

# SEVENTH FRAMEWORK PROGRAMME

## THEME 7: Transport (including Aeronautics)

### *Regulatory trends towards 2030*



<b>Project Acronym:</b>	MESA
<b>Project Full Title:</b>	Maritime Europe Strategy Action
<b>Grant agreement n°:</b>	604857
<b>Work Package</b>	5
<b>Deliverable</b>	5.5
<b>Responsible Beneficiary</b>	GL (DNV GL SE)
<b>Other Beneficiaries Involved in the Preparation</b>	CESA, ECMAR, ICOMIA
<b>Authors</b>	Dr. Pierre C. Sames, Peter Securius, Arne Schulz-Heimbeck, Wolfgang Franzelius, Uwe Langbecker
<b>Release</b>	1
<b>Date</b>	2015-03-20

**Description of the Task:**

**Task 5.5 Regulatory Trends towards 2030**

Technological advances and innovations in the maritime industry have recently often been triggered by upcoming changes in the regulatory framework. Today, IMO has set into motion a comprehensive set of measures to reduce emissions from shipping and this will shape ships of the future. Many of the upcoming regulations have timelines over a decade long and, therefore, responding to these challenges is needed at defined points in time. Looking at ship safety, no such clear indication of upcoming regulations is visible. This task will develop a regulatory roadmap outlining which rules are expected to enter into force over the next decade towards 2030. A second part will explore which additional topics may become regulated and lead to still not known future rules. Task leader GL will deliver a report on the above towards 2030 (D.5.5).



## Executive Summary

The MESA foresight activity provides market, societal and regulatory trends, with the aim to compare these with present and expected technology developments and, thus, to be able deriving R&D needs to address identified gaps. This document provides the regulatory trends foreseen until 2030 based on an analysis of the previously identified and assigned trends on energy supply and consumption, waterborne industries, ICT, climate change, health and safety, security and the IMO strategy.

Most foresight studies did not directly indicate regulatory trends for the maritime industry. Therefore, the authors analysed indicated trends with regard to the consequences for the maritime industry and in case it would affect the industry, whether regulatory trends were likely to be expected. Identified and consolidated trends are grouped into Maritime Transport, Blue Growth and Infrastructure. Overall, 36 regulatory trends have been identified and will be integrated into the upcoming foresight study.

## Table of Contents

1. Introduction.....	3
Background.....	3
Objectives.....	3
Scope.....	3
2. Relevant assigned studies.....	3
3. Method of work.....	3
4. Identified trends.....	4
General.....	4
Energy supply and consumption.....	4
Climate change and environment.....	7
ICT.....	7
Health and safety.....	8
Waterborne industries.....	9
Security.....	10
IMO strategy.....	11
5. Summary of main trends and conclusions.....	13
Main trends.....	13
Maritime Transport.....	13
Blue Growth.....	14
Infrastructure.....	14
Conclusions.....	15
6. References.....	16
Annexes.....	18
Annex 1 - Energy Supply and Consumption (ESC), Climate Change and Environment (CCE).....	18
Annex 2 - ICT (Information & Communication Technology).....	28
Annex 3 - Health and Safety.....	31
Annex 4 - Security.....	32
Annex 5 - IMO strategy.....	33

# 1. Introduction

## Background

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

## Objectives

Within work package 5 of MESA, three reports (D5.3, D5.4 and 5.5) will elaborate on market, societal and regulatory trends, respectively. This document provides the regulatory trends foreseen until 2030. They were derived from studying several foresight documents which were recommended for review in MESA Report D5.1 - Structure and first guidelines for Market, Societal, Regulatory trends.

## Scope

The work carried out followed the guidance given in MESA report D5.1 and minutes of the WP5 meeting held on 2014-06-03. The recommended foresight studies were reviewed regarding regulatory trends related to the topics marked with an “x” in table 1 below. For each of those topics it was aimed to identify regulatory trends related to maritime transport, blue growth and infrastructure.

# 2. Relevant assigned studies

This report deals with the activities in MESA WP5 task 5.4, related to the identification of regulatory trends. Table 1 indicates that the focus in task 5.4 is on the topics Energy supply & consumption, Waterborne industries, ICT, Climate change & environment, Health and safety, Security, IMO strategic plan. The foresight studies that were reviewed with regard to regulatory trends had been recommended in table 3 of MESA Report D5.1. they are listed in section 4 for each of the topics where regulatory trends were to be identified.

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

**Table 1: recommended focus assignment of trends/topics to subsequent tasks in work package 5**

# 3. Method of work

The work followed the path described in deliverable 5.1 and is schematically shown in the following picture.

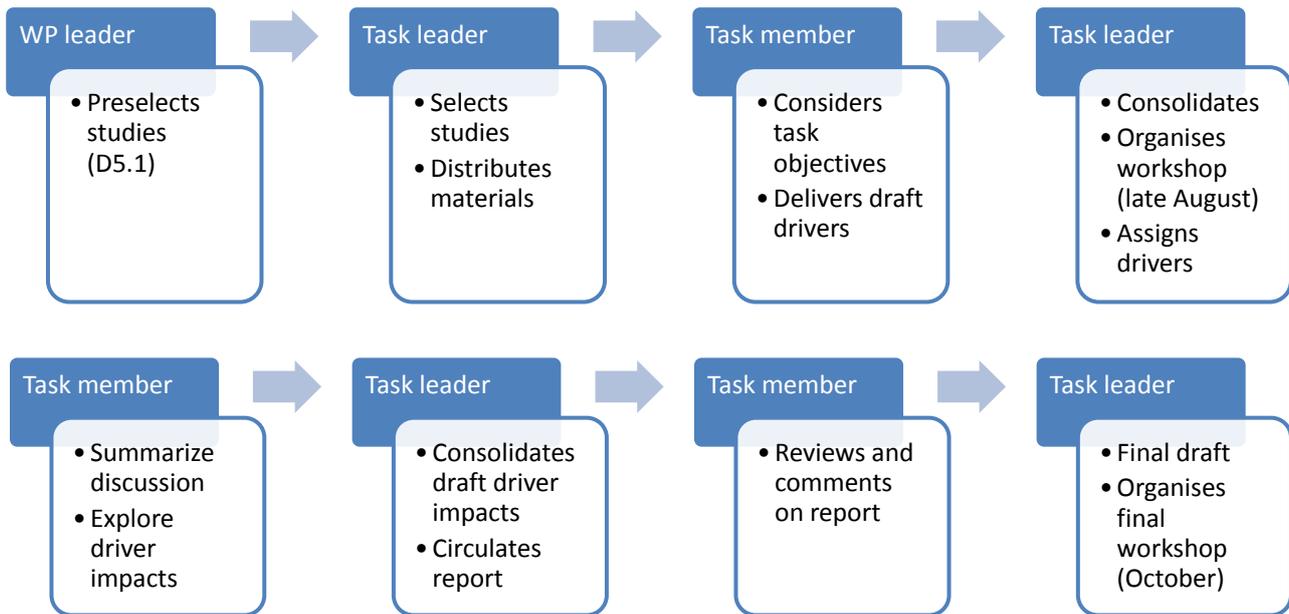


Figure 1: method of work

To facilitate work, the following research questions had been formulated:

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

## 4. Identified trends

### General

The foresight studies recommended in MESA Report D5.1 to be reviewed and listed in the following sections typically did not directly indicate regulatory trends for the maritime industry, except, of course, for those foresight studies that specifically focussing on the maritime industry, e.g. Europe 2020 Flagship Initiative, IMO strategic plan, etc. In the case that no direct regulatory trends for the maritime industry were mentioned in a foresight study, the authors tried to analyse indicated trends with regard to the consequences for the maritime industry and in case it would affect the industry, if regulatory trends were likely to be expected. In the next sections the regulatory trends related to the topics in table 1 and assigned to task 5.4 are summarized. The detailed explanation of derived trends and the reasoning behind is contained in annexes 1 to 6.

Identified and consolidated trends will be grouped to Maritime Transport (MT), Blue Growth and Infrastructure. MT will be further subdivided into the four topics addressed by the TTGs: energy efficiency, safety, e-maritime and production (indicated in the following by the respective TTG name in brackets).

### Energy supply and consumption

The regulatory trends were derived from the following foresight studies:

- IPCC (2013). "Climate Change 2013: The Physical Science Basis"

- Review of Maritime Transport, 2013, UNCTAD
- National Intelligence Council (2012). Global trends 2030
- McKinsey Global Institute (2011): Resource Revolution - Meeting the world's energy, materials, food, and water needs
- Royal Dutch Shell BV (2013): New Lens Scenarios (2030)- A shift in perspective for a world in transition
- Statoil (2013): Energy intensity of world economy
- Clarkson Shipping Intelligence Network (2013): Shifting Shipbuilding Shares
- Clarkson Research (2013): THE NEWBUILDING MARKET 2013-2025
- HWWI/Berenberg Bank (2007): Maritime trade and transport logistics, strategy 2030

### *Maritime transport*

The following regulatory trends have been identified for maritime transport:

1. Based on the expectation of a relatively high growth rate (compared to oil) in alternative energy as well as natural gas generation and consumption
  - Regulations related to alternative energy addressing
    - the challenges for shipping through and/or in the vicinity of offshore wind farms (safety)
    - the safety of maintenance and repair crews for offshore wind turbines (safety)
  - Regulations related to alternative energy addressing
    - the challenges from generation and storage of hydrogen generated from wind power on offshore platforms (safety)
    - ship transport of the hydrogen from platforms to land (safety)
    - charging hydrogen powered ships directly from offshore platform (safety)
  - Regulations related to natural gas addressing challenges due to
    - Increasing transportation of natural gas, especially LNG, into ports for supply as ship fuel (safety)
    - Increasing size of gas carriers (production)
    - Discharging of tankers and charging of ships bunkers with natural gas (safety)
    - The need of new tank technologies due to increase of tanker size (production)
2. Based on the expectation of a continuous drive to higher energy efficient ship operation (propulsion, auxiliary power generation and distribution) and more environmental friendly ship operation the following trends are expected
  - Regulations requiring a better energy management of ships power generation, distribution and propulsion systems (energy efficiency)
  - Regulations on environmental metrics, such as SEEMP, EEDI, and others and the increased establishment of ECAs all over the world (energy efficiency)
  - Regulations on scrapping of ships in facilities that ensure safe and environmental friendly dismantling and recycling procedures. (Scrapping age will decrease and vessel numbers increase if current difficult market situation will continue) (production)

