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

Maritime Technologies Skills Strategy: Shipbuilding and Offshore Renewable Energy sector

April 2022

Final Version

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 - 2022

www.projectmates.eu

This Executive Report describes the Maritime Technologies Skills Strategy for Shipbuilding and Offshore Renewable Energy sectors as an outcome of the MATES project's activities carried out from January 2018 until April 2022. This document is the consolidation of the project results and intelligence obtained from workshops with experts, Delphi questionnaires, desk-top studies and surveys and the development of eleven Pilot Experiences.

Completing this report, the **MATES Sustainability and long-term Action Plan** contains an inventory of the project results and knowledge outputs, a blueprint of actionable steps for practical application of the Skills Strategy, and also an analysis of available funding opportunities for re-skilling and up-skilling.

Acknowledgements

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Citation

Please cite this publication as:
Maritime Technologies Skills Strategy - MATES Project-April 2022. DOI: 10.5281/zenodo.6676557

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This Maritime Technologies Skills Strategy was distributed to gather candid and critical comments that make it as sound as possible and to ensure it meets institutional standards. Information was updated to include feedback from reviewers. We acknowledge the following institutions for their selfless contribution.

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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 Project

MATES, an Erasmus+ funded European Blueprint project consisting of 17 partners (Figure 1), 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 -

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

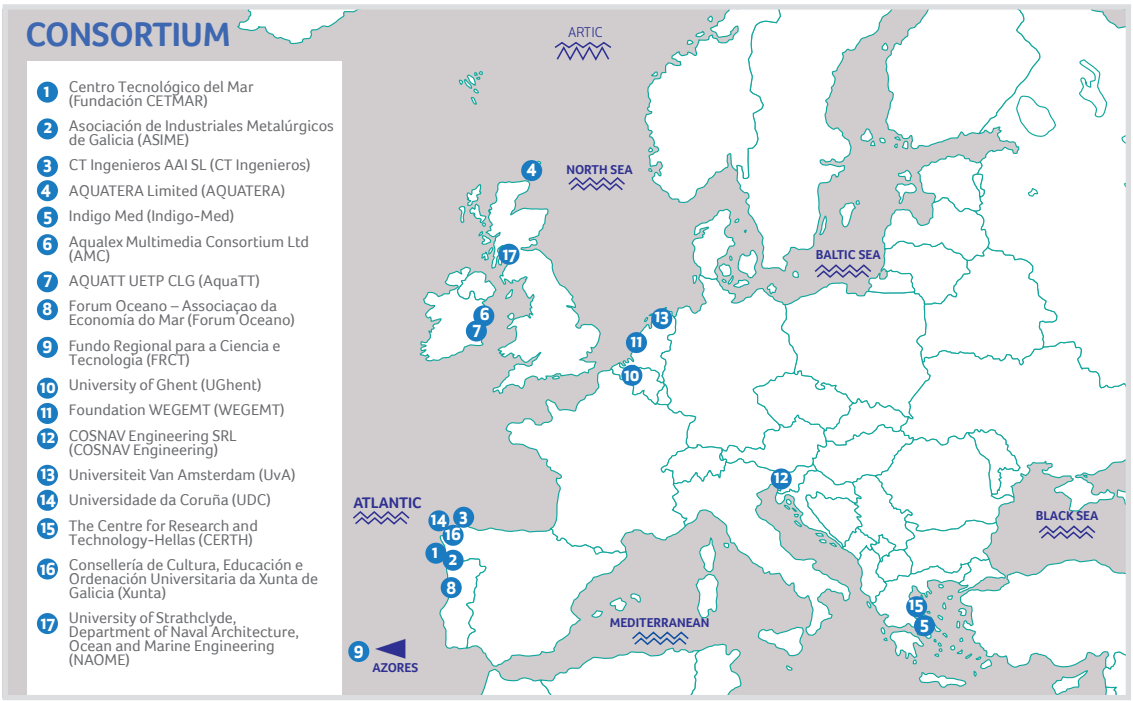

Figure 1. Geographical location of MATES partners

Maritime Technology Expert Network

At various stages of the project, 231 experts and stakeholders (Figures 2 and 3) contributed to ensure maximum uptake and impact of the strategy. The network of experts can be accessed through the MATES database: **whowhomates.com**

The network is organised into eight Thematic Groups (Figure 4) 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:

- 15 regional workshops held from 2018-2021
- State of the Art for the target sectors (contributions and revision)
- Baseline Report on Present Skills Gaps (contributions and revisions)
- Foresight analysis of future scenarios (Delphi Questionnaire)
- Webinar and voting for the prioritisation of 22 lines of action
- Consultancy for the development of 11 Pilot Experiences

Experts by sea basin

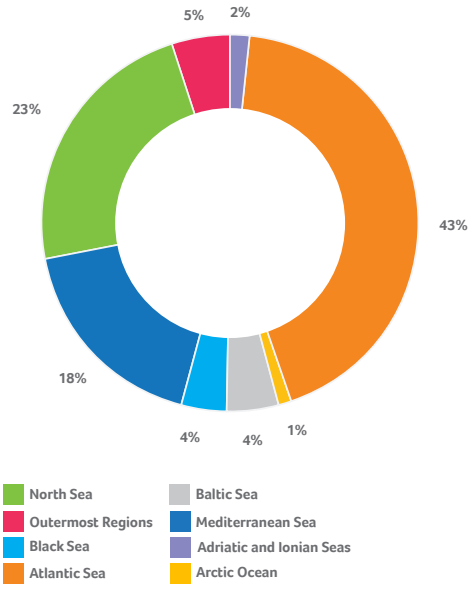

Figure 2. Percentage of experts by sea basin

Type of organisation

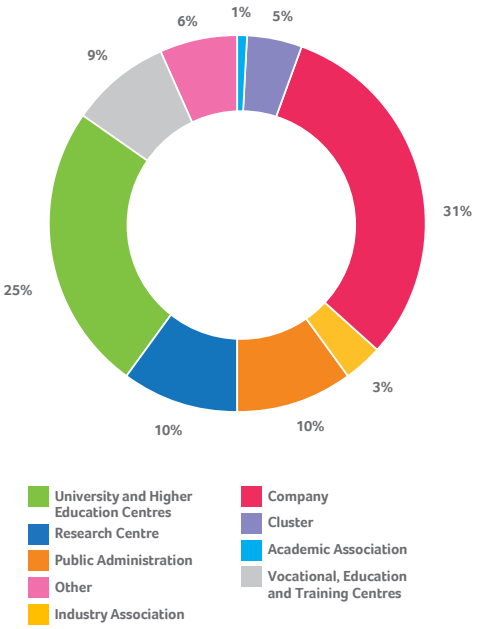

Figure 3. Percentage of experts by type of organisation

Thematic areas

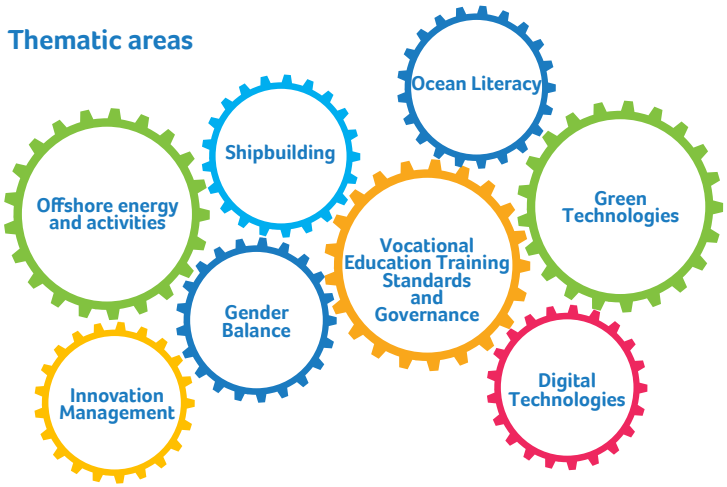

Figure 4. Overview of the eight thematic areas of interest

Methodological Framework

MATES adopted the Edwards Deming Circle methodology for permanent improvement: Plan, Do, Check, Act (PDCA), together with elements of the "Agile" technologies method (see Figure 5).

PLAN

The mobilisation of stakeholders beyond the project to broaden the partnership capacity to carry out the work, assure sustainability, multiply impact, and obtain continuous feedback.

The skills intelligence[1] to enable greater alignment of educational opportunities and the labour market; identification of present training offers and skills gaps; future trends and impact on capacities' needs; and agreement of Lines of Action to bridge the gap.

DO

11 Pilot Experiences were planned and launched to test the strategy and validate actions and priorities suggested by the skills intelligence.

