabling and industrial technologies - Information and Communication Technologies (ICT)	MOTOR Multi-ObjecTive Design Optimization of fluid eneRgy machines	FOF-08-2015 - ICT-ENABLED MODELLING, SIMULATION, ANALYTICS AND FORECASTING TECHNOLOGIES	4 302 875	4 302 875	2015-09-01	2018-08-31
FP7						
FP7-TRANSPORT	JOULES Joint Operation for Ultra Low Emission Shipping	SST.2013.1-2. - TOWARDS THE ZERO EMISSION SHIP	13 937 009	8 500 000	2013-06-01	2017-05-31
FP7-TRANSPORT	**STREAMLINE Strategic Research for Innovative Marine Propulsion Concepts**	SST.2008.1.1.8. - NEW SHIP PROPULSION SYSTEMS	10 905 432	7 946 234	2010-03-01	2014-02-28

Table 14: Participation of Rolls-Royce in shipbuilding supply chains in recently closed or ongoing EU-funded research projects
[Source: Divers European Commission Sources]

Wärtsilä / Finland

In 2013, the EIB granted a 10-year EUR 150 million loan to Wärtsilä to finance the company's research, development and innovation (RDI) activities in several European countries.

Table 15 shows the participation of Wärtsilä in shipbuilding supply chains in recently closed or ongoing EU-funded research projects

Company: Wärtsilä Headquarter / Country: Finland						
EU Programme / Funded under...	**Title / Short description**	**Topic(s)**	**Total cost (EUR)**	**Total EU contribution (EUR)**	**Start date / from**	**End date / up to**
Horizon 2020						
H2020-EU.3.4. - SOCIETAL CHALLENGES - Smart, Green and Integrated Transport	LeanShips Low Energy And Near to zero emissions Ships	MG-4.1-2014 - TOWARDS THE ENERGY EFFICIENT AND EMISSION FREE VESSEL	22 992 004	16 726 364	2015-05-01	2019-04-30
H2020-EU.3.4. - SOCIETAL CHALLENGES - Smart, Green And Integrated Transport	HERCULES-2 FUEL FLEXIBLE, NEAR -ZERO EMISSIONS, ADAPTIVE PERFORMANCE MARINE ENGINE	MG-4.1-2014 - TOWARDS THE ENERGY EFFICIENT AND EMISSION FREE VESSEL	25 108 685	16 813 400	2015-05-01	2018-04-30
FP7						
FP7-TRANSPORT	JOULES Joint Operation for Ultra Low Emission Shipping	SST.2013.1-2. - Towards the ZERO EMISSION SHIP	13 937 009	8 500 000	2013-06-01	2017-05-31
FP7-TRANSPORT	SONIC Suppression of Underwater Noise Induced by Cavitation	SST.2012.1.1-1. - Assessment and mitigation of noise impacts of the maritime transport on the marine environment	4 182 194	2 999 972	2012-10-01	2015-09-30
FP7-TRANSPORT	GRIP Green Retrofitting through Improved Propulsion	SST.2011.1.1-1. - Green retrofitting through optimization of hull-propulsion interaction	4 167 938	2 959 895	2011-11-01	2015-03-31

Table 15: Participation of Wärtsilä in shipbuilding supply chains in recently closed or ongoing EU-funded research projects
[Source: Divers European Commission Sources]

Alfa Laval / Sweden

PureBallast 3.1 is a third generation BWT technology. Over 1200 PureBallast systems have been sold to date, including hundreds installed as retrofits. Energy efficient, i claims to offer superior performance in all waters: fresh, brackish and marine and to be ideal for low-clarity water, being able to operate at full flow where UV transmittance is as low as 42%. In December 2016, the system added US Coast Guard type approval to IMO approval making is suitable for deballasting in US waters.

6.5 Assessment of Member States activities and the role of maritime clusters

Europe Cluster - The European Network of Maritime Clusters (ENMC)

The ENMC is a confederation of clusters or equivalent structures. It promotes the dissemination of best and an exchange platform through the website, informal talks and an annual summit, during which each country gives a brief presentation of the economic situation of its maritime sector and the recent actions of its national organization. The aim is to establish a framework for future common targeted actions.

All of the member organizations tend to be cross-industry organizations covering all or part of the maritime sub-sectors of their countries. National cluster varies, with some being almost state-controlled whilst others are purely private-owned or an intermediate mix. Some clusters include inland navigation and or logistic sectors, port industries, coastal tourism, insurance and finance in their scope; others do not.

ENMC aspires to become THE European maritime cluster within a few years, and has already grown from its initial 10-country membership and geographical coverage in 2005.

Members of the ENMC are mainly partners and associations from France, Italy, Spain, Belgium, Bulgaria, Denmark, Finland, Ireland, Norway, Poland, Spain, the Netherlands and the UK.

France

France has several leading marine cluster networks.

- The most important network is the Cluster Maritime Français (CMF) which is an organisation created to gather, stimulate and promote the French maritime economic sector. Its current membership of more than 360 organisations from the sector includes large groups and companies, SME, VSE, professional federations and associations, local governments, research centres and the French Navy. Established in 2006 to provide a voice for those professionally engaged in maritime related activities, it is the focal point and representative of the French maritime industries.
- Also important are both leading regional clusters “Pôle Mer Bretagne Altantique” and “Pôle Mer Provence-Alpes-Côte-D’Azur”.
- GICAN (Groupement des Industries de Construction et Activités Navales) is also a leading organisation. Its ambition is to promote the development of the French maritime industry to allow it to play a key role in promoting, securing and protecting maritime, air-sea, subsurface and coastal areas. To achieve this goal, the it has set itself three principal missions:
  - Defend the interests of the French maritime industry
  - Promote French maritime technological and industrial expertise
    - Identify the key technological issues at stake for maritimisation.
    - Promote the expertise and skills of the French industry in technological fields linked to naval construction and repair, defence, security, maritime safety and the development of resources at sea.
    - Support French businesses on the international stage.
  - Support smooth development and competitiveness of the industry.

Italy

Italy has some national and regional investment promotion activities as well as the support for foreign investors with support from different ministries and authorities as e.g.:

- Ministry of Economy and Finance
- National Agency for inward investment promotion and enterprise development SpA (INVITALIA)
- SIMEST supports companies in their growth over the entire internationalization lifecycle, from the initial assessment of new markets to the expansion through direct investments. It
    - provides soft loans for internationalization, export credit support and equity investments.
    - is a member of EDFI – the association of European Development Financial Institutions and cooperates with the world leading financing institutions.
- SACE, a joint-stock company wholly owned by Cassa Depositi e Prestiti, offers a wide range of insurance and financial products: export credit, investment protection, financial guarantees, surety bonds and factoring.

There are also strong activities from the national maritime cluster and from the shipbuilders' association ASSONAVE.

Spain

Spain ranks12th for FDI inward stock 13th in outward FDI stock worldwide, with US, Italian, French, German and UK companies being the largest investors. Interest is increasing from companies in Asia (especially from China, India, South Korea and Japan), Latin America (especially from Mexico, Brazil and Colombia) and from the Middle East.

In 2013 Petroleos Mexicanos (Pemex)acquired a 51% stake in the Hijos de J Barreras shipyard in Spain's north-western Galicia region. The deal was aimed at reviving the Spanish shipbuilding industry and developing, over the medium term, their capacity to build specialised tankers mainly for the Mexican oil industry.

Belgium

The Flanders' Maritime Cluster (FMC) is the largest maritime network in Belgium, its mission is to encourage Flemish companies to co-operate for the development, demonstration and commercialisation of innovative solutions for sustainable coastal and ocean management. FMC brings together industry, academia and policy makers into a supportive ecosystem for regional blue growth.

Bulgaria

Marine Cluster Bulgaria was founded in 2007 as an organization of companies and NGO's working in the maritime industry. The membership is voluntary and open to any business organization, public and private institutions in the field of maritime industry.

Denmark

The Maritime Development Center is the cluster organization for Blue Denmark, a network organization for the maritime business and stakeholders. The association was founded in 1999 and has close to 200 members representing all aspects of the maritime cluster.

Finland

The Finnish Maritime Association was established in 1926 and has now more than 300 members of which 40 are corporate members.

Ireland

The Irish Maritime and Energy Resource Cluster (IMERC) promotes Ireland as a world-renowned research and development location, to unlock Ireland's maritime and energy potential. It aims to harness and integrate diverse research and industry expertise. The initiative is seen as a new dawn for maritime Ireland, stimulated by the growing realisation of the economic opportunities around maritime and energy, and in particular with regard to marine renewables.

The Netherlands - Maritime by Holland

The maritime sector has been a significant part of the Dutch business community for centuries thriving on the core principles of co-operation, innovation and entrepreneurship. Over the years, the sector has become a global leader in delivering innovative solutions to the international markets. Stichting Nederland Maritiem Land (NML) is an organisation that connects twelve maritime sectors: ports, offshore, maritime suppliers, shipbuilding, ship operating, dredging, maritime services and knowledge institutes, inland shipping, Royal Navy, water sports and fisheries and facilitates the Dutch maritime network.

It is a market-driven initiative that was created in 1997 following a re-energised national shipping policy. Its core aim is to join-up the various maritime sectors and link them with government and academia. Doing this allows the creation of joint initiatives which strengthen individual sectors and promote the Netherlands as a significant maritime nation. Knowledge sharing across the network is facilitated to mutual advantage.

A privately funded organisation, NML seeks to co-finance a range of projects to further the interests of the Dutch maritime community. It is governed by a board of directors selected from the network to provide a range of skills that reflect the entire spectrum of the membership.

UK

Maritime UK brings together the UK's shipping, ports, marine and business services sectors, to drive forward an ambitious agenda for growth, to promote the UK as a world-class maritime centre and to unite the maritime community in meeting the challenges of tomorrow.

7 Aspects of Strengths, Weaknesses, Opportunities and Threats and related Recommendations for the European Shipbuilding Supply Chain industry

Given background previously outlined and the highly diversified nature of the shipbuilding supply chain it is both very difficult and complicated to perform a unified SWOT analysis which would be valid for all players in this industry. Furthermore, EU countries do not all operate under the same conditions in terms of cost bases, ship financing, research, academic and educational system and such like. This gives rise to a situation where some arguments may be valid only for selected countries and companies.

Despite this complication, a list of SWOT aspects has been identified which we believe apply to the most important aspects of the EU shipbuilding supply chain industry, such as framework conditions, market aspects, co-operation in the supply chain and innovation/research. These are discussed in the following sub-chapters. Recommendations are also proposed to address some of the issues that emerge.

7.1 Framework conditions

Framework conditions are the cornerstones for a successful marine supply chain industry globally. The key issues addressed are: infrastructure, access to finance, skilled personnel, a multi-industry economy with access to advanced technological developments, strong and reliable partners in the supply chain and political support.

In terms of strengths, we find the powerful European base of technical industries with competition between each other, a strong academic and educational environment and a good infrastructure. Political support however is claimed to be insufficient and at differing levels thus not providing a level playing field. This therefore constitutes a weakness, in conjunction with the high cost for personnel and material, and the lack of sufficient financing instruments.

With regard to the functioning of clusters and the role of associations, the situation within Europe is highly diversified, with little or no solidarity of approach or coherence evident. In some regions, maritime clusters have been established and have contributed well to the strengthening of the maritime industry through by targeted support. However, in many others, maritime clusters are essentially only business networks, which have very limited impact on the integration of the fragmented industry base in their region and improvement of market access.

The same issue arises for industry associations where a number of very strong and active national associations exist besides alongside other very weak and inactive ones. Furthermore, the representation of shipyards and suppliers is not organised in the same way across the board, which makes it difficult to establish a strong European association which can address all aspects of shipbuilding and its supply chain industry.

Threats seem to be more prevalent than opportunities when it comes to framework conditions. Strategic moves of overseas countries towards their own marine industries, more local content requirements, protective national shipbuilding policies, the lack of a level playing field with regard to political support, financing and subsidies, uneven implementation of environmental regulations etc. are all challenging the strong position of a unified European shipbuilding and marine supplies industries. Furthermore, it is felt that the future may see an increase in take-overs from US and/or Asian competitors.

On the opportunities side, more and better regulations with higher requirements for high-end equipment and systems together with higher energy cost, seen are the driving forces to maintain a strong European industry, at least for innovative products.

From the perspective of our overseas competitors, opportunities and threats apply in the opposite sense, i.e., our threat is their opportunity. Particular threats that have been are noted are the increasing wealth in emerging economies and the quickly rising level of costs. This applies not only to wages but also to social charges and the exchange rates of some currencies.

Finally, the strong competition between Asian countries is not only a threat for them, but may also become a threat for European suppliers if it triggers faster development of their competitiveness.

Some specific SWOT aspects are listed in the following box.

Framework Conditions	
S	• Strong European industry base in general, very good mechanical engineering and electrical engineering • Powerful research environment and educational system • Strong competitive environment with numerous flexible companies • Good infrastructure, reliable logistics
W	• Heterogeneous industry structure, few big, very many small companies • High wages and costly social system - High cost of production • Material cost comparatively high • Access to finance • Currency exchange rates • In comparison to other European industries, reluctant political support • Significant administrative burdens and cumbersome regulation
O	• Further harmonisation and standardisation of regulations in Europe to remove legislative barriers • High energy cost may trigger even more demand for energy efficient vessels • Further environmental regulations may lead to further increase of “green cost”, but may drive technological markets for powerful systems and components
T	• Accelerated strategic expansion of the Asian maritime supplies industry mainly in Japan, South Korea and China, in conjunction with increasing export activities to the European market • Increasing activities by strategic investors from North America and Asia to acquire stakes in European global-acting companies. This may lead to accelerated exodus of companies or knowledge drain • Comparatively high (e.g. environmental) requirements cause high production costs in Europe • Subsidies in competing countries

Table 16: Framework conditions SWOT analysis

Recommendations

The statistical analysis in this study shows that the European shipbuilding supply chain industry, as a whole, is bigger than that of its competitors in China, South Korea and Japan.

Inclusion of the wider range of maritime technology aspects is necessary to highlight this and essential to appreciating its full worth. The sector would benefit from further work to better recognise the full scope of the European maritime technology industry and its role as a strategic and strong pillar of industry with a significant impact on employment.

Shipyards, marine equipment manufacturers and service providers moreover contribute significantly to regional industrial infrastructure and national security interests through sophisticated naval shipbuilding capabilities. Furthermore, the ability to develop, produce and deliver high- performance ships, systems, other maritime equipment and service provisions, is the key not only for a competitive and sustainable sea-borne transport system but also for a wide range of other maritime business activities, these days summarised under the heading of 'blue growth' technologies.

As previously mentioned, this could be addressed by re-establishing a European Maritime Industries Forum, including a new political European Maritime Co-ordinator. Such a role could also be employed to consider and evaluate actual developments made by key Asian countries to protect and substantially support their national maritime industries, and hence enable the triggering of counter measures at WTO and OECD level where appropriate. Such an initiative may also help to co-ordinate efforts, at a European level, to capitalize on the true strength of the European position, in particular high-tech segments, and utilise the next 10 years to consolidate this position for the future.

Further observations and recommendations are noted under the following headings:

Structural Improvements in the European maritime industry (Associations, clusters) – The analysis of the shipbuilding supply chain industry structure shows that the majority of companies and potentially half of the employment is not represented by any industry association. This is due to the fact that many companies are very small and regional, but also that mid-sized companies are not necessarily members of an association.

It would be beneficial if associations and regional cluster organisations could think about how best to get these companies represented somehow or teamed-up. for joint marketing exercises and the like. Clusters in general should think about strengthening both their structures and activities. Industry associations should be involved in order to accommodate the integration process and to interlink with, typically, supporting regional clusters. Best practice in Europe show that this has an impact on all maritime players.

