

Study on Industrial and Technological Competences in the Naval Sector

Executive Summary

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Contents:

Introduction 2

Summary of Activities 2

Structure of the Project..... 3

Content of the Study 3

- ✚ Analysis of the naval industry by country and Operational Specificities of the European Naval Sector (WP2) 3
- ✚ Global position of the European Naval sector (WP3)..... 5
- ✚ Trends on technological and industrial capabilities in the naval sector (WP4) 6
- ✚ Supply chains and subcontractors (WP5) 7
- ✚ New Technologies and R&D. Potential impact on the naval EDTIB (WP6) 8
- ✚ Conclusions (WP7) 9

INTRODUCTION

The maintenance of a strong and competitive Defence Technological and Industrial Base (DTIB) in Europe is a fundamental underpinning of the Common Security and Defence Policy (CSDP). In May 2007 Member States endorsed the strategy to create a stronger European Defence Technological and Industrial Base (EDTIB), focused on meeting the real operational requirements of the Armed Forces of the future, able to rapidly exploit the most promising technologies and be more competitive both in Europe and around the world. This call to identify the key defence-related industrial capabilities for preservation or development in Europe was reinforced by the European Council in December 2013, stating the need of a “more integrated, sustainable, innovative and competitive EDTIB”. Furthermore, with the recent adoption of the EU Maritime Security Strategy and its CSDP dimension and following the developments in the Southern Mediterranean arena, the maritime domain has gained renewed focus at EU level. The ability for European nations to implement such strategy will of course depend on the availability of required capabilities and the existence of a competent and competitive naval industrial base.

In order to maintain the European naval sector’s global competitiveness and technological lead in the future, a good understanding is needed of its industrial and technological specificities and competences and of potential policy actions to ensure that such capabilities will be maintained and sustained in Europe.

In the light of the above, the current Study gives a unique and informed cross-cutting vision of this industry: it encompasses the examination of supply and demand, including market analysis and the identification of the major naval players, their supply chain and national research centres. It aims at showing the strategic positioning and geographical footprint of the industry, identifying the needs, trends and perceived gaps as well as new technologies with potential impact on the naval sector.

It identifies the European industrial and technological competences which are critical to the future of strong, competent and competitive EDTIB and ends with some initial recommendations for implementation through supporting policy instruments and further actions aimed at strengthening the Naval EDTIB.

SUMMARY OF ACTIVITIES

In order to carry out the present Study a consortium was established among the major industrial naval stakeholders at European level, representing a wide spectrum of expertise and knowledge in the naval field.

Consortium members:

Damen (Netherlands)	DCNS (France)
Fincantieri (Italy)	Navantia (Spain)
ThyssenKrupp (Germany)	SEA Europe- Coordinator

Consortium members brought into the development of the project their strategic, technical and historical knowledge and expertise. From their System Integrators standpoint, they have exploited the links, including structural, and contacts with virtually all European players in the naval field and in a number of related domains, whether military or commercial. This played an important role in the study, facilitating the information gathering and inclusion of suppliers' data.

STRUCTURE OF THE PROJECT

The differences in the national procurement processes (as described in Annex 2) as well as in the national structures and in the strategic positioning of the naval companies in Europe require an individual analysis of supply and demand sides of each country in order to map better and identify the key capabilities and technologies. The understanding of these specificities was critical to deliver well researched conclusions, valid for the European Naval industry as a whole.

Therefore, the management principle of this study was to structure the work in phases, basing each phase on the findings of the previous phases.

