mates

Maritime Alliance for fostering the European Blue Economy through a Marine Technology Skilling Strategy

Co-funded by the Erasmus+ Programme of the European Union

Strategy baseline to bridge the skills gap between training offers and industry demands of the Maritime Technologies value chain

September 2019

About this Report

This document was developed within the framework of the **MATES project, Maritime Alliance for Fostering the European Blue Economy through a Marine Technology Skilling Strategy.**

The objective of the project is to develop a skills strategy that addresses the main drivers of change to the maritime industry, in particular shipbuilding and offshore renewable energy. Both sectors are strongly linked and require new capacities to succeed in an increasingly digital, green and knowledge-driven economy.

Project duration: 2018 - 2021

https://www.projectmates.eu

This report provides a general overview of the MATES project and its outcomes from January 2018 until May 2019. This encompasses results from Work Package 1, 2, 3 and 4 from the project. These results were obtained from workshops with experts, Delphi questionnaires, desk-top studies and surveys. This executive report synthesises the MATES strategy baseline to bridge the skills gap between the training offers and the industry demands of the Maritime Technologies value chain.

A final report summarising the impact of the project will be published after the closing of the project in December 2021.

Acknowledgements

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Project Scope and Objectives

The Challenges

The European maritime labour market is under considerable stress due to an increased focus on innovation-driven processes, including the digitalisation of industrial processes and the rising demand for more sustainable practices, alongside geopolitical and socio-economic changes on a global scale. In addition, **Blue Economy** sectors are experiencing difficulties in finding the right employees, mostly due to:

- Skills gaps between educational opportunities and labour market needs
- Poor communication and cooperation between education providers and industry
- Lack of attractiveness and awareness of career opportunities in the Blue Economy
- Absence of Ocean Literacy culture

Addressing these challenges is key to maintaining the maritime industry's competitive edge.

The MATES Strategy

MATES, an Erasmus+ funded European Blueprint project, has the objective of developing a skills strategy that addresses the main drivers of change to the maritime industry, in particular the shipbuilding and offshore renewable energy sectors.

Programme: Erasmus+
Instrument: Sector Skills Alliances (SSA)
Total Budget: €4.9 million
Duration: January 2018 - December 2021 (48 months)

MATES will:

- Better align educational opportunities and labour market needs by closing the skill gaps
- Validate actions and priorities suggested by the skills strategy through 11 pilot case studies involving both education providers and industry
- Increase the attractiveness of maritime careers through awareness raising
- Widen perceptions of Ocean Literacy initiatives by embedding an appropriate industrial perspective

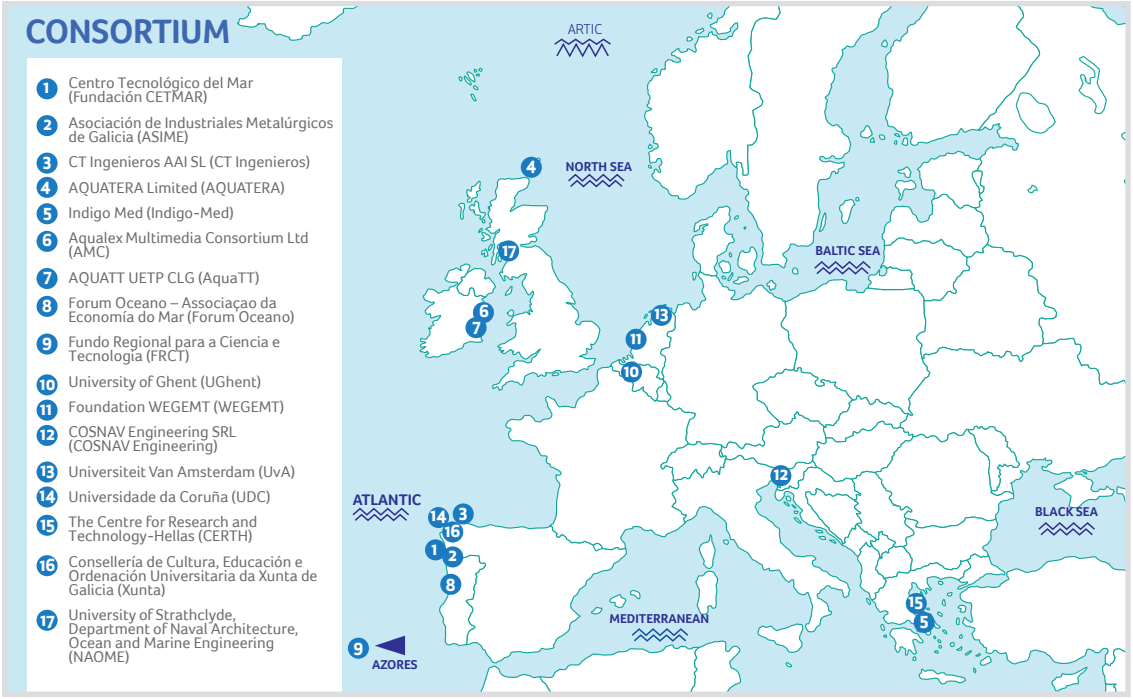


Figure 1. Information of the experts' network involved within the project: their spatial distribution within Europe and type of organisation to which they belong.

Expert Network & Thematic Groups

176 experts and stakeholders contributed at various stages of the project to ensure maximum uptake and impact of the MATES strategy:
http://whowhomates.com/

The network is organised into eight Thematic Groups that include experts both from the partnership and external stakeholders. These experts and stakeholders provide advice and assistance for the implementation of the MATES project. They also assist with measuring the project's impact. The network has been involved in the following activities:

- 10 regional workshops held during 2018
- Webinar and voting for the prioritisation of 22 lines of action
- Foresight analysis of future scenarios (Delphi questionnaire)
- State of the art for the target sectors (contributions and revision)
- Baseline on current skills gap (contributions and revision)

Experts by sea basin

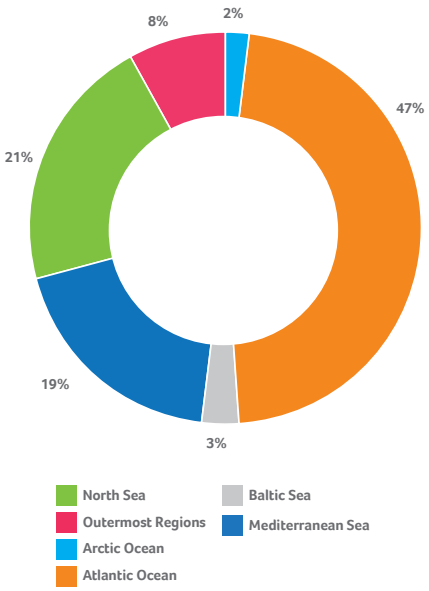


Figure 2. Percentage of experts by sea basin

Type of organisation

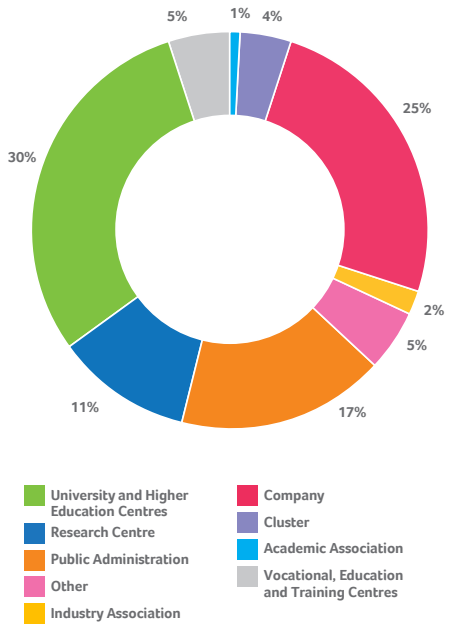


Figure 3. Percentage of experts by type of organisation

Thematic areas

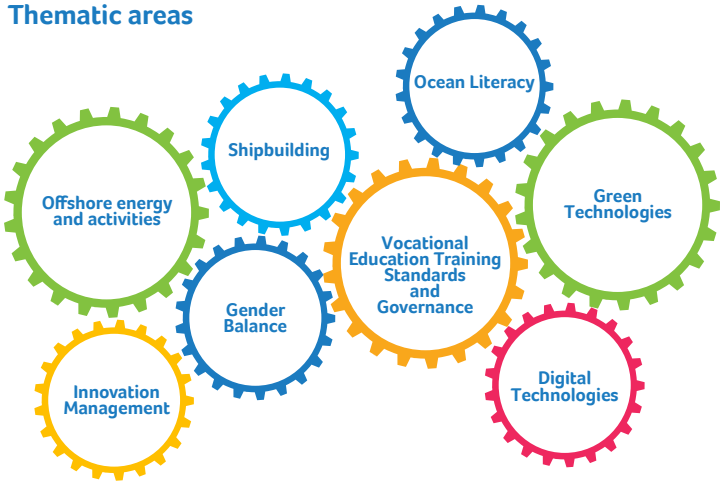


Figure 4. Overview of the eight thematic areas of interest

Repository of Relevant Information

Extensive information was gathered for the sectors of shipbuilding and offshore renewable energy. 242 publications and 149 projects relevant to MATES development were identified, summarised and classified. A selection of the most relevant documents has been uploaded to the MATES website and it serves as a repository for MATES' Thematic Groups.