3. Based on the expectation of an increased utilization of alternative energy for ship power generation and propulsion
  - Regulations that address the ship's manoeuvring challenges from a higher share of alternative energy for powering a ship, e.g. sail drives, Flettner rotors, solar power (safety)
4. Based on the expectation that transport distances for tanker trades will increase again, larger tankers will be seen on the oceans because of economy of scale effects. With larger sizes there are challenges related to manoeuvrability. The following regulations may be initiated:
  - Regulations related to backup propulsion of larger tankers in order to reduce the environmental risk in case of engine failure (safety)
  - Regulations related to the increased automation of loading/unloading operations to reduce consequences from human error (safety)

### *Blue growth*

1. Based on the expectation that the trend to exploit offshore oil and gas resources in areas of harsher environment, especially in Polar Regions, and in deeper waters and that more complex energy sources will be exploited, such as tar sands, the following regulatory trends may be expected.
  - Regulations addressing the higher operation risks in harsher environment and deeper waters, for offshore production facilities, supply vessels, i.e. regulations on improved environmental risk management (safety)
  - Regulations for the safe utilization of novel exploration technologies
2. Based on the expectation that the significant amount of methane hydrates in offshore fields will be exploited
  - Regulations related to the safe and environmental friendly offshore exploitation/production and transport of methane hydrates by ship may be expected. (safety)

### *Infrastructure*

1. Based on the expectation of a relatively high growth rate (compared to oil) in alternative energy as well as natural gas generation and consumption
  - Regulations related to CNG/LNG infrastructure in sea and inland waterway ports due to the increasing utilization of natural gas as ships fuel (safety)
  - Regulations related to hydrogen ports infrastructure due to the increasing offshore generation of hydrogen by wind energy and transporting it into ports for further utilization e.g. as ships fuel (safety)
2. Based on the expectation of a continuous drive to more environmental friendly ship operation
  - Regulations related to the safe charging of hydrogen into bunker tanks of larger number of ships with fuel cells for powering the ship (safety)
3. Based on the expectation that tanker trade distance will increase and thus larger tankers will be seen on the oceans (economy of scale effect), and that the trend to an increased number of very large container vessels will continue (economy of scale effect), relevant ports infrastructures need to be improved/developed for such ship sizes

- Regulations related to the challenges of manoeuvring of such ships in congested waters and approaching ports may be developed to manage collision and grounding risks (safety)

## Climate change and environment

The regulatory trends were derived from the following foresight studies:

- IPCC (2013). “Climate Change 2013: The Physical Science Basis”
- Review of Maritime Transport, 2013, UNCTAD
- National Intelligence Council (2012). Global trends 2030
- McKinsey Global Institute (2011): Resource Revolution - Meeting the world’s energy, materials, food, and water needs
- Royal Dutch Shell BV (2013): New Lens Scenarios (2030)- A shift in perspective for a world in transition
- Statoil (2013): Energy intensity of world economy
- Clarkson Shipping Intelligence Network (2013): Shifting Shipbuilding Shares
- Clarkson Research (2013): THE NEWBUILDING MARKET 2013-2025
- HWWI/Berenberg Bank (2007): Maritime trade and transport logistics, strategy 2030

### *Maritime transport*

1. Based on the expectation that trades through the arctic will increase due to the reduced ice situation and that significant oil resources are expected and will be exploited
  - Regulations addressing the challenges of operations in arctic regions will be developed, for oil production facilities, supply vessels, tankers. For ships ice strengthening and more powerful propulsion systems may be the most significant requirements (safety)

### *Blue growth*

1. Based on the expected continuous trend of more energy efficient and more environmental friendly operations
  - Regulations for the pricing of environmental concerns such as (carbon) emissions and water usage of the offshore oil & gas industry are to be expected (energy efficiency)
2. Assuming that more extreme weather conditions are to be expected due to the elevated CO2 level in the atmosphere
  - Regulations addressing the safe and environmental friendly operation of the blue growth industry under more extreme environmental conditions can be expected. (safety)

### *Infrastructure*

No items related to infrastructure were found in the reviewed foresight studies.

## ICT

The regulatory trends were derived from the following foresight studies:

- US National Intelligence Council (2012). Global trends 2030, (USNIC)
- Waterborne Transport Thematic Research Summary, WSRA 2011
- Consideration of the source “Waterborne Strategic Research Agenda, Vision 2020 – Route Map, WIRM 2011” is still pending at the time of issuing this version of the report.

### **Maritime transport**

1. Based on the assumption of a massive growth of computing power and data storage capabilities, globally accessible networks, cloud infrastructure providing pervasive services, increasingly connected software systems and smart devices (Internet of Things), and smart and cheap sensors, a need for the following regulations is seen:
  - Regulation of acquisition, storage, and use of private and public data (data ownership, data access) (e-maritime)
  - Regulation of the use of data as substitute for legal documents (e-maritime)
  - Regulation based updates of existing and development of new International standards for maritime transport domain, e.g. UN/EDIFACT (e-maritime)
  - Regulation on intellectual property rights (e-maritime)
2. Based on the deep interconnectivity between different software systems and smart devices, the remote accessibility to all kinds of systems (Internet of Things), the vulnerability of vessels and critical infrastructures system against of cyber-attacks and weather phenomena is expected to increase. Hence a need for the following regulations is seen:
  - Regulation on IT security for vessels and critical infrastructures (e-maritime)
  - Regulation on redundancy / backup for systems on-board and critical onshore infrastructures (e-maritime)
3. Based on the assumption, that complex software systems and distributed control systems consist of many individual modules will become more common, there is a need for a
  - Regulation of design, test and operation of hardware and software modules (safety)
4. Assuming higher degrees of automation and advanced decision support systems, future navigation systems will become increasingly proactive and interlinked with shore based systems. This would cause a need for the following:
  - Regulation covering the use of semi-autonomous, autonomous, and remotely controlled vehicles (underwater or air-based) on-board or in the vicinity of a vessel for the purpose of inspection, supervision, loading, etc. (safety)
  - Regulation of the use of intelligent systems and navigational aids when operating in high risk / dense traffic areas, for port approaches and port call preparation. (safety)

### **Blue growth**

No particular needs for regulation other than for those for Maritime Transport were identified.

### **Infrastructure**

No particular needs for regulation other than for those for Maritime Transport were identified.

### **Health and safety**

The regulatory trends were derived from the following foresight studies:

- United Nations (2013). Global Sustainable Development Report (GSD-Report)
- World Urbanization Prospects: The 2011 Revision, UN 2012 (WUP-Report)

### **Maritime transport**

1. Based on the necessity that Nature and Life Support need to be sustained, there will be a high demand in additional or amended regulations to reduce air pollution, protect resources and stabilize the climate

change. This will go in line with a demand for an enhanced marine pollution prevention regime.

The following are to be expected/developed:

- Regulations to ensure the target of cumulative fossil fuel limit to <520 Gtoe from 2010 to 2050 (energy efficiency, production)
- Regulations to keep the targets for air pollution and climate change (e.g. keep the PM2.5 concentration <35 µg/m<sup>3</sup> by 2030, Atmospheric GHG concentration stabilization below agreed level and Limit ocean acidification to keep aragonite stable, with pH=8.0 in 2150). (energy efficiency, production)
- Regulations to reduce the marine pollution by reducing the invasive aquatic species. (production)
- Regulation to improve the safety of navigation and maritime security (safety)

2. Due to the intensified urbanisation within the next decades, the supply chain from rural areas to urban areas with higher population rates need to be strengthened. Inland waterway traffic and coastal feeder services will become more important and will grow in the future. The costal traffic e.g. from bigger hubs to smaller harbours (inland and coastal) will increase.

The following is to be expected/developed:

- Regulations to support, regulate and standardize the Inter-European water transport. (safety)

### *Blue growth*

In addition to the trends identified under Maritime Transport item 1., like the reduction of invasive aquatic species, the following regulatory developments are to be expected:

- Regulations to slow down the overfishing and restore the fish stocks later. (production)
- Regulations to prevent unsustainable costal area developments. (production)

### *Infrastructure*

No specific trends are mentioned in the respective reports, which will have solely an effect on the infrastructure. Anyhow, many of the trends mentioned above under Maritime Transport and Blue Growth will have direct impact on additional regulation concerning the Infrastructure.

## **Waterborne industries**

The regulatory trends were derived from sources, including the following foresight studies:

- Clarkson Research: THE NEWBUILDING MARKET 2013-2025
- Clarkson Shipping Intelligence Network (2013). Shifting Shipbuilding Shares
- SEA Europe annual reports
- HWWI/Berenberg Bank, Maritime trade and transport logistics, strategy 2030, Germany 2007

### *Maritime transport*

The main European regulations relating to ship production and repair are the following [source: FP7 Project ECO-REFITEC [Project Reference: 266268]]:

- [Directive 2000/60/EC](#) establishing a framework for Community action in the field of water policy;
- Waste Framework [Directive 2008/98/EC](#);
- Council [Directive 1999/13/EC](#) on the limitation of emissions of volatile organic compound due

to the use of organic solvent in certain activities and installations/SED;

- [Directive 2008/1/EC](#) concerning integrated pollution prevention control /IPPCD;
- [Directive 2010/75/EU](#) on industrial emissions (integrated pollution prevention and control) (Recast) /IED;
- [Regulation \(EC\) No 166/2006](#) concerning the establishment of the European Pollutant Release and Transfer Register;
- [Regulation \(EC\) No 782/2003](#) on the prohibition of organotin compounds on ships.

It is likely that environmental regulations will become more stringent, and/or environmental levies will be increased.

In the area of safety of the workforce, the main legislation is the European Framework Directive on Safety and Health at Work (Directive 89/391 EEC). In 2004 the European Commission issued a “Communication on the practical implementation of the provisions of some of the directives, namely 89/391 EEC (framework directive), 89/654 EEC (workplaces), 89/655 EEC (work equipment), 89/656 EEC (personal protective equipment), 90/269 EEC (manual handling of loads) and 90/270 EEC (display screen equipment)” (ref. to COM (2004) 62).

In this area, the trend will also be to increase both stringency and enforcement.

### *Blue growth*

In relation to construction of offshore structures and platforms, the legislation, and associated trends related to Maritime Transport, will apply.

### *Infrastructure*

As in Maritime Transport, in relation to port construction and operational safety.

The HWWI report identified an additional area, in relation to environmental, and other, regulations, that apply to the modernisation and expansion of harbour facilities. In addition to the environmental regulations discussed above, there is likely to be increasing pressure from other coastal zone users, including those related to Blue Growth, e.g. marine renewable energy, mariculture, etc.