On the basis of the above management principle the Final Report has been developed along the following structure and responsibility allocation:

CHAPTERS OF THE FINAL REPORT	Tasks / Responsibility / WPs	
Chapter 1. Introduction	Task 2.1 – SEA Europe	WP2
Chapter 2. Operational Specificities of the European Naval Sector	Task 2.1 - DCNS	
Chapter 3. Naval shipbuilding in Europe: a strategic industry	Task 3 - Navantia	WP3
Chapter 4. Supply Chains and Subcontractors	Task 5 - TKMS	WP5
Chapter 5. Trends on Technological and Industrial Competences in the naval sector	Task 4 - Damen	WP4
Chapter 6. New Technologies and R&D. Potential impact on the naval EDTIB	Task 6 - Fincantieri	WP6
Chapter 7. Conclusions and policy recommendations	Task 7 – SEA Europe	WP7
Annex 1 List of European Dry Docks	Tasks 2.2 to 2.8 – All Partners	WP2
Annex 2. Analysis of the Naval Industry: France, Germany, Italy, Spain, The Netherlands, UK	Tasks 2.2 to 2.7 – Each Partner	
Annex 3. Analysis of the Naval Industry. Other European countries	Task 2.8 – All Partners	
Annex 4. List of Research Facilities in Europe	Tasks 2.2 to 2.8	

CONTENT OF THE STUDY

Analysis of the naval industry by country and Operational Specificities of the European Naval Sector (WP2)

The analysis carried out at national level has demonstrated that top-level shipbuilding companies exist in each of the main naval European countries (namely France, Germany, Italy, Spain, The Netherlands and UK) and together with the respective national supply-chains put Europe at the forefront when it comes to naval technology, innovation and cost-effectiveness, in the military domain.

Due to generalised market pressures both on the demand and on the supply sides, such companies have continuously adapted their product portfolios, their target markets and their cultures to a changing situation by which:

- on the civil side of the business they had to face a State-supported Far-Eastern price competition on standard cargo ships and have concentrated on the most technologically demanding types such as cruise ships, ferries and specialized vessels,
- on the military side they had to survive the cuts in the National defence budgets by increasingly exploiting the export markets for naval vessels where nevertheless competition is getting increasingly tense.

This repositioning process, carried out since the 90s and entailing mergers, acquisitions and the closure of a number of shipyards, has led on one side to a significant degree of concentration of the industry at National level and, at a same time, to a growing degree of diversification and globalization of the companies involved.

As a result, Europe has emerged as the undisputed world leader in the fields of cruise ships and complex offshore vessels ¹as well as across the whole range of naval ships.²

This overall positioning is mainly due to large Companies like DCNS (France), Navantia (Spain) Damen (Netherlands), ThyssenKrupp (Germany), Fincantieri (Italy) and BAE (UK), which are the center of gravity of a wide network of highly specialized sub-suppliers and collectively aggregate over 98 % of the over 75 bill. \$ EU naval orderbook at mid-2015.³

The naval shipbuilding industry in other maritime European countries covered by this study (Belgium, Denmark, Finland, Greece, Poland, Portugal, Romania, Sweden) is less prominent. Some excellences can be found along the respective national supply-chains, although not in terms of critical capabilities.

All the naval companies examined in this Study have in common some specificities that make them different from other industrial sectors. These specificities result mainly from “parameters” basically set by the historical customers (namely the Navies of the Member-States). The impact of these parameters is described along the following lines:

- **Products and programs:** The naval industry delivers a wide range of products through programs/processes which differentiate this industry from other industrial sectors:
 - ✓ Product complexity, which is due to the very large number of components, sub-systems and systems that have to be physically and functionally integrated into a naval asset;
 - ✓ Highly priced products, starting from about 50 mill € for a Patrol Vessel and increasing exponentially up to over 1 bill € for the most complex ship types. The life-cycle costs of these vessels are usually higher than the initial price;
 - ✓ Program timeframes: for a frigate, the design and development phase typically lasts about 5 years, the construction/integration/test phase lasts about 5 years, and the service life of the vessel lasts at least 30 years;
 - ✓ Small number of vessels per program as a consequence, especially in Europe, of the budget cuts and of the high value of naval assets. This implies that non-recurring costs (i.e. design) can be spread on a limited number of units and that there is no full-scale prototype of the vessel; the first vessel built being acquired by the client;

