D2.1 DESK RESEARCH REPORT ON INDUSTRY 4.0 CHALLENGES
In order to address the skills needs in the Shipbuilding Sector, we presented a proposal to the Call for Proposals of the Erasmus + Programme 2018 under the scheme KA2 Sector Skills Alliance Lot 1.

USWE project aims at detecting the skills gaps and future needs in the Shipbuilding Industry, including in the scope the several subsectors that make it up: manufacturing, repair, maintenance and conversion of vessels, including the equipment on board, and other maritime structures such as the offshore platforms.

Project nº — 600866-EPP-1-2018-1-ES-EPPKA2-SSA-N
USWE Project
Upskilling Shipbuilding Workforce for Europe

Forecast for Shipbuilding 4.0

Project Proposal

Objectives

• Research on new innovative trends in Shipbuilding Industry.

• Analyse 4.0 Industry and the potential effect it may have in the skill needs of the sector.

• Forecast the influence of these trends in the future of the sector.

Activities

• Desk Research on drivers & forces of change in the sector and in VET.
• Designing guidelines and rubrics for interviews with experts.
• Interview experts on drivers and forces of change in the sector.
• Publication of the Forecast for Shipbuilding 4.0

Approach and Methodology

1. Foreword
2. Identifying Trends
3. Drawing Conclusions
4. Forecasting Challenges
5. References
USWE Project - Upskilling Shipbuilding Workforce for Europe

PROCES ON FORECASTING TRENDS AND CHALLENGES

Key Factors on Forecasting  ➔  Supporting information  ➔  Conclusions on Forecasting

- Shipyards’ current activity
- Sectoral innovative projects
- Equipment Providers
- Previous Forecasting

CONCLUSION
The European Shipbuilding and Maritime Technology Market today

- European shipyards
- Europe’s Maritime Equipment Industry
- Complex ship types

Prospect for tomorrow: The shipbuilding Market Forecast

- Working group
- Trends and consideration
- Methodology

SEA Europe’s Newbuilding requirement Forecast

- Technological advancement
- Environmental rules
- Slowbalisation
- Forecast results
- Challenges

Macro economic
- GDP
- Demography
- Production
- Energy mix
- etc.

Global trade
- Trade patterns
- Type of trade
- Sea borne/land
- etc.

Fleet requirement to 2040
- Existing fleet size and age
- Deleted ships and replacement
- Regulations
- etc.

Newbuilding requirements to 2040
The European Shipbuilding and Maritime Technology Market today

Figure 1 Annual Average Production Values of the Shipbuilding Value Chain SEA Europe and EU-28

Figure 2 Production Value Development EU-28

Figure 3 Average Employment SEA Europe and EU-28

Figure 4 Average Employment by Country
The European Shipbuilding and Maritime Technology Market today

Blue Growth & Maritime Technology

Maritime tech and tools are provided to bring these activities to sea

Key Enabling Technologies

Figure 5 Product Complexity Curve

Figure 6 Maritime Technology - Key enabling technologies
Geopolitical Situation – The Shipbuilding Market

Geopolitical Trends

• Strategic industry
• Unfair competition
• Support and stability

The Global & European Shipbuilding Market

• Signs of recovery
• Newbuilding units ordered remains low
• South Korea, China
• Europe

Cybersecurity
The Global and European Shipbuilding Market – *Source: SEA Europe*

**Figure 7** Global commercial shipbuilding activity in CGT

**Figure 8** Global commercial shipbuilding activity in number of ships
*Source: SEA Europe based on IHS Fairplay*

**Figure 9** EU28+Norway commercial shipbuilding activity in CGT (source SEA Europe)

**Figure 10** Value of the World Commercial Orderbook by main shipbuilding areas (source SEA Europe)
Internationalization
- Lose of national influence
- Hyper connectivity: a borderless world
- Companies becoming more independent
- Need for Harmonisation and regulations
- Monitoring of laws & regulations
- Relationship & organisational structures: short-term and complex.