A state-of-the-art compilation report was developed to summarise the significant technologies and projects already under development and those planned for future implementation. The report also describes the current situation of shipbuilding and offshore renewable energy in Europe, including key factors supporting the development of technologies and foreseen prospects and challenges. Moreover, it contains a characterisation of the workforce with an explanation of the demographic situation and the skills that will be required for both sectors. The document concludes that permanent jobs will be created in the upcoming years not just in established industries like shipbuilding and offshore wind, but also in emerging areas such as marine energy, mainly wave and tidal, where some technologies have already reached the commercial stage. The upcoming years will be crucial for market positioning among the different activity sectors.

Publications by theme & sector

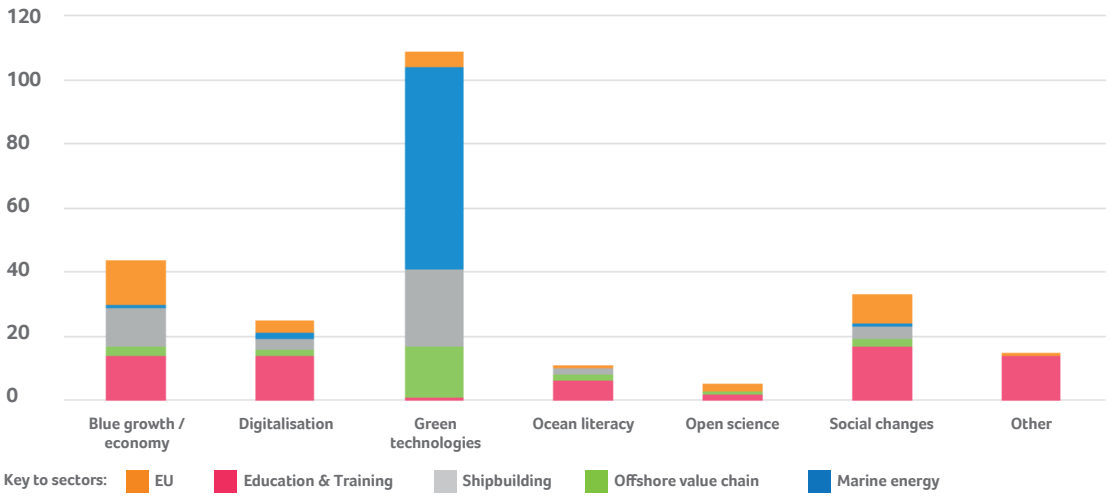


Figure 5. Repository of relevant information: number of publications identified and organised by theme and sector

Projects by theme & sector

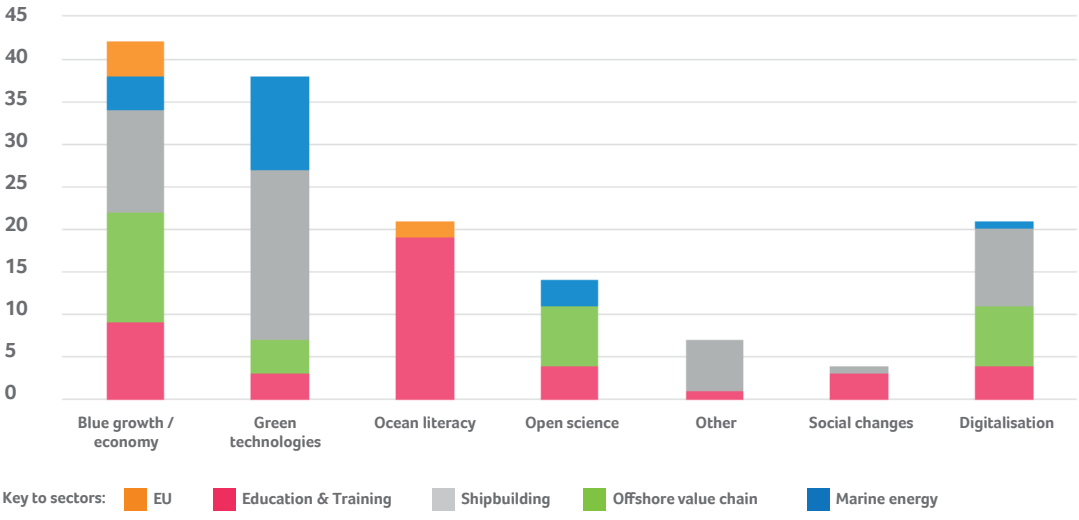


Figure 6. Repository of relevant information: number of projects identified and organised by theme and sector

Baseline Report on Current Skills Gap

Methodological Framework

The input sources to this framework - all sources included in the information repository - required a detailed review and prioritisation. Along with a detailed compilation report, expert feedback was received from two rounds of regional stakeholders' workshops conducted in different countries.

The methodological framework consists of the following steps;

1. Assessment and analysis of the current status and ongoing development of the two sectors targeted.
2. Set-up and adoption of a value chain approach, identifying key phases.
3. Mapping of primary and secondary occupational profiles and associated essential skills and competencies, taking the classification of the European Skills, Competences, Qualifications and Occupations (ESCO) system as a starting basis.
4. Mapping and assessment of relevant educational and training programmes. Consideration of all different levels of European Qualifications Framework as well as of non-academic programmes providing professional certification.
5. Identification and analysis of skills shortages and gaps in education and training.

The Shipbuidling Sector in Europe

Key facts on current status and adoption of a value chain approach:

In Europe, there are 300 facilities involved in vessel construction, repair and retrofitting. More than 200,000 people are directly employed. In terms of marine equipment, there are 22,000 manufacturers and suppliers of different sizes and sales volumes. This represents 52% of the global market generating over 350,000 jobs and an annual turnover of nearly €60 billion.

Shipbuilding Value Chain

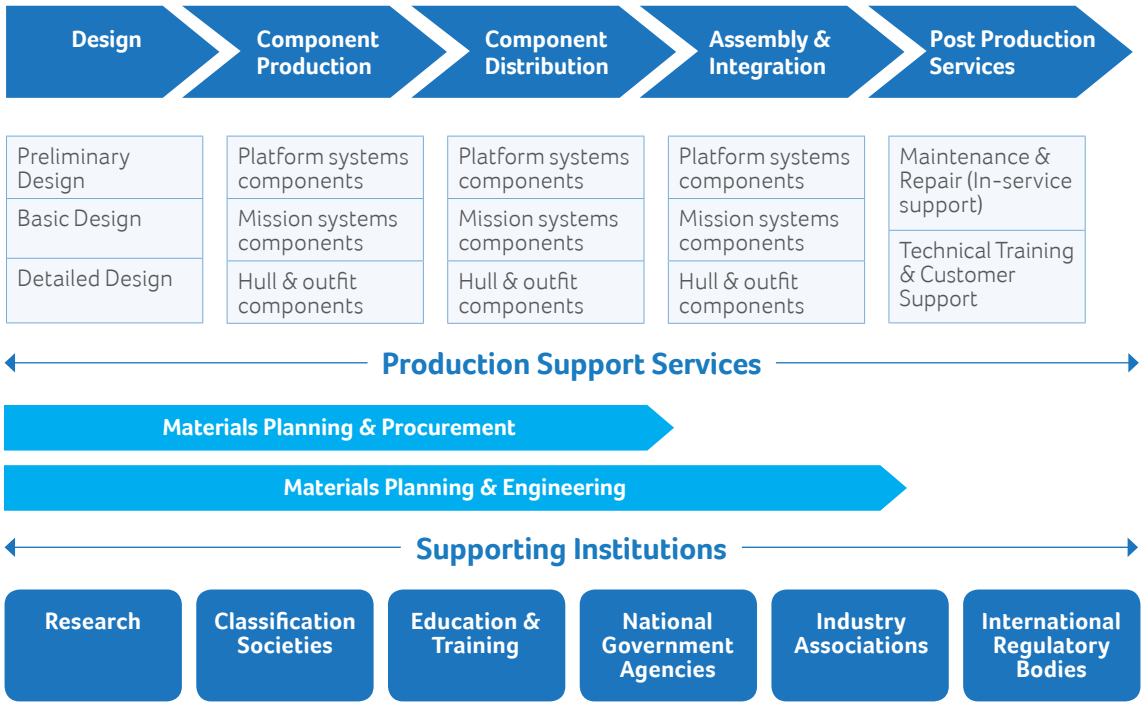


Figure 7:.Shipbuilding value chain

Mapping of Occupational Profiles

35 primary occupational profiles were selected based on their relative impact in the shipbuilding value chain. Complementing them, 25 supporting occupational profiles were also idenitifed.