¹ Measured by market share

² Measured by export market share

³ Source: Janes Database

- ✓ Production machinery, tools and facilities (dry-docks and sites used for testing combat or platform systems) are not standardized and are unique in terms of size and capabilities: cranes that can lift the weight of three Airbus' A380s, welding tools able to weld very thick or very thin metal-alloy (mainly steel and aluminium) pieces of large dimensions, up to more than 10 meters in some cases
- **Competencies and industrial capabilities:** the resources and the technical expertise necessary to design, integrate, build and maintain naval vessels cover many subdomains of physics, chemistry and electronics, to which have to be added unique system integration capabilities and know how. These technical fields of expertise are mainly found at the prime contractor and second level tiers of the naval industry and demand a dedicated and costly theoretical and practical formation that can span more than 5 years (10 years for some specialties).
- **Prime Contractors:** the responsibility to design, integrate and build naval ships are generally assigned to prime contractors which in many cases act also as “Whole Warship Design Authorities”, coordinating a wide and diversified supply-chain. In Europe, there are six main prime contractors in the naval industry ⁴ operating with different business models and adopting different market positioning and strategies. This has led each of them to specific product portfolios.
- **Network of suppliers and subcontractors:** The variety of ship types designed, built and maintained by the naval defence industry requires a supply chain made up by a high number of specialized suppliers which are varied in terms of size and type of activities. In this respect the analysis carried out in this study has shown that the main European naval countries have a high level of autonomy when it comes to sourcing the components and systems needed to build and maintain naval ships.
- **Nuclear deterrence:** France and the United Kingdom are among the five nuclear-weapon States under the Non-Proliferation Treaty. This has contributed to structure their naval sector and supply-chain to master nuclear energy. As a consequence, these two countries have had to develop and maintain a naval industry capable of designing, building, integrating and maintaining with the highest degree of autonomy complex vessels such as nuclear-armed ballistic missile submarines, some with nuclear propulsion, and of their related systems.

Global position of the European Naval sector (WP3)

The European naval industry manages to design, integrate and produce the whole range of naval ships and almost the totality of its core systems and components, with specific distinctive competencies in the field of the most complex surface/combatant ships and a world leadership in the one of conventional submarines equipped with AIP systems.

The European naval industries are highly competitive in the international markets, as reflected by the high market share and successful export results over the past years.

Traditionally, naval shipbuilding has been a highly protectionist market due to the reduced number of customers (namely governments) and reasons of national sovereignty, defence strategies and industrial/economic aspects. Historically, the national navies have been the main customers of the national shipbuilders, with a relatively limited export activity.

However, due to decreasing defence budgets in Europe, nowadays the export market accounts for 42% of the European naval orderbook value. It is very important for all the European companies,

⁴ BAE Systems, Damen, DCNS, Fincantieri, Navantia and TKMS

mainly targeting those countries in the Middle East, Africa, Asia and Latin America which are devoting a growing budget to defence expenses and do not have an indigenous naval industry.

As for the export destinations, there is very little activity from Europe to the US (due to the protectionist policy in the US) and no export from Europe to China and Russia (due to European/national export regulations, e.g. arms embargo on China).

European competitiveness in the global naval market is based primarily on proven and leading edge technology, especially in the product segments with higher technological complexity and higher added value (e.g. multi-purpose frigates and destroyers or conventional submarines).

In recent years, significant changes have occurred and are still occurring in the global naval market. First, growing defence budgets and growing demand for naval vessels from Middle East and Southeast Asian Navies in sharp contrast with the deep budget cuts experienced in Europe. Second, increasing export market penetration from Chinese shipyards (in developing countries, e.g. Pakistan) and from Korean shipyards (e.g. DSME), with some limited and targeted success also with the export of conventional submarines, frigates and logistic/supply vessels. It has to be noted that in these Countries the export of naval ships is strongly supported by political will and “power” as an act both of foreign and industrial policy. Third, the increasing request of technology transfer and construction of the follow-up ships in the customers’ country.

For Europe it means that the next technological breakthrough to keep one step ahead of the non-EU competition must be developed faster, through an increased level of investments R&D.

Notwithstanding these threats, the competitive position of the European shipbuilding industry is expected to remain healthy in the future, especially in the market segments of higher added value and with larger sales value (e.g. submarines, destroyers and frigates).