CHECK

A critical revision of the Pilot Experiences identifying the lessons learnt from their implementation and how their results contribute to the preliminary strategy design.

ACT

Creation of a Long-term Action Plan (Roadmap for the Maritime Technologies Skills Strategy). Responsibilities will be assigned and partners' and stakeholders' commitment reflected to harness and mainstream the strategy and its recommendations in the long term - 2030 horizon.

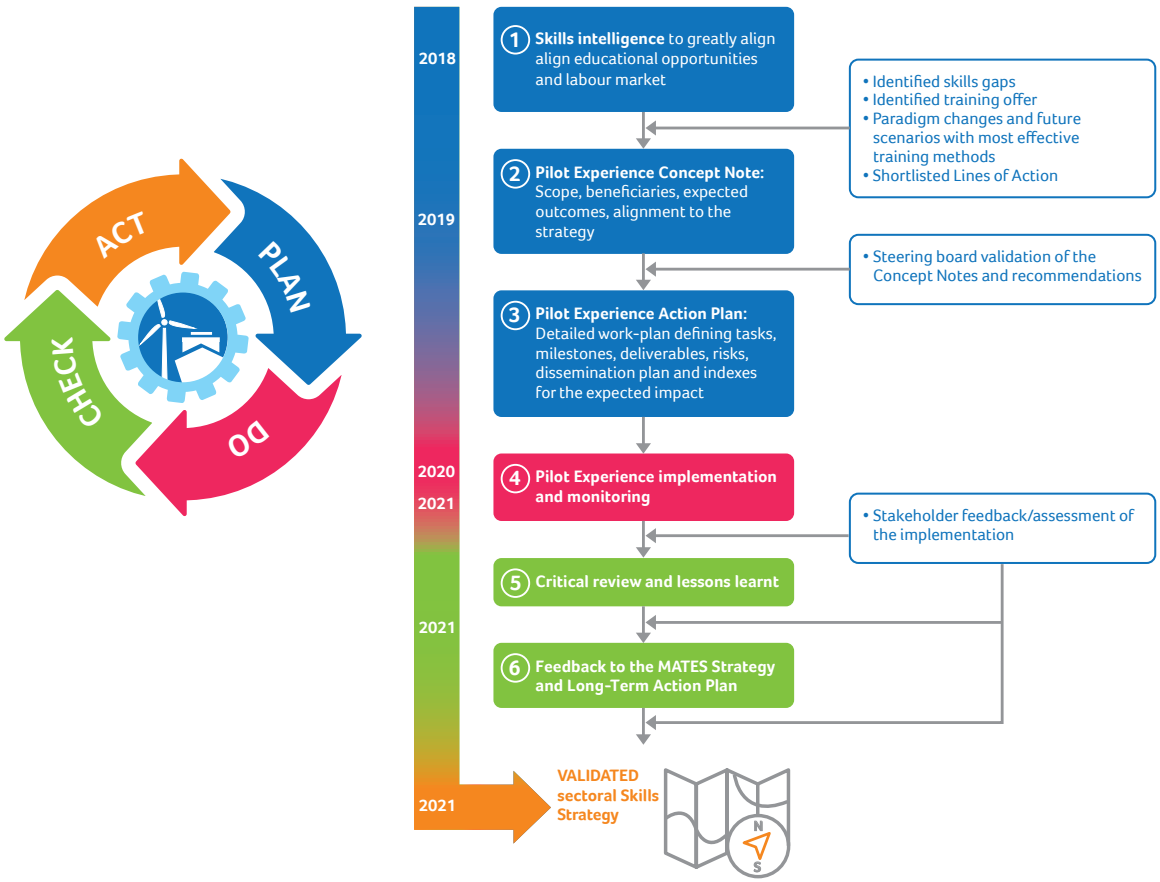

Figure 5. Mates Strategy Building Approach: timeline and process of development of the Pilot Experiences, incorporating the baseline data collection, future trends and prioritisation of Lines of Action to test the strategy and validate actions and priorities suggested by the skills intelligence

1. Skill intelligence is the outcome of an expert-driven process of identifying, analysing, synthesising and presenting quantitative and/or qualitative skills and labour market information. These may be drawn from multiple sources and adjusted to the needs of different users. From skillspanorama.cedefop.europa.eu/en/content/skills-intelligence-0


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State of the Art of the Maritime Industry

The MATES State of the Art Compilation (ASIME, 2019) includes a review and compilation of extensive information, including publications and projects, for the Shipbuilding and Offshore Renewable Energy sectors. The report summarises the significant technologies and projects already under development and those planned for future implementation. Following that, an identification of present and future skills needs was done (Sdoukopoulos et al., 2020), in which the value chain of Shipbuilding (Figure 6) and Offshore Renewable Energy (Figure 8) in Europe is described, key factors supporting the development of technologies and foreseen prospects and challenges explained, which give a whole picture about the maritime sector. The full report can be read **here**.