## **Security**

The regulatory trends were derived from the following foresight studies:

- US National Intelligence Council USNIC (2012). Global trends 2030
- Europe 2020 Flagship Initiative Energy 2020 (no hit)
- Waterborne Transport Thematic Research Summary
- DNVGL experts from IMO committees
- DNV: The Future of Shipping 2020

### *Maritime transport*

The following regulatory trends have been identified for maritime transport:

1. New technologies, like worldwide data connections and durable systems with very high availability enable the development of unmanned ships (remote controlled or autonomously operated). Remote and autonomous ships could transform shipping, transportation and geo-prospecting with reduced risks while simultaneously presenting novel security risks that could be difficult to address.
  - New regulations are expected to

- enable safe operation far from shore based maintenance facilities considering multi redundant systems on ships (safety)
- ensure cyber security of (un-)manned ship operations (safety)
- enable the change of responsibility of the ships master to an onshore operator (safety)
- redefine safety factors of non-redundant ship parts and systems (e.g. ship hull) (safety)
- enable safe operation and interaction with other manned or unmanned ships, especially in narrow fairways and fairways with high traffic density (e.g. North Sea) (safety, e-maritime)
- enable safe interaction between unmanned ships and involved parties for all harbour activities from pilot access over loading/unloading to fuelling and maintenance of the ship and its systems (safety, e-maritime)

### *Blue growth*

No security regulation trends related to blue growth are mentioned in the studies. However, the project team identified the following topics which likely will require new regulations in the future:

- Manage threats from unauthorized access to offshore installations (safety)
- ensure cyber security of (un-)manned offshore installation (safety)

### *Infrastructure*

In addition to the trends identified above (when unmanned ships meet port and fairway infrastructures), the following regulatory trends have been identified for infrastructure:

By 2030 it will be possible to transit both the Northern and Northwest Passage for about 110 days per year, with about 45 days easily navigable.

- Regulations are expected to Improve the arctic infrastructure to enable safe shipping in arctic waters (safety, e-maritime)

### **IMO strategy**

The regulatory trends were derived from the following foresight studies:

- IMO Strategic plan for the Organization **IMOSTRAT** (for the six-year period 2012 to 2017; 20.12.2011)
- IMO Strategic plan for the organization **IMOSTRAT** (for the six-year period 2014 to 2019; 27.01.2014)
- IMO publications on the development of the next “Polar Code” **IMOPOL**(2014-09)
- DNVGL experts working for IMO committees **IMO/DNVGL**

### *Maritime transport*

The following regulatory trends have been identified:

1. Based on the fact that maritime transport is fundamental to world trade and access to global markets and the continuous trend of globalization
  - regulations are expected to support a consolidation of shipping, terminal and operator conglomerates and alliances (e-maritime)
2. Based on the generally heightened maritime security concerns
  - Regulations are expected with the aim to raise the overall standard of shipping by ensuring that each link in the chain of responsibility fully meets its obligations is a priority for the maritime community as a whole (safety)
3. Based on the heightened maritime security concerns in view of piracy and armed robbery against ships
  - Regulations are expected to address
    - Ship based defence mechanisms (production)
    - Implementation of guidance for authorities and ship operators (safety)

- Develop measures to deter or prevent piracy attacks from being successful (safety)
- 4. Based on heightened environmental consciousness the enhancement of a sustainable environmental policy for the shipping industry remains a high-profile matter
  - Regulations are expected to increase awareness and promote corporate social responsibility by the shipping industry and to develop sustainable and environmentally conscious means of minimizing the negative impacts from shipping
    - enhancing energy efficiency for ships (energy efficiency)
    - preventing the introduction of polluting substances from ships into the marine environment (production)
    - ensuring the preservation of ecosystems and biodiversity (production)
    - developing safest and most effective measures for the recycling of ships (production)
- 5. With the increase in regulatory measures for safety, security and environmental protection, there is a need to achieve an appropriate balance between the multiple objectives (safe, secure and efficient shipping)
  - Measures are expected to elimination of unnecessary, disproportionate or obsolete administrative requirements
- 6. Based on the fact that shortcomings in human performance at all levels in the chain of responsibility are a major cause of incidents it is necessary to shift emphasis to people
  - Regulations are expected to
    - increase awareness of the human element in ship operation (safety)
    - improve training of crews and onshore staff of operators (Development of tools and training material supporting owners and operators) (safety)
    - increase awareness of the human element during ship design and building (production)
    - establish and improve training facilities (e-maritime)
- 7. Based on the ongoing trend that an increased number of people are at sea due to increased use of ferries and high-speed craft on international and domestic services, passenger ships with capacities of several thousand and a growing number of migrants transported by sea
  - Regulations are expected to improve safety concepts for large number of passengers (safety)
- 8. Considering global warming, trends and forecasts indicate that polar shipping will grow in volume and diversify in nature over the coming years
  - Regulations are expected to meet these challenges without compromising either safety of life at sea or the sustainability of the polar environments
    - considering winterization and strengthening of ship structures to withstand ice loads of all kind of ship types and sizes (production)
    - considering the human element in polar shipping, customized trainings are needed to operate and maintain ships and their systems safely in polar conditions (safety)
    - considering that large areas of polar waters are still not mapped in the same amount as other areas. Forecasts for drifting ice may also be considered (safety).
    - considering that with increased shipping activity an efficient shore based rescue system need to be implemented (safety)
- 9. Based on the ongoing trend to implement risk based methods (GBS, SLA), setting goals instead of prescriptive requirements to facilitate innovation
  - Regulations are expected to support of

- special tailored ship designs, providing more possibilities for innovative approaches outside of current prescriptive regulatory framework (safety)
- risk based safety assessment for ships (e.g. PSC, Class surveys) (safety)

### *Blue growth*

No regulation trends are mentioned in the IMO Strategy paper addressing blue growth.

### *Infrastructure*

The following regulatory trends have been identified for infrastructure:

1. Based on the fact that shortcomings in human performance at all levels in the chain of responsibility are a major cause of incidents it is necessary to shift emphasis to people
  - Regulations are expected to improve training of onshore staff including harbour operations and maintenance (safety)
2. Based on the ongoing trend that an increased number of people are at sea due to increased use of ferries and high-speed craft on international and domestic services, passenger ships with capacities of several thousand and a growing number of migrants transported by sea
  - Regulations are expected to develop enhanced shore based rescue concepts (safety)
3. Based on heightened environmental consciousness the enhancement of a sustainable environmental policy for the shipping industry remains a high-profile matter
  - Regulations are expected to increase awareness and promote corporate social responsibility by the shipping industry and to develop sustainable and environmentally conscious means of minimizing the negative impacts from shipping
    - developing safest and most effective measures for the recycling of ships (production)
4. Considering global warming, trends and forecasts indicate that polar shipping will grow in volume and diversify in nature over the coming years
  - Regulations are expected to meet these challenges without compromising either safety of life at sea or the sustainability of the polar environments
    - considering that with increased shipping activity an efficient shore based rescue system need to be implemented (safety)

## **5. Summary of main trends and conclusions**

### **Main trends**

#### **Maritime Transport**

The following future regulations can be expected - based on the trends analyzed above - addressing:

#### *Energy efficiency*

1. Improved onboard energy management for reduction of emissions
2. Further reduction of ship emissions to air and water, including waste
3. Stricter environmental metrics, such as SEEMP, EEDI, in combination with increased number of ECAs world wide

#### *Safety*

1. Safe ship transport, discharge and bunkering of natural gas as ships fuel

2. Safety of shipping along increased number of offshore wind farms, safety of shipping within wind farms, safety of maintenance and repair crews for offshore wind farms
3. Safe maneuverability of ships with increased sizes (back-up propulsion) and/or increased amount of power generation from alternative energy
4. Improved safety concepts for ships with increasing large numbers of passengers
5. Safe operation of ships and offshore facilities in arctic regions and/or far from shore based repair and maintenance facilities
6. Resilient/fault tolerant design, test and operation of hardware and software modules
7. Safety of workforce related to issues such as work places, work equipment, handling loads
8. Increased awareness of the human element in ship operations, including improved training of crew and onshore staff and increase of safety culture in shipping industry

### *E-Maritime*

1. Acquisition, storage and use of private and public data (data ownership and data access) including intellectual property rights
2. Electronic data substituting legal paper documents
3. IT security for (unmanned/manned) vessels and critical infrastructures, including back-up approaches for onboard systems and critical infrastructure
4. Improved coordination of logistics between ship, terminal and operator for more efficient transport chain
5. Establish and improve training facilities for crew

### *Production*

1. Safe production and handling of hydrogen on offshore wind farms
2. Safe and environmental friendly ship scrapping facilities and procedures
3. Safe and environmental friendly ships for operation in arctic regions
4. Reduction of invasive aquatic species
5. Further reduction of ship emissions to air and water, including waste
6. Ship based defense mechanisms and measures against piracy
7. Increased awareness of the human element in during ship design and building

### *Blue Growth*

The following future regulations can be expected – based on the trends analyzed above – addressing:

1. Safe and environmental friendly offshore energy exploration and production in harsh environments (arctic, deep sea, more extreme weather conditions) regarding installations and service vessels
2. Safe and environmental friendly exploration, production and transport of Methane hydrates
3. Emission reductions (to air and into the sea) for all types of offshore installations
4. Pollution reduction from offshore food production and offshore factories
5. Threats from unauthorized access to offshore installations
6. Cyber security of (un-)manned offshore installation

### *Infrastructure*

The following future regulations can be expected – based on the trends analyzed above – addressing:

1. Sea and inland port terminals for gas (CNG, LNG, Ethane, hydrogen) discharge, storage and fueling
2. Port approaches and fairways to manage collision and grounding risks due to increased number and sizes of ships with a focus on ships carrying dangerous cargoes

3. Port modernization and expansion in relation to resulting environmental and safety impacts
4. Safe and environmental friendly arctic shipping (navigation, rescue, ports of refuge, oil recovery)
5. Shore-based rescue addressing high speed craft, large passenger ships and possibly refugees
6. Emergency response system for offshore environmental accidents
7. Recycling yards for ships and offshore installations

## Conclusions

The MESA foresight activity provides market, societal and regulatory trends, with the aim to compare these with present and expected technology developments and, thus, to be able to derive R&D needs to address identified gaps. This document provides the regulatory trends foreseen until 2030 based on an analysis of the previously identified and assigned trends on energy supply and consumption, waterborne industries, ICT, climate change, health and safety, security and the IMO strategy documents.

Most foresight studies did not directly indicate regulatory trends for the maritime industry. Therefore, the authors tried to analyse indicated trends with regard to the consequences for the maritime industry and in case it would affect the industry, if regulatory trends were likely to be expected. Identified and consolidated trends are grouped to Maritime Transport, Blue Growth and Infrastructure. Overall, 36 regulatory trends have been identified and will be integrated into the upcoming foresight study.

## 6. References

The referred studies are listed below.