Trends on technological and industrial capabilities in the naval sector (WP4)

Given the different trends perceived in the different countries, all the Consortium Members contributed to this chapter in order to ensure that the relevant trends across Europe are identified and analysed. In-house expertise of the consortium has been crucial for this chapter.

The main trends on technological and industrial capabilities have been identified with reference to the phases of the ships’ lifecycle:

- Requirements Analysis
- Design and Engineering
- Manufacturing, Assembly and Outfitting
- Integration and Commissioning
- Project Management and Co-ordination
- In-Service Support

The most important of them are summarised here below:

Reduced manning	Automation of major systems
Energy efficiency	Multi mission capabilities
Built-in maintenance features	In-service support concepts using existing industrial resources

Availability-based contracting for services and life-cycle management concepts	Unmanned systems (stand-alone/ integration)
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These trends are to a large extent related to the following factors:

- A tendency of Navies to be less specific and more functional in their requirements, leaving more room for industry to come forward with their own (frequently more economic) solutions;
- The retreat of some Navies, due to budget constraints, from their role as technology drivers and prime sponsors of R&D, especially in the area of platform technology, thus leaving this key (and costly) activity to the industry without specific financial compensation;
- The Navies' will to optimise their operational cost by reducing crew on board, amplifying at the same time the need for more automation and remote command and control;
- The tendency, driven by budget-cuts, to opt for multi-mission solutions and for dual technology solutions, sometimes sacrificing the capabilities of the weapon-system;
- On the other side, and compared to the past decade where the focus was on peace keeping, piracy, drugs trafficking and humanitarian missions, more emphasis is expected on the more military aspects of the weapon-systems in terms of survivability, perseverance and battle hardening,
- Areas of operation are now extended to extreme climates both tropic and arctic.

Since the 90s the industry has embarked in a diversification strategy in non-military high tech markets from cruise liners and mega yachts to offshore oil and gas and energy. This was carried out in order to create an environment that could favor cross fertilization of military and commercial technology, leading to cost-savings in many areas which nevertheless still have to be exploited to their full extent.

In this context industry has concentrated on system integration and project management, making increasing use of third parties for manufacturing, assembly and part-outfitting, leaving less time and room for late modifications and changes.

Supply chains and subcontractors (WP5)

Within the European Naval Industrial Base different approaches and models exist as far as the role of state and government involvement is concerned, with companies that are partially or fully state-owned, and leaner private-owned companies. The same is true for a few of the main suppliers.

Whatever the difference, from the standpoint of turn-key solutions Europe has all the choices ready at all scales of the naval product range.

The European supply chain is diverse and complete at systems level and there is no competence area where a real monopoly exists; only in the category of the technologically sophisticated systems we find the most internationally oriented groups, a few of them already trans-European by design -e.g. Airbus- or by post-acquisition structure.

For systems/components sometimes procured from outside Europe there is a possible replacement provided by a European supplier, but in many cases political or legacy reasons justify preference made.

All in all, and the study has highlighted that all the countries considered source from 60 to 80 % of the purchased value within national borders and that over 95 % of the materials, components and systems that make up naval assets are sourced within Europe, with no dependency from non EU Countries for critical items.

Regarding the system suppliers having a worldwide footprint it can be observed that supplies of armaments/weapons control, propulsion/power generation and electrical systems /automation (items that make up a relevant proportions of the ships’ cost) are provided by a few European or even international champions (e.g. Thales, Rolls-Royce, Siemens, MBDA, etc.) who have the ability to manage the advanced trades involved and the technology/patent portfolio likewise.

Further down the supply chain, and in particular around supplies and services related to structure/platform or auxiliary systems, outfitting and furnishings, there is a vast national supply base which is mostly made up by small-to-medium enterprises. These companies are a traditional back-bone of local/coastal economies, their competences are present in nearly all countries and they are generally less focused on the defence market only.

Nowadays some of the key competencies of the naval shipbuilding business are to be found in the area Systems Integration. In this context Prime Contractors work together with a limited number of subcontractors/trades for e.g. Combat System and related sub-systems, armaments, platform automation and electrical installation, surface coating, etc. the relations with whom are either based on tradition of trust in quality and pricing or directly requested by the Customer. On the other hand, the construction of parts or of the complete hull is in some cases, especially for the less complex ships, subcontracted to lower cost producers in Central and Eastern Europe or as a consequence of outsourcing of trades subcontracted to domestic manufacturing facilities.