Shipbuilding Sector in Europe

Table 1. Key facts shaping the Shipbuilding sector in Europe today.

Industry Specialisation	More sophisticated vessels with innovative designs characterized by high-end equipment and technological components (e.g. research vessels) or green energy-fuelled vessels (hydrogen, batteries, etc.).
Economic Activity	€41 billion of production value annually from 2010 to 2014 following the performance of global competitors (e.g. South Korea, China) closely (Executive Agency for Small and Medium-sized Enterprises et al., 2017). The European value of marine equipment (± 22,000 big, small or medium-sized marine manufacturers and suppliers) generate an annual production value of about € 70 bn. ("Sea Europe - The Shipyards' & Maritime Equipment Association of Europe")
Market Size	300 companies actively involved in Shipbuilding, maintenance, repair and retrofitting activities & 22,000 marine equipment manufacturers and suppliers of different size and sales volume.
Allocation of Industry Productivity	Romania, Germany and Italy currently hold the largest productivity shares across the European context, but if we also consider the added value generated, the employment and prospects for future contracts as in fig 7, Italy, Germany and France are leading the ranking.
Employment	Over 200,000 people are directly employed & over 350,000 jobs are generated by the economic activity of marine equipment manufacturers and suppliers (SeaEurope, 2017).

Shipbuilding Value Chain

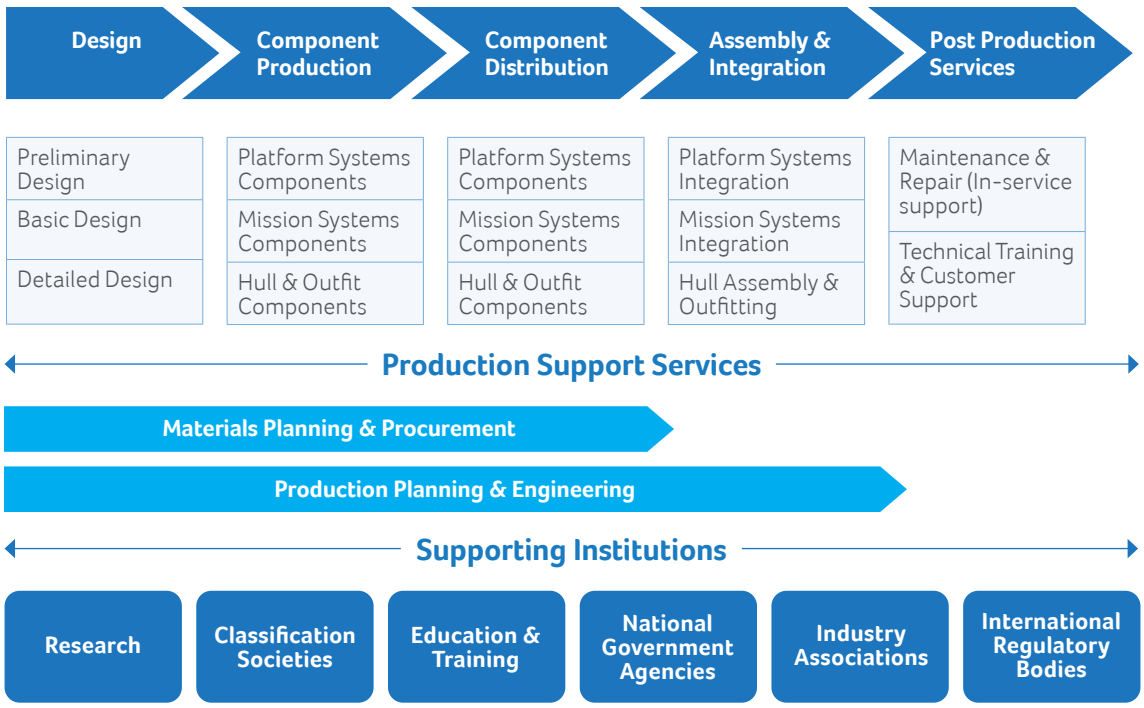

Figure 6. The shipbuilding value chain – key phases and processes (Own source, adapted from (Brun and Gereffi, 2013)

Based on the 2019 order book data expressed in Compensated Gross Tonnage (CGT) for each country, together with the number of employees in that industry and the value added at factor cost, a scale has been established to rank the most representative countries in the Shipbuilding and repair industry. As shown in Figure 7, the most important group of countries are Italy (17%), Germany (16%) France (14%) and UK (13%), followed by Spain (6%) and the Netherlands (5%).