Cybersecurity: sharing of knowledge

Geopolitical Situation – The Shipbuilding Market

Regionalisms
- Economic protectionism
- The entire process in one only place
- Facilitated by Robotisation
- Weaknesses of these countries economic competitiveness in the world

Europe’s situation
- Benefits of the specialisation and high tech.
- Diversify business and struggling
- Leading the WCO in terms of value
USWE Project - Upskilling Shipbuilding Workforce for Europe

Economic Activity and Seaborne Trade

Seaborne Trade
- Increasing Seaborne trade
- Economic growth. But softening in economic momentum.
- Slower pace

Economy and Trade trends
- Facts to be optimistic. Two caveats

Table: European maritime industry SWOT analysis (BALanced..., 2017)
Figure: Global Shipbuilding Activity in cgt (Source: SeaEurope)
Trends in Economic Activity and Seaborne Trade

Figure 11 Seaborne Trade Forecast by cargo type (source: SEA Europe Market Forecast WG 2019)

Figure 12 Seaborne Trade Forecast Comparison 2018 vs 2019 (Source SEA Europe MF WG 2019)

Figure 13 Forecast of global seaborne trade (Source: SEA Europe MF WG)
Social Developments

Global Megatrends

General Social Issues & Demography

- Population growth
- Shrinking population in Europe

Ageing

- Large ageing population: Economic effects
- Decrease in the number of children
- Increase in life-expectancy: developments in gene technologies

Migrations

- Economic refugees
- There is also a replacement demand: Call effect.
- Mitigate the lack of workforce
- Social tension in receiving countries due to the competition experienced by low-skilled indigenous workers
Social Developments: Global Megatrends

Global Megatrends

1. Digital Society. The digital society connects both people and objects, digitizes goods and services, enriches everything with information and automates human labor.

2. Aging Population. The world is growing older. A proportionally smaller workforce supports more seniors, who are more active and engaged as workers and consumers.

3. Urbanization. More and more of us are moving into cities, mainly in the developing world. Cities are becoming mega-sized, catalyze growth, and become innovation labs.

4. Global Growth. Everything is growing - populations, economies, and wealth. The developing world is a growth engine as the global middle class grows, particularly in Asia.

5. Sustainability. The consequences of climate change and unsustainable resource depletion are hitting home. Corporate sustainability is an urgent need - and a competitive advantage.

Figure 14 Global Megatrends in transport and logistics (Source: Finnish Marine Industries)
USWE Project - Upskilling Shipbuilding Workforce for Europe

**Technological Trends 1**

**New Materials at the shipyards**
- Smart lightweight materials
- Advantages: flexible and efficient vessels

**New Shipbuilding Processes**
- Advanced design & production technology
- Production chain and sites
- Modularization

**New Technologies in Shipbuilding**

**Digitalisation Processes – Digitalisation in shipbuilding**

**Automation and Robotisation**

**The IoT**

**Big Data**

**3D Printing**

**Nanotechnology**

**Simulation**

**Virtual Reality**

**New Systems**
- Advanced outfitting
- Merge of design and construction operation
- Artificial intelligence
- New production systems and business models
Marine Technology Trends
(Lloyd’s Register, Global Marine Technology Trends 2030)

<table>
<thead>
<tr>
<th>Trends</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Scientific and technological development speeding up</td>
</tr>
<tr>
<td>2. Technologies have interdependencies and overlap</td>
</tr>
<tr>
<td>3. Linkages between technologies and the human element will become more complex</td>
</tr>
<tr>
<td>4. The increasing complexity of the technologies will impose demands on the skills</td>
</tr>
</tbody>
</table>

Transformational Technologies

1. Big Data Analytics
2. Sensors
3. Autonomous Systems
4. Robotics
5. Smart Ship
6. Communications
7. Advanced Materials
8. Propulsion and Powering
9. Shipbuilding, Design and Construction
10. Advanced Manufacturing
11. Human–Computer Interaction
12. Human Augmentation
13. Cyber and Electronic Warfare
14. Energy Management
15. Marine Biotechnology
16. Deep Ocean Mining
17. Sustainable Energy Generation
18. Carbon Capture and Storage

Figure 15 Marine Technology Trends. Transformational Technologies (source: Finnish Marine Industries)

Industry 4.0 Maturity Matrix

Figure 16 Industry 4.0 Model of Maturity Stages (source: Industrie 4.0 Maturity Index)
New Technologies in Shipbuilding

Figure 17 Two-way closed loop for ship design, ship manufacturing and ship (source: Ang Goh, Salvidar, Li 2017)

Table 1 Milestones and potential impact for smart ship design, manufacturing and operating (source: Ang Goh, Salvidar, Li 2017)
New products and vessels concepts

Figure 18 Megatrends in Transport and Logistics (source: Finnish Marine Industries)
USWE Project - Upskilling Shipbuilding Workforce for Europe

Technological Trends 2

New products and vessels concept

- Zero emission shipping
- Safe and secure waterborne transport
- Digitisation in transport
- Trends in transportation and logistics