This notwithstanding, the knowledge of the supply chain beyond second-tier suppliers and subcontractors is relatively limited, due to high complexity of the products and to the resulting need of the System Integrators/Primes to limit the number of operational/sourcing interactions, otherwise excessively high.

New Technologies and R&D. Potential impact on the naval EDTIB (WP6)

In order to identify the new technologies and their potential impact on the naval EDTIB an analysis of previous studies commissioned by EDA was carried out.

Furthermore, starting from the EDA Naval Strategic Research Agenda a country by country survey was carried out in order to identify the technologies considered of primary importance both to maintain the European competitiveness and technological lead and to ensure the required level of operational superiority.

Thanks to this analysis 13 high priority topics and 4 new items were identified as follows.

High Priority Topics

SURFACE TECHNOLOGIES	SUBSEA TECHNOLOGIES	SERVICES/TRANSVERSAL TECHNOLOGIES
Virtual ship	Hydrodynamics and UxV integration	Uninhabited systems
Simulation	Modularity	Propulsors & propellers
Maintenance	UxV integration	

Oceanography	Vulnerability reduction	
Environmental protection	Propulsor	
Supply & Support		

New Topics:

3D printing	High capacity batteries	Augmented reality	Drones
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This investigation has led to some important considerations:

- it has been confirmed that the technological level of the Naval sector is already relatively high and matches areas like automotive, aeronautics and space;
- the European Naval sector is suffering the economic crisis and in the past decade Navies, once the prime owners of technology, are no longer funding Research, Development and Innovation (RDI) activity for budget reasons. In this context on one side there is the risk that typical naval knowledge of the Navies themselves will deteriorate in areas such as survivability, shock, blast, noise, armament, on the other side the industry has to bear the cost of a large part of the necessary investments in RDI;
- while there is a tendency to focus RDI on areas such as cyber, data management, C4I, the need emerged to increase focus on the platform side to design battle-capable platforms with a very limited crew, able to perform missions in extreme climate areas (tropical zones, Arctic area) and new combat conditions (eg asymmetrical threats);
- last but not least, it has been highlighted the need to dedicate significant investments also in innovating the production process and in modernizing fixed assets and production tools.

Conclusions (WP7)

General considerations

European Naval shipbuilders design, integrate and build some of the most complex and expensive assets at the disposal of the Armed Forces, supplying them with the capabilities and the strategic autonomy needed to counter the multi-faceted threats embedded in the current geo-political scenarios.

Considering the complexity and sophistication of the products designed and built by these companies, they should nowadays be regarded as “system integrators”, dismissing once forever the old image of shipbuilders as mere assemblers of steel blocks.

Such system integration capabilities are a distinctive strategic asset of the European Naval DTIB which should be carefully preserved and nurtured, especially in the light of the technological evolution, by which the overall capabilities of a naval ship depend all the more on the optimal functional and physical integration between the numerous platform’s and the payload’s systems.

Moreover, most of these companies have become true global players operating beyond the national and European borders and hence are less and less dependent on the naval business in general and on National naval demand in particular, the latter nevertheless keeping its importance as a reference in order to export proven designs.

In addition, the majority of the naval players (Damen, DCNS, Fincantieri, Navantia,) are also successful players in the high-end segments of merchant shipbuilding (e.g. cruise ships and mega-

yachts) and in related maritime activities (e.g. offshore and marine renewable energies). Only BAE Systems and TKMS, at least as far as the marine business is concerned, are still exclusively engaged in it.

This diversification strategy has created a favorable cross-fertilization between civil and military technologies (dual-use technologies), both at the Prime Contractors and at the Supply-Chain levels, leading to cost-effective designs and solutions.

Consequently, the European Naval Industrial Base today is made up by healthy, capable, diversified and successful export-oriented companies, proof of their technological leadership and commercial competitiveness.