Studies	URL
Clarkson Shipping Intelligence Network (2013). Shifting Shipbuilding Shares	<a href="http://www.clarksons.net/markets/feature_display.asp?section=&amp;news_id=33889&amp;title=Shifting+Shipbuilding+Shares">http://www.clarksons.net/markets/feature_display.asp?section=&amp;news_id=33889&amp;title=Shifting+Shipbuilding+Shares</a>
Wärtsilä shipping scenarios 2030	<a href="http://www.shippingscenarios.wartsila.com/Shipping_scenarios_2030_presentation.pdf">http://www.shippingscenarios.wartsila.com/Shipping_scenarios_2030_presentation.pdf</a>
Review of Maritime Transport, 2012, UNCTAD (Freight cost)	<a href="http://unctad.org/en/PublicationsLibrary/rmt2012_en.pdf">http://unctad.org/en/PublicationsLibrary/rmt2012_en.pdf</a>
World Urbanization Prospects: The 2011 Revision, UN 2012 (Urban population by major regions: 1950 – 2050)	<a href="http://esa.un.org/unup/pdf/WUP2011_Highlights.pdf">http://esa.un.org/unup/pdf/WUP2011_Highlights.pdf</a>
IEA/IHS (history) and Statoil (forecast): Energy intensity of world economy	<a href="http://www.statoil.com/en/NewsAndMedia/News/Energy Perspectives/Downloads/Energy%20Perspectives%202013.pdf">http://www.statoil.com/en/NewsAndMedia/News/Energy Perspectives/Downloads/Energy%20Perspectives%202013.pdf</a>
United Nations (2012). Sustainable Development in the 21st Century: Summary for policymakers.	<a href="http://sustainabledevelopment.un.org/content/documents/UN-DESA_Back_Common_Future_En.pdf">http://sustainabledevelopment.un.org/content/documents/UN-DESA_Back_Common_Future_En.pdf</a>
United Nations (2013). Global Sustainable Development Report	<a href="http://sustainabledevelopment.un.org/content/documents/975GSDR%20Executive%20Summary.pdf">http://sustainabledevelopment.un.org/content/documents/975GSDR%20Executive%20Summary.pdf</a>
IPCC (2013). “Climate Change 2013: The Physical Science Basis”, Summary for policymakers.	<a href="https://www.ipcc.ch/report/ar5/wg1/docs/WGIAR5_SPM_brochure_en.pdf">https://www.ipcc.ch/report/ar5/wg1/docs/WGIAR5_SPM_brochure_en.pdf</a>
Asian Development Bank (2011). Asia 2050: Realizing the Asian Century	<a href="http://www.oecd.org/site/iops/researchandworkingpapers/48263622.pdf">http://www.oecd.org/site/iops/researchandworkingpapers/48263622.pdf</a>
Food and Agriculture Organization of the United Nations (2009). How to Feed the World in 2050	<a href="http://www.fao.org/fileadmin/templates/wsfs/docs/expert_paper/How_to_Feed_the_World_in_2050.pdf">http://www.fao.org/fileadmin/templates/wsfs/docs/expert_paper/How_to_Feed_the_World_in_2050.pdf</a>
HSBC (2012). Consumer in 2050: The rise of the EM middle class	<a href="http://www.worldcaptiveforum.com/images/Consumer-in-2050-HSBCGlobalResearch.pdf">http://www.worldcaptiveforum.com/images/Consumer-in-2050-HSBCGlobalResearch.pdf</a>
National Intelligence Council (2012). Global trends 2030: Alternative Worlds	<a href="http://globaltrends2030.files.wordpress.com/2012/11/global-trends-2030-november2012.pdf">http://globaltrends2030.files.wordpress.com/2012/11/global-trends-2030-november2012.pdf</a>
UNCTAD (2013). UN Review of Maritime Transport	<a href="http://unctad.org/en/publicationslibrary/rmt2013_en.pdf">http://unctad.org/en/publicationslibrary/rmt2013_en.pdf</a>
WTO. Globalisation and trade World Trade Report 2013	<a href="http://www.wto.org/english/res_e/booksp_e/world_trade_report13_e.pdf">http://www.wto.org/english/res_e/booksp_e/world_trade_report13_e.pdf</a>
HWWI/Berenberg Bank, Maritime trade and transport logistics, strategy 2030, Germany 2007	<a href="http://www.hwwi.org/fileadmin/hwwi/Publikationen/Partnerpublikationen/Berenberg/Strategy_2030_Maritime_Trade_and_Transport_Logistics.pdf">http://www.hwwi.org/fileadmin/hwwi/Publikationen/Partnerpublikationen/Berenberg/Strategy_2030_Maritime_Trade_and_Transport_Logistics.pdf</a>
McKinsey Global Institute/McKinsey Sustainability & Resource Productivity Practice: Resource Revolution: Meeting the world’s energy, materials, food, and water needs	<a href="http://www.mckinsey.com/insights/energy_resources_materials/resource_revolution">http://www.mckinsey.com/insights/energy_resources_materials/resource_revolution</a>
Royal Dutch Shell BV, New Lens Scenarios: A shift in perspective for a world in transition.	<a href="http://s03.static-shell.com/content/dam/shell-new/local/corporate/Scenarios/New_Lens_Scenarios_Low_Res.pdf">http://s03.static-shell.com/content/dam/shell-new/local/corporate/Scenarios/New_Lens_Scenarios_Low_Res.pdf</a>

Studies	URL
UNCTAD: World Investment Report 2011 (UN)	<a href="http://unctad.org/en/docs/wir2011_embargoed_en.pdf">http://unctad.org/en/docs/wir2011_embargoed_en.pdf</a>
EU Blue Growth: Scenarios and Drivers for growth from Ocean, Seas and Coast	<a href="http://ec.europa.eu/maritimeaffairs/documentation/studies/documents/blue_growth_third_interim_report_en.pdf">http://ec.europa.eu/maritimeaffairs/documentation/studies/documents/blue_growth_third_interim_report_en.pdf</a>
Waterborne Transport Thematic Research Summary	<a href="http://www.transport-research.info/Upload/Documents/201007/20100705_152106_4661_100630_TRKC-%20Waterborne%20transport%20-%20Thematic%20Summary.pdf">http://www.transport-research.info/Upload/Documents/201007/20100705_152106_4661_100630_TRKC-%20Waterborne%20transport%20-%20Thematic%20Summary.pdf</a>
Europe 2020 Flagship Initiative Energy 2020 A strategy for competitive, sustainable and secure energy State of the Innovation Union 2011	<a href="http://ec.europa.eu/energy/publications/doc/2011_energy2020_en.pdf">http://ec.europa.eu/energy/publications/doc/2011_energy2020_en.pdf</a>
Europe 2020 Flagship Initiative Innovation Union	<a href="http://ec.europa.eu/research/innovation-union/pdf/innovation-union-communication_en.pdf">http://ec.europa.eu/research/innovation-union/pdf/innovation-union-communication_en.pdf</a>
Waterborne Strategic Research Agenda Vision 2020 – Route Map WIRM 2011	<a href="http://cordis.europa.eu/publication/rcn/14375_de.html">http://cordis.europa.eu/publication/rcn/14375_de.html</a>
IMO Strategic plan for the Organization (for the six-year period 2012 to 2017; 20.12.2011)	<a href="http://administrativeburdens.bimco.org/pdf/imo_res_a_1043-27.pdf">http://administrativeburdens.bimco.org/pdf/imo_res_a_1043-27.pdf</a>
IMO Strategic plan for the organization (for the six-year period 2014 to 2019; 27.01.2014)	<a href="http://www.imo.org/About/strategy/Documents/1060.pdf">http://www.imo.org/About/strategy/Documents/1060.pdf</a>

Further references:

COM (2004) 62	available at <a href="http://eur-lex.europa.eu/legal-content/EN/ALL/?uri=CELEX:52004DC0062">http://eur-lex.europa.eu/legal-content/EN/ALL/?uri=CELEX:52004DC0062</a>
MESA Report D5.1 – Structure and first guidelines for Market, Societal, Regulatory trends	DNVGL 2014

## Annexes

### Annex 1 - Energy Supply and Consumption (ESC), Climate Change and Environment (CCE)

Sources: UNCTAD, 2013 (UNC)  
 Intergovernmental Panel on Climate Change (IPCC), 2013 (IPCC full report (FR))  
 (IPCC Summary for PolicyMakers (SPM))  
 National Intelligence Council, 2012 (NIC)  
 Clarkson Research, 2013 (Clark.)  
 HWWI/Berenberg Bank, 2007 (HWWI)  
 McKinsey Global Institute 2011, (Mckin)  
 Royal Dutch Shell BV, 2013 (Shell)  
 Statoil, 2013 (Statoil)

Task 5.4	Regulatory Trend <sup>1</sup> and related impact	Subtrend/ item			Regulatory Trend and related impact	Subtrend/ item		
	<i>Energy supply &amp; consumption</i>	....			<i>Energy supply &amp; consumption</i>	....		
Describe impact to	In 2020		Reasoning (forecast information in study)	Source	In 2030		Reasoning (forecast information in study)	Source
Ships	New efficiency standards for cargo and passenger ships	The new efficiency standards may differ depending on the region (e.g. US vs. China coastal waters)	The efficiency standards in the US and efficiency measures in China will be tightened (for energy in general)	Statoil pg. 22	Trends for policies development regarding ship energy intensity (energy intensity is amount of energy consumed per unit of GDP produced)	New policies for ship energy intensity	Energy intensity declines annually (in global), this is also expected for transportation sector	Statoil pg. 14
					Rules for methane-hydrates carriers	Standards for methane-hydrates cargo tanks must be developed	New gas supply source (methane-hydrates). A lot of gas is held in place on this way where methane molecules may be trapped in ice	Statoil pg. 28 Shell pg. 43
					Rules for hydrogen carriers	Development of hydrogen storage tanks	Use of hydrogen for energy transportation from remote renewables by shipping	Shell pg. 35
Blue growth					Standards & regulations on wave power generation	Until now wave power generation was too expensive, might be realistic in future	Two drivers for this technology: the power sector's shift to the new renewables, and energy consumers'	Statoil pg. 31

<sup>1</sup> This may not exclusively be a regulatory trend, but could be also a trend which will likely result in the development of relevant regulations addressing the trend effects

