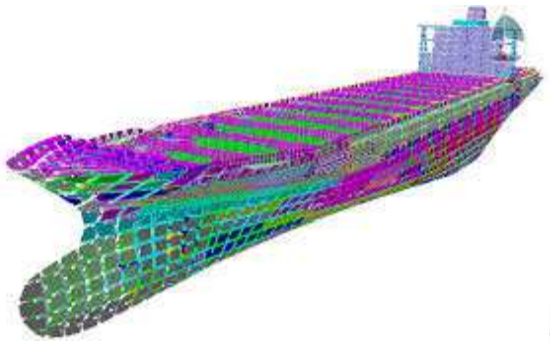
Technology Surveillance Report



Improvements in Maritime Safety

Fundación para o Fomento da Calidade Industrial e o Desenvolvemento Tecnolóxico de Galicia

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Executive Summary

This Technology Surveillance Report has been conducted by **FOUNDATION FOR THE PROMOTION OF INDUSTRIAL AND TECHNOLOGICAL DEVELOPMENT QUALITY OF GALICIA (FFTG)** under the project **AUXNAVALIA PLUS** to be constantly ahead of published developments in the field of **improvements in maritime safety**.

The aim of this report is to analyze the state of the art of development and identify future trends and applications of the technology in Europe. With this information we will have to measure the sector of the technology and make a preliminary analysis of how the technology has developed throughout time and its maturity level, what are the patents having greatest impact, what are the main research lines and most original developments and how the analyzed technology is positioned.

Furthermore, it will be an information tool in order to promote, disseminate and update the specific knowledge in the area, bringing to the auxiliary sector of the Naval Atlantic area the latest developments about the technology of interest.

Based on the analysis of the information gathered, it appears that most of the developments have been led by Asian companies. There is not a single leader with a dominant position in the development of technology, but some companies in shipbuilding such as **DAEWOO SHIPBUILDING&MARINE ENG CO LTD** and **SAMSUNG HEAVY IND CO LTD** are the key owners of the technology according to their amount of protected innovations.

China, **Republic of Korea** and **Japan**, which have generated 80% of the total innovations, represent the leadership of the Asiatic region in this technological area. This region is followed by Europe and North America that represent 7% and 6%, respectively.

1. Introduction

Shipping is perhaps the most international of the world's industries, serving more than 90 per cent of global trade by carrying huge quantities of cargo cost effectively, cleanly and safely.

Several types of hazards are common in this industry, including chemical (asbestos, welding fumes, solvents, paints, fuels), physical (noise, heat stress), and safety (fires, confined spaces, falls, heavy equipment).

The ownership and management chain surrounding any ship can embrace many countries and ships spend their economic life moving between different jurisdictions, often far from the country of registry. Because of the international nature of the shipping industry, it has long been recognized that action to improve safety in maritime operations is more effective if carried out at the international level rather than by individual countries acting unilaterally and without coordination.

It was against this background that a conference held by the United Nations in 1948 adopted a convention establishing the International Maritime Organization (IMO) as the first ever international body devoted exclusively to maritime matters.

Since then, IMO has promoted the adoption of some 50 conventions and protocols and adopted more than 1,000 codes and recommendations concerning maritime safety and security, the prevention of pollution and related matters.

The overall objectives are summed up in the IMO slogan: safe, secure and efficient shipping on clean oceans.

IMO is a technical organization and most of its work is carried out in a number of committees and sub-committees. Particularly, the Maritime Safety Committee (MSC) was one of the main organs, along with the Assembly and Council, established by the 1948 Convention on IMO.

Today, the MSC deals with all matters relating to the safety of shipping, as well as addressing maritime security issues.

The first conference organized by IMO in 1960 was concerned with maritime safety. That conference adopted the International Convention on Safety of Life at Sea (SOLAS), which came into force in 1965. The 1960 SOLAS Convention covered a wide range of measures designed to improve the safety of shipping. They included subdivision and stability; machinery and electrical installations; fire protection, detection and extinction; life-saving appliances; radiotelegraphy and radiotelephony; safety of navigation; carriage of grain; carriage of dangerous goods; and nuclear ships.

The main objective of the SOLAS Convention is to specify minimum standards for the construction, equipment and operation of ships, compatible with their safety. Flag States are responsible for ensuring that ships under their flag comply with its requirements, and a number of certificates are prescribed in the Convention as proof that this has been done. Control provisions also allow Contracting Governments to inspect ships of other Contracting States if there are clear grounds for believing that the ship and its equipment do not substantially comply with the requirements of the Convention - this procedure is known as port State control. The current SOLAS Convention includes Articles setting out general obligations, amendment procedure and so on, followed by an Annex divided into 12 Chapters (*see Annex I*).

In addition to the International Maritime Organization (IMO), there are other organizations as OSHA (Occupational Safety and Health Administration)[1] which also regards to shipbuilding and ship repair hazards for shipyard employment and the construction industry. OSHA is part of the United States Department of Labor, and its administrator is the Assistant Secretary of Labor for Occupational Safety and Health. OSHA's administrator answers to the Secretary of Labor, who is a member of the cabinet of the President of the United States.

With the Occupational Safety and Health Act of 1970, Congress created the Occupational Safety and Health Administration (OSHA) to assure safe and healthful working conditions for working men and women by setting and enforcing standards and by providing training, outreach, education and assistance (https://www.osha.gov/lawregs.html).

[1] Twenty-five states, Puerto Rico and the Virgin Islands have OSHA-approved State Plans and have adopted their own standards and enforcement policies. For the most part, these States adopt standards that are identical to Federal OSHA. However, some States have adopted different standards applicable to this topic or may have different enforcement policies.

In spite of these examples, standards provide guidance where established and recognized shipbuilding or national standards accepted by the Classification Society[2] do not exist.

Classification surveyors inspect ships to make sure that the ship, its components and machinery are built and maintained according to the standards required for their class. Marine vessels and structures are classified according to the soundness of their structure and design for the purpose of the vessel. The classification rules are designed to ensure an acceptable degree of stability, safety, environmental impact, etc.

As well as providing classification and certification services, the larger societies also conduct research at their own research facilities in order to improve the effectiveness of their rules and to investigate the safety of new innovations in shipbuilding.

There are more than 50 marine classification organizations worldwide (see Table 1), some of which are associated in The International Association of Classification Societies (IACS), with the objective of promoting the safety of life, property and the environment primarily through the establishment and verification of compliance with technical and engineering standards for the design, construction and life-cycle maintenance of ships, offshore units and other marine-related facilities (*see Annex II*).

These standards are contained in rules established by each Society. IACS also provides a forum within which the member societies can discuss research and adopt technical criteria that enhance maritime safety.

Although IACS is a non-governmental organization, it also plays a role within the International Maritime Organization (IMO), for which IACS provides technical support and guidance and develops unified interpretations of the international statutory regulations developed by the member states of the IMO.

In that sense, it is important to highlight that more than 90% of the world's cargo carrying tonnage is covered by the classification design, construction and through-life compliance Rules and standards set by the thirteen Member Societies of IACS.

It is the aim of IACS Member Societies to do all they can to manage the OSH[3] risks faced by their employees and to positively influence the safety performance of the industry.

[2] A Classification Society is a non-governmental organization that establishes and maintains technical standards for the construction and operation of ships and offshore structures. The society will also validate that construction is according to these standards and carry out regular surveys in service to ensure compliance with the standards. To avoid liability, they explicitly take no responsibility for the safety, fitness for purpose, or seaworthiness of the ship.