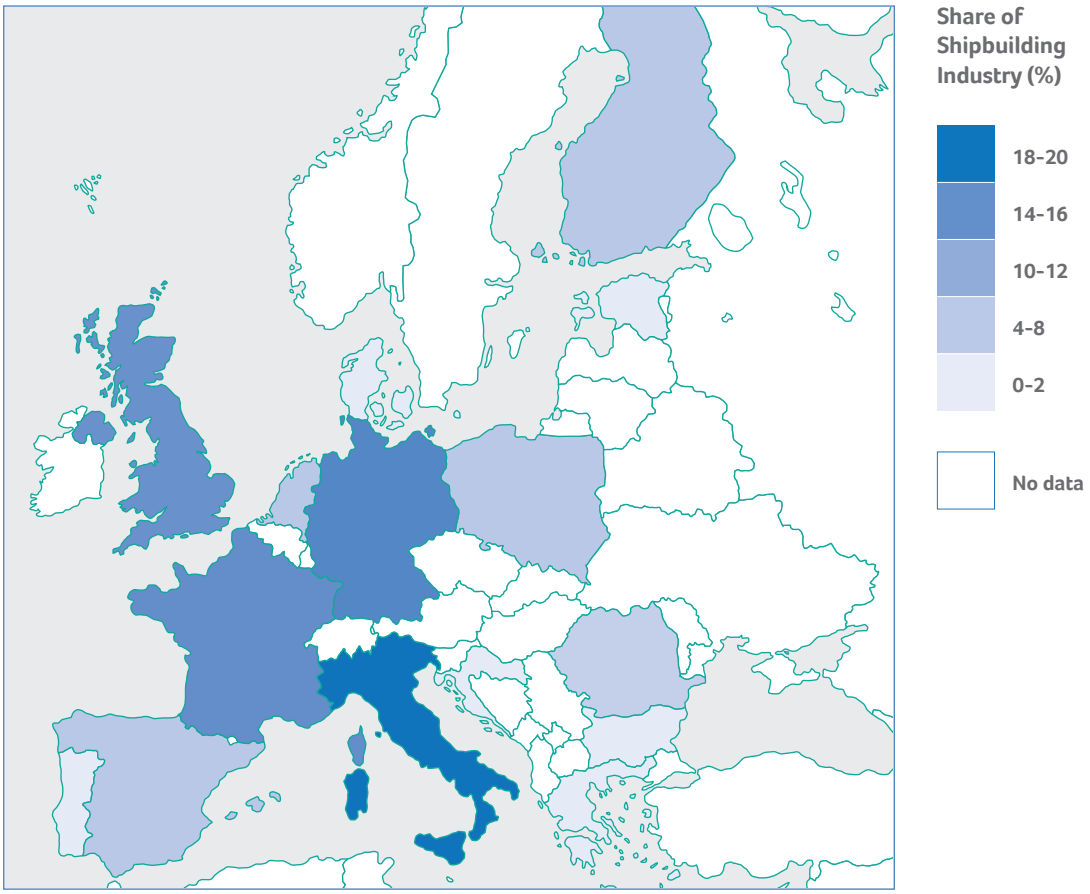

Figure 7. Importance of Shipbuilding sector in the EU and UK, considering the added value generated, the employment and prospects for future contracts. Based on the gross value added at factor cost (GVA[2]) and employment from 2018, and the order book 2020.Own calculations based on data from the European Commission, Directorate General for Maritime Affairs and Fisheries(2020 & 2021) and PYMAR (2019).