Task 5.4	Regulatory Trend <sup>1</sup> and related impact	Subtrend/ item			Regulatory Trend and related impact	Subtrend/ item		
	Energy supply & consumption	....			Energy supply & consumption	....		
							shift to electricity	
					Provide standards for deeper water and the Arctic drilling	Enabling access to deeper water and the Arctic	Improved capability to drill in ever harsher environment	Shell pg. 66
					Standards and guidelines for better water usage practise	Standards and guidelines for more efficient water desalination	Energy to desalinate water accounts for 65% of domestic oil use in some countries	Shell pg. 72
						Standards and guidelines for more efficient water usage in energy sector	Growing energy demand causing demand on water, as huge amount of water is used by energy companies	Shell pg. 72
Owners, operators	Standards on use of different "transportation fuels"	Use of LNG, CNG and bio fuels as ship fuels	HFO is challenged by LNG, CNG and biofuels	Statoil pg. 15 Shell pg. 65 (bio fuels)				
					Increased trade of LNG, further development of standards		LNG demand double up to 2030	Statoil pg. 28
					Region-specific fuel regulations for local operators of bunkering plants	"Interregional fuel mix differences"	Different fuels in different regions available (depending on available resources)	Statoil pg. 15
Yards, suppliers					Needs for more energy efficient engines/ components		High oil and gas prices	Shell pg. 59
					Standards for 3D printed components		3D printing is fast and low cost manufacturing technology	Shell pg. 88
Service suppliers								
Infrastructure	Standards addressing safety issues from Gas (market) penetration in the transportation sector	Bunkering facilities in ports for use of gas as fuel on board of cargo and passenger ships	A directive released in January 2013 for providing LNG refuelling possibilities in Europe's main ports	Statoil pg. 33	Provide standards on methane-hydrates gas production	Standards on loading infrastructure must be developed	New gas supply source (methane hydrates). A lot of gas is held in place on this way	Statoil pg. 28
	Developing appropriate standards for efficient energy transportation	Trend is to rather increasing lengths of the transportation ways	Energy transportation from remote renewables (remote renewables are positioned far away from	Shell pg. 35	Standards and regulations for (novel types of ) energy storage and transportation over distances	Standards and regulations for hydrogen energy transportation	Energy transportation from remote renewables by means of hydrogen	Shell pg. 35

Task 5.4	Regulatory Trend <sup>1</sup> and related impact	Subtrend/ item			Regulatory Trend and related impact	Subtrend/ item		
	<i>Energy supply &amp; consumption</i>	....			Energy supply & consumption	....		
			the consumers)					
						Standards for energy transportation via huge sub-sea cables	Cost-competitive storage and transportation of energy from remote renewables	Shell pg. 69

Task 5.4	Regulatory Trend and related impact	Subtrend/ item			Regulatory Trend and related impact	Subtrend/ item		
	<i>Climate Change &amp; Environment</i>	....			Climate Change & Environment	....		
Describe impact to	In 2020		Reasoning	Source	In 2030		Reasoning	Source
Ships	Reduction of CO2 emissions - > tightening of related policies is necessary	Global climate agreement is an open question until 2020	Existing disagreements regarding global climate politic are not resolved	Statoil pg. 17	Tightening of energy policies and standards		Emissions from hydrocarbon energy will continue to grow as use of hydrocarbons will grow (emissions will not be compensated by reduction of coal usage)	Shell pg. 45
Blue growth	Provide or prepare blue growth industry (e.g. drilling units, FPSOs and other) to excessive rain and flooding		Climate changes caused by increasing CO2 emissions and following global warming	Shell pg. 76	Provide or prepare blue growth industry (e.g. drilling units, FPSOs and other) to extreme climate changes	Extreme climate events caused by elevated levels of CO2 in the atmosphere	Offset by efficiencies and renewable energy, greenhouse gases reach the maximum	Shell pg. 68
					Environmental rules and regulations on Methan-hydrates gas production		There are environmental challenges remaining for methane hydrat gas production	Statoil pg. 28
Owners, operators								
Yards, suppliers								
Service suppliers					Smart resource policies		Very high CO2 emissions raising severe concerns about climate turbulence	Shell pg. 70
Infrastructure								

Regulatory Trend and related impact	Subtrend/ item	Reasoning	Source	ESC/ CCE	Ship	Blue Growth	Owners, operator	Yards, Suppliers	Service suppliers	Infrastructure
-------------------------------------	----------------	-----------	--------	----------	------	-------------	------------------	------------------	-------------------	----------------

Regulatory Trend and related impact	Subtrend/item	Reasoning	Source	ESC/CCE	Ship	Blue Growth	Owners, operator	Yards, Suppliers	Service suppliers	Infrastructure
2030 Transportation of liquid bulk goods (primarily crude oil, petroleum products, and liquid gas) stagnates, and could be shadowed by pipelines	Growth of liquid bulk uncertain	To estimate the volume of sea trade on the basis of the predicted trade volume, it is assumed that the relative shares of cargo conveyed by the various modes of transport will remain constant in the long term. Historical observations substantiate this assumption for the time frame of the forecast. Risks only exist for liquid bulk goods, since pipelines to be built in the future could supersede the sea transport now being used.	HWWI, P62	ESC				y		y
	Faster growth of container, stagnation of liquid bulk	... the strong expansion in European container traffic and the stagnation shown in liquid bulk goods.  ----- a broad push toward energy efficiency could reduce oil demand to the levels witnessed in the late 1990s (Exhibit 43).	HWWI, P63  --- Mckin, P159							
2030 Low or no growth in oil demand, moderate growth in that of gas and alternative energies  --> Regulation on gas and alternative energies (High Demand)		... it is assumed that, as the result of price increases for energy resources and energy-saving technical progress, worldwide demand for energy will grow at a rate that is 2.1% lower than that of production of goods.  There are considerable differences in the growth rates of the individual energy resources: The demand for oil and coal grows at a yearly rate of almost 1.7%, much more slowly than that of gas (2.4%) and alternative energy sources (3.3%).	HWWI, P63	ESC	y		y	y		y
		The minimal increase in overall energy demand in Europe, along with a relatively high growth rate in alternative energies and gas, which is expected to increase by 35% by 2030, leads to a constant demand for oil and a slight decline in the demand for coal (-6% by 2030). Since oil and oil products are clearly dominant in the trade volume of liquid bulk goods, the transport volume of this group of goods is hardly likely to increase in the future.	HWWI, P63	ESC	y		y	y		y
		outlook for LNG trade is positive as global consumption is set to increase in view of: (a) Surging production and exports in the United States; (b) New gas finds worldwide (for example, Cyprus, Israel, Mozambique and the United Republic of Tanzania); (c) The projected growth in Asian LNG imports sustained, in particular, by China's strategic commitment to promote gas use; (d) The decline in nuclear power use; (e) The attractiveness of gas as a "greener" alternative to other fossil fuels.	UNC, P18	ESC	y		y	y		y
2030 Weak increase in crude oil demand		According to an IEA forecast, crude oil demand until 2030 will increase annually by only 1.7%	HWWI, P101	ESC						
	Long distance transport increases, Larger tankers will benefit	Transport distances, which have declined in the past, will increase again .. this will primarily benefit larger tankers. During the first half of the forecast period, the importance of large tankers will also increase because the greatest growth in oil consumption and imports is expected in the Asian region, and because there are no size limitations on the route between the Persian Gulf and Asia.	HWWI, P102	ESC						
	Regulations on backup propulsion and automated loading and unloading (Normal)	In the future, the requirement for a second, back-up propulsion unit may be added to the list, to improve the maneuverability of the vessel and to maintain its operability in case of engine damage. Since retrofitting is likely to be too expensive, new tanker constructions would profit from this. The trend toward the automated loading and unloading of tankers will increase, reducing the likelihood of human operating errors	HWWI, P102	ESC, CCE	y		y	y		
	Regulations for activities in polar regions and ice-	Since significant oil resources are expected in the polar regions and petroleum exports from Russia will be climbing, tankers will be used in frozen waters to an increasing extent. A high ice class necessitates a more powerful propulsion system and a sturdier hull, raising construction costs by 10%-20%. This investment could	HWWI, P102	ESC, CCE	y	y	y	y	y	

Regulatory Trend and related impact	Subtrend/item	Reasoning	Source	ESC/CCE	Ship	Blue Growth				Infrastructure
						Owners, operator	Yards, Suppliers	Service suppliers		
	strengthened tankers (High Demand)	pay, however, since the demand for ice-strengthened tankers could climb in the medium term by as much as 30%.								
2030 Regulations on transport of oil products (Normal)		seaborne trade with oil products could grow more quickly than crude oil trade, a contrast with the past, and the major consumers (USA, China) will be increasingly dependent on imports ... the demand for products tankers is expected to rise at the expense of crude oil tankers.	HWWI, P103	ESC	y		y	y		
2030 Regulation on gas transportation (High demand)		With the exception of regenerative energies, the demand for natural gas up to 2030, at 2.4% annually, will show the highest growth rate among energy sources. As the result of the growing geographic imbalance between demand and production, international gas trade will increase even more rapidly, tripling by 2030. ...The current 70% share of pipeline-bound transport is expected to decline in the future, as the shipping of natural gas over long distances is more cost-effective.	HWWI, P104	ESC	y		y	y		y
2030 Regulations on LNG (High demand)		In 25 years, half of natural gas trade is likely to be handled by LNGs. The number of LNG exporting and importing countries will rise considerably.	HWWI, P105	ESC, CCE	y		y	y		y
		Increase in size...	HWWI, P105							
	Regulations on new LNG tanking technology for ships (High demand)	New Tank technologies and Cost degression	HWWI, P105							
2030 Regulations of new propulsion technologies (Potentially high demand)		The energy-efficient and environment-friendly ship	HWWI, P109	ESC, CCE	y		y	y		y
	Regulations on complex power/energy management (Potentially high demand)	the diesel-electric, indirect drive, is likely to prevail...	HWWI, P110							
	Regulations on fuel cells (Potentially high demand)	Fuel cells are already being used for the shipboard power supply. Spurred on by environmental legislation, this technology could gain acceptance even earlier in ecologically critical regions. <i>* This may raise requests on harbor infrastructure, i.e. Hydrogen storage and charge facilities</i>	HWWI, P110							
	Regulations on wind propulsion (Potentially high demand)	Wind as a propulsion force is cost-free and environmentally compatible. Ships equipped with auxiliary sail propulsion units can save 10%-70% of fuel, depending on the system and the application area.	HWWI, P110							
2030 Drilling Cost increases but the drilling activities also increases --> Regulations on new offshore tech. and systems, especially deep-water activities (High demand)	Old oil/gas reservoirs are getting deplete, new fields are located in hard-to-access areas, e.g. deep-water	As the quality of reserves deteriorates, production is shifting to more complex sources of supply, including tar sands and deepwater oil. This not only increases the risk of disruptions to supply but also makes supply even more inelastic. Deepwater offshore oil projects accounted for 24 percent of offshore oil wells in 2009, an increase from 19 percent in 2005.	Mckin, P45	ESC, CCE	y	y	y	y		
	Oil projects are becoming smaller and more expensive	Longer-term supply costs may also be increasing. Some oil projects are becoming smaller and more expensive. The average real cost of bringing a new well on line doubled from 2000 to 2010—a cost increase of more than 7 percent per annum. According to the IEA, increasing costs have been driven by soaring costs of drilling and oil-field services, skilled labor,	Mckin, P46							