[3] OHS. Occupational Health and Safety

Table 1. Marine Classification Organizations

Name	Abbreviation	Date	Head office	IACS[4] member
Lloyd's Register	LR	1760	London	Yes
Bureau Veritas	BV	1828	Paris	Yes
Registro Italiano Navale	RINA	1861	Genoa	Yes
American Bureau of Shipping	ABS	1862	Houston	Yes
Det Norske Veritas	DNV	1864	Oslo	Yes
Germanischer Lloyd	GL	1867	Hamburg	Yes
Nippon Kaiji Kyokai (ClassNK)	NK	1899	Tokyo	Yes
Russian Maritime Register of Shipping	RS	1913	Saint Petersburg	Yes
Hellenic Register of Shipping	HR	1919	Piraeus	No
Overseas Marine Certification Services	OMCS	2004	Panama	No
Polish Register of Shipping	PRS	1936	Gdansk	Yes
Croatian Register of Shipping	CRS	1949	Split	Yes
Bulgarian Register of Shipping	BRS (БКР)	1950	Varna	No
China Corporation Register of Shipping	CR	1951	Taipei	No
China Classification Society	CCS	1956	Beijing	Yes
Korean Register of Shipping	KR	1960	Busan	Yes
Turk Loydu	TL	1962	Istanbul	No
Biro Klasifikasi Indonesia	BKI	1964	Jakarta	No
Registro Internacional Naval	RINAVE	1973	Lisbon	No
Indian Register of Shipping	IRS	1975	Mumbai	Yes
International Naval Surveys Bureau	INSB	1977	Piraeus	No
Asia Classification Society	ACS	1980	Tehran	No
Brazilian Register of Shipping	RBNA	1982	Rio de Janeiro	No
International Register of Shipping	IROS	1993	Miami	No
Ships Classification Malaysia	SCM	1994	Shah Alam	No
Isthmus Bureau of Shipping	IBS	1995	Panama	No
Guardian Bureau of Shipping	GBS	1996	Syria	No
Shipping Register of Ukraine	RU (РУ)	1998	Kyiv	No
Dromon Bureau of Shipping	DBS	2003	Limassol	No
Intermaritime Certification Services	ICS Class	2005	Panama	No
Iranian Classification Society	ICS	2007	Tehran	No
Register of Shipping Albania	ARS	1970	Durres	No
Venezuelan Register of Shipping	VRS	2008	London	No

[4] The International Association of Classification Societies (IACS) is a technically based organization consisting of thirteen marine classification societies headquartered in London.

IACS Member Societies are committed to:
• Raising, discussing and proposing effective control measures to mitigate the OSH risks faced by the classification societies and their employees.
• Complying with applicable health and safety legislation.
• Providing adequate OSH training to their employees.
• Providing adequate resources (e.g. time, Personal Protective Equipment (PPE), safe systems of work) to allow the aspects of work that they control to be undertaken safely.
• Requiring that adequate resources are provided by Clients and other worksite controllers to allow work to be undertaken safely.
• Giving their employees the right and responsibility to refuse to conduct work they consider to present an unacceptable risk until it is safe to do so.
• Recognising, adopting, developing and promoting best practices within the industry.

This OSH Policy will be reviewed by IACS Council regularly in order to ensure that it remains suitable and appropriate to the work of IACS Members and is continually improved.
In summary, shipping and marine transportation is a highly regulated global industry. With heightened public awareness of the environmental and human cost of marine accidents, and tighter legislation from governments and international bodies on ships and shipping operations, the safe and efficient operation of ships is a priority for all ship builders, owners and operators.

All these standards are in continuous change, according to the technological developments in the field of maritime safety. In this sense, advances in the information technologies, monitoring systems and researches on new materials and shipbuilding methods play a key role.

Below some indicators are shown to assess trends in the technical area, countries and regions generators of innovation, as well as major markets and the leading entities in the area, speeding up the reading of the patent and scientific documents.

2. Analysis or Patent Documents

The search was conducted on more than one hundred patent databases including United States Patent and Trademark Office (USPTO), European Patent Office (EPO), World Intellectual Property Office, Spanish (OEPM), Japanese (JPO), Chinese and South Korean Patent Offices, to obtain sets of results relevant to the chosen subject of study.

The search strategy includes different methodologies. The main one consists in using keywords and concepts provided by the **Auxnavalia Plus** project partners, and others learned during the documentation process before designing the search strategy. In this search the keywords were directed to improvements in maritime safety. Therefore, the keywords were: *improvement, enhancement, safety, security, ship*, etc.

Besides the keywords, the International Patent Classification (IPC) has been used[5]. Specifically, the subclasses taken into account are related to

[5] This classification is a hierarchical system where the technology field is divided into a number of sections, classes, subclasses and subgroups. This system is essential to retrieve patent documents in the search in a specific field of technology. The is-burning classification contains approximately over 74,000 entries.

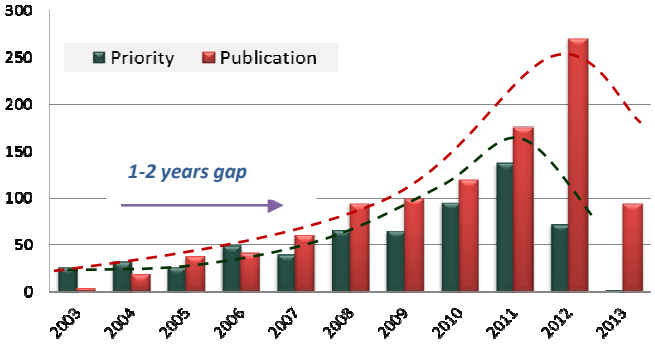
ships or other waterborne vessels; related equipment (**B63B**), which describe, among others, the technology of interest.

Finally, after the combination of the aforesaid search it has collected a total **of 813 families of patents and utility models** (1,019 documents) in the last 10 years (2003-2013). Regarding scientific literature about **430 publications** in the area of interest were collected[6].

2.1. Technological Development

The initial analysis of the last ten year patent data reveals how the technology is growing and the interest of the market in it. The Figure 1 shows the innovative level of the patents by analyzing the evolution of the yearly number of patents at a worldwide level. The chart was made using two variables: the earliest priority year and number of patents per year.

The area of maritime safety has caused a continuous interest in the last ten years, due to the progressive development of new inventions, overall since 2010. On the other hand, it should be mentioned that the figures of years 2012 and 2013 should be considered with reservations, due to the period of time from the application to the publication takes between 18 months and two years.



Source: Own generation based on patent databases

Figure 1. Patents per priority year)

Looking at the development of patent applications, it is inferred that despite being a technology has existed for more than a century, the continuous improvements in the development of new methods directed to improve and enhance the safety and security in a maritime environment and particularly in shipbuilding has motivated a new growth stage in the area.

2.2. Research Lines and Emerging Technologies

Then based on the initial analysis of the evolution of the technological area, it delves into the analysis by studying the codes of the International Patent Classification (IPC).

The procedure consists in analyzing these classifications in the hierarchical levels of classification which are more representative of the whole patent information. This process allows inferring the technological field covering and new potential research or application areas.

Main subclasses

Analysis of the main subclass provides an overview of trends in R & D and general applications presented in Table 2. The subclass that has a higher number of applications is **B63B** concern-

[6] The complete list of the patents families and scientific publications are compiled in the attached Excel document.

ing ships or other waterborne vessels, that along with subclasses **B63H, B63C, B63J,** and **B63G** comprise all the innovations related to ships or other waterborne vessels.

Moreover, the following sub-classes in the table concern where the above mentioned safety improvement are applied. Thus, subclasses **B63B**, **B63H**, **B63C**, **B63J**, **B63G** and **B66C** classify those innovations related to vessels, marine propulsion or steering, and cranes (51%); and the classes **G08** and **G05** refer to signaling, alarm systems and control or regulating systems in general (8%).

Furthermore, the safety in storage and transport are defined by the codes **B65D** and **B65G** (3%), those regarding engineering and electric hazards are under class **H01** (3%), and curiously over 2% regards to earth or rock drilling (**E21B**).
Interestingly, most subclasses listed in Table 2 have a high participation rate in the last three years, highlighting the codes **H01B** and **E06B**; which means that technologies that describe developments in the field of cables, conductors, insulators, selection of materials for their conductive, insulating or dielectric properties, and fixed or movable closures for openings are research lines currently under development.

Similarly, Figure 2 shows the relationship between the main IPC codes used in the technology under study. Thus, the subclass **B63B** referred to *equipment for shipping* includes more than two thirds of the inventions in the area.