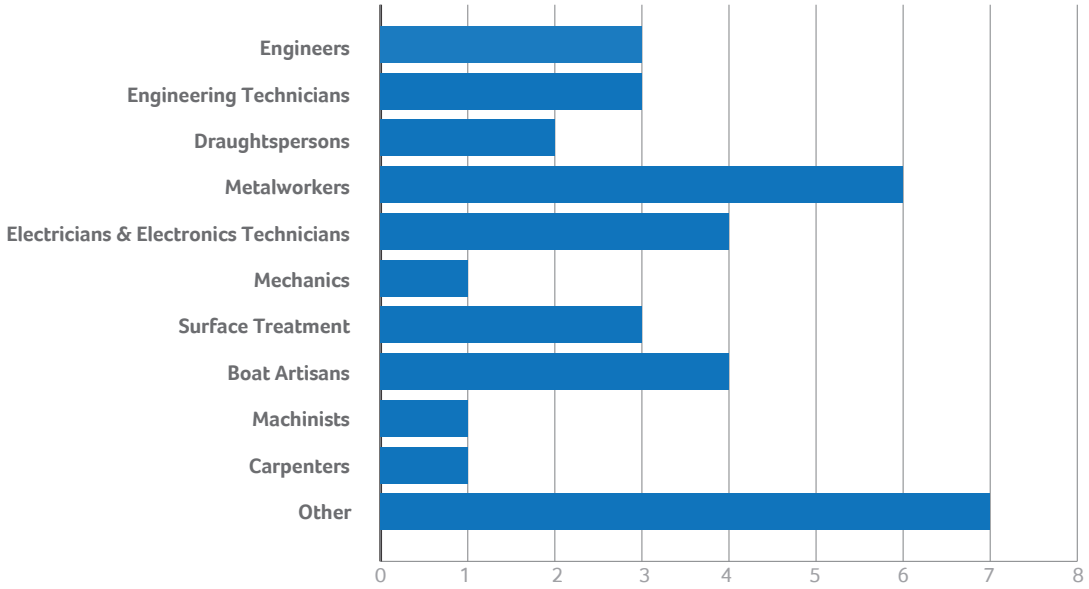


Figure 8. Number of primary occupational profiles per group

Mapping and assessment of relevant E&T programmes across Europe

450 Education and Training (E&T) programmes currently available (2018-2019) in 15 EU countries were identified and assessed. The EU countries accounting for the largest productivity shares were included in the analysis.

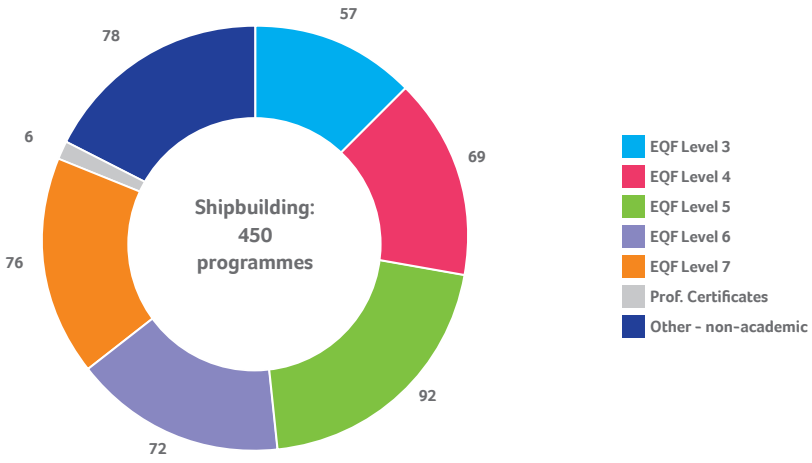


Figure 9. Relevant E&T programmes available within the EU

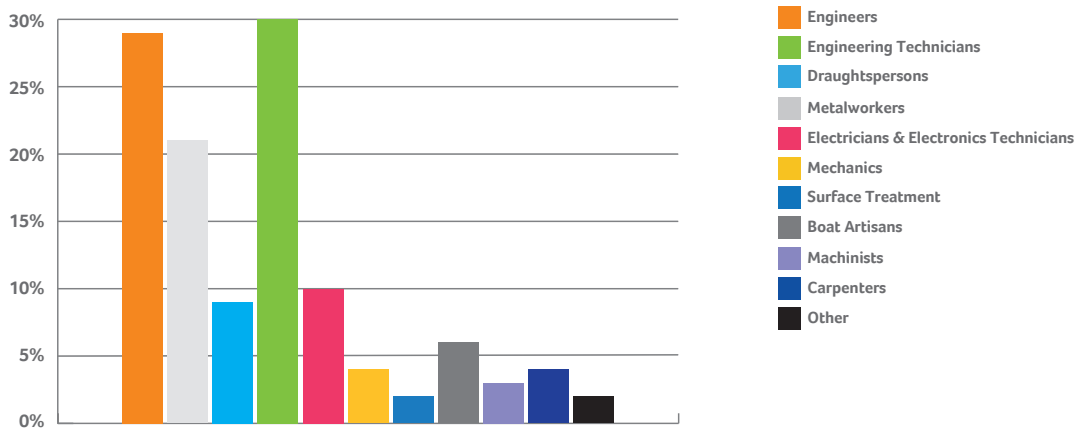


Figure 10. Percentage of E&T programmes addressing each group of shipbuilding occupational profiles

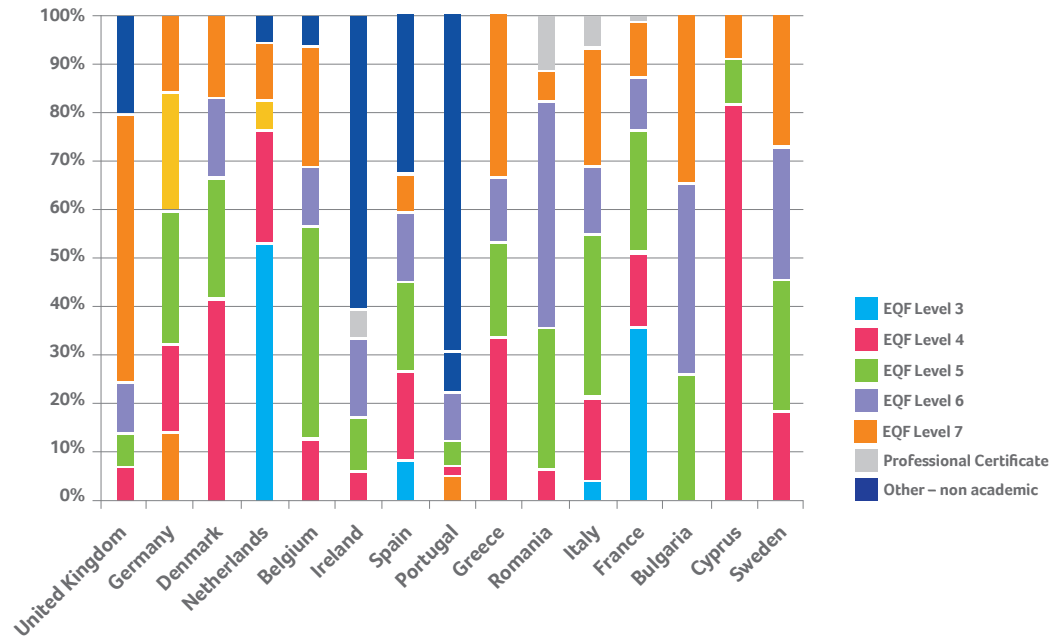


Figure 11. Distribution of E&T programmes per country and Education Qualification Framework (EQF) level

Current gaps in Education and Training (E&T)

Sector

Few programmes directly target the shipbuilding sector (although more general programmes exist that are applicable to specific sectors).

In some countries, E&T programmes are limited to / concentrated in institutions located in certain regions.

Occupations

Metalworkers, engineers and engineering technicians are the occupational groups mostly addressed by the available E&T programmes.

42% of identified primary occupational profiles are targeted by more than one programme.

Specialisation

The majority of available programmes are Vocational Educational Training (VET) that merely address the first phases of specialisation (mainly in metalworking), and do not provide technical workers with qualifications that will enable them to immediately enter the market.

Welding capabilities as well as the ability to work at heights, in confined spaces and with no light, are provided by a few training schemes only and are usually combined with apprenticeships in specific companies.

Language

Only 17% of the programmes are offered in English or are bilingual and these mainly consist of higher education programmes. VET programmes are provided only in the respective national language.