Co-operation between European clusters should be enhanced by advanced networking activities in order to remove national barriers. This may also include ‘unusual alliances’ to drive strategy and to establish links with other industries. The European structural funds may provide suitable instruments for this.

Strengthen the policy dialogue – The European shipbuilding supply chain industry is influenced by a number of policies at national, European and global levels. It is essential that the framework conditions are harmonised at all levels. Even globally a common European view on environmental issues, pro/cons of available technical solutions, taxation, logistic and infrastructure might be appreciated. In order to cope with all the differing aspects of these discussion, a strong European maritime association is essential as both discussion partner and lobbyist for the European and international institutions.

Enable and maintain the knowledge base through enhanced education and training in order to facilitate preparation and implementation of technology driven innovation in products and processes through such initiatives as the IoT and Maritime 4.0. The European shipbuilding supply chain industry builds its capabilities on a strong academic/educational framework with well-developed engineering skills, a strong general industry base and healthy competition in their markets.

It is therefore strongly recommended that on the basis of existing programmes, education and training in the marine disciplines are enhanced, maintained and if necessary adapted to the demand of new emerging markets and technologies. Industry and universities are requested to jointly develop adequate curricula and to offer related studies. This may also include maritime programmes to establish and support industry based lifelong training measures and as inter European educational exchange programmes.

Increase visibility as a high-tech industry and market – For many years shipbuilding had a difficult public reputation, however, this has improved over time and shipbuilding is now recognised as a high-tech branch, well established in a wide range of maritime technology branches and providing an important function as the “system integrator”.

In this context, the contribution of the supplies industry is to a large extent still invisible. This needs to be changed and the manifold contributions of the mechanical engineering and electrical engineering industries to the ship as a high-tech product need to be better communicated. This will also raise awareness of the fact that the shipbuilding supply chain industry is not only located in coastal areas and the shipbuilding centres of Europe but operates across the full region.

Align work on regulations and research to create innovation on time – It seems that the uncertainty of 'if and when' a market triggered by new legislation will emerge, often creates difficulties for frontrunners of technological innovation. Often it is the case that these markets do not materialise within the expected timeframe, but maybe postponed due to political discussions. To better protect the investments and research efforts of companies, improved alignment of Research and Technology measures with the continuous development of regulations at IMO it is therefore recommended. Legislation and application of regulations needs to be such that a level playing field is created. This is also essential to minimise risks and to create better opportunities to finance larger contracts.

In order to follow through on some of these recommendations, European marine industries should consider further strengthening their co-operation at a European level. Many aspects noted above are already addressed in the Leadership 2020 strategy and also strategic papers such as the WaterBorne Research Agenda or the concept for a public private partnership under the Horizon 2020 framework that focuses on the vessel of the future. However, in these strategies, most activities seem to be addressed more from the client side of shipbuilding supply chain and from that of only some key suppliers rather than the full gamut.

With regard to the large number and variety of European suppliers as outlined in this report, even if we only consider the top 100, these strategies should address a wider range and higher number of marine systems. It would be beneficial if a more of suppliers could be motivated and integrated into the 'European discussion'. At the broadest level, it needs to be recognised that the various marine markets are represented by different associations such as SeaEurope (shipbuilding, repair, naval shipbuilding), EBI (boatbuilding), EWEA (offshore wind). Offshore Oil and Gas does not even have such a European association, but rather acts on the basis of powerful company networks.

For shipbuilding and marine equipment, in the narrower sense of ship systems and equipment, the relatively new association of SeaEurope formed in 2012 by merger of the former associations of EMEC (marine equipment) and CESA (shipbuilding) does now represent the marine industry in a broader sense. However, it seems that internal structures in SeaEurope, need further development

to address the full scope of its stakeholders in the supply chain. In particular sub-contractors are rarely represented and design, engineering and consulting firms are not covered specifically. Such improvements are necessary to fully address new challenges and exploit the whole potential of new technologies such as digitisation, Internet of Things.

7.2 Markets

With regard to **market aspects**, European shipbuilders and suppliers are very self-confident in their strengths, claiming a strong market position and technological leadership. They basically build this on a deep understanding of requirements, high export shares, openness to new ideas and flexibility and access/stakes to different maritime markets.

In terms of weaknesses, they sometimes feel inadequately positioned within their own companies (maritime share of product portfolios is often comparably small) and feel a market drainage as a result of the shrinking shipbuilding industry and diminishing shipping activity. However, due to the still uncertain market development, some feel it is difficult to choose a way forward for developments and investments.

Markets	
S	• Very strong actual order book and good market position for technological high-end products, as well in shipbuilding, equipment systems and engineering abilities • High export share with global customer base • Understanding of owner requirements, flexibility towards tailor-made products • Provision of integrated and sustainable solutions, systems • High quality/reliability of products, strong brands • Very good after sales services, global service networks • Market penetration by serving different maritime markets, equipment certified by the majority of classification societies
W	• Concentration on some high-end market products creates weaknesses in flexibility and the ability to serve other market segments. • Declining European shipbuilding industry will lead to further knowledge drain, development partners will disappear • European supplier market is very fragmented, especially in Southern Europe with very many micro-firms • Although good general market position, maritime products often have a minor importance in bigger industrial companies' product portfolios.

Markets	
O	• Capitalise on the strong market position for some ship-types (cruise ships) and consolidate technological leadership • Emerging markets through regulatory requirements, e.g. environmental policies – advanced regulations create new market opportunities for systems and components (early scrapping, newbuilding and retrofitting) • Offshore markets in oil and gas (deep-sea, polar) and wind energy in the long term will provide continuous opportunities, including opportunities for diversification including service and maintenance activities • Increasing technological demand for ship operation and external control, increasing system integration • Although actually depressed, geographically emerging and growing markets such as. Russia, India and Brazil continue providing opportunities • Industry consolidation – overcoming industry fragmentation towards larger global players with broader market access • Closer co-operation with shipping companies to gain opportunities for prominent ranking on makers lists
T	• Slow recovery of global shipbuilding markets due to existing fleet overcapacities and under-utilised shipbuilding capacity • Asian competitors (especially China) establish strategies to conquer high-end shipbuilding markets as well as commodity vessels • European home markets continue to shrink for commodity ships, i.e. reference markets for marine supplies from Europe for those ships disappear • “One-of-a-kind” shipbuilding compared to series builds in Asia also provides negative scale effects for suppliers • Trend towards standard vessels – less sophisticated equipment • The market shifts towards a buyers’ market – higher price/cost pressure also on suppliers • New protectionism in national policies may increase local content requirements as seen in Asian strategies and also in Brazil in the offshore sector

Table 17: Market SWOT analysis

Recommendations

The observed strengths and weaknesses of competing overseas countries, especially Asia, are basically the opposite of those observed for Europe. On market aspects, the proximity to the larger end-markets in Asia is an advantage for them, especially in conjunction with increasing domestic markets and future sino-pacific growth. Further advantages can be seen from greater economies of scale and the learning curves of longer shipbuilding series production.

A particular weakness for parts of Asia is a low presence in niche markets of high added value (for non-cargo vessels, green technology, innovative products) which can be seen alongside the lack of credible global service operations, in some cases, to meet the global shipping market requirements. In addition to poorer performing infrastructure, related innovation activities are also perceived to be at a low level. However, this is changing rapidly with huge research and technology capacities are being established and strategic product offensives launched to increase domestic market shares and to trigger exports, particularly in the growing Asian countries.

Having said this, we reiterate that access to international markets is of crucial importance for the European maritime technology industry, which is by nature globally oriented, export-driven and at the core of international production networks. In serving global, highly competitive markets, the challenges for shipyards, marine equipment manufacturers and service providers are not necessarily the same. Whereas shipyards, by constraints of their facilities, are less flexible in terms of geographical relocation, equipment manufacturers and service providers can more flexibly follow the market, gain advantages of local price levels and fulfil local content requirements.

However, it is true for all stakeholders, that only an international level playing field will allow the industry to remain competitive with its global competitors. Europe with its open and liberal economic policy is keeping its import markets wide open. There is nothing wrong with this as long this is applying to all export markets. However, increasing international protectionism combined with the financial support seen in many countries of the world and specifically the fact that China and now even South Korea are increasingly enforcing “local content” policies, creates potential market distortions in several market segments. It is therefore essential that European policy should continue to press for fair competition in the global maritime technology industry in all relevant fora, and enforcement of this may be needed.

The following points also need consideration:

- To create and integrate provisions catering for the specific interests of the European maritime technology industry into future negotiations of free trade agreements with third countries so as to ensure new market opportunities for the European maritime technology industry and tackle those measures which could have a distorting impact on the bilateral trade-flows.
- To strongly oppose the opportunities for governments to introduce local content requirements in their public shipbuilding programs which favour local suppliers to the disadvantage of foreign suppliers.
- To ensure transparency of regulations and government measures in third countries, robust IPR protection enforcement regimes as well as effective reciprocity in the treatment of investments and public procurement.
- In order to regain flexibility for European shipyards, identify the few market segments (ship-types) where competition for European stakeholders may have become unfeasible as a result of state aids, protectionism and local contents policies in certain parts of Asia and to identify supporting activities for these segments which could help EU players to become competitive again and be ready when new market openings arise.
- Improve market access through the maintenance and/or development of global market shares. For globally acting European suppliers with competitive systems and components in their supply portfolio, the global market is important. Nevertheless, European markets provide suppliers with a base-load for their products and serve the full breadth of the marine markets rather than shipbuilding alone. Suppliers must preserve their international market access and maintain close contact with the final customers such as shipping companies, offshore firms, governmental purchasing instances.

- It would be beneficial if more technically oriented joint industry groups (suppliers, shipyards, shipping companies, offshore operators) could be formed at European level – similar to those already in place for some marine propulsion projects. These groups would discuss innovation needs, current and future regulation and the operational needs of engineering, production and after sales services. This kind of co-operation would strengthen the market position of European suppliers, improve the relations between the stakeholders in the value chain and may trigger future activities and contributions for the research agenda.
- Consideration should be given to identify opportunities for joint European initiatives to strengthen extra EU-28 export activities and to facilitate access to new emerging markets, including those addressing offshore and marine technology markets. The added value of these initiatives, which go beyond the usual activities of national associations, should be discussed and evaluated. Initial focus might be on SE Asia, Gulf countries (Middle East), Brazil and India with particular emphasis on the problematic issue of local content requirements.
- Strengthening the ability of European suppliers to offer skills and products covering entire systems, rather than just some elements of a system. Some major market stakeholders (e.g. in propulsion systems) are already doing this by acquiring or merging with component suppliers. Supporting the creation of consortia of maritime suppliers with integrated products and services to offer full system solutions might merit consideration. It is seen as beneficial to support such an integrated systems approach by developing and consolidating high value-adding functions across the full system life cycle. This could be achieved by strengthening supplier co-operation and management, establishing new business models for joint sales and after sales activities and potentially joint initiatives towards high efficiency and flexible value chains across Europe to counter the loss of business to lower cost countries.
- **Support regulation-driven innovative markets** – Over the next 10 or so years, emerging regulatory requirements are likely to offer significant market opportunities for both retrofitting and newbuilding. Key areas include environmental legislation to reduce emissions, polar waters navigation and e-navigation. European repair/conversion shipyards and relevant suppliers can, for example, team-up to offer tailored conversion solutions, potentially including both engineering and financing aspects.
- **Support blue growth markets** – most, if not all, of the marine industry is continuously exposed to the challenge of rapidly emerging or evolving high-end markets for their marine supplies. This applies, in particular, to oil & gas, offshore wind and other ocean-based renewables. In all these markets, European marine suppliers already hold a strong position, but need to consolidate this and further extend regional sales to export markets. Networking and strengthening strategic partnerships with relevant associations, such as WindEurope (formerly EWEA) is of vital importance.

7.3 Co-operation in the supply chain

Integrated supply chain management and mastering the production logistics between the shipyard and suppliers are key success factors for building complex, high-value, vessels such as cruise ships. However, analysis shows that supply chains still show significant weaknesses and hence offer room for improvement. Specific weaknesses include general supply chain integration and management, purchasing co-operation and co-operation between smaller and larger firms.

Outsourcing of some trades by shipyards may have led to cost reductions, but not necessarily to process improvements, due to poor integration and quality assurance of outsourced functions.

Co-operation in the supply chain	
S	• Experience and know-how of the most important manufacturers • Wide network of capable and specialised SMEs • Long-term partnerships between shipyards and suppliers, especially with subcontractors • Networking and teamwork by co-operation in normal business and research activities
W	• Lack of integrated supply–chain management • Supply chain is fragmented and does not benefit from a coherent benchmarking regime • Outsourcing by shipyards not sufficiently accompanied by process integration and QA
O	• Optimising supply chains by appropriate models of co-operation with for shipyards and offshore operators can create unique selling points • Employ IoT (Industry 4.0) approaches and technologies to enhance the integration and functions
T	• Strategies towards national supply and value chains in strong shipbuilding countries and emerging economies can weaken market positions.

Table 18: Co-operation in the supply chain SWOT analysis

Recommendations

These findings, raised an expectation of significant opportunities to improve the supply and value chains between suppliers and their customers, but we found little evidence of this, which indicates further potential the relatively stringent value chain integration practiced in South Korea demonstrates the potential to improve competitiveness. It should be a major objective for suppliers and subcontractors, as well as shipyards, to pro-actively integrate and harmonise supply processes.

The following main regional and structural activities are recommended:

The study shows that European shipbuilding supply chain industry plays a strong role in these very diverse global marine markets, however, this diversity, including many SMEs, makes it harder to create harmonised and focused strategies. Shipyards as system integrators and key suppliers have to play a key role in this task, but this can conflict with the objectives of some global suppliers to relocate production to Asia. The following recommendations try to reflect and balance the needs of all stakeholders.

- **Revitalization of localised maritime supply markets especially those in Southern Europe -** This focuses on the particular needs of those suppliers and subcontractors which are strongly dependent on localised maritime markets. For these suppliers, many of which are SMEs, their local marine market is the key and they are critically dependent on the survival of shipyards and boatyards in Europe. Their particular needs merit attention with programmes to improve their role in the supply chain. This includes developing strategies to gain more trans-regional business, to help them participate in RTD measures using special SME funding regimes, diversification strategies for new products/services for other sectors or trans-sectoral applications and better integration of their innovation path with those of their customers.

Improve competitiveness in value chains based on the principles of and smart transition to the Industry 4.0 concept – It is recommended that the maritime clusters in the different European regions are supported and encouraged to be more active in the '4th generation industry' initiative such as extension into the global spare part market of the shipping industry. This may involve thinking of new business models, creating advanced organisational models, enhancing skills and education and employing related research projects. Examples of particular interest include: dealing with cyber-physical systems; Internet of Things; big data and cloud solutions; i.e. those initiatives which strengthen the regional Industry 4.0 related capabilities for the broader European maritime industry.

It is recommended that ERDF and ESF be used to address the issues for improvement of the co-operation within the supply chain.

7.4 Innovation and RTD

Research and innovation is a centre-piece of European maritime sector to underpin the development of new ship concepts and system technologies, to implement radical onboard technologies and to support continuous improvement of processes. Innovation is seen as essential for gaining access to new markets (e.g. blue growth), accessing high value niches (e.g. specialised vessels for offshore) and maintaining a competitive edge in these markets. Many innovation needs arise from the emerging markets for ships and other marine products with lower environmental footprint, higher safety standards, increased level of autonomy in operation or novel vessel concepts.

This includes not only direct product innovation, but also further integration and more holistic and life-cycle sustainable solutions. Offshore markets have created demand for totally new solutions and business models for underwater, arctic and safety applications.