Source: Own generation based on patent databases

Figure 2. Relationship between IPC codes

Table 2. Main subclases

Subclass	Nº Families	%Total	%10-13
***B63B**: Ships or other waterborne vessels; equipment for shipping*	297	36.5	26%
***B63H**: marine propulsion or steering*	55	6.8	29%
***B66C**: cranes; load-engaging elements or devices for cranes, capstans, winches, or tackles*	32	3.9	34%
***E02B**: hydraulic engineering*	30	3.7	27%
***B63C:** Launching, hauling-out, or dry-docking of vessels; life-saving in water; equipment for dwelling or working under water; means for salvaging or searching for underwater objects*	30	3.7	17%
***G08G**: traffic control systems (guiding railway traffic, ensuring the safety of railway traffic; radar or analogous systems, sonar systems or lidar systems specially adapted for traffic control)*	24	3.0	8%
***H01B**: cables; conductors; insulators; selection of materials for their conductive, insulating or dielectric properties*	24	3.0	92%
***A01K**: animal husbandry; care of birds, fishes, insects; fishing; rearing or breeding animals, not otherwise provided for; new breeds of animals*	21	2.6	14%
***B63J**: auxiliaries on vessels*	20	2.5	25%
***G01S**: radio direction-finding; radio navigation; determining distance or velocity by use of radio waves; locating or presence-detecting by use of the reflection or reradiation of radio waves; analogous arrangements using other waves*	19	2.3	11%
***B63G**: offensive or defensive arrangements on vessels; mine-laying; mine-sweeping; submarines; aircraft carriers*	17	2.1	12%
***E21B**: earth or rock drilling; obtaining oil, gas, water, soluble or meltable materials or a slurry of minerals from wells*	17	2.1	18%
***G08B**: signalling or calling systems; order telegraphs; alarm systems*	16	2.0	6%
***B66F**: hoisting, lifting, hauling, or pushing, not otherwise provided for, e.g. devices which apply a lifting or pushing force directly to the surface of a load*	15	1.8	40%
***B23K**: Soldering or unsoldering; welding; cladding or plating by soldering or welding; cutting by applying heat locally, e.g. flame cutting; working by laser beam*	14	1.7	14%
***B65D**: containers for storage or transport of articles or materials, e.g. bags, barrels, bottles, boxes, cans, cartons, crates, drums, jars, tanks, hoppers, forwarding containers; accessories, closures, or fittings therefor; packaging elements; packages*	12	1.5	17%
***B65G**: transport or storage devices, e.g. conveyors for loading or tipping, shop conveyor systems or pneumatic tube conveyors*	12	1.5	25%
***F16L**: pipes; joints or fittings for pipes; supports for pipes, cables or protective tubing; means for thermal insulation in general*	12	1.5	33%
***H04W**: wireless communication networks*	12	1.5	17%
***G05B**: control or regulating systems in general; functional elements of such systems; monitoring or testing arrangements for such systems or elements*	11	1.4	36%
***E06B**: fixed or movable closures for openings in buildings, vehicles, fences, or like enclosures, in general, e.g. doors, windows, blinds, gates*	11	1.4	91%
***F17C**: vessels for containing or storing compressed, liquefied, or solidified gases; fixed-capacity gas-holders; filling vessels with, or discharging from vessels, compressed, liquefied, or solidified gases*	10	1.2	20%
***E01D**: bridges*	10	1.2	30%
Total	**721**	**88.7%**	

Source: Own generation based on patent databases

2.3. Most Innovative Technologies

From the previous state of the art, a small number of those patents are the ones being currently investigated. By studying the impact of those documents on later documents and R&D projects, it can detect those developments having a higher repercussion, thus facilitating a comparative study between the Technological Offer and the most consolidated technological developments.

The grade of innovation (i) is calculated by combining the analysis of three different variables:
- Priority year, showing how novel the patent is
- How many cites the patent has, measuring how close is the patent to the general state of the art and the degree of innovation it represents
- How many times has the patent been cited, showing the relevance of the patent.

A ranking has been made where the top patent is the one that has the bigger positive value of the defined innovation indicator (i). In general, 12% of the innovations have been cited.

Table 3 shows the largest patent innovation index relative to the universe technologies that allow an improvement in maritime safety or security, from highest to lowest in terms of this innovation indicator.

First, it is important to highlight that about two thirds of the innovations compiled in the table have been developed by Asiatic applicants, and 75% does not cite previous papers, so that could be regarded as new researches which involved a break with the state of the art existing at the time when those innovations were first published[7].

First, the application **US20040056779A1** has been cited an average of 4 times a year since its publication in 2004. It regards an apparatus for generating buoy light signals using a collimated light source. The system provides for communication of system conditions and ambient conditions, and can provide homeland security monitoring. The system senses motion of the buoy and compensates the direction of lighting, and optionally acoustics, being generated out over a body of water.

The following application, **JP2004204344A**, developed by the Japanese company **NIPPON STEEL CORP**[8] has been cited 24 times since its publication in 2004. It describes a new steel for a crude oil tank which is excellent in resistances against general and local corrosion concerning crude oil corrosion in the oil tank made of steel and inhibits its generation of corrosion products (sludge) containing solid S, a production method for the steel, the crude oil tank and a corrosion prevention method for the crude oil tank. In this sense, the subsequent application **KR2005008832A** also claims a high resistance steel for crude oil tanks, which comprises alloying additions of manganese, copper, aluminum, molybdenum and tungsten.

[7] These innovations are the most innovative at the present, notwithstanding that recent patents with less cites will accumulate more, and in the following years may result in patents with a higher innovative indicator.

[8] **NIPPON STEEL** is one of the largest steel makers in the world. The company is engaged in steel making and fabrication, engineering and construction, chemicals, new materials, system solutions, and urban development businesses.

Besides **NIPPON STEEL CORP**, another of the largest heavy industries company and one of the leading shipbuilders in the world, **HYUNDAI HEAVY INDUSTRIES CO**, is the owner of the Korean application **KR2006086071A**, which describes a heat insulating structure of an insulated tank of an LNG (Liquefied Natural Gas) cargo ship that improves the safety of the ship by detecting whether the leaked LNG passes through a first insulating wall by forming an insulating space unit between the first insulating wall and a second insulating wall.

In addition, among the most recent innovations of the table, it is worth mentioning the development of **DAEWOO SHIPBUILDING&MARINE ENG CO LTD**. The innovation regards to a cylinder device for controlling position of ship girder steel material. The weight of the aluminum cylinder can be reduced and the longitudinal structure such as wall and deck can be easily aligned by the cylinder device. Hence safety of ship is enhanced.

Finally, it is of interest that some of the most innovative developments have been developed by European applicants:

- **US20110227753A1**. The application applied in Germany by the military transport and fighter aircraft, defence electronics and security systems and space systems, **EADS**, in 2011 provides a method for automatically landing an aircraft, on a movable landing platform. The method enables automatic control of the landing of the aircraft, thus ensuring improvement of safety of the aircraft during landing the unmanned aircraft on a deck of the ship.
- **FR2892377A1**. This French application was published in 2007 and regards outer bridge protection devices.