Nature: Biomimetic

Case: Navantia. Shipyard 4.0
SHIPYARD 4.0 – 10 Key Digital Technologies

- Modelling & Simulation
- Cloud computing
- Cybersecurity
- Big Data & Analytics
- Internet of Things
- Robotics
- 3D Printing
- New materials
- Autonomous vehicles
- Virtual & Augmented Reality
- Autonomous vehicles
New Energies

Introduction:
- Energy demand
- Renewable energy as the fastest source of energy
- Transport demand – oil demand – natural gas - greening
- The Energy transition

Energy conservation
- Less energy consumes due to process optimization and improvements in propulsion
- Energy management
- Databased energy savings

Alternative Fuels
- Emissions reduction
- Environmental regulations
- Biodiesel. LNG. Offshore oil & gas
- Blue growth activities

Renewables energies
- Offshore marine renewables
- Solar and wind ppowered ships
- Energy storage and distribution
New Energies - Introduction

Figure 20 Global Energy Demand by Region (source SEA Europe based on BP)

Figure 21 Global Energy Demand by Energy type (Source SEA Europe, based on BP)
**Sustainability**

**Introduction**
- Factors: climate change. Mindset change
- Green shipbuilding technology
- Reduce fossils energy consumption

**Environmental regulations**
- Xxxxx
- Main regulations

**Circular economy**

**Action Plan**
- Protect environment
- Generate sustainable growth
Health and Safety

Health & Safety in the Shipbuilding and Ship repair Sector

- Highest health and safety standards
- Robotics to avoid manual repetitive tasks
- Positive trends:
  - Exposure to hazardous substances
  - Exposure to physical hazards
  - Manual handling
  - Big Data for better OHS

Safe and secure Waterborne Transport

- New technologies and methodologies
- Safety culture
- Zero accident, zero facilities and zero pollution policy
- Safe and secure ships and vessels
USWE Project - Upskilling Shipbuilding Workforce for Europe

Human Capital 1

Introduction

- Human factor: relevant for issues such as digitalisation, automation and cybercrime
- Human factor and training: Essential to reduce incidents and to manage new technologies
- Human capital impacted by Cyber Physical Systems.

The Skills Demand

- Skills less well defined: 21st century skills. Survival skills
- Some traditional skills not being useful anymore
- New skills that do not exist yet
- Focus on the skills, to get a better salary, and not on the years in a job
- Increment of skilled work

The Skills and Competences

EU Level 5

Future skills & transferable skills

Case: Welder and robotisation in welding
Human Capital 2

Education and skills are the key drivers for growth and jobs. The sustainability of Europe’s position depends on designing and building high-end products that are leaders in their field.

Timely anticipation of employment and skills needs coupled with re-skilling/re-training programs that address emerging skill gaps and shortages where identifiable. In this respect, the creation of sectoral training institutes should be encouraged.

The curriculum of training centres in Europe should be reviewed and harmonized to such extent as to establish a common European standard that facilitates the award of EU-wide recognized degrees. An EU Skills Council could play an essential role in such a process.

Dual education systems (VET and the simultaneous pursuit of a university degree) should be extended, in particular in regions with maritime clusters. Cooperation between universities and on-site training centres needs to be deepened and extended.

The promotion of lifelong learning and transfer of competences between junior and senior staff should be promoted.
USWE Project - Upskilling Shipbuilding Workforce for Europe

Human Capital 3

TRENDS

Careers

- Greater demand for highly-skilled workers: Non-routine work involving a great deal of interaction with people: Interpersonal contact.
- Machines will also take over the work of highly skilled workers and non-routine works.
- Jobs will be disappearing in the middle segment due to digitalisation.
- New jobs in different locations

From job security to work security

- Flexibility. Flexi-workers. Flexible labour contracts risk being borne by people already in a weak position in the labour market.
- Self-employment
- Employees with a flexible contract
- Job hopping

New paradigm: A Job as a way of developing oneself

- Job polarisation: Haves and have-nots

- New jobs due to environmental regulations

Lack of economic prospect for low-skilled workers: social unrest
CONCLUSIONS

The European shipbuilding and maritime technology industry is a global leader in the design, construction and repair of the most sophisticated ships, technologies and structures for maritime and marine activities.

The sector is delivering smart, clean, safe ships but also offshore platforms and offshore renewable energy devices.

The industry is engaged with the 4.0 revolution and adapting company and workers to the new design and production processes.

Digitalisation steps are taken, but the pace of digitalization in different shipyards, regions and countries may vary a lot.

Large and most successful companies are now investing in renewing their machines and technology, reorganizing work and investing in the skills and competences of their workforce.

These changes require huge investments of companies and it is not always possible or easy (mainly when looking at SMEs).