[2]GVA: Gross income from operating activities after adjusting to operating subsidies and indirect taxes, obtained from the European Commission, Directorate General for Maritime Affairs and Fisheries(2020 & 2021)

Offshore Renewable Energy Sector in Europe

Current status - Key Facts

Table 2. Key facts shaping the Offshore Renewable Energy sector in Europe today

Industry Specialisation	The sector includes several technologies that present different levels of market and technology readiness (TRL). The more mature one is fixed offshore wind energy. Floating offshore wind and ocean – which includes emerging technologies such as wave and tidal as well as some projects on solar energy - also presents considerable growth.
Installed Capacities	The installed capacity of offshore wind energy in Europe[3] amounted to 18.5GW in 2018, produced by 4,543 grid-connected wind turbines organised in 105 offshore wind farms. Ocean energy capacity, during the same year, was approximately 250 MW, with tidal energy being the biggest player.
Market Potential	The Offshore Renewable Energy sector in Europe presents a significant potential for further development in the upcoming years. Offshore wind energy is expected to reach 60GW of installed capacity by 2030, and 300GW by 2050. Floating wind energy is also growing, but in common with ocean energy, the pace is much slower. Also ocean energy (i.e. wave and tidal energy technologies) is expected to reach 1 GW of installed capacity by 2030 and 40 GW by 2050. (European Commission. Directorate General for Energy, 2020).
Allocation of Industry Productivity	70% of the installed capacity of Offshore Renewable Energy is concentrated in the North Sea. The UK holds the largest share (43%) followed by Germany, Denmark, Belgium and the Netherlands. Regarding ocean energy, about 90% of its total capacity is installed in France, while 8% is located in the UK.
Employment	In 2018, offshore wind energy accounted for approximately 210,000 jobs, which represents a 14.7% increase compared to the previous year. Ocean energy generated a much smaller number of jobs, estimated at 2,250 in 2016. However, employment rates for both offshore wind and ocean energy are expected to significantly rise in the near future, considering planned investments and the consequential increase in the number of installations and capacities.

Offshore Renewable Energy Value Chain

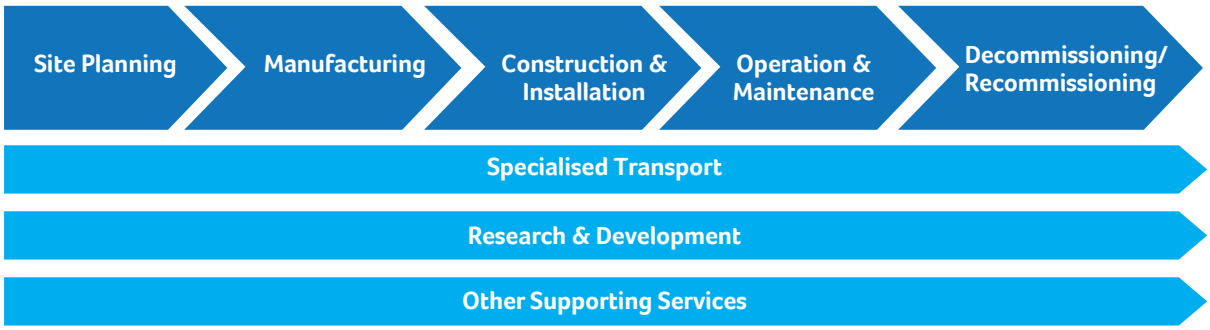

Figure 8. The offshore renewable energies value chain – key phases (Source: authors' own elaboration based on data from (International Labour Office and Skills and Employability Department, 2011); (International Economic Development Council, 2013); (DNV-GL, 2014); (Expert Group on Future Skills Needs, 2015); (Brown, 2017); (Gould and Cresswell, 2017); (IRENA, 2018); and (RenewableUK, 2018))

[3]EU Member States, UK and Norway have been considered for the calculation. It is also noteworthy that the ocean energy figures consider tidal barriers as tidal energy and not only the emerging wave and tidal sector.

Regarding the geographic spread of the Offshore Renewable Energy sector in Europe (see Figure 9 below), there are two different landscapes depending on the type of energy technology:

In the more mature sector of fixed offshore wind energy, the UK is the European country with the largest installed capacity (45%) followed by Germany (34%), Denmark (8%), Belgium (7%) and the Netherlands (5.5%). A nascent industry is present in Finland, Sweden, France, Spain, Ireland and Portugal.

Considering ocean energy technologies and floating offshore wind projects, France leads the ranking (51%), followed by the UK (20%), leading the promising tidal and wave energy sector, then Norway (14%), Spain (10%),and Portugal (4%). The Netherlands represents less than 1%.