This notwithstanding, and in the light of given the growing importance of exports markets for the naval industry some threats stemming from non-European competitors are on the horizon, of a twofold nature:

- price competition from non-EU countries, generally fueled by generous financial support to the exporting companies, in addition to structural cost gaps
- political will and “power” of these States, strongly supporting the export of naval newbuildings as an act both of foreign and industrial policy. Reference is made to countries like China, South Korea, Russia.

From an industrial point of view such threats can be countered only by keeping the technological lead at the Prime/System Integrators level as well as all across the supply-chain through increased, more supported, more coordinated and more focused investments in RDI at national and European level.

Increased and sustained funding and a closer cooperation in RDI at the level of naval shipbuilders may lead to an increased trans-European overall cooperation, as has happened since decades in the area of merchant shipbuilding within the Frameworks of FP6, FP7 and now H2020.

This is becoming all the more important when the increasing transfer of technology transfers requested by the foreign customers some of which, starting from the transferred technologies, try to develop indigenous capabilities are considered.

In this perspective the EUMSS Action Plan, the Preparatory Action on CSDP Related Research and the Action Plan on Defence being set up by the EU Commission will play a key role as political “frameworks” to significantly increase the resources devoted to defence RDI activities, including the naval domain, and a more effective use of them.

Here a distinct role of overall coordinator is foreseen and advocated for EDA.

Policy recommendations

Today’s successful competitive positioning and the leading international/global status of the main European shipbuilding companies should be fully appreciated and accepted.

As a consequence, the “policy recommendation” of the Consortium are:

- in the absence of collaborative programs, of harmonized requirements and technical standards, any consolidation of the European Naval DTIB will be driven exclusively by business opportunities and related considerations, and not by political “top-down” pressures, also considering that where such a consolidation took place no benefits have occurred in

terms of reduction of the acquisition cost of the naval assets. Definition of common requirements, joint programmes, standardisation is in any case to be considered as a prerequisite to trigger such a consolidation process.

- in order to increase intra-EU cooperation in the naval defence and security domain a dedicated area within the next multi-annual Framework for Research, Development and Innovation, should be foreseen, as has been the case for merchant shipbuilding with FP6, FP7 and H2020. Since this is essential to the long-term sustainability of the European naval industry, focused initiatives should be carried out by the industry and supported by EDA and by the EU Commission within the Preparatory Action on CSDP-related Research.
- a regular exchange of ideas between the European Defence Agency (EDA) and the major players in the naval shipbuilding sector should be considered as pivotal in order to better coordinate and integrate the objectives of the future RDI programs in this field considering that, like in the aerospace sector, companies invest in naval technology developments as long as there are naval markets large enough to justify such funding.
- an increased public awareness of the competencies, of the international reputation of the naval industry and of its role both as initiator and supporter of high-technology in Europe should be more proactively promoted.

Practical recommendations

- Launch RDI programs especially in the fields of System Integration and robust and redundant Platform Design, where there are some threats due to lack of RDI public funding, in addition to the High Priority areas (such as survivability, shock, blast, noise, armament) and emerging topics highlighted in this study.
- Facilitate the development of European Naval standards especially in areas where cooperation between European Navies is effected (i.e. standards to reflect mission profiles (duration, area of operation, size of ship)).
- Promote the “in service support” concept by developing standard solutions and facilitating industrial participation.
- Reinforce the EU Naval RDI infrastructure by promoting centers of excellence, a model case being e.g. the German WTD71 military research unit (co)operating a test range for underwater acoustics with the Netherlands and Norway.
- Launch initiatives to modernise/improve the design and production-simulation tools of the main players (according to the digital transformation of industry, or industry/shipyard 4.0).
- Launch an economic study to evaluate how common purchasing policies managed by the main naval contractors could reinforce the supply chain; the purpose being to create a less diverged, stronger and more competitive supply chain specifically at the first tier level.
- Use an established naval event/exhibition as a transporter to attach a new side event to it in order to give more visibility to the EU naval industry. In this context a technological challenge/task could be defined and teams of young R&D people in the EU invited to present solutions and to compete: pay a prize but buy a chance of building partnerships.