Table 3. Patents with higher innovation grade

Publication number	Title	Applicant	Pub. Year	Priority Country	Count Cited Patents	Count Citing Patents	*i*
US20040056779A1	Transportation signaling device	RAST R H	2004	USA	0	36	3.6
JP2004204344A	Steel for crude oil tank, its production method, crude oil tank and its corrosion prevention method	NIPPON STEEL CORP	2004	Japan	7	24	1.7
US20110227753A1	Reinforced marine optic fiber security fence	IFFERGAN D	2011	USA	0	4	1.3
US20120292911A1	Subsystems for a Water Current Power Generation System	BOLIN W D	2012	USA	0	2	1.0
KR2006086071A	Heat insulating structure of insulated cargo tanks of lng carrier	HYUNDAI HEAVY IND CO LTD	2006	Rep. Korea	2	8	0.8
KR2010072738A	Docking aid system for ship; ship guiding system, capable of improving reliability, stability, and profitability of a harbor	GS CALTEX CORP	2010	Rep. Korea	2	5	0.8
US20110066307A1	Procedure for Automatically Landing an Aircraft	EADS DEUT GMBH	2011	Germany	0	2	0.7
KR2005008832A	Steel for crude oil tanks, with good resistance to total corrosion or localized corrosion, comprises alloying additions of manganese, copper, aluminum, molybdenum and tungsten	NIPPON STEEL CORP	2005	Rep. Korea	0	5	0.6
KR2012015880A	Communication system for ship construction capable of increasing the productivity of a worker	HYUNDAI HEAVY IND CO LTD	2012	Rep. Korea	0	1	0.5
KR2008101307A	Boarding device of a ship for steadily compensating the irregular flow of the ship	CHEOL-SAN J	2008	Rep. Korea	0	3	0.5
KR2008004825A	Integrated marine safety apparatus for preventing marine accidents by receiving sailing information on other ships from a control system and recording and storing sailing information	DDWIZ INC	2008	Rep. Korea	0	3	0.5
KR201201491U	Cylinder apparatus for adjusting position of coaming stiffener | The cylinder device for the position control of the ship girder steel material.	DAEWOO SHIPBUILDING&MARINE ENG CO LTD	2012	Rep. Korea	0	1	0.5
FR2892377A1	Ship`s e.g. yacht, outer bridge protection device, has translation guide installed on outer bridge or on coamings and cooperating with retractable telescopic covering elements for guiding, deploying or retracting movement of elements	TINCELIN T J E	2007	France	5	8	0.4
CN1931662A	Hydraulic lifting stern platform | Hydraulic elevator foot platform on the stern	HUDONG ZHONGHUA SHIPBUILDING GROUP CO LTD | UNIV SHANGHAI JIAO TONG	2007	China	0	3	0.4

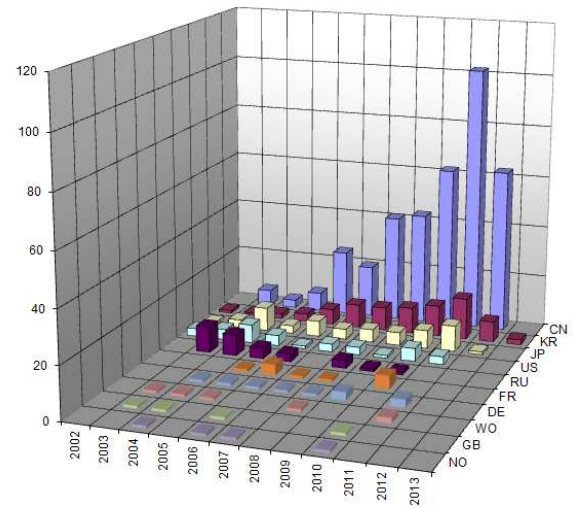
Source: Own generation based on patent databases

2.4. Geo-strategical Position

The analysis of the geographical extension of patents belonging to a specific technical area allows for analyzing both the impact of technology and its potential market. This is accomplished by a double geographical analysis, ranging from an approach to generating regions of innovations to the regions of publication of those patents, explaining the flow of technology. The following tables and figures summarize the activity of generating and publishing the offices and countries with more activity.

Table 4 highlights in the first instance the leadership of the Asiatic region wherein China, Republic of Korea and Japan have generated 80% of the total patents in the technological area of interest. This region is followed by Europe and North America that represent 7% and 6%, respectively.

In turn, Figure 3 shows the evolution of applications in the top ten priority countries or offices which adds a temporal nuance that allows for the continuity of research and development in the area.



Source: Own generation based on patent databases

Figure 3. Evolution of the distribution of patents by priority country

It emphasizes the exponential activity in the Asiatic region with a growth of over 60% in the last three years, highlighting the activity in China.

Table 4. Number of patents by major countries or offices of Priority Application

Application Country/Office	Applications	% Total
China (CN)	372	49.9%
Korea. Rep (KR)	127	17.0%
Japan (JP)	104	14.0%
USA (US)	41	5.5%
Russia (RU)	30	4.0%
France (FR)	15	2.0%
Germany (DE)	15	2.0%
WIPO (WO)	10	1.3%
Great Britain (GB)	5	0.7%
Norway (NO)	6	0.8%
EPO (EP)	2	0.3%
Australia (AU)	4	0.5%
Taiwan (TW)	4	0.5%
Canada (CA)	2	0.3%
Sweden (SE)	1	0.1%
Spain (ES)	1	0.1%
Netherlands (NL)	1	0.1%
Italy (IT)	1	0.1%
Ukraine (UK)	1	0.1%
India (IN)	1	0.1%
Mexico (MX)	1	0.1%
Finland (FI)	1	0.1%
TOTAL	**745**	

Source: Own generation based on patent databases

Regarding publication, Table 5 shows the distribution of patents (1,019) by country or office where its extension has been managed.

China, Republic of Korea and Japan represent 70.5% of the publication mentioned above, so the Asiatic region continues to stand out, not only for having the leading countries in the gen-

eration of innovations but also as a market of interest.

The Asiatic region is followed by the North American area with around 6%, and wherein the United States remains as the head country of the region.

At European level it is worth mentioning the strong presence of Germany, France and Spain. Finally, in Latin America, only Mexico appears to have interest at market level.

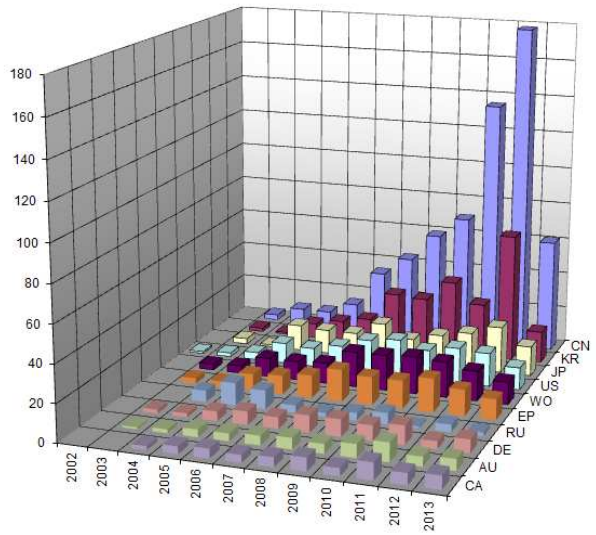
There is also a discrete interest in extending the protection of inventions through International Office (WIPO) and European (EPO), with a 7.5% share of the publications, due in part to the policies in Asian countries, wherein the protections are in most cases nationaly conducted.

Table 5. Number of patents by major countries or offices

Publication Country/Office	Publications	% Total	Major Companies
China (CN)	487	47.8%	LUBAO CABLE GROUP CO LTD; HUNAN DIHAO MARINE EQUIP MFG CO LTD; CHINA NAT PETROLEUM CORP
Korea Rep. (KR)	166	16.3%	DAEWOO SHIPBUILDING&MARINE ENG CO LTD ; SAMSUNG HEAVY IND CO LTD; HYUNDAI HEAVY IND CO LTD
Japan (JP)	65	6.4%	MITSUI ENG&SHIPBUILDING CO LTD ; DOKURITSU GYOSEI HOJIN KAIJO GIJUTSU ANZ;
USA (US)	48	1.4%	NAVY SECRETARY OF THE UNITED STATES OF AMERICA; NOKIA CORP; KOREA GAS CORP
WIPO (WO)	44	4.3%	BILBO MARINE TECH IND; NOKIA CORP; DCNS
EPO (EP)	33	3.2%	KOREA GAS CORP
Russia (RU)	33	3.2%	UNIV ST PETERSBURG AEROCOSMIC INSTR; AVIATION MATERIALS RES INST;
Germany (DE)	18	1.8%	---
Australia (AU)	15	1.5%	---
Canada (CA)	14	1.4%	---
France (FR)	12	1.2%	DCNS; BILBO MARINE TECH IND
Austria (AT)	6	0.6%	---
Spain (ES)	6	0.6%	---
Norway (NO)	6	0.6%	---
Great Britain (GB)	6	0.6%	---
Taiwan (TW)	5	0.5%	---
Singapur (SG)	4	0.4%	---
Denmark (DK)	3	0.3%	---
Hong Kong (HK)	2	0.2%	---
Mexico (MX)	2	0.2%	---
Portugal (PT)	2	0.2%	---
TOTAL	**977**	**92.5%**	

Source: Own generation based on patent databases

In addition, Figure 4 shows the evolution of patents published in the top ten countries or offices, which adds a temporary shade to assess the market interest. Specifically China continues to stand as the main market of interest over the years, followed by its neighbours Korea and Japan.