Regulatory Trend and related impact	Subtrend/item	Reasoning	Source	ESC/CCE	Ship	Blue Growth	Owners, operator	Yards, Suppliers	Service suppliers	Infrastructure
		materials, and energy, as well as a shift in spending toward more technically complex projects such as deepwater fields and smaller fields, where unit costs tend to be higher. These factors have more than offset the reduction in costs due to technology improvements that helped lower costs in the 1990s.								
	Cost increases and drilling technologies are developing	In the case of oil, a large share of the new production that is necessary between 2010 and 2030 is due to the depletion of existing wells. Peter Voser, chief executive officer of Shell, recently stated that the equivalent of "four Saudi Arabias or ten North Seas over the next ten years" needs to be added just to replace declining production and to keep oil output flat. ----- The rising capital cost of extraction is another challenge for the industry. Capital costs have increased sharply even over the past decade. Capital investment is likely to increase by 30 to 50 percent above historical levels between now and 2030. Steel accounts for around 30 percent of the capital cost of any new oil project, and steel costs are likely to increase as the oil and gas industries move increasingly into more challenging forms of exploration such as ultra-deepwater. J.P. Morgan notes that the global count of shallow water wells dropped by 25 percent between 2005 and 2009, while ultra-deepwater wells increased by 30 percent. In addition, more complicated drilling methods, such as horizontal drilling, can require four times the amount of steel as traditional vertical drilling.	Mckin, P63 --- Mckin, P159							
Gas remains similar importance		Within power, we assume that gas maintains a similar share of 21 percent with a 50 percent increase in total production capacity over the next 20 years.	Mckin, P63	ESC, CCE						
2030 Regulations on renewable energies (High demand)		Within renewables, we expect wind to increase its share of power generation the quickest, from 1.5 percent today to around 5 percent in 2030; installed capacity is likely to increase by almost 400 percent. We see solar power increasing its share of power generation from 0.1 percent today to 1 percent in 2030, a 12-fold increase in generation and an eightfold increase in total capacity.	Mckin, P64			y	y	y		
2030 Regulation for pricing of environmental concerns, such as carbon emission and water usage (Potentially high demand)		As in the mining industry, the oil and gas industry is likely to face increasing pressure from regulators to pay for currently largely unpriced inputs such as carbon and water, to address production-related environmental concerns, and to capture more of the value of their resource endowments.	Mckin, P159	CCE			y	y	y	
		Continued emissions of greenhouse gases will cause further warming and changes in all components of the climate system. Limiting climate change will require substantial and sustained reductions of greenhouse gas emissions.	IPCC SFP Pg2	CCE	y	y	y	y		
Regulations introducing Market based measures for GHG reduction		Despite improvements in the fuel-efficiency of ships, GHG emissions from maritime transport are projected to increase rapidly over the coming decades. To address their growth, market based measures (MBMs) for the reduction of GHG emissions from international shipping <sup>29</sup> have been proposed to complement technical and operational measures already adopted.	UNC P108	ESC, CCE	y			y	y	
Setting into force the 1996 HNS Convention, as amended by its 2010 Protocol (2010 Hazardous and Noxious Substances Convention)		While the 2001 BOPC is in force internationally, the 1996 HNS Convention, as amended by its 2010 Protocol (2010 HNS Convention) has not yet attracted the required number of accessions for its entry into force. Thus, at present, no international regime is in force to provide for liability and compensation arising in connection with the carriage of HNS cargos. This is a matter of concern, given the potential for coastal pollution, as well as personal injury and death that may be associated with an incident involving the carriage of chemicals and other HNS cargos.	UNC P110	CCE			y			
2030		Risk management: Pursuing more sophisticated environmental risk	Mckin,	CCE						

Regulatory Trend and related impact	Subtrend/item	Reasoning	Source	ESC/CCE	Ship	Blue Growth	Owners, operator	Yards, Suppliers	Service suppliers	Infrastructure
Regulation on sophisticated environmental risk Management On Oil&Gas (High demand)		management. Risk management: Pursuing more sophisticated regulatory risk management.	P161							
Regulations regarding liability and compensation of pollution damage from offshored oil exploration		IMO Legal Committee decided to analyse further liability and compensation issues connected with transboundary pollution damage resulting from offshore oil exploration and exploitation activities, with the aim of developing guidance to assist States interested in pursuing bilateral or regional arrangements	UNC P111	CCE		y	y			
2025 Containership will see firm growth		Of the largest 'volume' sectors, the fastest long-term demand growth is projected to be in the containership sector.	Clark., P20	CCE	y		y	y	y	y
	Containerships are becoming larger, potential influence on 1. infrastructure 2. Eco and fuel-efficient design	Demand for the larger vessel sizes is expected to be especially firm, with demand growth of 6.9% per annum projected in the 8,000+ TEU VLPP sector, and 6.5% per annum in the 3-8,000 TEU Post-Panamax sector. Investment in these large ships for deployment on the mainlane trades and increasingly the non-mainlane trades, is likely to continue into the long-term as owners and charterers take further advantage of economies of scale and fuel efficient designs.	Clark., P20	CCE	y		y	y	y	y
		The long-term requirement growth for 2-3,000 TEU Sub-Panamax vessels is also expected to be firm at 6.0% p.a, as vessels of this size are expected to be increasingly utilised as feeder vessels for the largest containerships, in addition to further deployment on intra-regional trades.	Clark., P20	CCE	y		y	y		
2025 Tanker is expected to have the weakest growth		In the tanker sector, long-term demand growth is expected to average 2.5% p.a.	Clark., P20	ESC	y		y	y		
	Large and long-haul tanks will see relative strong growth	Growth is expected to be fastest in the VLCC sector at 2.8% p.a., due to the sector's high exposure to Asian long-haul imports (particularly into China), which are expected to remain the major driver of crude oil trade growth going forwards. Demand growth in the smaller crude tanker sectors is expected to be more limited, as oil demand growth in developed countries remains relatively weak (particularly as countries continue to aim towards greater energy efficiency) and higher US oil production continues to limit demand.	Clark., P20	ESC	y		y	y	y	y
	Growth of product tanker driven by growing refineries in oil-export lands and closure in developed countries	Meanwhile, products tanker demand growth is expected to be partially driven by increased export availability in India and the Middle East Gulf, in addition to improvements in European and US import demand following the closure of some refinery capacity.	Clark., P20 Also HWWI, P103	ESC	y		y	y	y	y
2025 Moderate growth in dry bulk sector, driven by China's demand on coal and metal ore		Dry bulk demand growth is expected to average 3.6% per annum in the long-term. Growth in the intra-Asian coal and mineral trade is expected to be firm, particularly in Indian coal imports and Chinese imports of coal, bauxite and nickel ore. This growth supports demand growth projections for 4.1% for Panamax and 3.3% for Handymaxes in the long-term. Meanwhile, Capesize growth is expected to average 4.4% p.a., driven by continued firm	Clark., P20	CCE	y		y	y		

Regulatory Trend and related impact	Subtrend/item	Reasoning	Source	ESC/CCE	Ship	Blue Growth				
						Owners, operator	Yards, Suppliers	Service suppliers	Infrastructure	
		growth in Chinese iron ore demand and increased exports from Australia, Brazil, and potentially West Africa in the long-term.								
2025 Firm growth on LNG related activities		Long-term demand for gas is expected to grow strongly. Rising demand for low-carbon energy sources in Asia and Europe and rising exports from the US is expected to support growth as is a long list of scheduled LNG projects.	Clark., P20	ESC, CCE	y		y	y	y	y
2025 Firm growth on offshore activities		Demand for offshore units is projected to grow by 6.5%, driven by strong demand for general offshore oil and gas support.	Clark., P20	ESC CCE	y	y	y	y	y	y
2025 Cruise ship growth well → Expand class and advisory services in emerging market, e.g. Asia	Diversify: 1. Emerging tourism market in east Asia 2. New player in cruise ship building, e.g. Japan	Cruise ship demand is expected to reach 5% p.a. in the long-term, as passenger sourcing continues to diversify.	Clark., P20	CCE	y		y	y	y	y
2025 Younger scrapping age  Regulations → 1. Environmental metrics, e.g. SEMP, EEDI 2. ECA 3. Fuel-Saving and Eco design 4. HK convention for ship recycling		Current market conditions and the future regulatory environment means that a younger scrapping age is assumed for many sectors. Future fleet replacement requirements reflect this accelerated demolition.	Clark., P22	CCE	y		y	y	y	y
2018 In Europe, only high-tech and niche new-building markets are to sustain		Overall, output from European yards is expected to decline by 54.1% between 2012 and 2018 in terms of CGT. However, demand for niche sector vessels, particularly cruise ship, and offshore support vessels will offer some support to these yards. The relative lack of government support for the European shipbuilding industry, and their higher operating costs, will increase the pressure on yards to sustain technological and design innovation if they are to secure new orders.	Clark., P36	CCE				y		
2016-2020 VLGC demand will grow moderately, while LPG demand focused in Asia		Average VLGC demand growth is projected to remain firm in the medium-term at 4.0% p.a. in 2016-20, while mid-sized LPG carrier demand is projected to increase by 3.0% p.a. in the same period. LPG demand growth is likely to remain focused in Asia, where expansion in downstream capacity is expected to drive growth in use of LPG as a petrochemical feedstock.	Clark., P62	ESC	y		y	y	y	y
2018 Shale oil and gas production in US will benefit trans-Atlantic LPG and ethylene carriers; US export to far east is also possible, which benefits VLGC. → Consulting on		However, the headline story for LPG remains the further development of shale oil and gas production in the US, which is expected to benefit LPG carriers in the short and mediumterm. Since the impact of shale began to be felt in 2008, US LPG exports have grown rapidly (56% p.a. between 2008 and 2012) to stand at 3.8mt in 2012. This trend is likely to continue, with US exports becoming an increasingly key driver of Atlantic LPG demand in the mediumterm. Furthermore, ethane exports from the US could develop from mid-decade, which may support demand for ethylene carriers. US cargoes are also likely to be exported on increasingly long-haul routes, particularly to the Far East, further supporting VLGC demand.	Clark., P62	ESC	y		y	y	y	Y