Challenges to be considered

- Ageing workforce (average age exceeds 45 years)
- Inefficient exploitation and risk of loss of knowledge and experience of older workers
- Young people not interested in the industrial maritime sectors: lack of knowledge of the sector and of responsibilities and working conditions of different occupations. A negative image often prevails
- Women are under-represented. There is little statistical data available

Shortages in Skills

- Specific technical skills (e.g. welding, assembly, etc.)
- Skills on Information and Communication Technologies
- Skills addressing Health & Safety issues
- Foreign languages
- Mechatronics
- Machine handling and operating

	no gap	very small gap	small gap	big gap	very big gap
Soft skills (leadership, teamwork, etc.)	10	20	20	20	20
Information Communication Technology (ICT)	10	20	25	30	10
Interdisciplinary	5	10	35	25	10
Foreign languages	0	25	35	30	0
Machine handling and operating	0	25	40	10	10
Health and safety	5	15	30	30	15
Mechatronics	5	15	40	10	20
Engineering	0	40	25	10	15
Specific technical skills (welding, assembly, etc.)	5	10	20	40	20

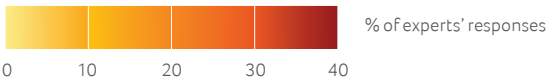


Table 1. Heat map of current skills gaps in the shipbuilding sector (% of experts' responses)

The Offshore Renewable Energy Sector in Europe

Key facts on current status and adoption of a value chain approach:

Offshore wind

There was 18.5GW of installed capacity in 2018, 70% of which was produced in the North Sea. Offshore wind is the most advanced sector of offshore renewables.

Offshore solar

Still under investigation / development.

Ocean energy

In 2018 there was 246.91 MW of installed capacity (wave, tidal and hydropower), 89% of which was produced in France.

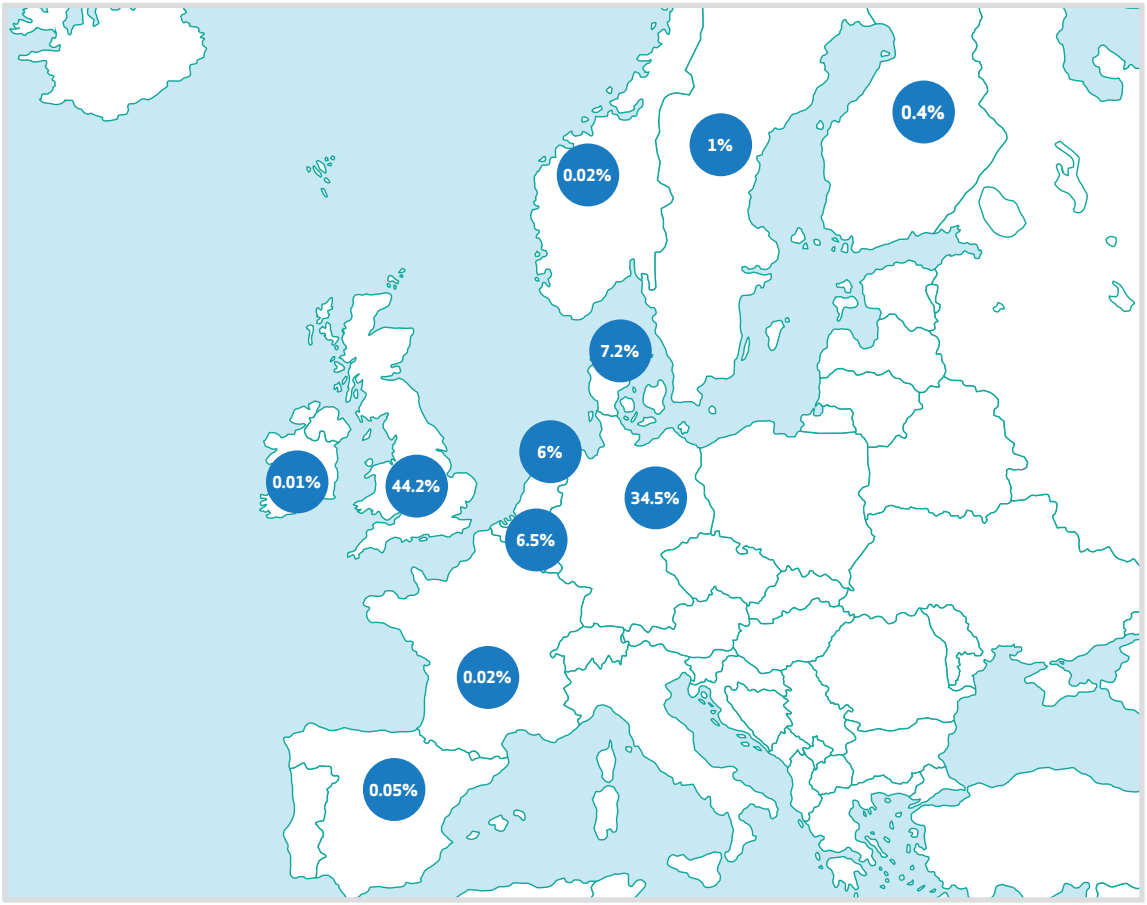


Figure 12. Total offshore wind energy capacity installed across Europe (WindEurope, 2019)

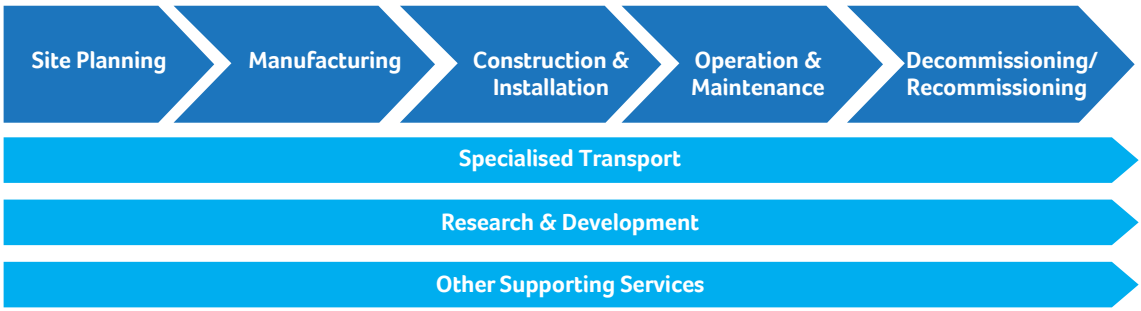


Figure 13. The marine offshore renewable energy value chain

Mapping of Occupational Profiles

23 primary occupational profiles were selected based on their relative impact in the offshore renewable energy sector. Complementing them, 43 supporting occupational profiles were also idenitifed.

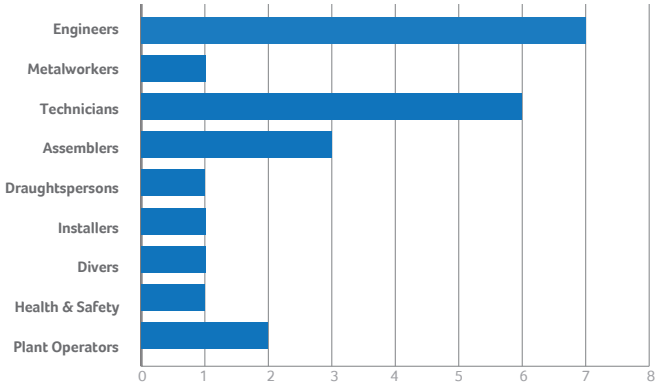


Figure 14. Number of primary occupational profiles per group

Mapping and assessment of relevant E&T programmes across Europe

486 E&T programmes currently available (2018-2019) in 11 EU countries were identified and assessed. The EU countries accounting for the largest productivity shares were included in the analysis.

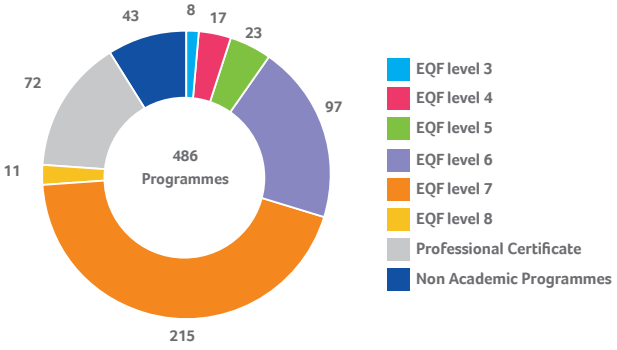


Figure 15. Type and number of E&T programmes available within the EU

Distribution of E&T programmes per country

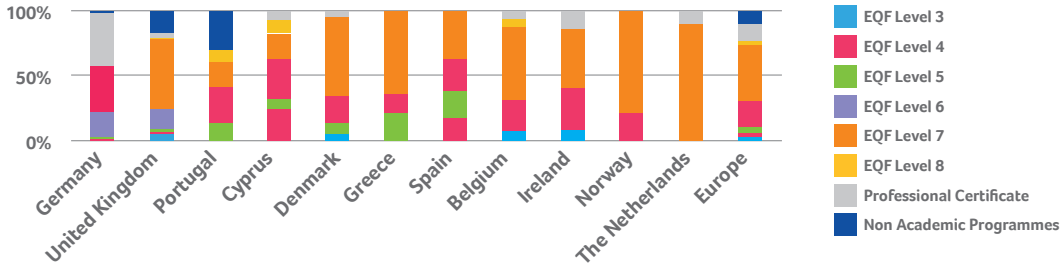


Figure 16. Distribution of E&T programmes per type and country

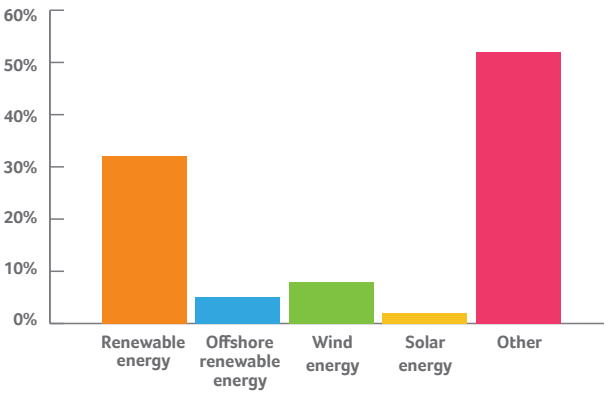


Figure 17. Specialisation of available E&T programmes (other refer to programmes addressing supporting occupational profiles)