Source: Own generation based on patent databases

Figure 4. Evolution of the distribution of patents by publication country/office

2.5. Competitive Landscape

Regarding the type of applicants, it is possible to have an idea about who is developing the technology, its distribution and how close is its commercialization.

In this sense, the companies own a 57% share of the innovation, 11% comes from universities and/or research institutes, and the remaining 32% is owned by individual inventors. It is therefore an area introduced in the market, with a direct application in shipbuilding, and pushed by the International Maritime Organizations' objectives regarding safe, secure and efficient shipping on clean oceans.

On the other hand, based on the search results of the State of the Art, firstly a competitive intelligence landscape analysis was conducted to identify key owners behind the innovations in the field of improvements in maritime safety.

These key players are identified based on the number of patents they have. Players owning patents and published applications in the last ten years could be important players in the research and development of this technology.

The initial analysis of the patent data reveals the following key players active in the area of interest, which could be seen in Table 6.

This table comprises entirely Asian companies in the shipbuilding, metallurgical, naval and/or aerospace industries, cable manufacturer, oil and/or gas corporations, etc. This group only represents a 2.7% share of the total applicants but accounts for 24.4% of all innovations in the area.

The Korean companies **DAEWOO SHIPBUILDING&MARINE ENG CO LTD** and **SAMSUNG HEAVY IND CO LTD** highlight as the technological leaderships, which together with the Chinese **LUBAO CABLE GROUP CO LTD**, represent about 10% of total publications.

The table also indicates that the protection strategy is eminently national, that means that the main applicants protect their inventions through their national patent and trademark offices.

Table 6. Top Applicants

Applicants	Nº Families	% Total	Priority Country
DAEWOO SHIPBUILDING&MARINE ENG CO LTD	36	4.4%	Korea Rep.
SAMSUNG HEAVY IND CO LTD	21	2.6%	Korea Rep.
LUBAO CABLE GROUP CO LTD	20	2.5%	China
HUNAN DIHAO MARINE EQUIP MFG CO LTD	13	1.6%	China
HYUNDAI HEAVY IND CO LTD	13	1.6%	Korea Rep.
CHINA NAT PETROLEUM CORP	12	1.5%	China
HUDONG ZHONGHUA SHIPBUILDING GROUP CO LT	9	1.1%	China
UNIV SHANGHAI MARITIME	8	1.0%	China
OFFSHORE OIL ENG CO LTD	8	1.0%	China
DALIAN SHIPBUILDING IND CO LTD	8	1.0%	China
KOREA OCEAN RES&DEV INST	7	0.9%	Korea Rep.
UNIV DALIAN OCEANOGRAPHY	6	0.7%	China
UNIV DALIAN TECHNOLOGY	6	0.7%	China
KOREA GAS CORP	6	0.7%	Korea Rep.
UNIV HARBIN	5	0.6%	China
UNIV SHANGHAI JIAOTONG	5	0.6%	China
CHINA SHIP DEV&DESIGN CENT	5	0.6%	China
WUXI TONGCHUANG GLASS STEEL BOATS FACTOR	5	0.6%	China
TOTAL	**198***	**24.4%**	

Source: Own generation based on patent databases

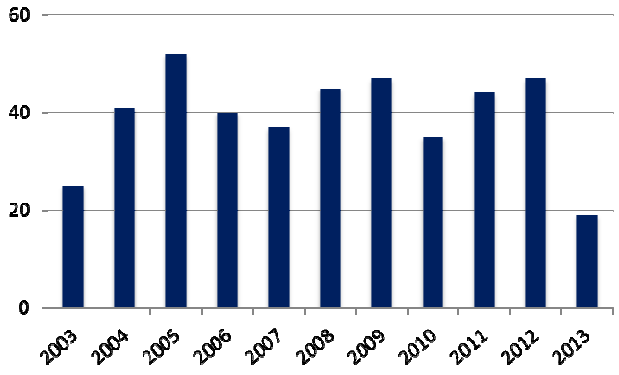
Note (*) Some of these companies can perform their innovations with other companies. Thus one can belong to several patent applicants.

3. Analysis of Scientific Publications

Regarding the literature, it has used a search strategy similar to that employed with patents in order to identify those scientific papers published since 2003 and related with maritime safety improvements.

Some simple conclusions could be recovered from the 430 scientific publications, such as the evolution of publications. In this case the following figure shows a continuous and constant growing publication trend throughout the past decade, with an average of 40 science publications.

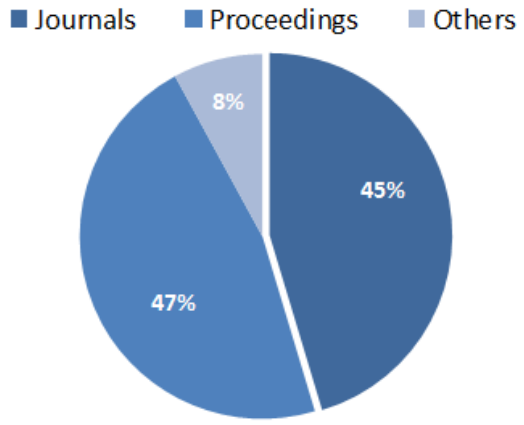
This trend, together with the observed in section 2.1. *Technological Evolution*, reinforces the idea that the technology under study is in a development stage and it is also introduced in the market with a substantial business sector that protects its innovations by intellectual property mechanisms, and also a research core reports its results in specialized scientific journals.



Source: Own generation based on scientific publications databases

Figure 5. Evolution of scientific publications

In this sense, regarding the distribution of scientific publications by document type, Figure 6 shows that journals and proceedings are the first sources of broadcasting the studies in the area, representing more than 90% of the total scientific documents published, while the remaining 8% corresponds to books and news.



Source: Own generation based on scientific publications databases

Figure 6. Publications type

Table 7 shows the main sources of information, which one third of all publications which have been published from 2003 to the present.

Table 7. Main Sources

Source	Total
NAVAL ARCHITECT	27
SEA TECHNOLOGY	13
MARITIME SECURITY AND MET	12
OCEANS IEEE	10
PROCEEDINGS OF THE SOCIETY OF PHOTO OPTICAL INSTRUMENTATION ENGINEERS SPIE	10
PROGRESS IN SAFETY SCIENCE AND TECHNOLOGY SERIES	10
JOURNAL OF NAVIGATION	8
PROCEEDINGS AND MONOGRAPHS IN ENGINEERING WATER AND EARTH SCIENCES	8
SAFETY SCIENCE	7
MARINE POLICY	6
OCEAN ENGINEERING	6
ADVANCED MATERIALS RESEARCH	5
JOURNAL OF MARITIME LAW AND COMMERCE	5
MARITIME POLICY MANAGEMENT	5
NATO SCIENCE FOR PEACE AND SECURITY SERIES C ENVIRONMENTAL SECURITY	5
PROGRESS IN SAFETY SCIENCE AND TECHNOLOGY	5
CONTROL ENGINEERING	4
MARINE TECHNOLOGY AND SNAME NEWS	4
MARITIME INDUSTRY OCEAN ENGINEERING AND COASTAL RESOURCES	4
MARITIME TRANSPORTATION AND EXPLOITATION OF OCEAN AND COASTAL RESOURCES	4
OCEANS 2005	4
POLISH MARITIME RESEARCH	4
RELIABILITY ENGINEERING SYSTEM SAFETY	4
SAFETY AND RELIABILITY	4
Total	**174**

Source: Own generation based on scientific publications databases

Almost half of the scientific articles are retrieved in the environment of engineering and computer science. Thus, the journals with more publications in the area are **NAVAL ARCHITECT**, **SEA TECHNOLOGY** and **MARITIME SECURITY AND MET**, which account for 12% of total scientific publications.