Historically Europe has built on its existing strengths using the research funding of the various FPs, with the maritime Industries benefitting from their share of research projects. However, other overseas economies are now strategically increasing their support for RDI and innovation, and this is a benchmark Europe should follow. Recently:

- China announced a new 5-year action plan indicating that their shipbuilding industry will invest >2,5% sales revenue in RDI measures. This implies a public funded support of around EUR 1,5 billion p.a. It is their intention to also build strategic research infrastructures with differently targeted centres of excellence.
- South Korea announced support their industry in 2017 by launching an RDI programme worth KRW 180 billion (~USD 150 million).

- Japan which has done much work already in structural adjustment and capacity alignment of their shipbuilding industry, is working on further plans to consolidate the industry further and support the development by concentration of research into a huge research organisation, supported by approx. USD 100 million.

Innovation and RTD	
S	• Innovative products, very good quality • Engineering/Design capacity • Added value concepts • Exchange to other branches /diversity of sales markets for similar products • The maritime industry research agenda increasingly maps needs of marine suppliers • Good record of co-operation on RDI topics among stakeholders for setting the agenda and priorities (e.g. Waterborne and Vessel for the Future). The continuous maintenance of maritime industry research agenda maps the future needs of maritime stakeholders • Good record of cooperation on RDI projects on the basis of European framework programmes.
W	• De-centralised RDI and comparable level of funding • Product related research difficult, because one-off products (prototypes) and RDI must be synchronised with the very fast pace of delivery-time to the market. • Engineering work not regarded as research unlike other industries. • Risk averse behaviour of customers • Potential for IPR violation through uncontrolled know-how transfer and very limited possibility of patent enforcing • Limited investment capital available for innovation and research • Innovation management not necessarily established as a priority management process – technology driven RDI (often by research institutions) partly lacks market focus

Innovation and RTD	
O	• Closer co-operation with shipping companies and shipyards towards better regulation and shipping standards • Far-sighted and market oriented RDI work in combination with consequent exploitation will lead to high market shares in new technology areas • Emerging markets open “an ocean of opportunities” for innovation, technology development and new business models • European environmental policy leadership may provide opportunities for early technological references. Attention has to be taken on driving the development of a coherent international regulatory framework as a European approach. • Co-operative European research strategies jointly with shipyards and shipping companies/offshore operators – besides systems and components address transport chain and other value chains
T	• Innovation: • Violation of IPR • Competing (Asian) countries begin to invest more heavily in RDI – technological leadership is challenged • Uncontrolled knowledge transfer to Asia and emerging countries • Investment in research and product development for markets which do not or too slowly materialise (e.g. due to regulations) –investments are not safeguarded

Table 19: Innovation and RTD SWOT analysis

Recommendations

Maintain and support excellence in Innovation and Technology – This is a key factor in high product quality, long term system reliability, after sales services and cost competitiveness for globally acting European suppliers across all marine markets. These suppliers build their products on, not only, their marine knowledge but also their fundamental mechanical engineering and electrical engineering capability. To preserve their global position, they must stay at the forefront of innovation. This requires good knowledge of the customer needs, technological trends, and co-operation with yards across all ship types, boats and offshore products, because the product portfolio of European suppliers is not limited to niche products, but also to products which are now mainly built in Asia.

European yards are the leading-edge development partners for many offshore products and for some specialised ship types including high-end NCCV, cruise ships, mega-yachts. However, some design offices, suppliers and research centres are gradually moving outside Europe to following end-user markets. This should be a wake-up-call to strengthen the support for the European RDI network and technological leadership. European joint industry projects to drive technology and innovation in marine technologies should be a priority, to continue building a common shared technology platform for Europe.

These efforts have to be coordinated, tuned and synchronised with national and regional initiatives in line with the European instruments for integrating their stakeholders (e.g. structural funds). Rules to improve protection of IPR and to avoid unintended know-how transfer must be created at EU and international level.

The task and recommendations:

- Continued financial support for investments in RDI through existing and future European and regional instruments and FPs. To defend our high-tech positions in ships and systems, components and services, the industry needs to be better supported by RDI programmes at a level comparable to its Asian competitors. Through a dedicated maritime sectoral research programme, in FP5 – FP7 and H2020, the industry had access to funds and implemented projects valued at approximately EUR 40-50 million p.a. on average. A number of example success stories of maritime research are documented in the brochure "Maritime Innovations for the 21st century" of the latest TRA conference in 2016.
- The complex structure of ships involving multiple on-board system and complex manufacturing processes requires sophisticated management skills, around which it is difficult to formulate concise technical objectives. Lighthouse projects such as "Autonomous Ship", "Sustainable Ship" over a way to cover the wide variety of shipboard systems and ship integration challenges including related onshore/offshore control functions. These should focus on addressing smart, green, safe products, processes and working conditions.
- The following ship systems are seen as a main priority: Alternative fuel and electric propulsion systems, e-navigation, low voltage systems/networks (sensors, IT etc.), HVAC, particular accommodation systems, all aspects of shipboard digitalization (IoT), virtual and augmented reality and light weight structures. Maritime 'Big Data' processing, involving advanced communication to map and service ship total life cycles, is a topic of the future which will support the development of sustainable technologies. Advancements in hydrodynamic calculations, conceptual engineering and structural calculations are the priority for engineering services.
- In shipbuilding processes, it is the integration of the supply chain and the optimization of shipyard production by "Industry 4.0" technologies that is the main focus and 'hard-to-copy' asset of the EU cruise shipbuilders. Programmes must look at ways to develop/improve smart skills (i.e. cross-company integration, organizational aspects, education and training) and how to adapt technologies to maritime needs and should cover, both the technology development and adaptation and integration of available IT systems. For suppliers, the technically advanced integration into the supply chain of shipbuilders from other global regions (Asia) is definitely also of equal importance.
- Further develop the potential of Blue Growth markets, which provide shipyards and suppliers access into new market which capitalize on their maritime background and experience. These also offer possibilities for new ventures and a wide range of technological developments in pre-mature markets. Research emphasis should be on growth area such as deep-sea mining, maritime safety and security, underwater technologies, offshore wind and other maritime renewables. Strategic papers like WaterBorne Vision 2025+ and Research Agenda give more comprehensive guidance on these.
- Maritime is the only transport sector that does not have a contractual Public Private Partnership (PPP), which leaves it exposed when the RDI transport budget is being re-assessed or reduced for any reason. Reviewing and establishing the concept of a large PPP for maritime sector is therefore a priority.

- . Europe has an excellent and extensive network of research institutions, but consideration should be given to a dedicated maritime research area specifically for industrial research. Regional/structural funds might be used for this in addition to direct research funds, because under the new framework, they allow for the building of research infrastructures. The merits of combining this with the strengthening of maritime clusters in maritime regions or sea basins should be discussed. This may require the co-operation between different programmes and COM DGs.
- Improve the integration between the H2020 programmes developing “Key Enabling Technologies” (KET) and the initiatives to support innovative solution implementation within the Transport programme. Calls for KET should be launched without any reference to particular target sectors, so as to ensure new solutions address the widest possible markets.
- The building of digital maritime infrastructures is another important issue that needs addressing and should not be limited to land-based initiatives. Concepts for broadband communication coverage of major sea routes and other commercially active maritime areas (e.g. wind farms and other new offshore energy technologies) need active consideration. This kind of infrastructure is required to enable maritime areas to improve their participation in and control of the building of maritime economic activities.
- Industrial research must complement academic study to get technologies fit for the final product. In the last FPs, the trend was clearly to move from research activities with lower TRL towards innovation activities ensuring a high market uptake and better impact of results. This has offset the recent trend within the EU back to low TRL. The Commission also decided to set broader calls with high level targets. This has proved to be successful in orientating the industrial sector towards higher and shared environmental, safety, competitive targets and must continue if we want to guide of the industrial sector towards EC targets and a high market impact of the results.
- In the maritime technology industry, Blue Growth represents a new frontier of technological excellence for the European maritime research and industrial community. This is a field that calls for large RDI support within the new FP, however it is recognised that competitiveness may only come from close cooperation between academia and industry. Calls must therefore reflect a good balance between these, and cannot be focused only on the low TRL academic research.
- Continued involvement of technology platforms and representatives of industry and various other stakeholders in the definition of RDI priorities.
- Support and enhance the role of “first-movers” and SME’s by continuing to strive for a reduction of the administrative burdens associated with applying for funding and managing existing grants. In this way safe, efficient and innovative maritime technologies and structures will continue to develop. Equally, large companies should have the opportunity to act as "integrators” of the activities carried of SMEs. Enhancing the role of large companies will enable the industry to reach the critical mass necessary for large-scale innovation projects at European level.
- Create possibilities for cross-fertilisation between civil and military technologies (known as dual-use technologies), both at the prime contractor and supply chain levels, which lead to cost-effective designs and solutions.
- In light of the complexities of their products (both civil and naval) and the sophistication of their businesses, these companies should nowadays be regarded as “system integrators”, dismissing once forever the old image of shipbuilders as mere assemblers of steel blocks. Such system integration capabilities are a distinctive strategic asset of the European Naval DTIB which must be carefully preserved and nurtured.

- Instruments like “Fast Track to Innovation” represented a positive innovation in H2020 and should be kept alive in the FP9 and extended into high level and ambitious work programmes
- FP9 should have a stronger strategic focus on the needs and requirements of the European maritime industry. FP8 H2020, will run until the end of 2020. Discussions and preparations for FP9, which will cover the period 2021 – 2027, have already begun and the following main maritime related strategic subjects are recommended:

    - Preparation of significantly more industry-related funding opportunities for the shipbuilding and marine supplies industry,
    - Stronger concentration on joint maritime projects between shipyards and marine suppliers,
    - Strategic support for joint industry groups (suppliers, shipyards, shipping companies, offshore operators) at European level,
    - Stronger support especially for future strategic offshore and marine technology markets,
    - Preparation of IoT/Industry 4.0 related strategic activities for the European maritime industry,
    - Strengthening of the activities of regional and structural funding activities for the European maritime industry mainly in Southern Europe.

- FP 9 should address activities enabling a competitiveness improvement of the supply chain enhancing the importance of European maritime technology, reactivating maritime PPP initiatives, support to dual use technologies, re-concentrate RTD (and also regional development clusters) on projects able to improve growth and market share aspects instead of focusing only on sustainability although this remains important if it becomes the leverage to develop technologies targeted to improve efficiency.

8 Bibliography

Aker Solutions Strategy and International Growth [Report]. - 2013.

AMI International 2013 World Naval Market Forecast, Press Release [Report]. - 2013.

BALance Technology Consulting et al Competitive position and future opportunities of the European marine supplies industry [Report]. - 2014.

Banco Santander, S.A China: Foreign investment [Online]. - 04 27 2017. - https://en.portal.santandertrade.com/establish-overseas/china/foreign-investment.

Banco Santander, S.A South Korea: Foreign investment [Online]. - 26 04 2017. - https://en.portal.santandertrade.com/establish-overseas/south-korea/foreign-investment<.

DefenceSA Advisory Board Naval Shipbuilding - Australia's 250USD billion Nation Building Opportunity [Report]. - 2011.

Dutch ministries of Infrastructure and the Environment, Economic Affairs, Defence, Education, Culture and Science, Finance, Foreign Affairs, Security and Justice, Social Affairs and Employment The Dutch Maritime strategy 2015 - 2025. - Den Haag : [s.n.], January 2015.

European Commission Multiannual Financial Framework [Book]. - 2015.

Eurostat Structural business statistics (sbs) [Online]. - 2016-2017. - http://ec.europa.eu/eurostat/data/database.

French Government, inter-ministerial sea committee National strategy for the security of maritime areas [Book]. - 2015.

Haun Eric Marine link [Online]. - 22 February 2017. - http://www.marinelink.com/news/carnival-orders-cruise422382?utm_source=MT-ENews-2017-02-2....

International Monetary Fund - IMF World Economic Outlook [Report]. - 2013. - ISBN 978-1-61635-555-5.

Lloyd's Register Global Maritime Outlook 2030.

Lloyd's Register Marine Market Update 2012FY [Report]. - 2013.

Lloyd's Register, Qinetiq and University of Strathclyde Global Marine Trends 2030 [Report]. - UK : [s.n.], 2013.

Maritime and Port Authority of Singapore MPA Singapore [Online]. - 24 03 2017. - http://www.mpa.gov.sg/web/portal/home/maritime-singapore/green-efforts/maritime-singapore-green-initiative/!ut/p/z1/hc_BDoIwDADQb_HAUVYH6PA2SUSEhItG3MVAnIMEGRno4t-7qBeNYm9tX5sWMZQh1uTXSuR9JZu8NvmeTQ8pSXBEAcept3GBUuKnwTYBjB20-weYacOPoGDm2YP82hB4wyBeOp8gXPk.

Mercator Institute for China Studies The new Silk Road [Book]. - 2017.

OECD - WORKING PARTY ON SHIPBUILDING PEER REVIEW OF THE KOREAN SHIPBUILDING INDUSTRY AND RELATED GOVERNMENT. - 13 January 2015.

OECD OECD STAN Database for Structural Analysis [Online] // OECD.Stat. - OECD. - 2016-2017. - http://stats.oecd.org/.

RAND Why has the cost of navy ships risen - A macroscopic examination of the trends in US naval ship costs over the past several decades [Report]. - 2006.

UNCTAD Recent developments and trends in international maritime transport affecting trade of developing countries [Report]. - 2013.

UNCTAD World investment report 2016. - [s.l.] : UNITED NATIONS PUBLICATION , 2016.

9 Annex 1 – Detailed shipbuilding forecast 2016-2025 by ship-type

Bulk Carrier Forecast 2016 - 2025

10-Year forecast value: **USD 49.3 bn**

Orderbook 2015 / 10-year forecast ratio:

93.18%

10-year ordering tendency:

-- / --

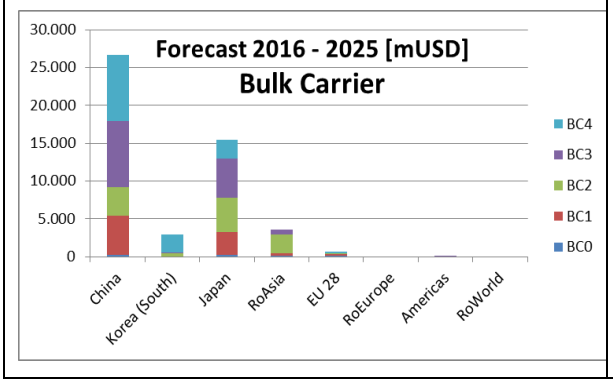
Newbuilding activity is likely to continue to be driven by the orderbook, although the market situation must increase the risk of cancellations and delays.

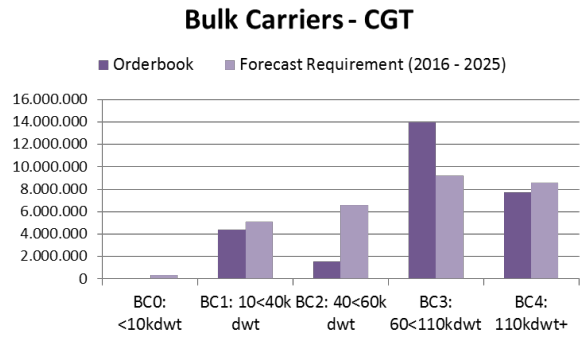
Demand growth rate 2016 – 2020 = 0% pa

Demand growth rate 2021 – 2025 = 1% pa

Scrapping age:

- <10 kDWT = 35 years
- 10<110 kDWT = 30 years
- 110 kDWT + = 25 years





Discussions of related forecasts available from international associations

SAJ, SEA Europe and CANSI presented forecasts for bulk carriers, over a variety of time periods and in varying Units of Measure (UoM). The results of the SEA Europe forecast were presented in graphical rather than tabular format and hence the values below have been estimated by reading off from these graphs. Additionally, in the SEA Europe forecast, the figures for 2016 are given individually and it is not clear whether the 2020 figure is an average for the 5 years including 2016 or for the four remaining years 2017-2020 (which is what we have assumed) and given the very high production in 2016 (presumably driven by Orderbook rather than requirement) if this is not the case, then this would radically alter the interpretation of the forecast for the remainder of that 5-year period.