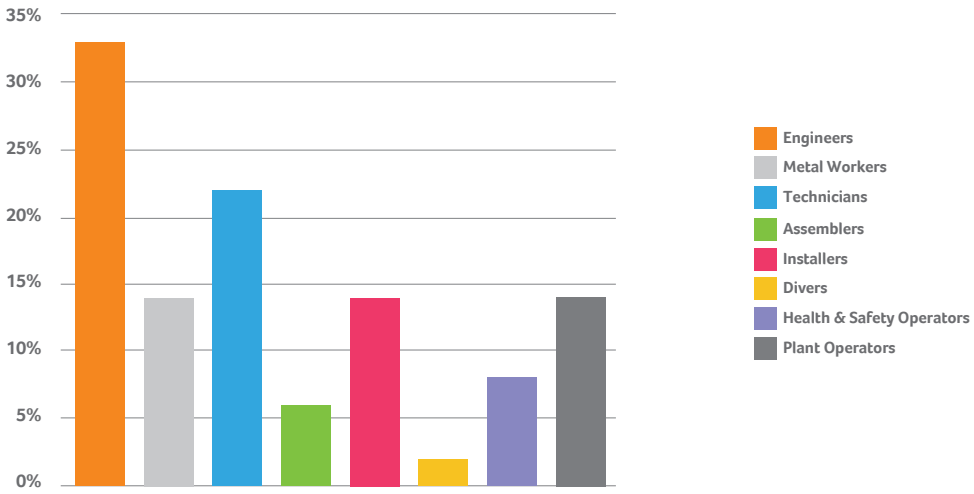


Figure 18. Percentage of E&T programmes addressing each group of ORE occupational profiles

Current Gaps in Education and Training

Sector

Only 5% of available programmes directly address offshore renewable energy. In most cases, programmes address the broader framework of renewable energy with graduates then transiting to the offshore industry.

Occupations

Only 35% of the primary occupational profiles are being targeted to a satisfactory extent by available programmes.

Gaps were identified for occupations in the groups of electro-mechanics, assembling, diving, metalworking and health & safety.

Gaps vary across Europe. Some countries have gaps in common, mainly related to: ocean energy technologies, cable installation, maintenance of energy systems, and energy distribution.

Specialisation

The majority of the identified programmes were Master Degree programmes (44%), a fact that highlights that the relevant qualifications are provided only as a specialisation. Very few VET programmes were found to provide technical skills.

Language

Approximately 50% of available programmes are being offered in English or are bilingual.

Challenges to be considered

- Increased subcontracting of certain activities – lack of collective experience, specialisation in the sector and multidisciplinary skills development as well as development of certain skills and competences on-the-job
- Temporary employment – employees deprived of the opportunity to closely follow and monitor sector developments
- Unwillingness to move to more distant locations where new offshore renewable energy projects are planned – constrains the collection of diverse knowledge and experiences taking into account different local characteristics

Shortages in skills

Shortages in skills qualities rather than specific skills required for performing specific tasks / activities.

Hard skills (technical and offshore-specific)

- Diversification and transferability of technical skills – timely adaptation to new needs
- Multidisciplinary knowledge and better and more integrated understanding of the offshore renewable energy value chain
- Specialisation of managerial positions (e.g. project managers, offshore financial officers, etc.)
- Upcoming demand for undertaking decommissioning / recommissioning processes since some offshore wind farms are entering the end phase of their lifecycle

Soft skills

- Teamwork and communication are most important and desirable (considering also the multi-cultural business environment)
- Analytical skills acknowledged as essential for overcoming technical challenges
- More for white-collar occupations: leadership, critical thinking, time management and prioritisation

Future Scenarios: Delphi Questionnaire

The Delphi methodology is a method of congregating experts' opinions through a series of iterative questionnaires with a goal of achieving a group consensus. It is based on the assumption that judgments of a structured group are more valid than judgments of individuals. It implies:

- Anonymity: this prevents the domination of some participant opinions over others due to his/her authority, personality, or reputation.
- Iteration that allows participants to revise their perspectives.
- Regular Feedback: allows participants to comment on the responses of others, the progress of the panel as a whole, and the review of their own forecasts and opinions in real time.

The information retrieved from the shortlisted key paradigm shifters identified as most significant for the future include the following:

- The effect on current and future jobs
- Requirements of emerging jobs
- Timeframe of changes
- Any critical technologies required for the evolution of the paradigm

Two Delphi round-questionnaires were deployed for the purposes of the current research and distributed to two specific groups of experts in the sectors of offshore renewable energy and shipbuilding. In order to obtain high quality data these groups were balanced with respect to key characteristics: organisation type (academic, industry etc.), experience level, gender, age, etc.

The following figures show the breakdown of characteristics of the participants.

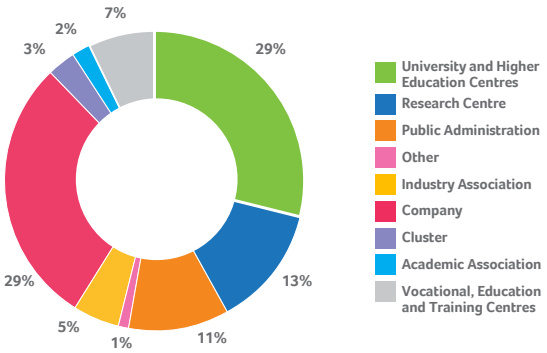


Figure 19. Type of organisation

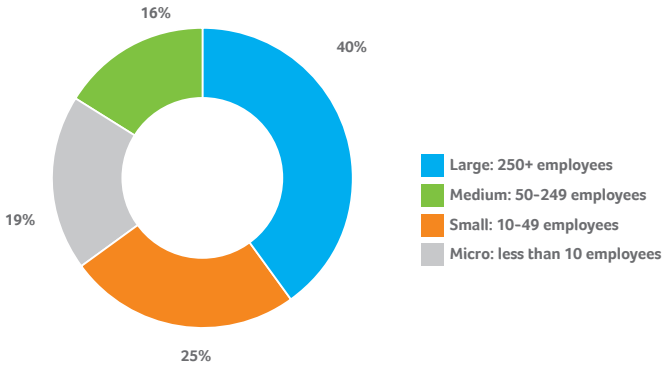


Figure 20. Size of organisations

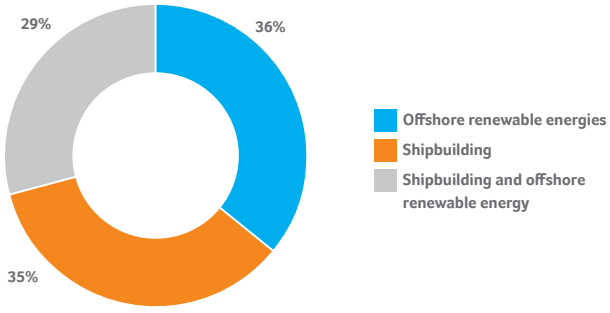


Figure 21. Sector of expertise of the experts

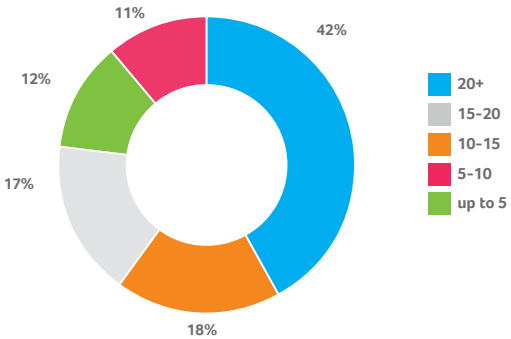


Figure 22. Years of experience of the experts

Paradigm Shifters

A critical review and analysis of the existing needs for education, training and skills in the sectors of shipbuilding and offshore renewable energy in Europe was conducted to address current shortages and gaps in relevant skills and qualifications. This provided a basis for the subsequent foresight exercise to identify emerging trends with respect to new skills and training programmes.