In addition, the list also collects journals directly applied to international relations and government law (**MARINE POLICY**, **JOURNAL OF MARITIME LAW AND COMMERCE**, **MARITIME POLICY MANAGEMENT**, **NATO SCIENCE FOR PEACE AND**

SECURITY SERIES); transportation (**MARITIME TRANSPORTATION AND EXPLOITATION OF OCEAN AND COASTAL RESOURCES**), new materials (**ADVANCED MATERIALS RESEARCH**), etc.

Finally, the following table lists the main entities (universities and research centres) that have published in specialized journals in the technological area of interest, i. e. **GDYNIA MARITIME UNIV**, **GDANSK UNIV TECHNOL**, and **NAVAL UNIV ENGN**.

Tabla 8. Top Entities

Entity	Total
GDYNIA MARITIME UNIV	19
GDANSK UNIV TECHNOL	9
NAVAL UNIV ENGN	7
ERASMUS UNIV	6
ISTANBUL TECH UNIV	6
SHANGHAI MARITIME UNIV	6
CHALMERS	5
LIVERPOOL JOHN MOORES UNIV	5
NATL TAIWAN OCEAN UNIV	5
DALIAN MARITIME UNIV	4
MARITIME UNIV	4
MARITIME UNIV SZCZECIN	4
NATL TECH UNIV ATHENS	4
UNIV GLASGOW	4
UNIV SOUTHAMPTON	4
UNIV STRATHCLYDE	4
WUHAN UNIV TECHNOL	4
Total	**100**

Source: Own generation based on scientific publications databases

4. Bibliographic References

To complement the results of the searches, additional information is provided concerning the top companies in the area. In this section we attach a brief summary of the company and relevant data that may be of interest.

4.1. DAEWOO SHIPBUILDING & MARINE ENGINEERING CO. LTD

85 Da dong
Jung gu
Seoul
KOR
T: 82 2 2129 0114
www.dsme.co.kr

Daewoo Shipbuilding & Marine Engineering (DSME) is a shipbuilding and offshore contractor that builds various vessels, offshore platforms, drilling rigs, floating oil production units, submarines, and destroyers. The company offers commercial vessels including tankers, liquefied natural gas and liquefied petroleum gas (LNG and LPG) carriers, container carriers, roll-on roll-off carrier, chemical carrier, product tanker, and passenger ferry; Offshore and Onshore Plants including fixed platforms, RIGs, and FPSO/FPU/FSOs for offshore oil and gas exploration & production of Onshore plants such as chemical plants, seawater treatment plants, power plants; Industrial facilities such as offloading facilities; steel structures such as steel bridges and steel cages; and specialty vessels including submarine, destroyer, battle ship, submarine rescue vessel, autonomous underwater vehicle (AUV), and other specialty vessels.

The company operates in Korea, China, Greece, Romania, the US, Angola, the UK, Norway, Japan

and the UAE. It is headquartered in Seoul, South Korea and employs around 30,000 people.

The company recorded revenues of KRW1,22,57,626 million (approximately $11,154.4 million) in the fiscal year ended December 2011. Its net profit was KRW7,43,177 million (approximately $676.3 million) in fiscal 2011.

4.2. SAMSUNG HEAVY IND CO LTD

Samsung Life Insurance Seocho Tower
1321-15
Seocho-Dong
Seocho-Gu
Seoul 137 955
KOR
T: 82 2 3458 7000
www.shi.samsung.co.kr

Samsung Heavy Industries (SHI) is a shipbuilding and offshore company. It develops ships for polar applications, Arctic ice-breaker container ships, Arctic shuttle tankers, LNG carriers, ultra-large container ships and passenger ships. SHI is also engaged in the construction of premium office buildings. The company operates in the US, Asia and Europe. It is headquartered in Seoul, South Korea, and employs around 13,185 people.

The company recorded revenues of KRW13,358,610.8 million (approximately $12,156.3 million) in the fiscal year ended December 2011, an increase of 2.2% over 2010. The company's operating profit was KRW1,101,701.9 million (approximately $1,002.5 million) in fiscal 2011, a decrease of 20% compared to 2010. Its net profit was KRW863,934.1 million (approximately $786.2 million) in fiscal 2011, a decrease of 11.5% compared to 2010.

4.3. LUBAO CABLE GROUP

WenZhong Road
Hefei City, Anhui Province
PRO China
Tel : +86-13865965950
www.lubaocables.com

Lubao Cable Group Co. is an extra-large high-tech privately owned enterprise with diversification industrial structure. The registered capital of the enterprise is CNY248 Million .The comprehensive strength is in top position of Chinese Electric wire and Power Cable Industry. And it is a cross-regional, inter-industry, cross-ownership, cross-country modernized enterprise group. The group main business are as following , electric wire and power cable,electric switch, refining molten metal ,building material and pipe system,chemical engineering materials,Real Estate Industry,high-technology development, cultural diffusion,enterprise inverstment and mergers,etc.

Founded in 1958 and originated from "Hefei Cable Factory","Anhui Lubao Cable Co.,Ltd", Lubao Cable (Group) CO.,Ltd is appointed by the Ministry of Machinery Industry as designated enterprise with self import and export rights.It is key enterprise in national electric cable industry,Anhui Provincal Industrial Leading enterprise , and one of Hefei City ten major enperise .

The company continues to strengthen the structural adjustment and product upgrades. The sales network has covered 34 provinces, municipalities and autonomous regions all over the country, and has also entered for great national projects including the Three Gorges Project, the Beijing-Kowloon Railway, Beijing International Airport, Chengdu Shuangliu International Airport, Xi'an Airport, the network transformation of

North China Electric Power Group, Xiaolangdi Project, Karamay oil field, Heilongjiang Coal Group and Shenhua Group, and is well received by clients. The company is the first class supplier for China National Petroleum Corporation and a member of China Railway Engineering Trading Center enterprise network. In addition, the company explores the international market, as the products have passed CE ,GOST certification, and are exported to Southeast Asia, the Middle East, Africa, South America, North America and Europe.

4.4. HYUNDAI HEAVY IND CO LTD

Suite 1 Jeonha-dong
Dong-gu
Ulsan 682 792
KOR
T: 82 2 746 4603
www.hyundaiheavy.co

Hyundai Heavy Industries Co., Ltd. (HHI or "the company") is one of the largest heavy industries company and one of the leading shipbuilders in the world. The company is also engaged in other businesses, including oil refining, construction equipment, offshore and engineering, engine and machinery, industrial plant and engineering, electro electric systems, financial services and green energy. The company has operations in the Americas, Europe, Asia, Middle East and Africa. It is headquartered in Ulsan, South Korea and employs 24,948 people.

The company recorded revenues of KRW53,711,665.8 million ($48,877.6 million) during the financial year ended December 2011 (FY2011), an increase of 43.8% over FY2010. The operating profit of the company was KRW4,535,738.7 million ($4,127.5 million) in FY2011, a decrease of 18% compared to FY2010. Its net profit was KRW2,559,005.8 million ($2,328.7 million) in FY2011, a decrease of 38.4% compared to FY2010.

4.5. CHINA NAT PETROLEUM CORP

9 Dongzhimen North Street
Dongcheng District
Beijing 100007
CHN
T: 86 10 6209 4114
F: 86 10 6209 4205
www.cnpc.com.cn

China National Petroleum Corporation (CNPC or the company) is an integrated energy company. It is engaged in oil and gas upstream and downstream operations, chemicals, engineering and construction, and petroleum equipment manufacturing. CNPC primarily operates in China, and has oil and gas assets and interests in 33 countries. The company is headquartered in Beijing, China.