BAL/SHE		CGT	GT	DWT	Ships
2016-2020	per year	2.2	9.1	5.0	120
2021-2025	per year	3.8	15.6	8.6	215
2016-2025	per year	3.0	6.8	12.4	167

SAJ		CGT	GT	DWT	Ships
2014-2020H1	per year	5.4	10.2		
2020-2025H1	per year	7.1	15.4		
2025H2-2030H1	per year	9.3	21.2		

2030H2-2035H1	per year	10.6	23.7		
2014-2035H1	per year	8.0	17.3		
2016-2025	per year	**6.4**	**13.4**		

SEA Europe		CGT	GT	DWT	Ships
2016	per year	10.3			575
2017-2020	per year	2.5			140
2020-2025	per year	4.0			225
2025-2030	per year	8.3			465
2030-2035	per year	14.3			800
2016-2035	per year	7.7			429
2016-2025	per year	4.0			226

Values read from graphs

CANSI		CGT	GT	DWT	Ships
2016-2020	per year	4.4			
2021-2025	per year	5.2			
2026-2030	per year	7.0			
2031-2035	per year				
2016-2035	per year				
2016-2025	per year	4.8			

None of the shipbuilding majors' forecasts show demand in DWT, which is the primary cargo measure for these ships. In CGT terms, there is considerable spread between the forecasts, with the BAL/SHE forecast being lower than both SEA Europe and CANSI and nearly half that of SAJ. The forecasts also show differing trends over the time periods.

The SEA Europe forecast requirement for bulk carriers does not appear to have been updated in their recent update 2017.

Container 2016 - 2025

10-Year forecast value: **USD 123.7 bn**

Orderbook 2015 / 10-year forecast ratio:

29.00%

10-year ordering tendency:

+ / +

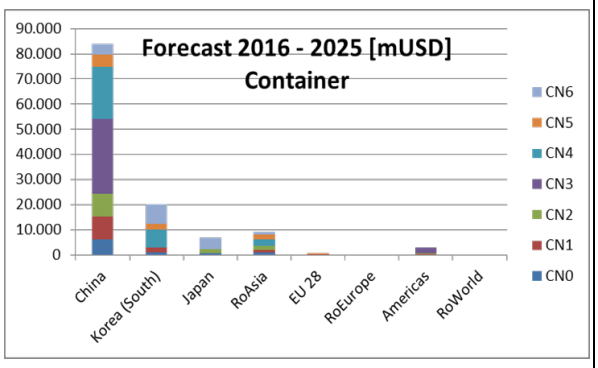
The forecast requirement for the next 10 years totals 9.7 mTEU. The current orderbook will provide 3,2 mTEU of them - which is largely in accordance with the forecast demand over that time period – and hence further contracting of new orders may be expected on a progressive basis.

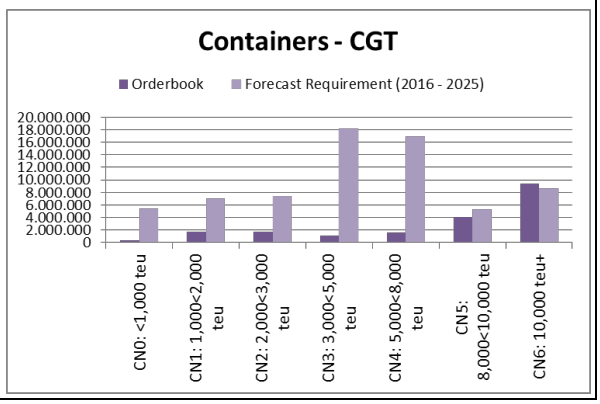
Assumed demand growth rates (% pa)

2016 - 2020 4%

2021 - 2025 4%

Forecast demand assumes a continued shift towards replacement with larger vessels and orderbook trends towards the larger vessel size bands.





Discussions of related forecasts available from international associations

SAJ and KOSHIPA both provided forecasts for the container sector, with the KOSHIPA one being slightly higher than the SAJ forecast over the full 20-year period, but with similar phasing of increasing demand over each of the four 5-year periods.

BAL/SHE		CGT	GT	DWT	Ships	TEU
2016-2020	per year	5.9	10.3	11.7	243	0.8
2021-2025	per year	7.9	13.8	15.6	320	1.1
2016-2025	per year	6.9	12.0	13.6	281	1.0
SAJ		CGT	GT	DWT	Ships	TEU
2014-2020H1	per year	2.6	7.1			
2020-2025H1	per year	7.1	15.4			
2025H2-2030H1	per year	9.4	19.7			
2030H2-2035H1	per year	11.7	25.3			
2014-2035H1	per year	7.3	16.2			
2016-2025	**per year**	**5.2**	**11.9**			

KOSHIPA		CGT	GT	DWT	Ships	TEU
2016-2020	per year		7.7	8.8		0.7
2021-2025	per year		16.8	19.0		1.5
2026-2030	per year		22.2	25.2		2.0
2031-2035	per year		32.0	36.4		2.9
2016-2035	per year		19.7	22.4		1.8
2016-2025	**per year**		**12.3**	**13.9**		**1.1**

The BAL/SHE forecast covers a shorter period and the only common parameter between the forecasts is GT, however over the 10-year period from 2016-2025 all three forecasts are quite similar. The BAL/SHE forecast, at an average of 12 million GT lies between the SAJ one at 11.9 million GT and the KOSHIPA one at 12.3 million CGT.

In terms of cargo measures, it should be noted that the TEU/DWT assumption of the KOSHIPA forecasts is different to that of the BAL/SHE forecasts which uses the industry average of 14 t equivalent TEU basis.

SEA Europe included a forecast for containerships in their 2017 update, which forecasts the average demand for the period 2016-2025 at 7.8 m CGT per year and rising to 9.4 m CGT per year when viewed over the longer period 2016-2035.

Oil Tanker Forecast 2016 - 2025

10-Year forecast value: **USD 77.1 bn**

Orderbook 2015 / 10-year forecast ratio:

63.8%

10-year ordering tendency:

- / -

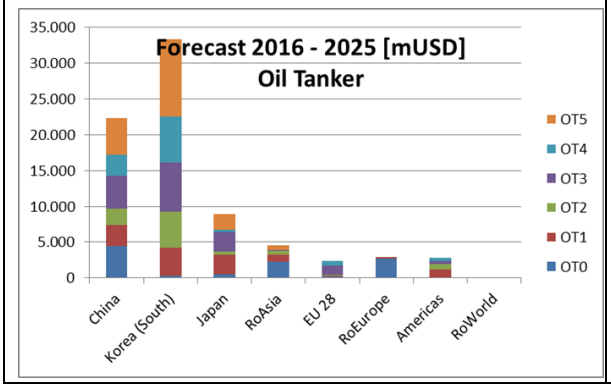
Logically, it would be expected that contracting of new orders will be significantly reduced, in light of the high level of the current orderbook, however historically orders have continued to be placed when there was no logical demand, and if this trend continues then the orderbook may increase even though there is no forecast demand for orders.

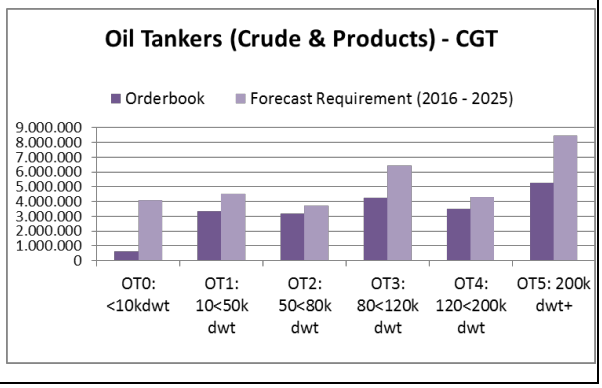
Demand growth rate assumptions (%pa)

Size Band	2016-2020	2021-2025
<10 kDWT	3.50%	2.50%
10<50 kDWT	3.50%	3.50%
50<80 kDWT	2.50%	2.50%
80<120 kDWT	1.40%	1.40%
120<200 kDWT	1.40%	1.40%
200 kDWT +	1.40%	1.40%

Scrapping age:

- <10 kDWT = 35 years
- 10<50 kDWT = 30 years
- 50 kDWT + = 26 years





Chemical Tanker Forecast 2016 - 2025

10-Year forecast value: **USD 49.89 bn**

Orderbook 2015 / 10-year forecast ratio:

8.73%

10-year ordering tendency:

+ / +

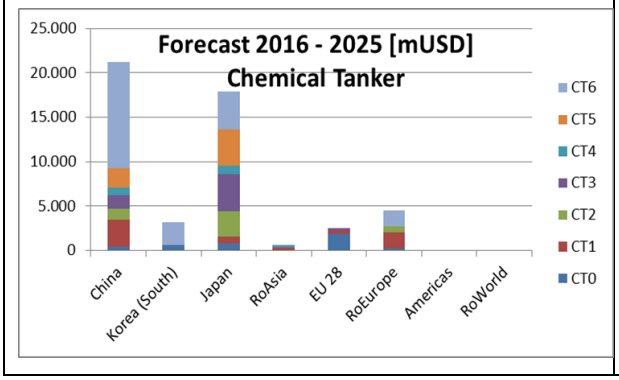
The forecast assumes continued growth levels of 2.5% pa across all size bands in the first 5 years and dropping slightly to 2.25% for years 6 – 10 in all but the smallest size band (<5 kDWT vessels) where it remains at 2.5% p.a.

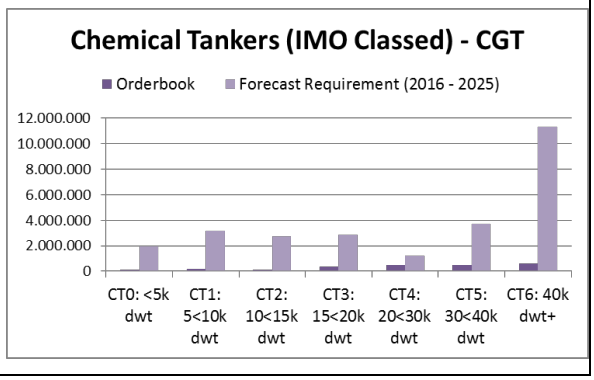
Assumed demand growth rates per annum:

2016 - 2020	2.5%	
2021 - 2025	2.5%	<5 kDWT vessels
	2.25%	All other size bands

Scrapping age assumed as:

<5 kDWT vessels: 35 years
5<10 kDWT vessels: 30 years
10<20 kDWT vessels: 28 years
20 kDWT + vessels: 25 years





Special Tanker 2016 - 2025

10-Year forecast value: **2,9 bn USD**

Orderbook 2015 / 10-year forecast ratio:

21,30%

10-year ordering tendency:

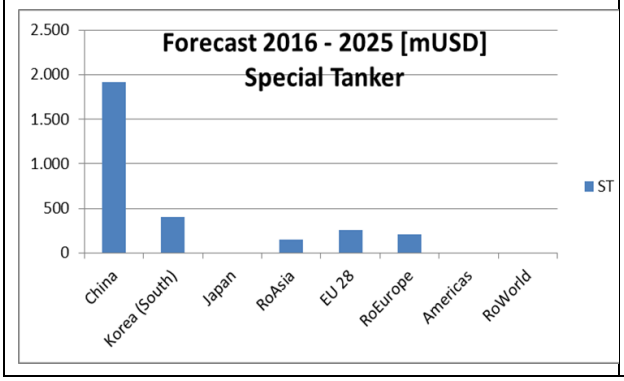
+ / +

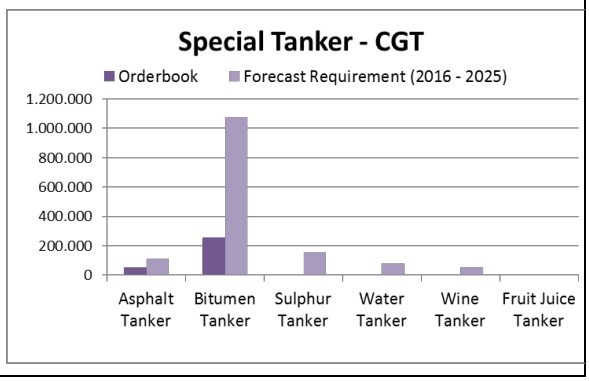
Assumed demand growth rates for the 10-year period:

- Asphalt tankers: static
- Bitumen tankers: 150% (CAGR ~ 9.6%)
- All other fleets in decline or static

Scrapping age assumed is:

- Asphalt / Bitumen – 34 yrs
- Molten Sulphur – 20 yrs
- Water – 44 yrs
- Wine – 42 yrs
- Fruit Juice – 38 yrs





Discussions of related forecasts available from international associations

SAJ, SEA Europe and CANSI presented forecasts for the Tanker Sector. Although not expressly stated, from the context of the presentation these all seem to be restricted to the oil tanker sector and no separate forecasts were presented by any of the major shipbuilders for the chemical tanker sector or for other specialist tanker types (such as bitumen/asphalt, wine, water etc.).

The forecast newbuilding requirements are summarised in the tables below, expressed in average yearly values over each period.

BAL/SHE		CGT	GT	DWT	Ships
2016-2020	per year	2.5	5.7	10.4	180
2021-2025	per year	3.8	9.2	16.9	261
2016-2025	per year	3.2	7.4	13.6	221

SAJ		CGT	GT	DWT	Ships
2014-2020H1	per year	1.7	4.0	7.3	
2020-2025H1	per year	4.0	9.9	18.2	
2025H2-2030H1	per year	6.7	16.3	29.9	
2030H2-2035H1	per year	8.2	19.4	35.6	
2014-2035H1	per year	4.9	11.8	21.7	
2016-2025	per year	**3.1**	**7.6**	**13.9**	

SEA Europe		CGT	GT	DWT	Ships
2015-2020	per year	2.4	4.7	8.2	93.6
2020-2025	per year	6.0	11.9	20.8	198.2
2025-2030	per year	8.2	16.3	28.6	260.0
2030-2035	per year	14.7	29.1	51.0	467.4
2016-2035	per year	7.8	15.5	27.2	254.8
2016-2025	per year	**4.8**	**9.5**	**16.6**	**163**

CANSI		CGT	GT	DWT	Ships
2016-2020	per year	4.9		25.8	
2021-2025	per year	6.4			
2026-2030	per year	9.1		36.5	
2031-2035	per year	8.3			
2016-2035	per year	7.2		31.2	
2016-2025	per year	**5.7**		**25.8**	

BAL/SHE		CGT	GT	DWT	Ships

2016-2025	Oil Tankers	per year	3.2	7.4	13.6	221
2016-2025	Chemical Tkrs	per year	2.7	2.6	4.1	187
2016-2025	Special Tkrs	per year	0.1	0.1	0.1	15
2016-2025	Total (exc gas)	per year	6.0	10.1	17.9	423

A general trend of increasing demand over the next 10-20 years is common to most of these forecasts, which reflects the overcapacity and relative youth of the existing tanker fleet. The forecasts from BAL/SHE are slightly lower than but with SAJ more pessimistic about prospects in the first 5-year period and a slightly stronger performance in the 2nd 5-year period.

SEA Europe forecasts a more buoyant trend over most periods with a major upsurge in demand in the 4th 5-year period, whereas CANSI is considerably more optimistic than the other about current period prospects and with slightly higher forecasts for the 2nd and 3rd periods before a slight reduction in demand in the 4th period.