Shipbuilding

Vessel automation, vessel autonomy and advanced robotics

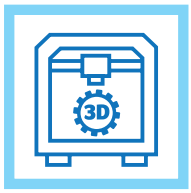
Modernisation of vessels based on the development and application of automated systems on ships, more sophisticated information systems, sensors, cameras and radars.

Exploitation of alternative fuels and renewable energy sources

Alternative fuels are substances which might replace conventional fossil fuels (methanol, liquefied biogas, hydrogen, etc.).

Digitalisation

The use of digital technologies to change the business model and provide new revenue and value-producing opportunities.



3D Printing

Manufacturing process whereby a design is used to create a physical product in 3D through a computer and a printer.

Green retrofitting

An upgrade to an existing structure to improve energy and environmental performance.

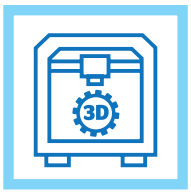
Drones

Unmanned aerial vehicles that can perform work and inspection safely in open and confined spaces.

Marine Renewable Energy

Automation & advanced robotics

Development and application of automated and intelligent systems on equipment and processes.

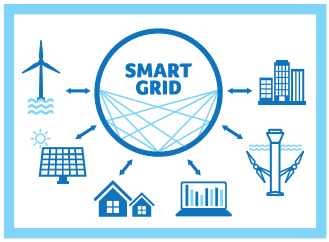


3D printing

Manufacturing process whereby a design is used to create a physical product in 3D through a computer and a printer.

Energy storage

Management of energy supply and demand by storing the energy.



Smart grid & smart sensors

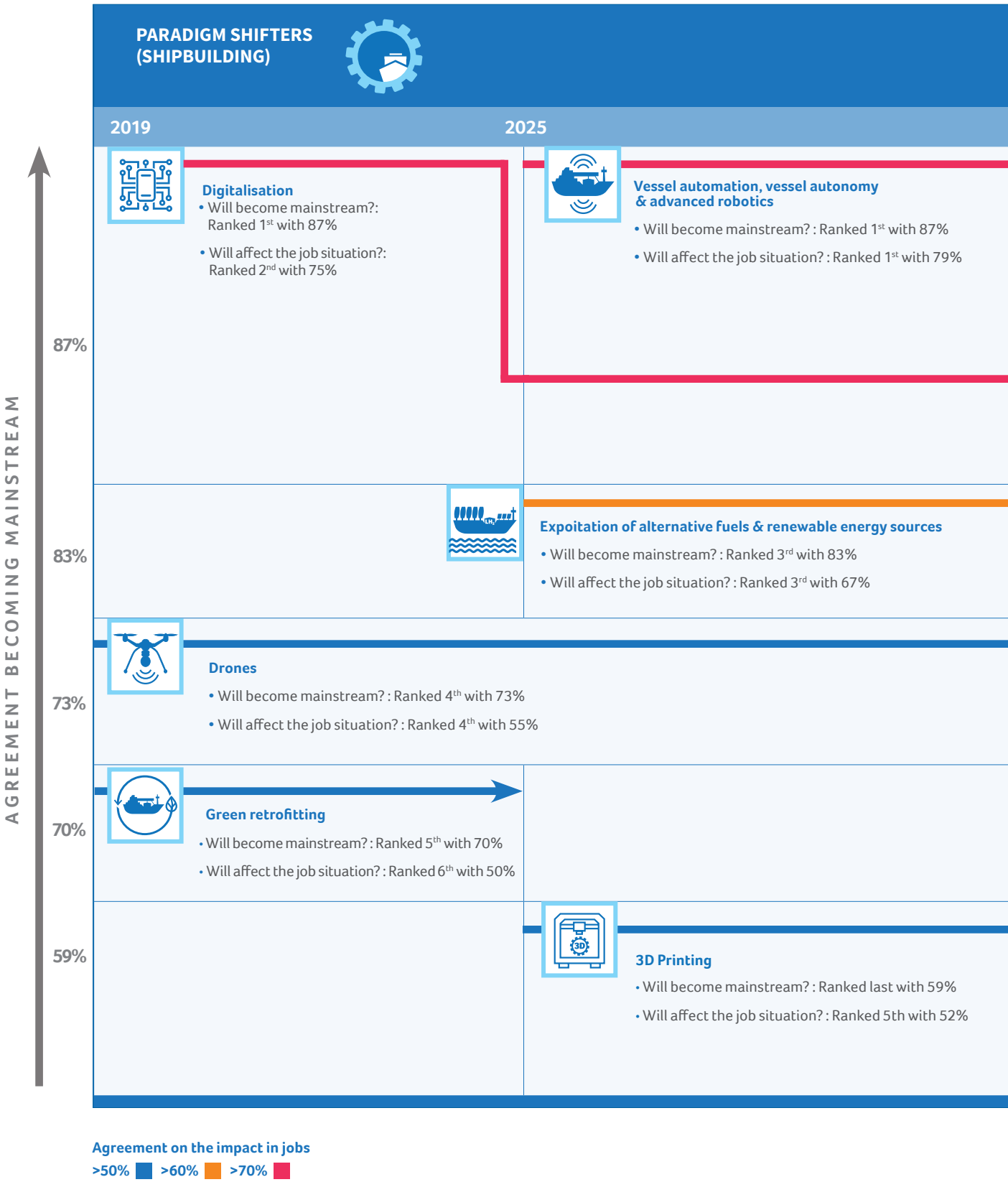
Optimisation of electricity generation, transmission and distribution by creating a highly interactive and responsive electricity grid that creates a balance between energy demand and supply.

Big data

Massive volume of structured, semi-structured and unstructured data that has the potential to be mined for information and used in machine learning projects and other advanced analytics applications.

Future scenarios were identified in the short, mid and long-term.

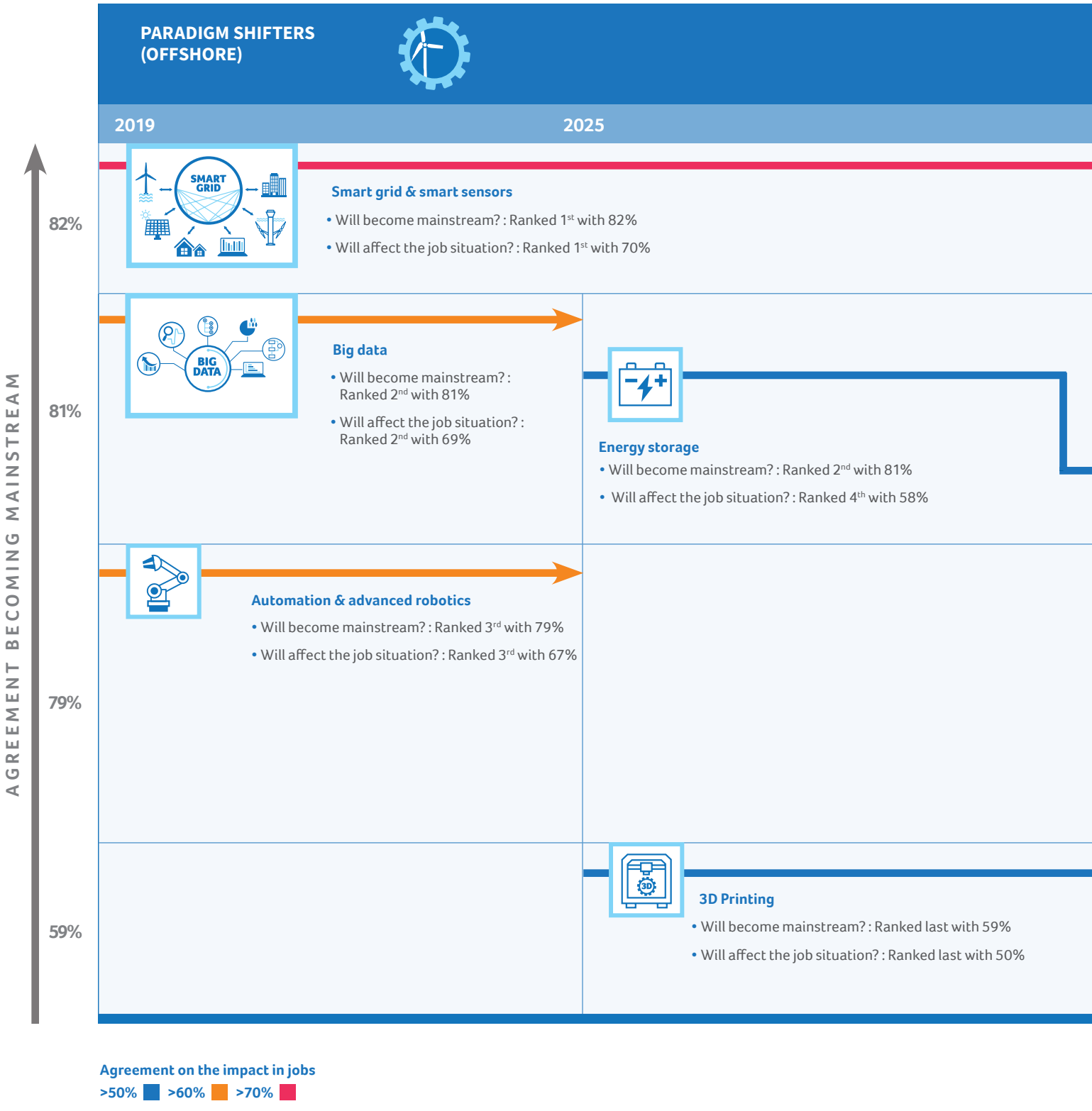
Table 2. Representation of the periods in which the respondents consider that each paradigm shifter will become mainstream in the shipbuilding sector, indicating if they consider that the employment landscape will be affected. List of main occupations considered to be affected, and anticipated emerging occupations. Rankings based on the percentage of respondents in agreement.