The company recorded revenues of CNY2,381,278.2 million ($369,002.9 million) during the financial year ended December 2011 (FY2011), an increase of 38.4% over FY2010. The operating profit of the company was CNY181,696.3 million ($28,155.7 million) in FY2011, a decrease of 0.3% compared to FY2010. The net profit was CNY105,490.2 million ($16,346.8 million) in FY2011, an increase of 8.5% over FY2010.

4.6. HUDONG ZHONGHUA SHIPBUILDING GROUP

2851 pudong dadao
Shanghai China
200129
T: 0086-21-58713222
F: 0086-21-58712603
http://www.hz-shipgroup.com

Hudong-Zhonghua Shipbuilding, Ltd. is a large shipbuilding enterprise under the leadership of China Shipbuilding Group Corporation (CSSC). As a comprehensive enterprise group in China building not only merchant and military ships but also heavy duty diesel engines as well as large steel structures, the Group is founded through merger between Hudong Shipbuilding Group and Zhonghua shipyard.

The head office of the group is located at Pudong New Area, with major production areas at the east part of Shanghai, along both sides of Huangpu River, covering an area of 1.35 million m2 and 2000 meters of wharf line. The Group possesses the total assets of 7 billin Yuan and employs 14,000 staff and workers.

4.7. OFFSHORE OIL ENGINEERING CO. LTD.

616 No 1078 Danjiang Road
Tanggu District
Tianjin 300451
CHN
T: 86 22 6690 8709
F: 86 22 6690 8899
www.cnoocengineering.com

Offshore Oil Engineering (COOEC), an affiliate company of China National Offshore Oil Corporation (CNOOC), is involved in the provision of offshore petroleum engineering services. The company provides engineering; procurement; construction; installation; maintenance; underwater engineering; and energy services. It operates its projects in Bohai Sea, South Sea and other parts in the world. The company is headquartered in Tianjin, China and employs around 8,948 people.

The company recorded revenues of CNY7,384.5 million (approximately $1,144.3 million) in the fiscal year ended December 2011, an increase of 3.5% over 2010. The company's operating profit was CNY244.7 million (approximately $37.9 million) in fiscal 2011, an increase of 71.8% over 2010. Its net profit was CNY181 million (approximately $28 million) in fiscal 2011, as compared to the net profit of CNY84.3 million (approximately $13.1 million) in 2010.

4.8. DALIAN SHIPBUILDING IND CO LTD

Number 72 Kunminghu Nan Lu
Haidian District
Beijing 100097
CHN
T: 86 10 8859 8000
F: 86 10 8859 9000
www.csic.com.cn

Dalian Shipbuilding Industry Company located in Dalian, Liaoning, China, is the largest shipbuilding company in China. It is part **of China Shipbuilding Industry Corporation** (CSIC), one of the two state-owned shipbuilding enterprises in China.

China Shipbuilding Industry Corporation (CSIC) is a state-owned enterprise group engaged in shipbuilding and ship repairing. The group's business operations include asset management for the group and its subsidiaries; domestic and overseas investment and financing; researching, developing and producing military products such as naval ships; designing, building and repairing merchant ships; and designing and manufacturing marine equipment and non-marine products for domestic and overseas markets. CSIC is also

involved in turnkey project contracting and labour supply; manufacturing products under overseas licences and technology transfer agreements; and carrying out other businesses under the state authorization and appointment. The group primarily operates in China, where it is headquartered in Beijing and employs around 140,000 people.

4.9. KOREA GAS CORPORATION

93 Dolmaro
215 Jeongja-dong
Bundang-gu
Seongnam
Gyeonggi-do 463-754
T: 82 31 710 0114
www.kogas.or.kr

Korea Gas Corporation (KOGAS) is a diversified energy company. It is engaged in the production and distribution of natural gas, import and export of natural gas and liquefied natural gas (LNG), purification and sales of by-products, and construction and operation of LNG terminals and natural gas distribution networks. The company operates in Southeast Asia, Australia, the US, Canada, Europe, the Middle East and Africa. It is headquartered in Seongnam, South Korea and employs around 3,026 people.

The company recorded revenues of KRW35,031.3 billion (approximately $31.2 billion) in the fiscal year ended December 2012, an increase of 23.2% over 2011. The company's operating profit was KRW1,266.7 billion (approximately $1.1 billion) in fiscal 2012, an increase of 23.8% over 2011. Its net profit was KRW366.7 billion (approximately $0.3 billion) in fiscal 2012, as compared to the net profit of KRW181.5 billion (approximately $0.2 billion) in 2011.

5. ANNEX

5.1. Annex I: SOLAS

The current SOLAS Convention includes Articles setting out general obligations, amendment procedure and so on, followed by an Annex divided into 12 Chapters:

Chapter I - General Provisions
Includes regulations concerning the survey of the various types of ships and the issuing of documents signifying that the ship meets the requirements of the Convention. The Chapter also includes provisions for the control of ships in ports of other Contracting Governments.

Chapter II-1 - Construction - Subdivision and stability, machinery and electrical installations
The subdivision of passenger ships into watertight compartments must be such that after assumed damage to the ship's hull the vessel will remain afloat and stable. Requirements for watertight integrity and bilge pumping arrangements for passenger ships are also laid down as well as stability requirements for both passenger and cargo ships.

The degree of subdivision - measured by the maximum permissible distance between two adjacent bulkheads - varies with ship's length and the service in which it is engaged. The highest degree of subdivision applies to passenger ships.

Requirements covering machinery and electrical installations are designed to ensure that services which are essential for the safety of the ship, passengers and crew are maintained under various emergency conditions.

"Goal-based standards" for oil tankers and bulk carriers were adopted in 2010, requiring new

ships to be designed and constructed for a specified design life and to be safe and environmentally friendly, in intact and specified damage conditions, throughout their life. Under the regulation, ships should have adequate strength, integrity and stability to minimize the risk of loss of the ship or pollution to the marine environment due to structural failure, including collapse, resulting in flooding or loss of watertight integrity.

Chapter II-2 - Fire protection, fire detection and fire extinction

Includes detailed fire safety provisions for all ships and specific measures for passenger ships, cargo ships and tankers.

They include the following principles: division of the ship into main and vertical zones by thermal and structural boundaries; separation of accommodation spaces from the remainder of the ship by thermal and structural boundaries; restricted use of combustible materials; detection of any fire in the zone of origin; containment and extinction of any fire in the space of origin; protection of the means of escape or of access for fire-fighting purposes; ready availability of fire-extinguishing appliances; minimization of the possibility of ignition of flammable cargo vapour.

Chapter III - Life-saving appliances and arrangements

The Chapter includes requirements for life-saving appliances and arrangements, including requirements for life boats, rescue boats and life jackets according to type of ship. The International Life-Saving Appliance (LSA) Code gives specific technical requirements for LSAs and is mandatory under Regulation 34, which states that all life-saving appliances and arrangements shall comply with the applicable requirements of the LSA Code.

Chapter IV - Radiocommunications

The Chapter incorporates the Global Maritime Distress and Safety System (GMDSS). All passenger ships and all cargo ships of 300 gross tonnage and upwards on international voyages are required to carry equipment designed to improve the chances of rescue following an accident, including satellite emergency position indicating radio beacons (EPIRBs) and search and rescue transponders (SARTs) for the location of the ship or survival craft.

Regulations in Chapter IV cover undertakings by contracting governments to provide radiocommunication services as well as ship requirements for carriage of radiocommunications equipment. The Chapter is closely linked to the Radio Regulations of the International Telecommunication Union.

Chapter V - Safety of navigation

Chapter V identifies certain navigation safety services which should be provided by Contracting Governments and sets forth provisions of an operational nature applicable in general to all ships on all voyages. This is in contrast to the Convention as a whole, which only applies to certain classes of ship engaged on international voyages.

The subjects covered include the maintenance of meteorological services for ships; the ice patrol service; routeing of ships; and the maintenance of search and rescue services.

This Chapter also includes a general obligation for masters to proceed to the assistance of those in distress and for Contracting Governments to ensure that all ships shall be sufficiently and efficiently manned from a safety point of view.