Most forecasts show the trend increasing over time, although CANSI has a peak in 2031/5.

The SEA Europe 2017 updated forecast covers both Oil & Chemical tankers, forecasts that the requirement for oil tankers over the period 2015-2035, averages 7.8 m CGT, 27m DWT or 250 ships - essentially unchanged from their previous forecast.

LNG Tanker Forecast 2016 - 2025

10-Year forecast value: **26,6 bn USD**

Orderbook 2015 / 10-year forecast ratio:

122,23%

10-year ordering tendency:

-- / --

The current forecast is based on more conservative growth rates at 2% pa and however the scrapping assumptions have hardened from 34 years (all size bands) to 32 years for smaller vessels (< 50k cu m) and 30 years for all other size bands. The majority (over 80%) of this requirement is forecast to be in the 125 < 200k size bands.

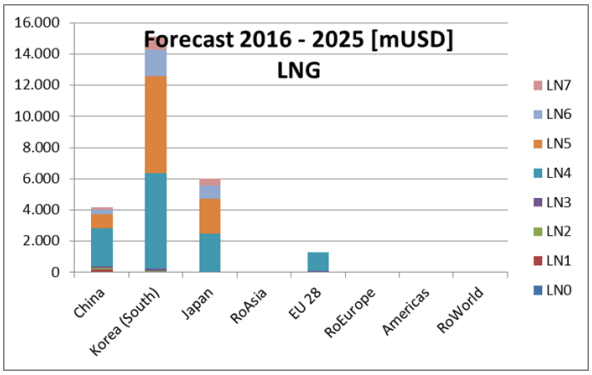
Assumptions

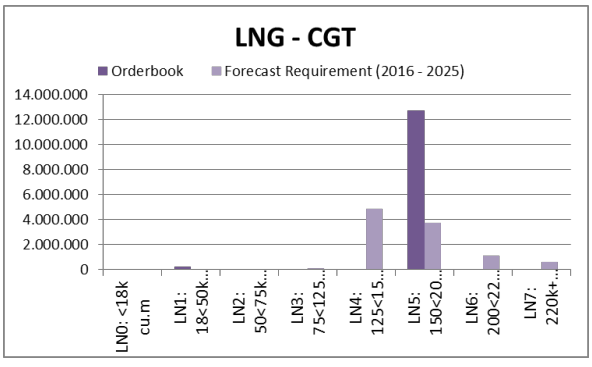
Assumed demand growth rates per annum:

2016 - 2020 2.00%
2021 - 2025 2.00%

Scrapping age assumed as:

< 50k cu m: 32 years
50k+ cu m: 30 years





Discussions of related forecasts available from international associations

SAJ, SEA Europe and KOSHIPA provided presentations on the LNG sector; those for SAJ and SEA Europe are summarised below from which it can be seen that the SAJ forecast anticipates a significantly higher AND earlier demand over the 20-year period than that forecast by SEA Europe. The forecast from BAL/SHE which covers a shorter period, concurs with the SAJ forecast in terms of earlier demand but with a lower level of demand which increases over time.

The future projections in the KOSHIPA presentation, were presented in a different format, which has made direct comparison more difficult. The presentation anticipates a fleet growth from 357 ships in Jan 2016 to more than 500 by 2017 and then to 510 by 2020, however it is not clear whether this is based on demand or ordering activity (supply). A summary conclusion is that up to 70 further newbuilding orders are anticipated by 2020 to satisfy forecast demand up to 2023 from already sanctioned LNG projects (30 orders) and forecast other LNG projects currently unsanctioned (40 orders) in addition to the current orderbook of 160. This appears to indicate a forecast of demand (measured by orders) of 230 ships over the period of 2015 - 2023 (9 years) - which equates to an average of 25.5 ships per year over that period.

If this interpretation of the forecast is correct it is similar but slightly lower to that of SAJ which anticipates an average of 24 ships per annum over the period 2014 - 2025. This would make it **much** higher than the 5 ships per annum forecast requirement by SEA Europe and higher than the BAL/SHE forecast of 14.5 ships per annum over similar timescales.

BAL/SHE		CGT	GT	DWT	Ships	Cu m
2016-2020	per year	1.1	1.4	1.1	16	
2021-2025	per year	1.0	1.3	1.0	13	
2016-2025	per year	1.1	1.4	1.1	14.4	2.0

SAJ		CGT	GT	DWT	Ships	Cu m
2014-2020H1	per year	3.0	4.0	2.7	32.0	4.8
2020-2025H1	per year	1.5	2.0	1.3	16.0	2.4
2025H2-2030H1	per year	2.0	2.6	1.8	21.0	3.1
2030H2-2035H1	per year	2.0	2.7	1.8	22.0	3.3
2014-2035H1	per year	2.2	2.9	2.0	23.0	3.5
2016-2025	**per year**	**2.2**	**2.9**	**2.0**	**23**	**3.5**

KOSHIPA		CGT	GT	DWT	Ships	Cu m
2015-2023	per year				25.5	

SEA Europe		CGT	GT	DWT	Ships	Cu m
2015-2020	per year	0.0	0.1	0.1	1	
2020-2025	per year	0.4	0.9	0.7	9	
2025-2030	per year	0.6	1.3	1.0	13	
2030-2035	per year	1.6	3.7	2.9	36	
2016-2035	per year	0.7	1.5	1.2	15	
2016-2025	**per year**	**0.3**	**0.6**	**0.5**	**6**	

Values read from graphs

The forecasts by SAJ and SEA Europe differ massively with the SAJ one being nearly 5 times (by GT) that of SEA Europe. The BAL/SHE falls in between these, being approximately half that of SAJ in GT but slightly closer in Cu metre terms.

The SEA Europe forecast requirement for LNG does not appear to have been updated in their 2017 update.

LPG Tanker Forecast 2016 - 2025

10-Year forecast value: **USD 20.9 bn**

Orderbook 2015 / 10-year forecast ratio:

55.65%

10-year ordering tendency:

+ / -

The current forecast assumes continued growth at modest rates, which together with some hardened scrap age assumptions for larger vessels, results in a forecast requirement of 13.7 million cu m over the 10-year period meaning that newbuilding activity in the near term will be driven by orderbook volumes rather than long-term requirement forecasts.

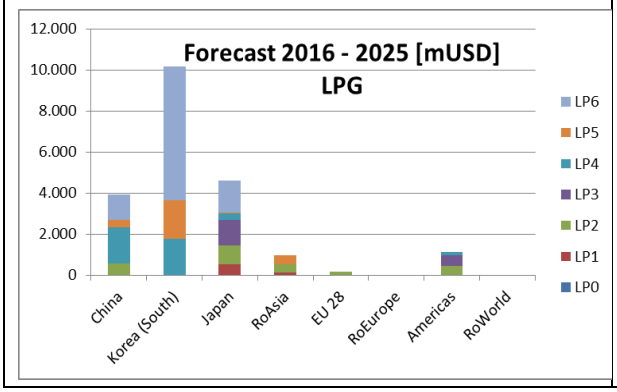
Assumptions

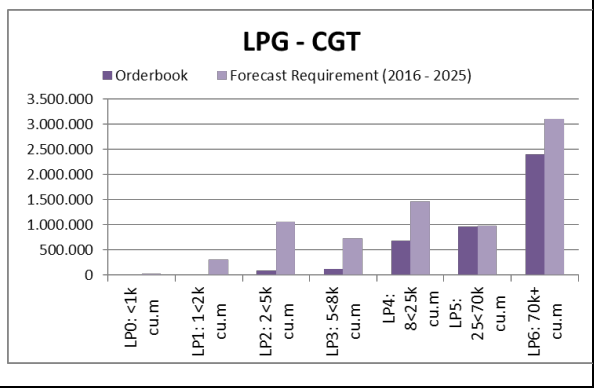
Assumed demand growth rates per annum:

2016 - 2020 3.00%
2021 - 2025 2.50%

Scrapping age assumed as

< 8k cu m: 30 years
8k+ cu m: 27 years





Discussions of related forecasts available from international associations

SAJ and SEA Europe both provided forecasts for the LPG sector, however there were considerable phasing differences between them. As neither provided data on Cubic Metre capacity, comparison by GT is probably the most helpful to illustrate the differences. Both organisations forecast the same average annual requirement of 0.7 million GT per annum over the 20-year period. The SAJ forecast anticipated a stronger performance in the first 5-year period followed by a drop of 50% in the next and partial recovery in the 3rd and 4th whereas the SEA Europe forecast anticipated a lower demand in the first period but rising to a significantly higher demand in the last period. The greater variation in CGT forecasts between these two is presumably due to a different assumption on vessel sizes, with SEA Europe assuming smaller vessel sizes which would increase the complexity factors and hence CGT measure.

BAL/SHE		CGT	GT	DWT	Ships	Cu m
2016-2020	per year	0.9	1.1	1.2	73	
2021-2025	per year	0.6	0.7	0.8	52	
2016-2025	per year	1.1	1.4	1.1	14	2.0

SAJ		CGT	GT	DWT	Ships	Cu m
2014-2020H1	per year	0.9	1.0	1.1		
2020-2025H1	per year	0.5	0.5	0.6		
2025H2-2030H1	per year	0.6	0.7	0.8		
2030H2-2035H1	per year	0.6	0.7	0.8		
2014-2035H1	per year	0.7	0.7	0.9		
2016-2025	**per year**	**0.7**	**0.7**	**0.8**		

SEA Europe		CGT	GT	DWT	Ships	Cu m
2015-2020	per year	1.1	0.7	0.9	55	
2020-2025	per year	0.8	0.5	0.6	40	
2025-2030	per year	0.8	0.6	0.6	41	
2030-2035	per year	1.7	1.1	1.3	82	
2016-2035	per year	1.1	0.7	0.8	54.4	
2016-2025	**per year**	**1.0**	**0.6**	**0.7**	**46**	

Values read from graphs

The BAL/SHE forecast which covered 10 years was higher than both, and anticipated a slightly stronger demand than SAJ for the first period followed by a more muted decline.

SEA Europe provides no forecast requirement for LPG in their 2017 update.

General Cargo Forecast 2016 - 2025

10-Year forecast value: **USD 27.1 bn**

Orderbook 2015 / 10-year forecast ratio:

14.27%

5 Years Ordering Tendency:

+ / +

Given that the orderbook substantially exceeds the expected replacement requirement, it is evident that new construction activity will be driven by the orderbook volume rather than any forecast requirement. If the orderbook masks an emerging trend then it is too early for this to be apparent.

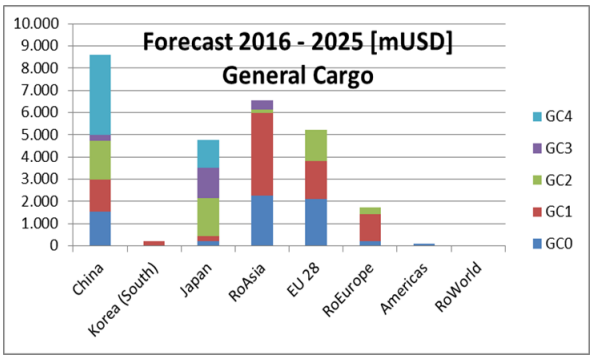
Assumptions

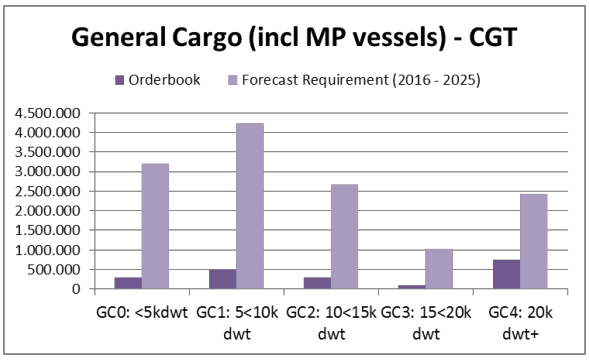
Growth rates not applicable

Scrapping age assumed as:

GC0: <5 kDWT	35 yrs
GC1: 5<10 kDWT	35 yrs
GC2: 10<15 kDWT	35 yrs
GC3: 15<20 kDWT	35 yrs
GC4: 20 kDWT+	30 yrs

5% of scrapped capacity assumed not to be replaced





Special Cargo Forecast 2016 - 2025

10-Year forecast value: **USD 19 bn**

Orderbook 2015 / 10-year forecast ratio:

21.17%

10-year ordering tendency:

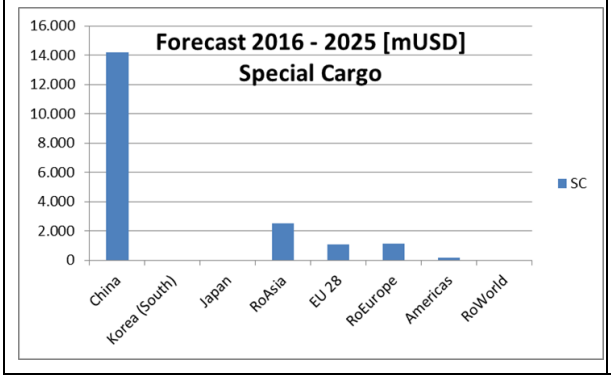
+ / +

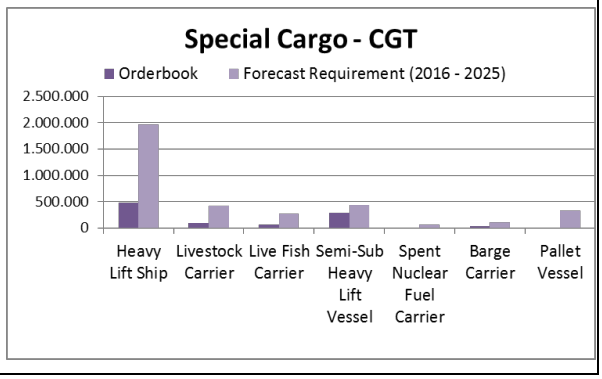
Assumed demand growth rates for 10 years – all based on DWT:

- Heavy Lift vessels – 40% (CAGR ~ 3.4%)
- Livestock carriers – 27% (CAGR ~ 2.4%)
- Live Fish carriers – 200% (CAGR ~ 11.6%)
- Semi-submersible Heavy Lift vessels – 80% (CAGR ~ 6.1%)

Scrapping age assumed as:

- Heavy Lift vessels – 29 years
- Livestock carriers – 49 years
- Live Fish carriers – 36 years
- Semi-submersible Heavy Lift vessels – 27 years





Car Carrier Forecast 2016 - 2025

10-Year forecast value: **USD 14.99 bn**

Orderbook 2015 / 10-year forecast ratio:

41.67%

10-year ordering tendency:

+ / -

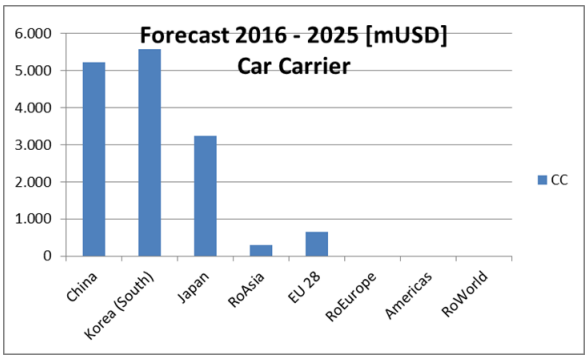
The forecast assumes future growth rates at 2% pa over the next 10 years which is lower than previously, although the assumption on scrapping ages has softened from 28 years previously to 30 years in the current forecast. The forecast demand and orderbook appear to be in balance for the next few years and progressive further ordering at the same level would meet the forecast requirement.