Score 75-85% Score 85-95% Score 95-100%

	LIST OF MAIN OCCUPATIONS AFFECTED		EXPECTED EMERGING OCCUPATIONS ▲ New △ Existing gaining in relevance
2030			
→	• Naval architect • Electromechanical engineer • Electromechanical equipment assembler • Marine engineer • Electromechanical engineering technician • Electronics engineering technician • Marine electronics technician • Electronic equipment assembler	• Welder • Boilermaker • Pipe welder (pipe fitter) • Sheet metal worker • Surface treatment operator • Abrasive blasting operator • Mobile crane operator • Production plant crane operator • Shipwright • Transport equipment painter	△ Robotics (technician, operator, engineer, repair engineer) △ Vessel automation (sensor technician, marine automation technician, automation engineer) △ Cyber-security (officer) ▲ Vessel autonomy (fleet manager, operator, system engineer) △ Mechatronics (engineer) △ Innovation management
→	• Marine engineering drafter • Electromechanical drafter • Electromechanical engineering technician • Marine engineer • Marine engineering technician • Electronics engineering technician	• Electromechanical engineer • Marine engineering drafter • Marine electronics technician • Naval architect • Electromechanical equipment assembler • Electronic equipment assembler	△ Cyber-security (officer) △ (Big) data (manager, analyst)
→	• Marine engineering technician • Marine engineering drafter • Marine engineer • Naval architect • Vessel engine assembler		△ Energy management (planner, infrastructure engineer) ▲ Alternative fuels (fuel cell engineer)
→	• Vessel assembly supervisor • Vessel assembly inspector • Marine surveyor		△ Innovation management
	• Marine engineer • Naval architect • Marine engineering technician		△ Innovation management
→	• Electromechanical engineering technician • Vessel engine assembler • Electromechanical equipment assembler • Computer numerical control (CNC machine operator) • Welder • Shipwright • Oilermaker • Pipe welder (pipe fitter) • Boat rigger		△ 3D printing (operator)

Table 3. Representation of the periods in which the respondents consider that each paradigm shifter will become mainstream in the Offshore Renewable Energy sector, indicating if they consider that the employement landscape will be affected. List of main occupations considered to be affected, and anticipated emerging occupations. Rankings based on the percentage of respondents in agreement.



Score 75-85% Score 85-95% Score 95-100%

	LIST OF MAIN OCCUPATIONS AFFECTED		EXPECTED EMERGING OCCUPATIONS ▲ New △ Existing gaining in relevance
2030			
→	• Power distribution engineer • Electric power generation engineer • Maintenance and repair engineer	• Power production plant operator • Solar power plant operator	△ Sensors (developer, installer, technician) △ Big Data analyst △ Artificial Intelligence (AI) professional ▲ Remote controller
	• Renewable energy engineer • Energy systems engineer • Wind energy engineer • Power distribution engineer • Power production plant operator • Electric power generation engineer • Maintenance and repair engineer	• Wind turbine technician • Solar energy engineer • Solar energy technician • Solar power plant operator • Hydropower technician • Wave power technician • Tidal power technician	△ Big Data systems (developer, engineer)
→	• Power production plant operator • Solar power plant operator • Power distribution engineer	• Electric power generation engineer • Maintenance and repair engineer	△ Energy storage specialist △ Grid insulation and construction professional
	• Cable installer • Tidal power technician • Electromechanical engineering technician • Wave power technician • Wind turbine technician • Electromechanical equipment assembler • Welder	• Maintenance and repair engineer • Construction commercial diver • Electronic equipment assembler • Solar energy technician • Hydropower technician	△ Robotics (constructor, programmer, operator) △ Autonomous system operator △ Artificial Intelligence (AI) professional ▲ Drone and Unmanned Aerial Vehicles (UAVs) pilot-operator ▲ Virtual Reality (VR) designer △ Cyber security expert △ Big Data manager ▲ Predictive maintenance analyst △ Mechatronics technician △ Sustainability engineer
→	• Welder • Wave power technician • Electromechanical equipment assembler • Wind turbine technician • Tidal power technician • Solar energy technician	• Hydropower technician • Electromechanical engineering technician • Electronic equipment assembler • Printed circuit board assembler	△ 3D printing (technician, engineer, expert) △ Designer of parts for 3D printing △ 3D printer maintenance worker

Proposed Lines of Action

The objectives of the Identification of Priorities and Lines of Action are to:

- Prioritise actions needed and select those to be addressed by the project.
- Establish a prioritisation system (including priority criteria and terms of reference to apply them) and classify all training needs identified in the different scenarios of the foresight.
- Define the actions needed to address the top priorities.
- Cross-link priority Lines of Action and Pilot Experiences to identify how best to maximise their strategic alignment and impact.
- Provide feedback for the Pilot Experiences' comprehensive planning, execution and assessment.

Five standard criteria were used to determine priorities:

Sector relevance
Political relevance
Urgency
Impact on employability
Attractiveness

Three different sets of information were analysed:

1. The results of a consultation process with over 50 experts
2. The results from a Delphi questionnaire
3. The alignment of the Pilot Experiences with the selected Lines of Action.

Based on this analysis, the 22 Lines of Actions were ranked and compared.

Table 4. Survey results of 51 experts scoring the Lines of Action by the prioritisation criteria for shipbuilding (SB)

	Shipbuilding Lines of Action	Score
SB 1	**Training, reskilling/ upskilling** workforce in the use of **digital and data driven technologies** (big data, Internet of Things, cloud computing, 3D printing, artificial intelligence).	8.3
SB 2	**Training, reskilling/ upskilling** workforce in the use of **automation and robotics as well as in the human – robot interactions** (automation/autonomous ships, mechatronics, augmented reality).	8.0
SB 3	**Training, reskilling/ upskilling** workforce in the use of technologies for minimising environmental impact in shipbuilding (sustainable practices, reduction of polluting emissions, construction materials and antifouling systems).	7.7
SB 7	**Increase attractiveness of maritime careers** for graduates and early-career skilled workers promoting Ocean Literacy.	7.1
SB 6	**Progressive introduction and increasing relevance of 21st century skills within the training offer** ("Soft skills" e.g. creative thinking and innovation, critical thinking and problem solving, communication and collaboration, knowledge management and transfer, flexibility and adaptability, initiative and self-direction, productivity and accountability).	6.9
SB 5	Promoting a **better matching of trainings to current needs in technical disciplines** (electrical systems, beam welding and various other techniques like gas metal arc welding, gas tungsten arc welding and oxyacetylene welding, fitting and cutting).	6.7
SB 4	Optimising the processes of **decontamination and recycling of decommissioned vessels.**	6.5
SB 8	**Enhancing visibility and promoting women in the shipbuilding sector**	6.5
SB 10	**Training, reskilling/ upskilling** workforce in health and safety, adapted to new processes, materials and tasks.	6.2
SB 9	**Skills ecosystems:** meeting points for the most relevant stakeholders from industry, academia and research.	6.0

Table 5. Survey results of 51 experts scoring the Lines of Action by the prioritisation criteria for offshore renewable energy (ORE)