Regulatory Trend and related impact	Subtrend/item	Reasoning	Source	ESC/CCE	Ship	Blue Growth				
						Owners, operator	Yards, Suppliers	Service suppliers	Infrastructure	
shale gas topics?										
2025 Long term demand of VLGC is less than medium term, focused in developing economies		Long term demand for VLGCs is projected to increase by 3.5% p.a. on average over 2021 to 2025, while demand for mid-sized vessels is projected to increase by 2.7% p.a. in the same period. Demand for LPG is expected to remain focused in the developing economies of Asia and South America,	Clark., P62	ESC	y		y	y	y	Y
2018 Medium term growth of LNG is expected to be driven by US shale gas and consumption market in Asia. → Consulting on shale gas topics?		In the medium-term, the start-up of planned projects is expected to accelerate (see projects list on pages 194-195 of this report). Primarily this growth is expected to be driven by the shale gas boom in the US, which is projected to result in significantly higher US export volumes...  The Asian market is expected to remain the key area of demand growth for LNG, with positive implications for vessel demand owing to the increasingly long-haul nature of many routes ...	Clark., P64	ESC	y		y	y	y	y
2025 Firm growth of LNG is expected in long term → LNG related regulations and services		The long-term outlook for the LNG market remains positive, with a number of liquefaction and re-gasification projects likely to be proposed. As most of these projects will require additional vessels, firm growth in demand for LNG carriers is expected in 2021-25.	Clark., P64	ESC	y		y	y	y	y
2025 Offshore oil production is to increase in significance → More offshore standards and service products		Offshore oil production currently accounts for 30.5% of global oil supply and the equivalent proportion for gas is 31% (and rising). By 2020, these proportions are expected to have reached 32% and 36% respectively. The offshore oil industry is expected to be a key part of servicing an expected increase in global oil demand to 110m bpd over the next 25 years as new technological developments render previously inaccessible oil extractable.	Clark., P86 Also in Mckin, P45	ESC, CCE	y	y	y	y	y	y
	More deep water drilling demands more offshore vessels → Regulation on deep water activities	With more Drillships being delivered over the next few years, more oil will be accessible in deeper water in the medium and long-term. These factors suggest that demand for offshore vessels will continue to grow steadily in the long-term. On current projections, an average of 350 contracts p.a. are projected in 2016-22.	Clark., P86	ESC, CCE	y	y	y	y	y	y
	More offshore and offshore support vessels	Long-term demand assumptions for drilling and production units are underpinned by analysis of oil and gas fields under construction and those regarded as potential development prospects, including a prospective developments offshore Brazil. Further growth in the offshore fleet will also drive demand for support vessels.	Clark., P86	ESC, CCE	y	y	y	y	y	y
	More vessels for harsh and remote environments, e.g. ice class → Regulation on	Additionally, the trend towards increasing offshore operations in harsh and more remote environments such as the Arctic will potentially lead to greater demand for vessels with iceclass status in the medium to long term.	Clark., P86 Also in Mckin, P45, HWWI,	ESC, CCE	Y	Y	Y	Y	y	y

Regulatory Trend and related impact	Subtrend/item	Reasoning	Source	ESC/CCE	Ship	Blue Growth	Owners, operator	Yards, Suppliers	Service suppliers	Infrastructure
	vessels and operation in ice or harsh environments	<p>... reduced sea ice extent has altered, and in the future may continue to alter, ocean circulation, ocean productivity and regional climate and will have direct impacts on shipping and mineral and oil exploration.</p> <p>It is very likely that the Arctic sea ice cover will continue to shrink.</p>	<p>P102</p> <p>IPCC FR P321</p> <p>IPCC SFP Pg2</p>		Y	Y		Y		
					Y	Y	Y			

## Annex 2 - ICT (Information & Communication Technology)

Sources: US National Intelligence Council, 2012 (USNIC)  
Waterborne Transport Thematic Research Summary, WSRA 2011

Regulatory Trend and related impact	Subtrend/item	Reasoning	Source	ICT	Ship	Blue Growth	Owner's operator	Yards, Suppliers	Service suppliers	Infrastructure
2030 Massive growth in capability and complexity as well as more widespread diffusion of IT -> regulate the use of customer data		Information technology is entering the big data era. Process power and data storage are becoming almost free; networks and the cloud will provide global access and pervasive services; social media and cybersecurity will be large new markets.	NIC, p. 86	ICT						
2030 widespread use of enabled IT - providing new capabilities	Cloud infrastructure and services	Cloud architecture will improve utilization rates of computing infrastructure and optimize network use. The cloud also will put increased computing capability and meaningful analysis in the hands of 80 percent of the world's population. Network efficiency will increase by more than a factor of 200.	USNIC, p. 55	ICT						
	smart mobile devices	Mobile devices are becoming increasingly rich sensor platforms, enabling nearly all communication mediated by technology to be tracked and analyzed at a fine level of detail. More than 70 percent of the world's population already has at least one mobile device; global mobile data traffic in 2010 was three times the size of the entire Internet in 2000.	USNIC, p. 55	ICT						
	Cheap digital storage	Cheap digital storage means nearly all data will be archived indefinitely. Information will be "smart" about itself – indexed, categorized, and richly tagged upon collection so that it can be easily analyzed later. Computer memory costs to drop by 95 percent, raw data storage costs to reduce to one percent of the current price.	USNIC, p. 55	ICT						
	Widespread use of Bots	Bots—programs that run automated tasks in the Internet-connected world—could become as prevalent as robotics in the industrial world. Although bots are best known for their use in hacking and disruptive activities, they can be used for any purpose. When combined with massive data, bots could manage complex and persistent tasks on behalf of individuals and networked groups.	USNIC, p. 55	ICT						
2030 Increased vulnerability to cyber attacks  -> regulate IT security of critical infrastructures	cyber attacks directed at critical infrastructures	Growing interconnectivity of devices and software, including greater use of the cloud and integration between systems will increase the vulnerabilities of technology leaders to attacks.  ... deep interconnectivity between different software systems and devices is likely to become the norm, enabling remote access to all kinds of systems that are offline today. More and more everyday actions will have a digital component ...  As societies become more dependent on software and systems become more interconnected, the potential levels of damage that cyber weapons will be able to inflict will increase.	USNIC, p. 66	y	y	y	y	y	y	
	theft of intellectual property	... widespread and enabled IT use also will benefit illicit networks involved in crime, terrorism, human and drug trafficking, and the theft of intellectual property ...	USNIC, p. 55	ICT	y	y	y	y	y	y
2030 Increased vulnerability to weather phenomena -> regulate potential redundancies or fall-backs		Solar geomagnetic storms could knock out satellites, the electric grid, and many sensitive electronic devices. The recurrence intervals of crippling solar geomagnetic storms, which are less than a century, now pose a substantial threat because of the world's dependence on electricity. Until "cures" are implemented, solar super-storms will pose a large-scale threat to the world's social and economic fabric.	NIC, p. 52							
		Automation enabled by smart sensing and intelligent control	WSRA,							

Regulatory Trend and related impact	Subtrend/ item	Reasoning	Source	ICT	Ship	Blue Growth	Owners, operator	Yards, Suppliers	Service suppliers	Infrastructure
		systems	p. 7							
		Monitoring and data logging?	WSRA, p. 13							
	Automation, Control and navigation	Next generation automation, navigation and control systems on-board commercial vessels need to be substantially improved to reduce the costs of hardware, installation, commissioning and maintenance by 20% to 30%. The key technology is distributed control systems, where one module can be equipped, tested and set into operation on its own and the completed modules can be commissioned in a few hours.	WSRA, p. 18							
	Intelligent Data Management	Greater systems sophistication and traffic densities will require higher degrees of automation and decision support in all areas of vessel operation including navigation, communication, pilotage, docking, collision avoidance and communications. Future navigation systems will become increasingly proactive and interlinked with shore based logistics management systems, for example port scheduling. They will take external data about weather systems and traffic patterns and integrate this with information on ocean currents and tides, fairway conditions and lock status, to set an optimum routing that both minimises operating costs and maximises throughput in our ports. The development of automation and communication technology could enable operational concepts of semi autonomous, slow moving ship or barge 'pipelines', delivering cargoes with an extremely low carbon footprint. A key enabling technology is available through the EU sponsored Galileo satellite navigation system.	WSRA, p. 18							
	Product Model and Inter-System Data Communication	Wrong description in document (duplication)	WSRA, p. 20							
	Intelligent Maintenance Planning and Optimisation	Improved and optimised maintenance scheduling is a key factor for competitiveness. It will be enhanced by the further development and implementation of emerging technologies such as embedded Equipment Health Monitoring (EHM) to provide an enhanced and reliable predictive maintenance support. European leadership in the world equipment market is the platform for service business expansion. All high value equipment needs to have EHM systems embedded into the design. Equipment through life reliability models will be required to provide the prognostic capability to deliver condition-based maintenance. Increased equipment lifetimes and possible extended periods of lay up will require new methods for environmental protection and monitoring. Development of in service performance databases and innovative intelligent pattern recognition tools will deliver robust maintenance planning information. This will maximise the availability of the ship and its asset value. It will enable ship operators to upgrade ships in service for optimum efficiency and new regulatory standards.	WSRA, p. 24							
	Automation and Platform Management	New developments in process automation, computer technology, sensors, smart components and communication must be applied to the maritime industry to enable the safe and efficient operation of increasingly complex vessels with a minimum of crew. The control systems must be designed by risk based methods to achieve the objectives of economic operation, safety and environmental protection. The individual systems need to be designed to standardise hardware and software interfaces within a holistic platform management concept. The on-board decision support systems will be linked to shore based control centres for technical back up and incident management support. The development of automation and communication technology could enable operational concepts of semi-autonomous, slow moving ship or barge 'pipelines', delivering cargoes with an extremely low carbon footprint.	WSRA, p. 24							
	High Quality and Efficient Intermodal Services	IT system must control all points in the supply chain (based on harmonized information availability and automated tracking & tracing features), including terminals and trans-shipment points.	WSRA, p. 29							

Regulatory Trend and related impact	Subtrend/item	Reasoning	Source	ICT	Ship	Blue Growth	Owners, operator	Yards, Suppliers	Service suppliers	Infrastructure
	Automatic Operations	Automated control of vessels approaching/departing port using intelligent systems and improved navigational aids could significantly help to increase efficiency and safety of ship handling. The technological aspects of such development should be investigated along with a consideration of the legal and regulatory aspects.	WSRA, p. 30							
	Integrated ICT solutions	Integrated ICT and ITS will be a key future capability, these include the IMO e-Navigation Strategy and the EC e-Maritime initiative. They are a European key competence demonstrated e.g. by the status of development of River Information Services (RIS). Innovation in this field is essential. It will enable more efficient planning, booking, simulation, routing and control of cargo along the different transport modes as well as providing other services supporting efficiency, safety and security.	WSRA,							
A need for data security ...	Ports Network and Data Exchange	To maximise the efficiency of the real time transport opportunities and vessel utilisation it is necessary to develop a web-based system of port networking to identify and exchange vessel locations, planned routes, cargo facilities and dates and times of movement.	WSRA,							
	Decision Support Systems and ICT	Efficient data models and algorithms are required for shore based traffic management systems. These must be developed, tested and implemented for large numbers of participants and high risk / dense traffic areas; as well as for port approaches and port call preparation. Man-machine interfaces will have to be improved and simple to use. Decision support systems need to be developed and tailored for land based and on-board use to minimise the potential for human error.	WSRA,							