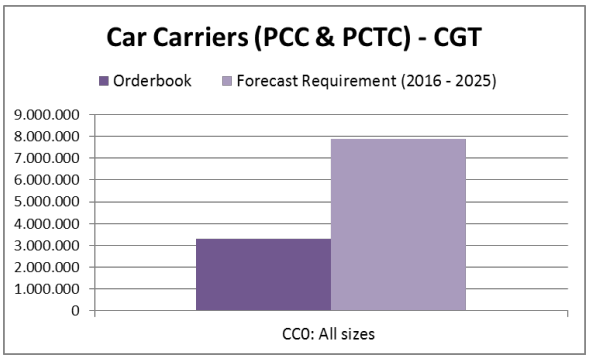
Assumptions

Assumed demand growth rates per annum:

2013 - 2017 2%
2018 - 2022 2%

Scrapping age assumed as 30 years for all vessels





Reefer Vessel Forecast 2016 - 2025

10-Year forecast value: **USD 13.3 bn**

Orderbook 2015 / 10-year forecast ratio:

4.64%

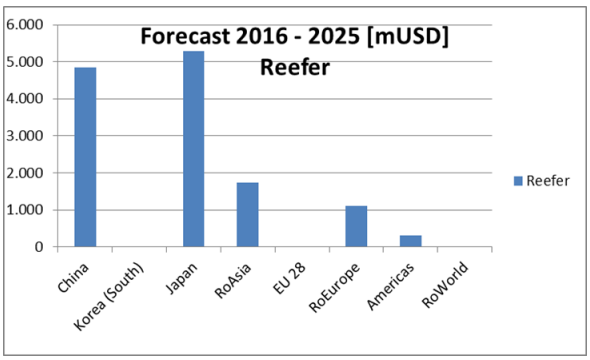
10-year ordering tendency:

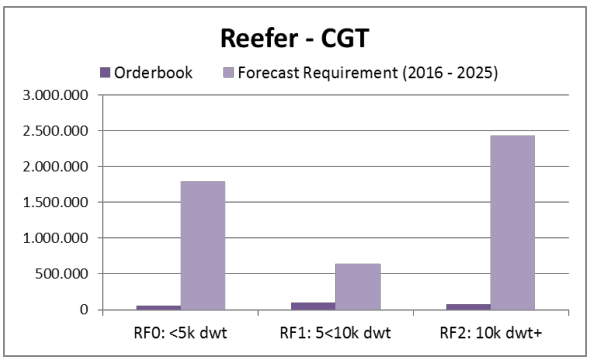
+ / +

Realistically, the current orderbook seems to be the most realistic guide to new construction activity over the next 3 years (which is the scheduled delivery timescale for the orderbook) and then on a progressive basis. Whilst there may well be some additional ordering, it seems likely that the high numbers of smaller vessels that are estimated to be scrapped are unlikely to be replaced to any significant extent.

Scrapping age assumed as 32 years for all size bands

30% of scrapped capacity assumed not to be replaced





RoRo Vessel Forecast 2016 - 2025

10-Year forecast value: **USD 16.6 bn**

Orderbook 2015 / 10-year forecast ratio:

5.61%

10-year ordering tendency:

+ / +

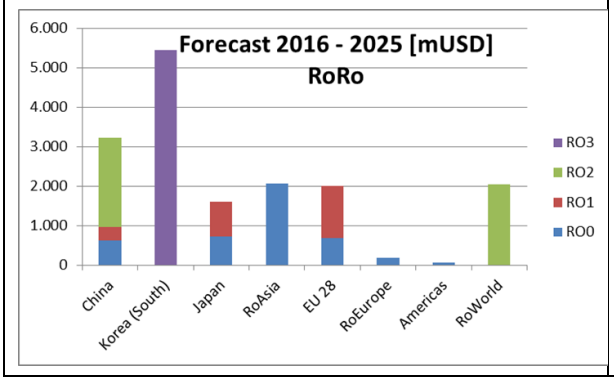
The forecast is based upon an assumed growth rate of 2% pa and a hardening of scrapping age to 30 years across all size bands (compared with 33 years in the previous forecast) and this generates a forecast requirement of 4.2 mDWT over the next 10 years. A high level of new orders will be required to achieve this.

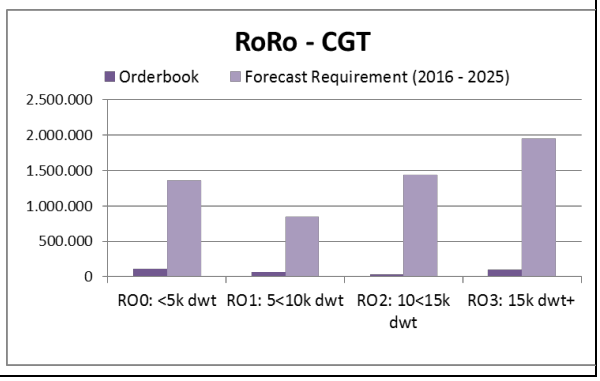
Assumptions

Assumed demand growth rates per annum:

2016 - 2020 2.00%
2021 - 2025 2.00%

Scrapping age assumed as 30 years for all size bands





Discussions of related forecasts available from international associations

None of the major shipbuilders provided forecasts for general cargo vessels and other cargo carrying vessel types such as RoRo, Reefer, Special Cargo vessels.

BAL/SHE		CGT	GT	DWT	Ships
General Cargo	per year	1.4	1.3	1.7	221
RoRo	per year	0.6	0.7	0.4	61
Reefer	per year	0.5	0.3	0.3	54
Car Carriers	per year	0.8	1.4	0.5	30
Special Cargo	per year	0.4	0.4	0.7	46
Other Cargo: 2016-2025	per year	3.6	4.1	3.6	411

SEA Europe's 2017 update forecasts deliveries for the period 2016-2020 averaging 1.4 m CGT per year for general cargo ships, 0.5 m CGT per year for RoRo ships and 1.0 m CGT for car carriers.

PAX Cruise Forecast 2016 - 2025

10-Year forecast value: **USD 63.79 bn**

Orderbook 2015 / 10-year forecast ratio:

45.36%

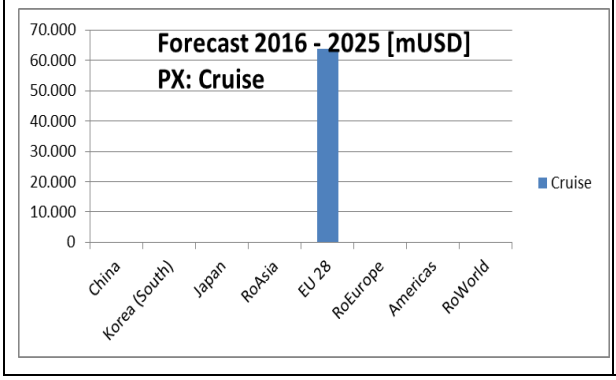
10-year ordering tendency:

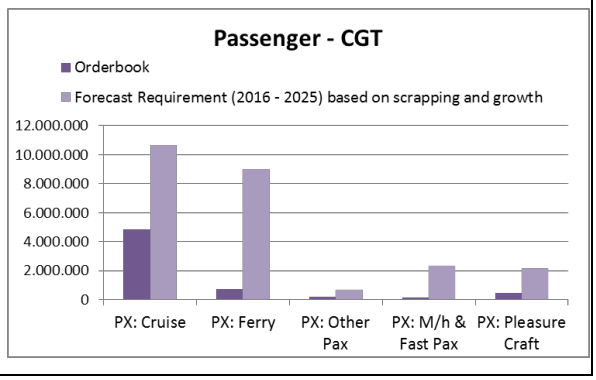
+ / -

The forecast therefore shows a more bullish projection than previously with a forecast requirement for 97 vessels over the 10-year period providing 10.6 m GT.

Assumed demand 10-year growth rates:
Cruise: 40% (CAGR ~ 3.4%)

Scrapping age assumed:
PX: Cruise 31yrs





PAX Ferry Forecast 2016 - 2025

10-Year forecast value: **USD 44.9 bn**

Orderbook 2015 / 10-year forecast ratio:

7.93%

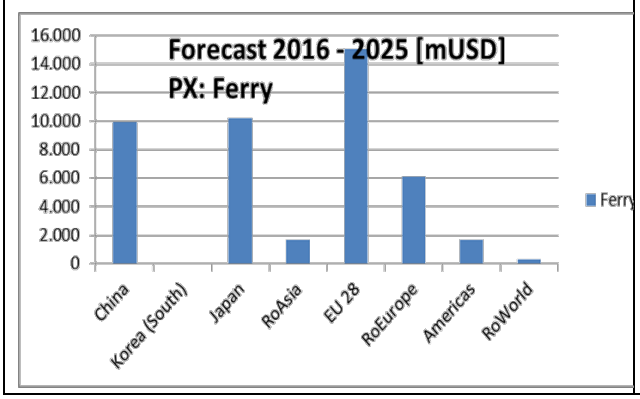
10-year ordering tendency:

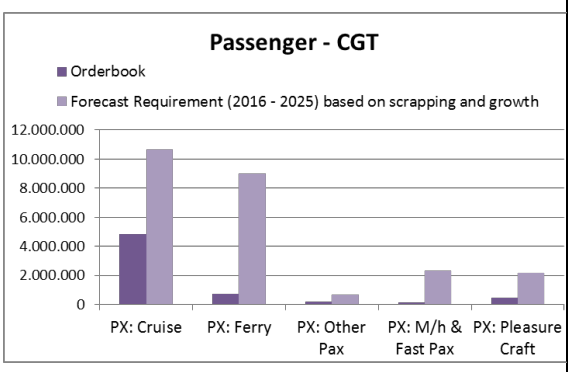
+ / +

The 10-year delivery trends of around 42 vessels / 400,000 GT per year seem to be a more likely scenario of newbuilding activity at least in the short-term until optimism returns to the market when scrapping age may reduce and stimulate replacement demand

Assumed demand 10-year growth rates:
Ferry: 2016-2020 = 5.1% (CAGR 1%)
2021-2025 = 7.7% (CAGR 1.5%)

Scrapping age assumed:
PX: Ferry 35yrs





PAX Other 2016 - 2025

10-Year forecast value: **USD 2 bn**

Orderbook 2015 / 10-year forecast ratio:

23.54%

10-year ordering tendency:

+ / +

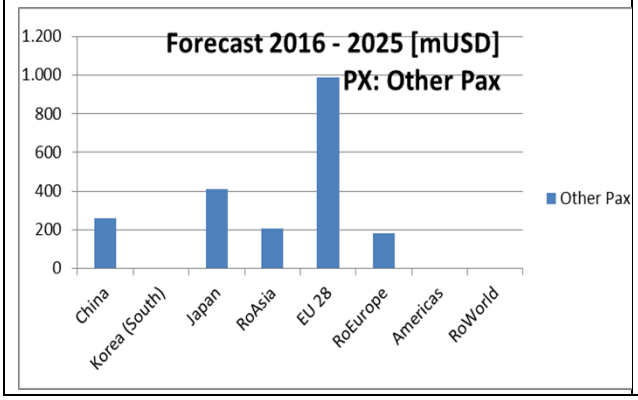
The forecast requirement reflects the growing replacement need arising from the ageing fleet, however with such low ordering activity, there seem no reasons to forecast any material realisation of this. For this reason, 10-year ordering trends of 7-8 vessels providing 21 000-24 000 GT per year seem a more realistic basis of newbuilding activity.

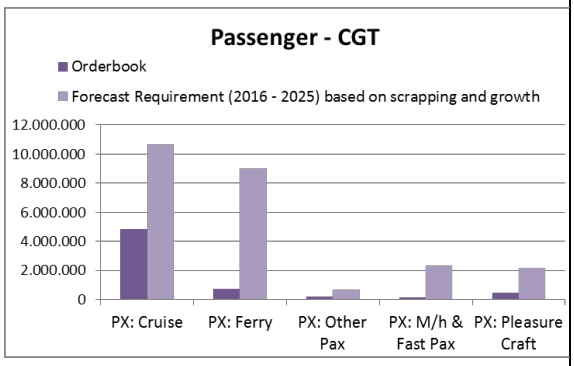
Assumed demand 10-year growth rates:

Other Pax: Static

Scrapping age assumed:

PX: Other Pax 49yrs





PAX Yacht Forecast 2016 - 2025

10-Year forecast value: **USD 13.9 bn**

Orderbook 2015 / 10-year forecast ratio:

20.02%

10-year ordering tendency:

+ / +

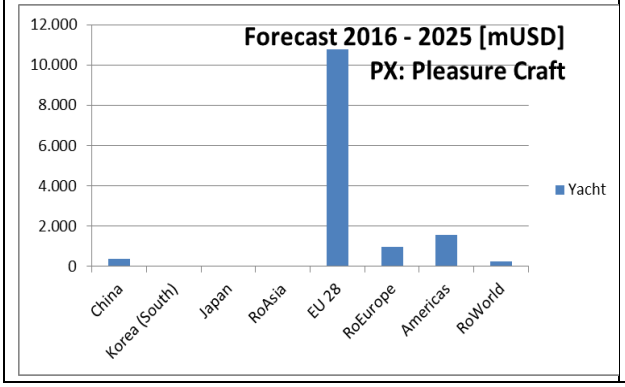
High growth rates in long term forecast projection can generate anomalous results and hence the forecast is based on a more moderate growth rate of 2.7% pa, with the assumed scrapping age maintained at 45 years. This results in a forecast requirement of 240 vessels over the 10-year period. 10-year delivery trends have averaged 28 deliveries per year and this is consistent with the forecast which seems a reasonable indicator of likely newbuilding activity over the 10-year period.

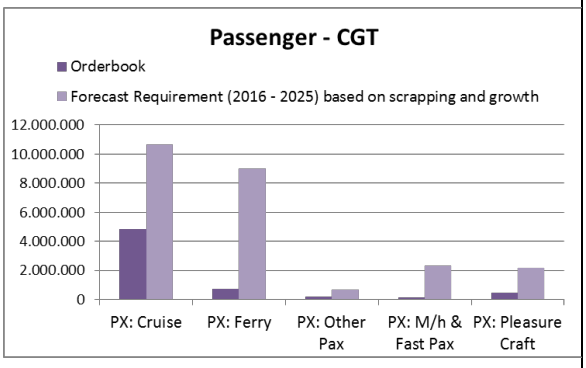
Assumed demand 10-year growth rates:

Pleasure Craft: 30% pa (CAGR ~ 2.6%)

Scrapping age assumed:

PX: Pleasure Craft 45yrs





PAX Multihull & Fast PAX Forecast 2016 - 2025

10-Year forecast value: **USD 11.6 bn**

Orderbook 2015/10 Y Forecast Ratio:

4.53%

10-year ordering tendency:

+ / +

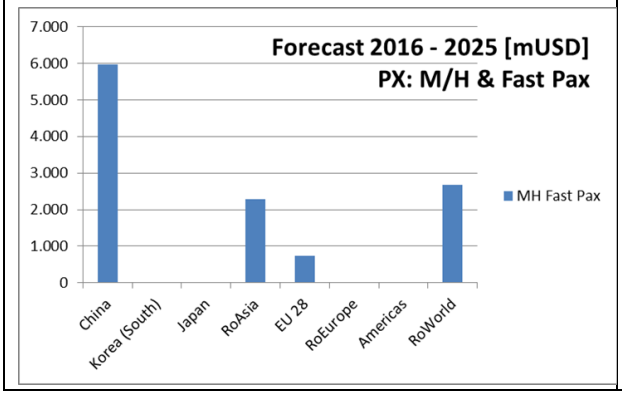
Recent ordering trends over the last 10 years have averaged around 9 deliveries per year, and this if felt to be a more realistic indicator of newbuilding activity than either the forecast or the orderbook.