	Offshore Renewable Energy Lines of Action	Score
ORE 1	**Training, reskilling/ upskilling** workforce in the use of new digital technologies (artificial intelligence, mechatronics, 3D printing, Internet of things, cloud computing, big data).	7.4
ORE 2	**Training, reskilling/ upskilling** workforce in order to increase technical knowledge on energy storage.	6.6
ORE 11	Enhance **Ocean Literacy** in offshore renewable energy to increase attractiveness of maritime careers for graduates and early-career skilled workers.	6.5
ORE 10	**Promote/ enhance 21st Century skills: adapted to the different needs of 'bluecollar' and "white collar" roles:** teamwork, communication, analytical skills. (Also referred to as soft skills, and including capacities such as creative thinking and innovation, critical thinking and problem solving, communication and collaboration,knowledge management and transfer, flexibility and adaptability, initiative and selfdirection,productivity and accountability).	6.4
ORE 3	**Develop synergies among sectors** with significant similarities in their needs to promote skills transferability between them (e.g. oil and gas, offshore wind energy, ocean energy).	6.0
ORE 9	Research and development of **legislation, guidelines and policies** associated with ORE.	6.0
ORE 12	Promoting **STEM women** in ORE.	5.8
ORE 4	Opportunities for **skills diversification** from parallel sectors e.g. fisheries, aquaculture, and marine operations. Particular skills in ROVs, health and safety, marine operations.	5.5
ORE 5	**Multi-disciplinary skills** outside of specialisation e.g. Ecologists should also have skills in technological development, business/ financial aspect of ORE.	5.3
ORE 8	Need for specialisation and expertise in **skills that are not yet standardised** and are still under development e.g. decommissioning.	5.2
ORE 6	Increasing the levels of **experience and specialisation** gained by temporary employment.	4.7
ORE 7	Specialisation and experience in **offshore economics** related to market, financial and investment analysis, such as Levelised Cost of Energy (LCOE) reduction, subsidy framework, etc.	4.6

Pilot Experiences

Eleven Pilot Experiences are proposed to test the strategy in consistency with the Action Lines.

Table 6. Brief description of Pilot Experiences (PE) and their sector, activity and goal

Activity	Description	Sector	Goal
Training design, material development and delivery	**ED²MIT: Education and Training for Data Driven Maritime Industry** Training development focused on digital and data skills for future & emerging digitalisation of maritime industries. **Participants:** Industry and HE students	SB ORE	Providing latest methodology for training, reskilling/ upskilling workforce to facilitate the use of new technologies Developing training materials in line with new EU recommendations
	Upgrade of traditional shipbuilding tools to 4.0 industry (KT) Developing MOOC (Massive Online Open Course) in order to enhance shipbuilding workers' knowledge on industry 4.0. **Participants:** Industry, HE and VET students	SB	
	Freeboard: Fitting out shipyard replica for workshop training Design and build a training space to simulate a real shipyard working environment. It will also include a digital twin, using virtual reality, of the real training space. **Participants:** VET students	SB	Simulation of industry spaces in professional learning centers and building innovative devices for training purposes
	The Magnus effect: wind and marine energy Building a marine jacket structure for an offshore wind turbine in order to test the latest research in jacket structures. **Participants:** VET students	ORE	
	Innovation manager course Showing potential of metal and naval construction sector to Industrial Engineering students. **Participants:** HE students	SB	Specialisation
Mobility	**Green move** Exchanges on green technologies, promoting interaction between different types of organisations, white collar & blue-collar workers, different education levels and among both sectors (SB and ORE). **Participants:** Industry, VET and HE students and teachers.	SB ORE	Innovation in training Enhancing collaboration between academy & industry

Activity	Description	Sector	Goal
Training of trainers	**Renewable Energy Crash Courses** with visits to companies. Offshore Wind Energy & Marine Renewable Energy. **Participants:** Industry, VET and HE teachers.	ORE	Improving trainer's curricula
	Summer school Identification of skills diversification, 21st Century Skills, the promotion of attractiveness of maritime careers for early-career skilled workers, and the promotion of contact between different educational levels and industry. **Participants:** Entrepreneurs, SB staff, VET and SE students and teachers.	SB	
Training materials for contest	**Green Maritime Hackathon** Design and development of a sprint-like event for young professionals and university students to face several challenges: improve energy efficiency, decrease inputs consumption, monitor emissions, etc. **Participants:** Industry, HE and VET students	SB	Attractiveness of maritime careers
	MOL²: Maritime on the Loop of Ocean Literacy Supplementary course materials (digital design, 3D printing, electronics, etc.) in the framework of a competition environment. **Participants:** SE and VET students and teachers	SB	Seeking for technical solutions Visibility
Definition/ Guidelines	**DOP: Definition of new Occupational Profiles** following ESCO taxonomy. The existing SB and ORE occupational profiles will be revised to ensure the integration of new sectoral and transversal skills and their Learning Outcomes. New occupational profiles foreseen will be defined and transferred to ESCO community. **Participants:** Industry and VET and HE teachers.	SB ORE	Recognition & identification of skills

SE: Secondary school / HE: Higher Education / VET: Vocational Education and Training / SB: Shipbuilding / ORE: Offshore Renewable Energy / ESCO: European Skills, Competences, Qualifications and Occupations

Table 7. Correlation of the Lines of Action with the Pilot Experiences (PE) for shipbuilding (SB)

SHIPBUILDING	ED²MIT: Education and Training for Data Driven Maritime Industry.	Upgrade of traditional shipbuilding tools to 4.0 industry	Freeboard	Magnus Effect	Innovation manager course	Green Marine Hackathon	Maritime on the loop of Ocean Literacy (MOL²)	MRE Crash Courses: Offshore Wind and Marine Energy	Summer School	Green move	Definition of new Occupational Profiles (DOP)
SB1: Digital and data driven technologies	✔	✔	✔		✔	✔	✔				✔
SB2: Automation and robotics	✔	✔			✔		✔				✔
SB3: Minimising environmental impact						✔	✔			✔	
SB4: Decontamination and recycling of decommissioned vessels						✔			✔	✔	✔
SB5: Better matching of trainings to current needs in technical disciplines		✔	✔	✔		✔			✔		
SB6: 21st century skills within the training offer	●	✔	●	✔	✔	✔	✔		✔	✔	●
SB7: Ocean Literacy			●			●	✔		✔	●	
SB8: Promoting women	●	●	●	✔	●	●	✔		●	●	●
SB9: Skills ecosystems					✔	✔			✔	✔	
SB10: Health and safety		●	✔				✔				

✔ = Directly correlated ● = Transversal impact

Table 8. Correlation of the Lines of Action with the Pilot Experiences (PE) for offshore renewable energy (ORE)

OFFSHORE RENEWABLE ENERGY	ED²MIT: Education and Training for Data Driven Maritime Industry.	Upgrade of traditional shipbuilding tools to 4.0 industry	Freeboard	Magnus Effect	Innovation manager course	Green Marine Hackathon	Maritime on the loop of Ocean Literacy (MOL²)	MRE Crash Courses: Offshore Wind and Marine Energy	Summer School	Green move	Definition of new Occupational Profiles (DOP)
ORE1: New digital technologies	✔	✔									✔
OR2: Energy storage	✔							✔			✔
ORE3: Synergies among sectors with significant similarities		✔		✔	✔			✔		✔	
ORE4: Skills diversification from parallel sectors		✔						✔	✔	✔	
ORE5: Multi-disciplinary skills outside of specialisation								✔		✔	
ORE6: Specialisation gained by temporary employment											
ORE7: Offshore economics											✔
ORE8: Skills that are not yet standardised				✔				✔			✔
ORE9: Legislation, guidelines and policies										✔	✔
ORE10: 21st Century skills	●	●		✔	●			✔	✔	●	●
ORE11: Ocean Literacy								✔	✔	✔	
ORE12: Promoting STEM women in ORE	●	●		✔	●			✔	✔	●	●

✔ = Directly correlated ● = Transversal impact

Lessons Learnt and Further Insights

Designing a participatory approach for the development of a strategy can present challenges. However, judging from the MATES project's experience, the involvement of different types of entities (from industry, academia, education administrations, training and education centres operating at different levels, etc.) and a large pool of experts with many different backgrounds is one of the major assets of this project and a fundamental basis on which robust results can be produced.

Language barriers are one of the main impediments in the the skills intelligence analysis. In addition, the way in which data on the skills requirements are collected presents another challenge. There are several disparate sources and to date, no systematic way of mapping current skills in the industry and the new skills required.

The first results from the project allow us to anticipate preliminary trends:

- There is a need to strengthen existing education provision in the marine fields, to develop new capacities and specialised training offers appropriate to the specific features of the maritime industry. The shipbuilding sector is in urgent need of educational and training programmes in the digital domain, green technologies and soft skills, all adapted to the specific requirements of the sector and developed in collaboration with it.
  The marine offshore renewable energy sector could be boosted through the improvement of dedicated training offers for the sector, and especially at VET qualification levels (EQF 3-5).
- The shipbuilding sector must attract new talent while also implementing generational replacement systems. The growing demand for specialised jobs may constitute an opportunity for this.
- Raising the level of Ocean Literacy would increase the visibility of professional opportunities from the maritime industry likely to attract youngsters and women, but also specialists from other sectors.
- Skills' ecosystems, enabling meeting points for the most relevant stakeholders from industry, academia and research, will help in the task of obtaining 'fresh' and reliable data at a time when skills needs are constantly evolving.
- The maritime industry could also benefit from efforts towards a special Digital Literacy and Data Literacy training for white collar workers and managers in particular.

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