The technological change requires a new set of skills, and will lead to the creation of new jobs and occupations. For certain, it creates demand for re-skilling and training of the current workforce.

Identifying which are the concrete skills gaps and future needs is not easy. A lot of work is being done at company level, multiplying the efforts all over Europe.

This is why industry and workers representatives decided to undertake this project and support the stakeholders in the identification of skills gaps and needs.
USWE Project - Upskilling Shipbuilding Workforce for Europe

CHALLENGES

Geopolitical Situation

- Need for sectoral actions and initiatives:
  - Review internal training programmes
  - Utilise external training programmes
  - Work with other actors in the sector to develop the skills required
  - Promote the sector to school leavers and graduates

- Skills set of workers will need reforming for complex repair tasks and conversion retrofits.

- To be more efficient: Enhancing performance. Consuming less fuel. Processing data.
USWE Project - Upskilling Shipbuilding Workforce for Europe

**Economic Perspective**

**CHALLENGES**

- Investment and effective policies.
- Match the demand for energy and materials.
- Need to supply of highly educated knowledge people.
- Avoid protectionisms, nationalisms.
- Master Industry 4.0 technologies.
USWE Project - Upskilling Shipbuilding Workforce for Europe

Social Developments

- Aging population: To retain know-how in the sector.
- Needs for food, energy, water, organic or mineral resources.

Health and Safety

- Increase safety and improve incident prevention: zero-casualties shipping.
USWE Project - Upskilling Shipbuilding Workforce for Europe

CHALLENGES

- Improve operation efficiency.
- Optimize ship's performance.
- To boost research, development and innovation efforts.
- Introduce sustainable technologies. Exploit the full potential of green technologies.
- Face the scarcity of materials, resources and land available.
- Improve hydrodynamic design, the use of lightweight material and advanced hybrid-power generation system, with energy storage to optimise performance.

Technological Progress

- Cybersecurity improvement measures: Training skills and technologies.
- Appropriate conditions that are frequently subjected to rapid changes and address the human interface challenges. Extremely low temperatures affect: human, materials, equipment and the environmental systems involved.
USWE Project - Upskilling Shipbuilding Workforce for Europe

**New Energies**

- Take a comprehensive holistic energy saving approach.
- There is a need for alternative fuels
- Growing pressure on governments to close polluting coal-field power station.
- At the same level of power consumption, the generation of green electricity reduces the impact on nature and the environment.
- Workers capable of coping with more new equipment and the interaction with the ship equipment and its operation.
- To reduce fuel consumption
- Competent workforce to handle new business model appropriately.
- Optimize the use of energy sources. Offer superior energy efficiency.
- Renewable and clean energy sources are gaining ground. We are currently going through an energy transition.
- Energy supply is still a problem
USWE Project - Upskilling Shipbuilding Workforce for Europe

CHALLENGES

Sustainability

• To turn the shipbuilding industry into a sustainable business model
• To meet environmental legislation and minimise the environmental impact,
• How to deal with “peak voltages”
• Lack of harmonisation: The energy policies of different countries have not yet been properly coordinated.
• To bring sustainable produced products to a competitive level with non-sustainable ones.
• Eliminate harmful emission and lower impact on the environment.
• Deliver a more eco-friendly, smarter and safer maritime industry.
• Stricter regulations on: Carbon dioxide. Sulphur oxide. Nitrogen oxide
• Improve work and vibration emission controls: further work to collect data on underwater noise and emission levels.
Human Capital - Skills

- To adapt the skills profile of their workers to the new technological advances.
- Increase in the number of subcontractors on European shipyards.
- Need to manage the employment development by increasing cooperation between employees and employers’ organizations, education and institutions & more proactively use of anticipation of change instruments.
- Need to develop skills for the successful development of technologies and vessels.
- New set of skills is needed to manage new Blue Growth activities.
- Rise in the need for digital skills.
CHALLENGES

Human Capital - Skills

- Required for more and more highly skilled technical people and sellers and fewer qualified people.

- The skills of the employees is one of the key strengths of the sector on whose utilisation depend the long term future of the sector.

- The most demanded skills and occupations: Engineer, naval architect, designer, project manager, welder, fitters, electrical engineers and 3D design experts.

- Shipyards need professionals able to perform analysis, diagnosis, reporting, decision making tasks in large, complex projects.

- To attract the next generation of maritime professional.
Mismatches between educational curricula and business needs

There is a need for competences in different areas: welding, electricity and boiler making.

A centralised Europe-wide on-line Recruitment Platform?

Education is lagging behind.

Cybersecurity.