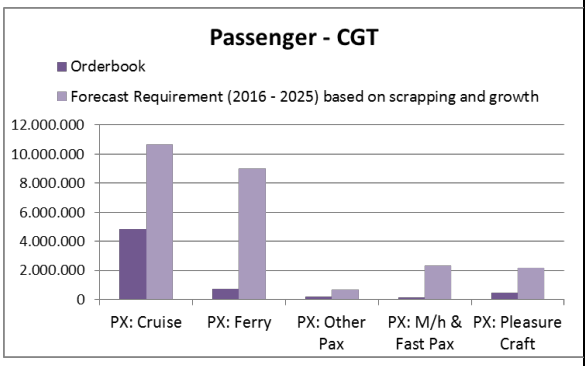
Assumed demand 10-year growth rates:

M/H & Fast Pax: 20% (CAGR ~ 1.85%)

Scrapping age assumed:

PX: M/H & Fast Pax 21 yrs





Discussions of related forecasts available from international associations

Only SEA Europe, out of the major shipbuilders, presented a forecast for the Passenger vessel sector and this comprised two presentations one specifically covering cruise ships and the other passenger vessels excluding cruise ships. The full definition of this latter category is not included, but references on slides indicate that this included Pax /RORO Cargo, Pax/Gen Cargo and Passenger vessels.

The cruise sector forecast, concludes with a projected development of the cruise ship fleet from a base of 307 (in 2015?) to 565 by the period 2030-2035. This results in a forecast demand for cruise ships which is approximately double that of the BAL/SHE forecast,

The SEA Europe forecast for the sector excluding cruise, concludes with a projected development of the fleet based on vessels numbers in graphical format, but does not provide and GT or CGT data or any tables of numeric projection. In simplistic terms, this forecast shows an anticipated increase in fleet numbers from circa 6,700 in 2015 to circa 9,000 in the period 2035-40

The BAL/SHE forecast covers Passenger (which includes cruise and fast pax - such as high-speed ferries) and separately, Ferries and Ro-Ro. Vessels carrying passengers on cargo vessels are included, instead, in the forecast for general cargo. This makes direct comparisons complicated and the base numbers of vessels currently in the fleet is significantly lower at 4,598 compared to the SEA Europe fleet numbers of circa 7,000 including cruise vessels.

BAL/SHE		CGT	GT	DWT	Ships
PX: Cruise	per year	1.1	1.1	0.1	10
PX: Ferry	per year	0.9	0.7	0.2	90
PX: Other Pax	per year	0.1	0.0	0.0	8
PX: M/hull & Fast Pax	per year	0.2	0.1	0.0	32
PX: Pleasure Craft	per year	0.2	0.1	0.0	24
2016-2025	**per year**	**2.5**	**1.9**	**0.3**	**162**

SEA Europe - Cruise		CGT	GT	DWT	Ships
2015-2020	per year	1.6	1.6	1.8	240
2020-2025	per year	2.4	2.3	2.8	310
2025-2030	per year	2.3	2.1	240.0	295
2030-2035	per year	2.3	2.2	270.0	270
2016-2035	per year	2.2	2.0	128.7	279
2016-2025	**per year**	**2.1**	**2.0**	**26.1**	**281**

The SEA Europe 2017 update for the passenger ferry market forecasts an average requirement of 68 ships per year (reading from the graph) for the period 2016-2025. In the cruise sector the forecast is for 103 ships over the period 2016-25 - an average of 10 ships per year.

NCCV Dredger Forecast 2016 - 2025

10-Year forecast value: **USD 16.5 bn**

Orderbook 2015 / 10-year forecast ratio:

8.71%

10-year ordering tendency:

+ / +

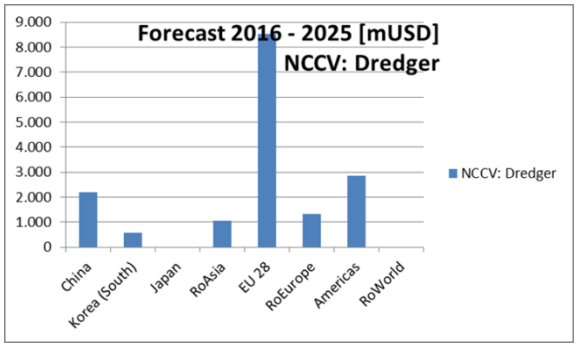
Orderbooks for all fleets are small, totalling only 248 vessels and generally badly reported. Scrapping and growth projections are therefore seen as the best indicator of new construction activity,

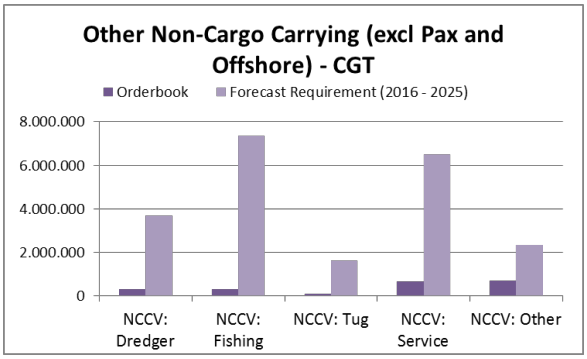
Assumed demand growth rates over 10 years:

- Dredger: 15% (CAGR ~ 1.4%)
- Fishing Vessels: 16% (CAGR ~1.5%)
- Tugs: 20% (CAGR ~ 1.85%)
- Service: 50% pa (CAGR ~ 4.1%)
- Other: Not able to be forecast

Scrapping age assumed:

NCCV: Dredger	46yrs
NCCV: Fishing	46yrs
NCCV: Tug	46yrs
NCCV: Service	48yrs
NCCV: Other	55yrs





NCCV Tug Forecast 2016 – 2025

10-Year forecast value: **USD 10.7 bn**

Orderbook 2015 / 10-year forecast ratio:

5.53%

10-year ordering tendency:

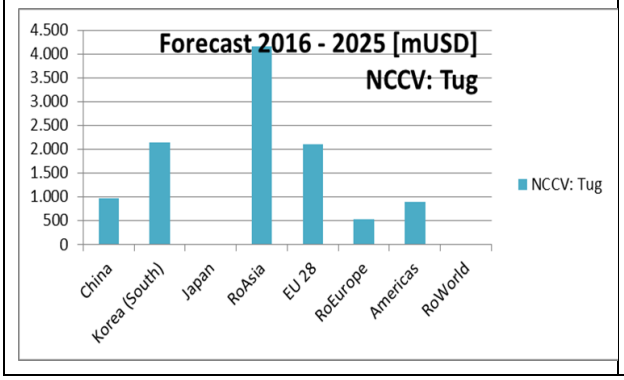
+ / +

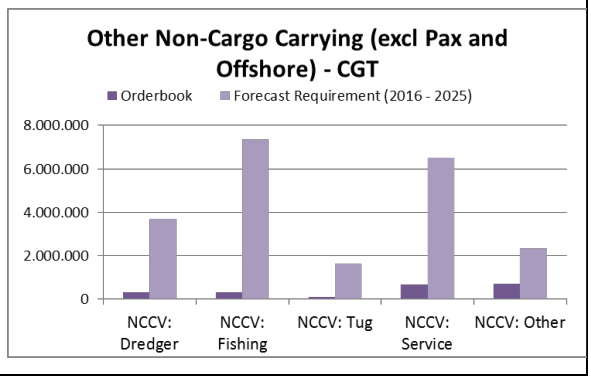
Orderbooks for all fleets are small, totalling only 248 vessels and generally badly reported. Scrapping and growth projections are therefore seen as the best indicator of new construction activity,
Assumed demand growth rates over 10 years:

- Dredger: 15% (CAGR ~ 1.4%)
- Fishing Vessels: 16% (CAGR ~1.5%)
- Tugs: 20% (CAGR ~ 1.85%)
- Service: 50% pa (CAGR ~ 4.1%)
- Other: Not able to be forecast

Scrapping age assumed:

NCCV: Dredger	46yrs
NCCV: Fishing	46yrs
NCCV: Tug	46yrs
NCCV: Service	48yrs





NCCV Fishing Forecast 2016 - 2025

10-Year forecast value: **USD 38 bn**

Orderbook 2015 / 10-year forecast ratio:

4.24%

10-year ordering tendency:

+ / +

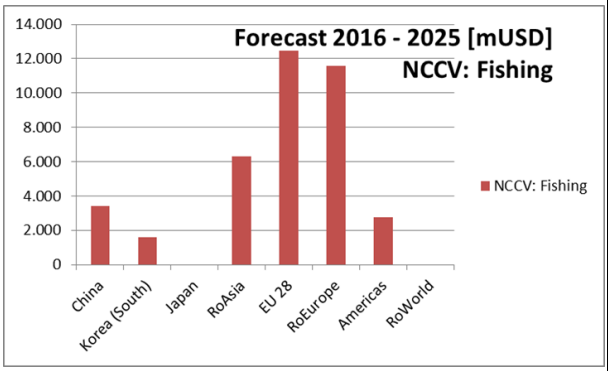
Orderbooks for all fleets are small, totalling only 248 vessels and generally badly reported. Scrapping and growth projections are therefore seen as the best indicator of new construction activity,

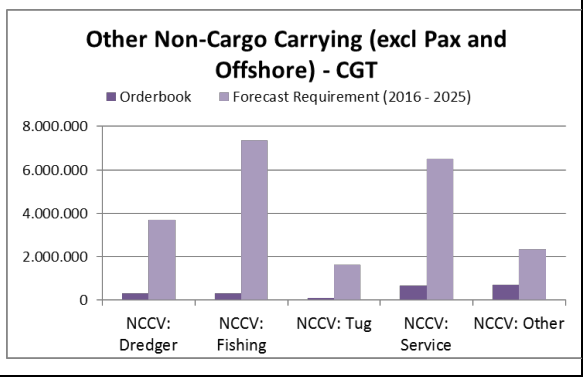
Assumed demand growth rates over 10 years:

- Dredger: 15% (CAGR ~ 1.4%)
- Fishing Vessels: 16% (CAGR ~1.5%)
- Tugs: 20% (CAGR ~ 1.85%)
- Service: 50% pa (CAGR ~ 4.1%)
- Other: Not able to be forecast

Scrapping age assumed:

NCCV: Dredger	46yrs
NCCV: Fishing	46yrs
NCCV: Tug	46yrs
NCCV: Service	48yrs
NCCV: Other	55yrs





NCCV Service Forecast 2016 - 2025

10-Year forecast value: **USD 44.9 bn**

Orderbook 2015 / 10-year forecast ratio:

10.30%

10-year ordering tendency:

+ / +

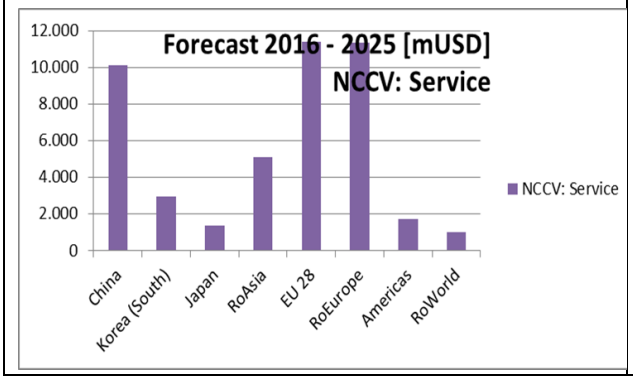
Orderbooks for all fleets are small, totalling only 248 vessels and generally badly reported. Scrapping and growth projections are therefore seen as the best indicator of new construction activity,

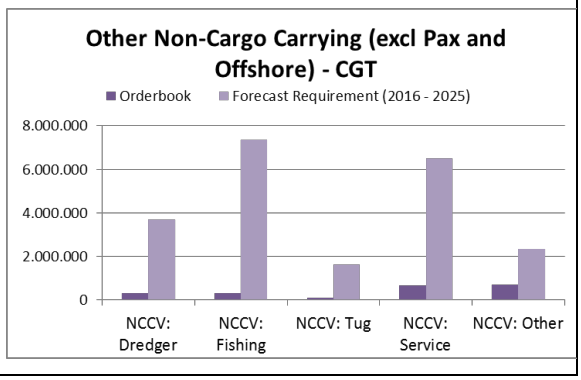
Assumed demand growth rates over 10 years:

- Dredger: 15% (CAGR ~ 1.4%)
- Fishing Vessels: 16% (CAGR ~1.5%)
- Tugs: 20% (CAGR ~ 1.85%)
- Service: 50% pa (CAGR ~ 4.1%)
- Other: Not able to be forecast

Scrapping age assumed:

NCCV: Dredger	46yrs
NCCV: Fishing	46yrs
NCCV: Tug	46yrs
NCCV: Service	48yrs





NCCV Other Forecast 2016 - 2025

10-Year forecast value: **USD 24.2 bn**

Orderbook 2015 / 10-year forecast ratio:

29.60%

10Years Ordering Tendency:

+ / +

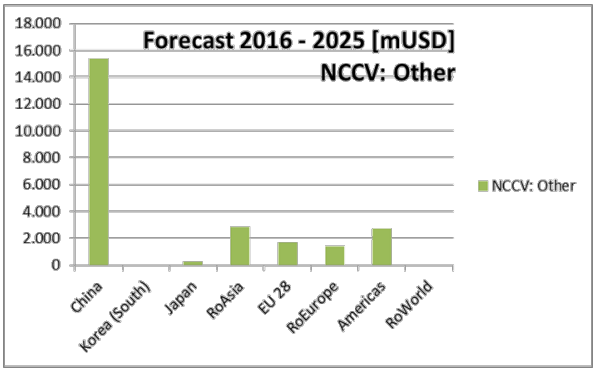
Orderbooks for all fleets are small, totalling only 248 vessels and generally badly reported. Scrapping and growth projections are therefore seen as the best indicator of new construction activity,

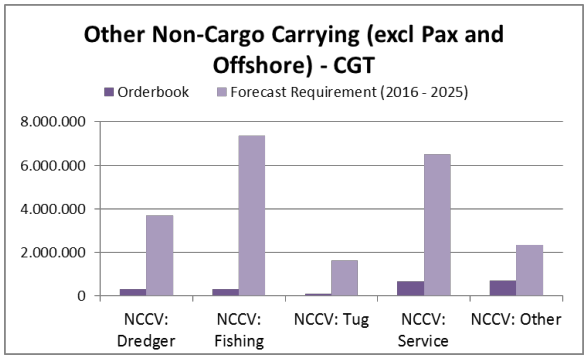
Assumed demand growth rates over 10 years:

- Dredger: 15% (CAGR ~ 1.4%)
- Fishing Vessels: 16% (CAGR ~1.5%)
- Tugs: 20% (CAGR ~ 1.85%)
- Service: 50% pa (CAGR ~ 4.1%)
- Other: Not able to be forecast

Scrapping age assumed:

NCCV: Dredger	46yrs
NCCV: Fishing	46yrs
NCCV: Tug	46yrs
NCCV: Service	48yrs





Discussions of related forecasts available from international associations

SEA Europe also provided presentations on the following specialist ship sectors - Artic Vessels, Fishing and Research Vessels and Tugs, Dredgers and Other Specialist Vessels.

None of the other major shipbuilders provided any such forecasts to contrast with and these categories overlap or do not line up easily with the BAL/SHE NCCV sectors. For this reason, direct comparison of forecasts has not been made.

BAL/SHE		CGT	GT	DWT	Ships
NCCV: Dredger	per year	0.4	0.2	0.3	40
NCCV: Fishing	per year	0.7	0.3	0.1	164
NCCV: Tug	per year	0.2	0.1	0.0	48
NCCV: Service	per year	0.7	0.4	0.2	89
NCCV: Other	per year	0.2	0.2	0.1	19
Total NCCV: 2016-2025	per year	2.1	1.1	0.8	360

The SEA Europe 2017 update forecasts fishing vessel completion averaging 0.5 m cGT or 188 ships per year and tug completions averaging 1.1 m CGT per year, although this seems to include vessels below 500 GT, which were handled separately in the BAL/SHE forecast.