### Annex 3 - Health and Safety

Sources: United Nations (2013). Global Sustainable Development Report (GSD-Report)  
World Urbanization Prospects: The 2011 Revision, UN 2012 (WUP-Report)

Regulatory Trend and related impact	Subtrend/ item	Reasoning	Source		Ship	Blue Growth				
						Owners, operator	Yards, Suppliers	Service suppliers	Infrastructure	
<p>To sustain Nature and Life Support</p> <p>=&gt; High demand in regulation to reduce air pollution, protect resources and stabilize the climate change</p> <p>=&gt; Demand for an enhanced marine pollution prevention</p>	<p><u>Focus on:</u> <u>Resources:</u></p>	<ul style="list-style-type: none"> <li>Cumulative fossil fuel use limited to &lt;520 Gtoe from 2010 to 2050</li> <li>Slow overfishing and later restore fish stocks</li> </ul>	GSD-Report		Y	Y	Y	Y	Y	Y
	<p><u>Focus on:</u> <u>Air pollution &amp; climate change:</u></p>	<ul style="list-style-type: none"> <li>Keep PM2.5 concentration below 35 µg/m3 by 2030</li> <li>Reduce NOx, SO2 and black carbon emission by 25% vs. baseline by 2050</li> <li>Reduce SO2 by 42% and black carbon by 21% by 2050 vs. 2010</li> <li>Limit global average temperature change to 2°C [or 2.8°C] above pre-industrial levels with a likelihood of &gt;50% (or 60%) by 2100.</li> <li>Atmospheric GHG concentration stabilization below 450 ppm [or 350ppmv] (or 550ppmv) CO2-eq. by 2100</li> <li>Limit ocean acidification to keep aragonite stable, with pH=8.0 in 2150</li> </ul>	GSD-Report		Y	Y	Y	Y	Y	Y
	<p><u>Focus on:</u> <u>Marine pollution</u></p>	<ul style="list-style-type: none"> <li>To reduce the marine pollution:               <ul style="list-style-type: none"> <li>➢ Reduction the invasive aquatic species</li> <li>➢ Avoid unsustainable costal area development,</li> <li>➢ Improve the safety of navigation and maritime security</li> </ul> </li> </ul> <p>is to be enforced by new regulations</p>	GSD-Report		Y	Y	Y	Y	Y	Y
<p>Inland waterway traffic and coastal feeder services will become more important/will grow in the future</p>	<p>Inter-European water transport need to be supported, regulated and standardized</p>	<ul style="list-style-type: none"> <li>The urbanization within the next decades will intensify the need to strengthen the supply chain from rural areas to urban areas with higher population rates. Furthermore the coastal traffic e.g. from bigger hubs to smaller harbors (coastal and in-land) will increase.</li> </ul>	WUP-Report		Y		Y	Y	Y	Y

## Annex 4 - Security

Sources: US National Intelligence Council / Global trends 2030 (USNIC)  
 N.A.: Europe 2020 Flagship Initiative Energy 2020  
 N.A.: Waterborne Transport Thematic Research Summary  
 DNVGL experts from IMO committees (IMO/DNVGL)  
 DNVGL - The Future of Shipping 2020 (DNVGL)

Regulatory Trend and related impact	Subtrend/ item	Reasoning	Source	ESC/ CCE/	Ship	Blue Growth	Owner's, operator	Yards, Suppliers	Service suppliers	Infrastructure
Risk based methods – Goal based Standards GBS and Safety Level Approach SLA	Development of special tailored ship designs in view of special operation or service area		IMO/DN VGL		y		y	y		
	More possibilities for innovative approaches outside of current prescriptive regulatory framework		IMO/DN VGL		y		y	y	y	y
	New services like risk assessments for risk based designs or risk based PSC		IMO/DN VGL						y	y
Unmanned Ships (US)		New technologies, like worldwide data connections, durable systems with very high availability enable shipping industry to develop USs.	DNVGL							
	Multi redundant systems on ships	Independent operating far away from shore based maintenance facilities	DNVGL		y			y		
	New ship and fleet management via ITC	Responsibility for the ship change from a master to an on shore operator	DNVGL				y		y	y
	Increased safety factors	Safety of non-redundant ship parts (e.g. ship hull) need to be re-defined	DNVGL		y			y		y
	IT services around the world	Key technology is the 24h availability of on board and on shore IT systems and their connectivity	DNVGL				y		y	y
	Handling of fully automatic acting ships in harbour operations	Safe interaction between US and involved parties for all harbour activities from pilot access over loading/unloading to fuelling and maintenance	DNVGL		y		y	y		y
	New procedures for navigation, especially in narrow fairways and with high traffic densities	Safe operation/interaction of an US and other manned and unmanned ships	DNVGL		y		y			y
Redefined Ocean Geography - Arctic	Arctic coastal infrastructure and agreed safety standards for commercial vessels need to be defined	By 2030 it will be possible to transit both the Northern and Northwest Passage for about 110 days per year, with about 45 days easily navigable.	USNIC		y		y	y	y	y
Remote and autonomous Vehicles	Remote and autonomous vehicles could transform ..., transportation, and geo-prospecting with reduced risks for the actuators, while simultaneously presenting novel security risks that could be difficult to address.	Fast evolving robotic technologies will enable the development of autonomous vehicles (remote and non-remote controlled)	USNIC		y		y	y	y	y

## Annex 5 - IMO strategy

Sources: IMO Strategic plan for the Organization, 2011 (IMOSTRAT)  
 IMO Strategic plan for the organization, 2014 (IMOSTRAT)  
 IMO publications on the development of the next "Polar Code", 2014 (IMOPOL)  
 DNVGL experts working for IMO committees, 2014 (IMO/DNVGL)

Regulatory Trend and related impact	Subtrend/ item	Reasoning	Source	E S C / C C E /	Ship	Blue Growth	Owners, operator	Yards, Suppliers	Service suppliers	Infrastructure
Globalization	Consolidation of shipping conglomerates and alliances	Maritime transport is fundamental to world trade and access to global markets.	IMOSTRAT				y	y		
	Consolidation of terminal operator alliances	Maritime transport is fundamental to world trade and access to global markets.	IMOSTRAT						y	
Maritime security concerns	Raising standard of shipping	Enhancing maritime safety by ensuring that each link in the chain of responsibility fully meets its obligations is a priority for the maritime community as a whole	IMOSTRAT		y		y	y	y	y
Heightened maritime security concerns	Ship based defence mechanisms	Piracy and armed robbery against ships remain a real and ever-present danger to those who use the seas for peaceful purposes	IMOSTRAT		y		y	y		
	Implementation of guidance		IMOSTRAT				y			
	Develop measures to deter or prevent piracy attacks from being successful		IMOSTRAT		y		y	y	y	
Heightened environmental consciousness	+Increase awareness, promote corporate social responsibility by the shipping industry +Enhanced energy efficiency for ships	The enhancement of a sustainable environmental policy for the shipping industry remains a high-profile matter	IMOSTRAT		y		y	y	y	y
	+ Preventing the introduction of polluting substances from ships into the marine environment.		IMOSTRAT		y		y			
	+ Develop sustainable and environmentally conscious means of minimizing the negative impacts from shipping + Ensuring the preservation of ecosystems and biodiversity		IMOSTRAT		y			y	y	
	+ Safest and most effective measures for the recycling of ships		IMOSTRAT		y			y		y
Efficiency of shipping	Elimination of unnecessary, disproportionate or obsolete administrative requirements	With the increase in regulatory measures for safety, security and environmental protection, there is a need to achieve an appropriate balance between the multiple objectives (safe, secure and efficient shipping)	IMOSTRAT		y		y			
Shifting emphasis to people	Training of crews and onshore staff	Shortcomings in human performance at all levels in the chain of responsibility are a major cause of incidents	IMOSTRAT				y		y	y
	Development of tools and training material supporting owners and operators		IMOSTRAT					y	y	
	Establish training facilities		IMOSTRAT						y	y
Increase number of people at sea	Improved safety concepts for large number of passengers	+ Increased use of ferries and high-speed craft on international and domestic services + Passenger ships with capacities of several thousand + Growing number of migrants transported by sea + Continuing incidence of stowaway cases and of piracy and armed robbery + continuing loss of seafarers' and fishers' lives at	IMOSTRAT		y		y	y		y
	Develop enhanced shore based rescue concepts		IMOSTRAT				y			y

Regulatory Trend and related impact	Subtrend/ item	Reasoning	Source	E S C / C C E /	Ship	Blue Growth	Owners, operator	Yards, Suppliers	Service suppliers	Infrastructure
		sea								
Ensuring universal and uniform application of IMO instruments		The IACS Integrated Technical Cooperation Program (ITCP) need to be enabled to ensure and improve a uniform application of IMO and UN based regulations, especially on small island, developing States and least developed countries.	IMOSTRAT							
Technology as a major driving force for change in the maritime transport sector	Technological developments have created new opportunities, but may include adverse impacts.	New opportunities therefore exist that may encourage development of various IMO initiatives, from safety and security to environmental protection and the facilitation of international maritime traffic. Developments in communications and information technology may provide opportunities to develop knowledge management so as to increase transparency and accessibility to information.	IMOSTRAT		y		y	y	y	y
Polar Shipping	Larger and more ships are operating in polar waters	Considering global warming, trends and forecasts indicate that polar shipping will grow in volume and diversify in nature over the coming years and these challenges need to be met without compromising either safety of life at sea or the sustainability of the polar environments.	IMOPOL		y					y
	Human element in polar shipping; training of people	Special trainings are needed to operate and maintain ships and their systems safely in polar conditions.	IMOPOL				y		y	y
	Increased requirements for charts	Large areas of polar waters are still not mapped in the same amount as other areas. Forecasts for drifting ice may also be considered.	IMOPOL							y
	Rescue facilities in polar areas	With increased shipping activity an efficient shore based rescue system need to be implemented	IMOPOL							y
Risk based methods / GBS - SLA	Development of special tailored ship designs (service area)	Setting goals instead of prescriptive requirements to facilitate innovation	IMO/ DNVGL		y			y		
	More possibilities for innovative approaches outside of current prescriptive regulatory framework		IMO/ DNVGL		y			y		
	New services like risk assessments for risk based designs	Enable RBM for new ship designs, systems and proedures (e.g. evacuation)	IMO/ DNVGL		y			y		
	Risk analyses for harbour design and operation Risk based PSC and/or Class surveys	Improve survey efficiency with increased reliability	IMO/ DNVGL				y		y	y