The chapter makes mandatory the carriage of voyage data recorders (VDRs) and automatic ship identification systems (AIS).

Chapter VI - Carriage of Cargoes

The Chapter covers all types of cargo (except liquids and gases in bulk) "which, owing to their particular hazards to ships or persons on board, may require special precautions". The regulations include requirements for stowage and securing of cargo or cargo units (such as containers). The Chapter requires cargo ships carrying grain to comply with the International Grain Code.

Chapter VII - Carriage of dangerous goods

The regulations are contained in three parts:
Part A - Carriage of dangerous goods in packaged form - includes provisions for the classification, packing, marking, labelling and placarding, documentation and stowage of dangerous goods. Contracting Governments are required to issue instructions at the national level and the Chapter makes mandatory the International Maritime Dangerous Goods (IMDG) Code, developed by IMO, which is constantly updated to accommodate new dangerous goods and to supplement or revise existing provisions.

Part A-1 - Carriage of dangerous goods in solid form in bulk - covers the documentation, stowage and segregation requirements for these goods and requires reporting of incidents involving such goods.

Part B covers Construction and equipment of ships carrying dangerous liquid chemicals in bulk and requires chemical tankers to comply with the International Bulk Chemical Code (IBC Code).

Part C covers Construction and equipment of ships carrying liquefied gases in bulk and gas carriers to comply with the requirements of the International Gas Carrier Code (IGC Code).

Part D includes special requirements for the carriage of packaged irradiated nuclear fuel, plutonium and high-level radioactive wastes on board ships and requires ships carrying such products to comply with the International Code for the Safe Carriage of Packaged Irradiated Nuclear Fuel, Plutonium and High-Level Radioactive Wastes on Board Ships (INF Code).

The chapter requires carriage of dangerous goods to be in compliance with the relevant provisions of the International Maritime Dangerous Goods Code (IMDG Code).

Chapter VIII - Nuclear ships

Gives basic requirements for nuclear-powered ships and is particularly concerned with radiation hazards. It refers to detailed and comprehensive Code of Safety for Nuclear Merchant Ships which was adopted by the IMO Assembly in 1981.

Chapter IX - Management for the Safe Operation of Ships

The Chapter makes mandatory the International Safety Management (ISM) Code, which requires a safety management system to be established by the shipowner or any person who has assumed responsibility for the ship (the "Company").

Chapter X - Safety measures for high-speed craft

The Chapter makes mandatory the International Code of Safety for High-Speed Craft (HSC Code).

Chapter XI-1 - Special measures to enhance maritime safety

The Chapter clarifies requirements relating to authorization of recognized organizations (responsible for carrying out surveys and inspec-

tions on Administrations' behalves); enhanced surveys; ship identification number scheme; and port State control on operational requirements.

Chapter XI-2 - Special measures to enhance maritime security

Regulation XI-2/3 of the chapter enshrines the International Ship and Port Facilities Security Code (ISPS Code). Part A of the Code is mandatory and part B contains guidance as to how best to comply with the mandatory requirements. Regulation XI-2/8 confirms the role of the Master in exercising his professional judgement over decisions necessary to maintain the security of the ship. It says he shall not be constrained by the Company, the charterer or any other person in this respect.

Regulation XI-2/5 requires all ships to be provided with a ship security alert system. ,Regulation XI-2/6 covers requirements for port facilities, providing among other things for Contracting Governments to ensure that port facility security assessments are carried out and that port facility security plans are developed, implemented and reviewed in accordance with the ISPS Code.Other regulations in this chapter cover the provision of information to IMO, the control of ships in port, (including measures such as the delay, detention, restriction of operations including movement within the port, or expulsion of a ship from port), and the specific responsibility of Companies.

Chapter XII - Additional safety measures for bulk carriers

The Chapter includes structural requirements for bulk carriers over 150 metres in length.

5.2. Annex II: Standars in shipbuilding

Below are some examples of engineering standards for the design, construction and life-cycle maintenance of ships, offshore units and other marine-related facilities.

- **ISO 14001** is the international standard for an environmental quality management system.
- **ISO 14064** is an international standard against which GHG emissions reports are voluntarily verified.
- **ISO 28000** is an international supply chain security management system standard.
- **ISO 9001.** The internationally recognized quality management system standard and the preferred solution for over half a million organizations in 159 countries.
- **ISO/IEC 27001** aims to ensure that adequate controls addressing confidentiality, integrity and availability of information are in place to safeguard the information of interested parties. These include customers, employees, trading partners and the needs of society in general.
- **OHSAS 18001.** This standard provides a systematic approach to identifying helath and safety hazards, and then either eliminating the hazards or reducing their risks.
- **BS 25999** provides the framework for assessing, planning and testing your contingency plans which helps build organisational resilience.
- **ATEX 95.** Equipment and protective systems intended for use in potentially explosive atmospheres. ATEX 95 (94/9/EC) sets the requirements for equipment and protective systems intended for use in potentially explosive atmospheres. In order to sell such equipment within the Europe-

an Economic Area, manufacturers must prove products meet the requirements of this directive.

- **SA 8000.** Social Accountability 8000 is an assessment and certification standard; it is based on international human rights conventions that focus on improving working conditions. It was developed by Social Accountability International (SAI).

- **SOLAS.** As a result of amendments to SOLAS 1974 a major retroactive requirement will be introduced in October 2010 that will impact on passenger ships.

- **MARPOL.** The International Maritime Organisations Marine Environment Protection Committee (MEPC) adopted a revised MARPOL 73/78 Annex II Regulations for the Control of Pollution by Noxious Liquid Substances in Bulk in 2004 and will enter into force 1 January 2007 and will apply to both new and existing ships.

- **Marine Equipment Directive.** On February 27, 2004 the European Community (EC) and the United States (US) signed a Mutual Recognition Agreement (MRA) on marine equipment, under which designated equipment certified as complying with the Marine Equipment Directive (MED) 96/98/EC, as amended to date, will be accepted for sale in the US without the need for additional testing or certification and vice-versa.

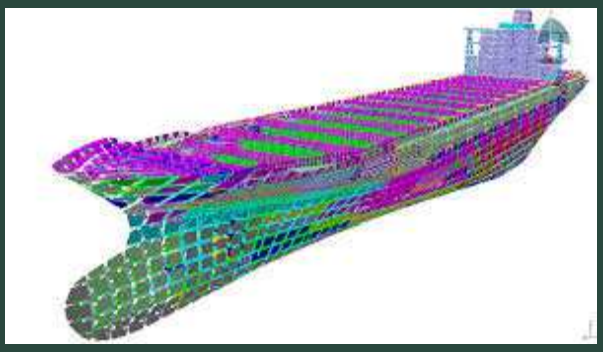
- **Recreational Craft Directive.** The Recreational Craft Directive details the requirements and modules that manufacturers of recreational craft must comply with.

6. Disclaimer

International Patent Classification is made according to objective criteria. However, the interpretation of these documents always involves a degree of subjectivity, due to the fact that the classification is made by different examiners, from different technical sectors and countries of origin (and, therefore, different languages), and therefore that leaves certain limits to subjectivity and interpretation of some concepts. Therefore, it should always keep in mind that we have to accept a margin of error.

During the investigations, the only files (either patents or utility models) that can be detected are those that have already been published. In Spain (as in most countries), the utility model applications are not published until at least 6 months from the date of application, and patents to a minimum of 18 months from the date of application. Therefore, the utility model applications filed in the last 6 months and the patent of the last 18 months are not "detected" during investigations. In some countries, patent applications are not published until they are granted, so that in such cases, the period during which they are not detectable is 2-3 years or more. In other countries such as Italy (and some Latin American countries), there is an enormous delay in the Patent Office and this process could take several years. Either way, it should be noted that patent applications are not published, in most cases, even after 18 months from the filing date or priority date (if claimed).

On the other hand, it is desirable to indicate that many companies do not apply for patents and / or utility models using their name, but using other companies or individuals to make the applications.



Improvements in Maritime Safety

TECHNOLOGY SURVEILLANCE REPORT