Offshore AHTS 2016 - 2025

10-Year forecast value: **USD 49.5 bn**

Orderbook 2015 / 10-year forecast ratio:

19.85%

10-year ordering tendency:

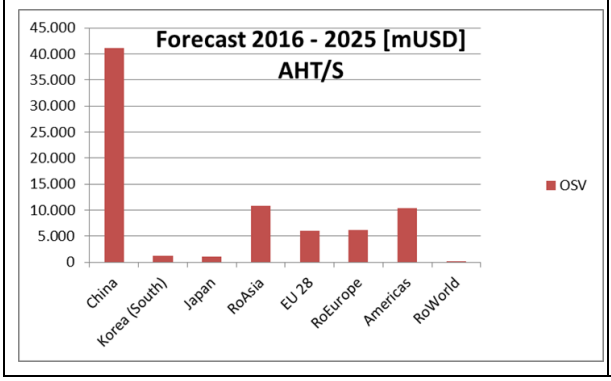
+ / +

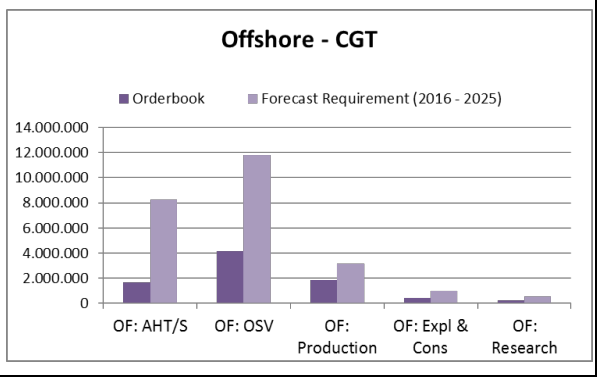
Assumed demand growth rates for the 10 years:

- AHT/S: 23% (CAGR ~ 2.1%)
- OSV: 30% (CAGR ~ 2.7%)
- Production: 30% (CAGR ~ 2.7%)
- Expl & Const: Stable
- Research: 13% (CAGR ~ 1.2%)

Scrapping age assumed:

OF: AHT/S	39yrs
OF: OSV	41yrs
OF: Production	43yrs
OF: Expl & Const	40yrs
OF: Research	50yrs





Offshore OSV Forecast 2016 - 2025

10-Year forecast value: **USD 76.8 bn**

Orderbook 2015 / 10-year forecast ratio:

34.84%

10-year ordering tendency:

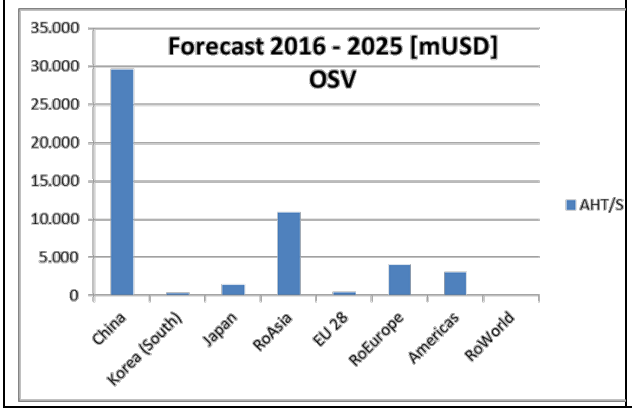
+ / -

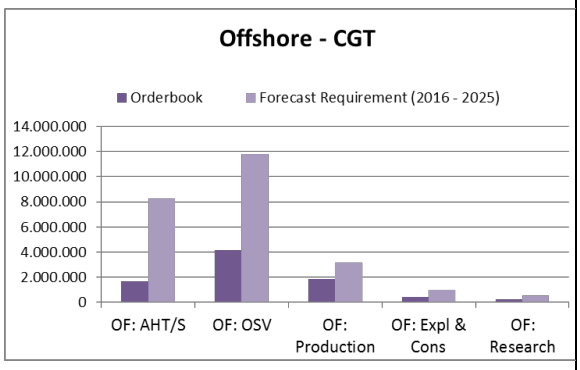
Assumed demand growth rates for the 10 years:

- AHT/S: 23% (CAGR ~ 2.1%)
- OSV: 30% (CAGR ~ 2.7%)
- Production: 30% (CAGR ~ 2.7%)
- Expl & Const: Stable
- Research: 13% (CAGR ~ 1.2%)

Scrapping age assumed:

OF: AHT/S	39yrs
OF: OSV	41yrs
OF: Production	43yrs
OF: Expl & Const	40yrs
OF: Research	50yrs





Offshore Production Forecast 2016 - 2025

10-Year forecast value: **USD 43.8 bn**

Orderbook 2015 / 10-year forecast ratio:

58.10%

10-year ordering tendency:

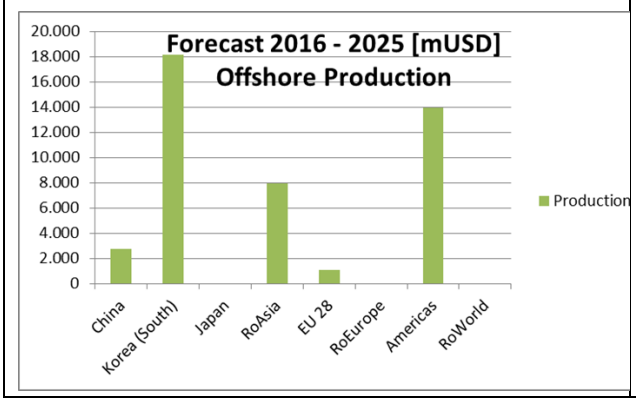
+ / -

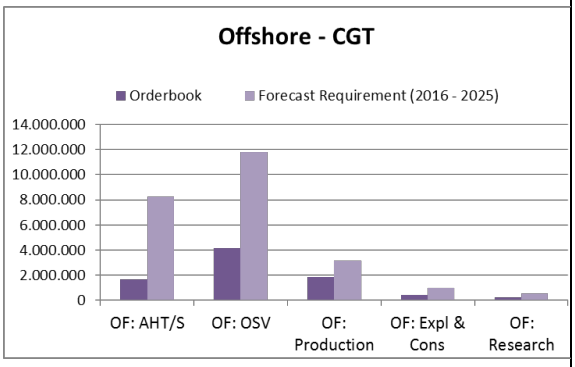
Assumed demand growth rates for the 10 years:

- AHT/S: 23% (CAGR ~ 2.1%)
- OSV: 30% (CAGR ~ 2.7%)
- Production: 30% (CAGR ~ 2.7%)
- Expl & Const: Stable
- Research: 13% (CAGR ~ 1.2%)

Scrapping age assumed:

OF: AHT/S	39 yrs
OF: OSV	41 yrs
OF: Production	43 yrs
OF: Expl & Const	40 yrs
OF: Research	50 yrs





Offshore Construction Forecast 2016 - 2025

10-Year forecast value: **USD 7.6 bn**

Orderbook 2015 / 10-year forecast ratio:

40.91%

10-year ordering tendency:

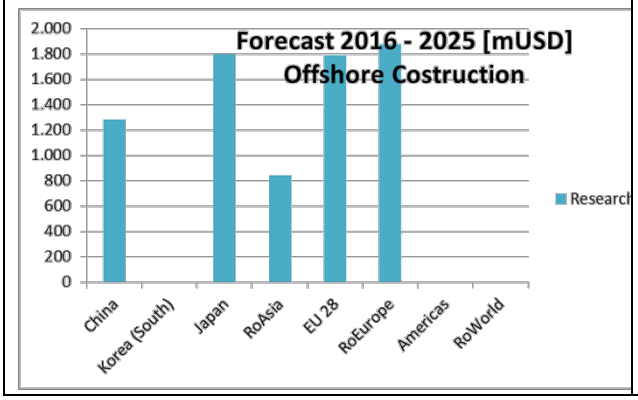
+ / -

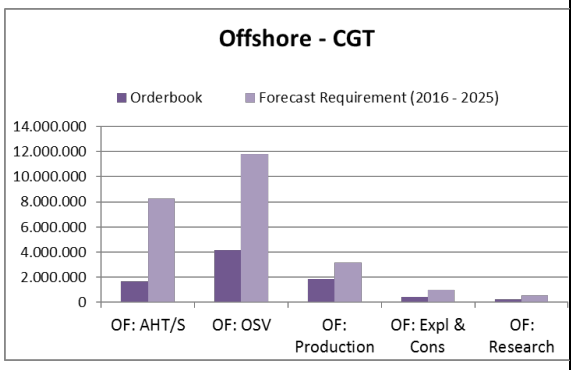
Assumed demand growth rates for the 10 years:

- AHT/S: 23% (CAGR ~ 2.1%)
- OSV: 30% (CAGR ~ 2.7%)
- Production: 30% (CAGR ~ 2.7%)
- Expl & Const: Stable
- Research: 13% (CAGR ~ 1.2%)

Scrapping age assumed:

OF: AHT/S	39yrs
OF: OSV	41yrs
OF: Production	43yrs
OF: Expl & Const	40yrs
OF: Research	50yrs





Offshore Research Vessels Forecast 2016 - 2025

10-Year forecast value: **USD 7.5 bn**

Orderbook 2015 / 10-year forecast ratio:

41.58%

10-year ordering tendency:

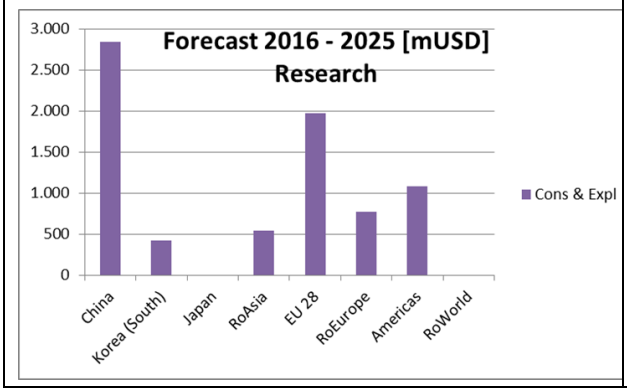
+ / -

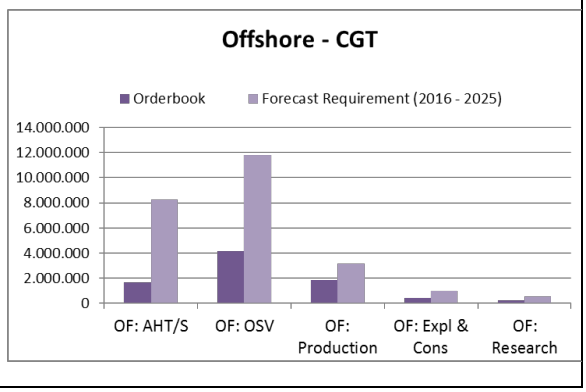
Assumed demand growth rates for the 10 years:

- AHT/S: 23% (CAGR ~ 2.1%)
- OSV: 30% (CAGR ~ 2.7%)
- Production: 30% (CAGR ~ 2.7%)
- Expl & Const: Stable
- Research: 13% (CAGR ~ 1.2%)

Scrapping age assumed:

OF: AHT/S	39yrs
OF: OSV	41yrs
OF: Production	43yrs
OF: Expl & Const	40yrs
OF: Research	50yrs





Discussions of related forecasts available from international associations

In the offshore sector, both SEA Europe and CANSI, presented forecasts covering Offshore Vessels, however the CANSI forecast focused mainly on AHTS and PSVs rather than the broader spectrum of SEA Europe which covered Offshore Wind, Supply & Service, Construction & Subsea, and Exploration & Production vessels. The forecast requirement in the SEA Europe forecast was provided only in graphical format, so the table below comprises approximated values read off these graphs. The CANSI forecast was expressed solely in vessel numbers for the two ship-types they covered. Whilst the SEA Europe forecast indicates a much higher number of ships in the first 5-year period, the graphical breakdown indicates this is unlikely to be solely due to the broader scope of vessel types in this forecast but a more optimistic view on demand for the Supply and Service element which AHTV and PSV fall within.

BAL/SHE		CGT	GT	DWT	Ships
2016-2020	per year				
2021-2025	per year				
2015-2025	per year	2.5	1.6	1.4	306

SEA Europe		CGT	GT	DWT	Ships
2015-2020	per year	1.6	1.6	1.8	240
2020-2025	per year	2.4	2.3	2.8	310
2025-2030	per year	2.3	2.1	240.0	295
2030-2035	per year	2.3	2.2	270.0	270
2016-2035	per year	2.2	2.0	128.7	279
2016-2025	**per year**	**2.1**	**2.0**	**26.1**	**281**

CANSI		CGT	GT	DWT	Ships
2016-2020	per year	0.0			112
2021-2025	per year	0.0			
2026-2030	per year	0.0			
2031-2035	per year	0.0			
2016-2035	per year	0.0			

BAL/SHE		CGT	GT	DWT	Ships
OF: AHT/S	per year	0.8	0.4	0.3	139
OF: OSV	per year	1.2	0.7	0.6	149
OF: Production	per year	0.3	0.4	0.4	9
OF: Expl & Cons	per year	0.1	0.1	0.1	4
OF: Research	per year	0.1	0.0	0.0	5
OF: Total 2016-2025	per year	2.5	1.6	1.4	306

The BAL/SHE forecast is slightly higher in both GT and ship numbers than that of SEA Europe, and this is despite the fact that the SEA Europe forecast covers a broader vessel base.

CANSI also provided a forecast for the offshore structure sector, covering MODU and MOPU units, which although not defined in the presentation are acronyms usually used for Mobile Offshore Drilling Units and Mobile Offshore Production Units, but as Drilling Units are part of the Production Unit definition this leaves uncertainty about what the CANSI forecast was intended to cover - possibly MOPU relates mainly to storage units (because reference is made to FPSO, FSRU and FLNG but it also includes TLP/Spar/ Semi which can also be drilling units.

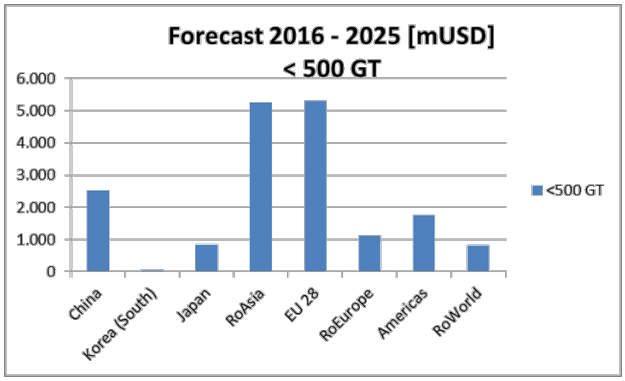
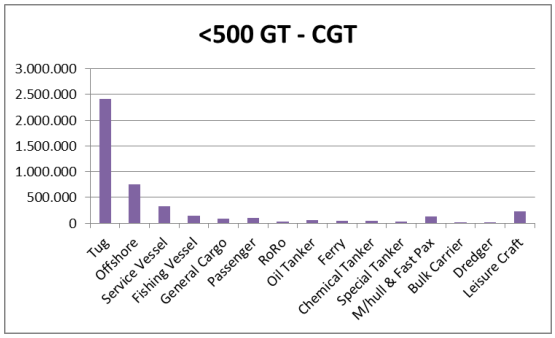
The SEA Europe 2017 update for the Offshore sectors includes a small scale graphical forecast in terms of vessel numbers, however it is not practicable to quantify this by scaling off the graph.

<500GT Forecast 2016 - 2025

10-Year forecast value: **USD 17.6 bn**

Orderbook 2015 / 10-year forecast ratio:

36.64%

10-year ordering tendency:

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