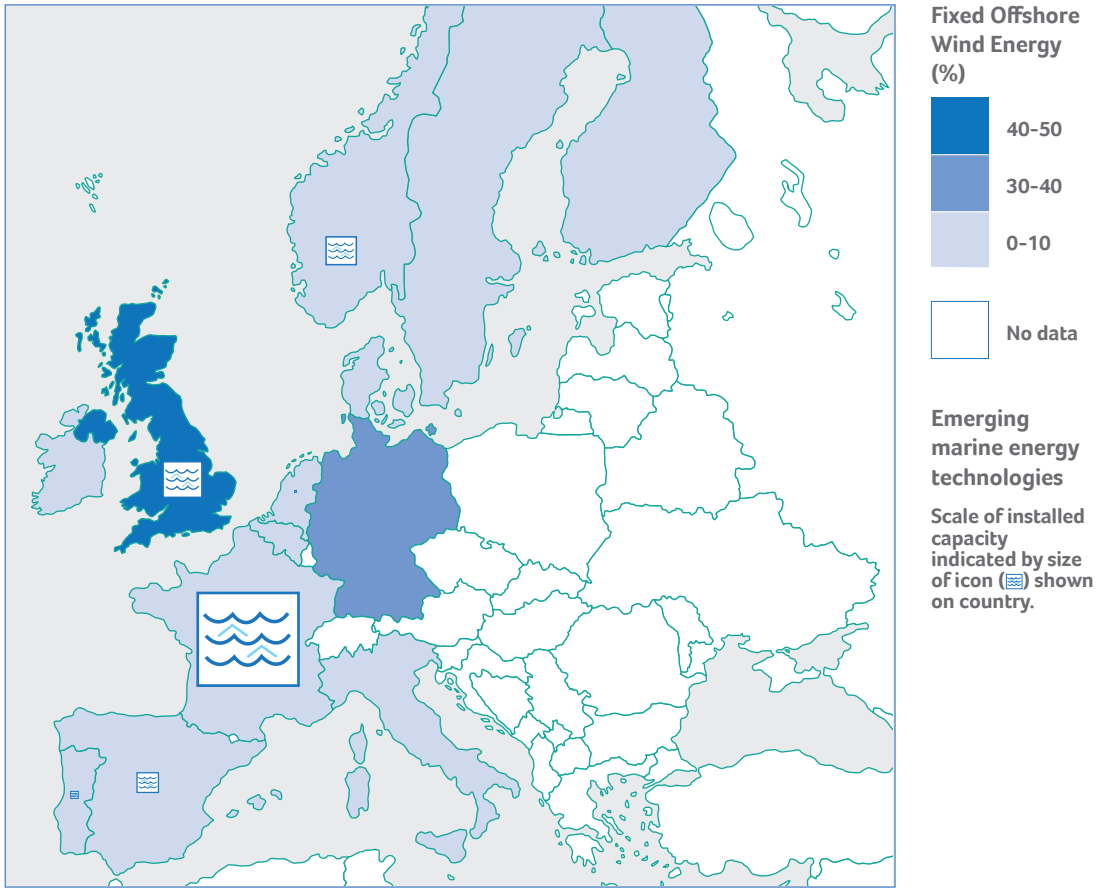

Figure 9. Importance of offshore wind energy sector in the European countries[4], based on the fixed offshore wind installed capacity. The icons show the installed capacity share of the emerging marine energies in the European countries (floating wind energy projects + ocean energy (i.e. wave & tide). Own source based on Wind Europe (2019), IRENA (2019) & European Commission. Directorate General for Maritime Affairs and Fisheries, (2020).

[4]EU Member States, UK and Norway data are included in these figures.

Identification of Present Skills Gaps

The development of the MATES Baseline Report on Current Skills Gaps (Sdoukopoulos, E. et al., 2020) required a detailed review and prioritisation process. In addition to a compilation report, expert feedback was received from two rounds of regional stakeholders' workshops conducted in different countries.

The methodological framework consisted of the following steps (see Figure 10):

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 v1.0) system as a starting basis.
4. Mapping and assessment of relevant educational and training programmes. Consideration of all different levels of European Qualifications Frameworks as well as of non-academic programmes providing professional certification.
5. Mapping and definition of skills demand (both hard and soft/tranversal).
6. Evaluation of the skills supply and demand mismatch putting forward the main current gaps and shortages. Set of actions proposed to address them.

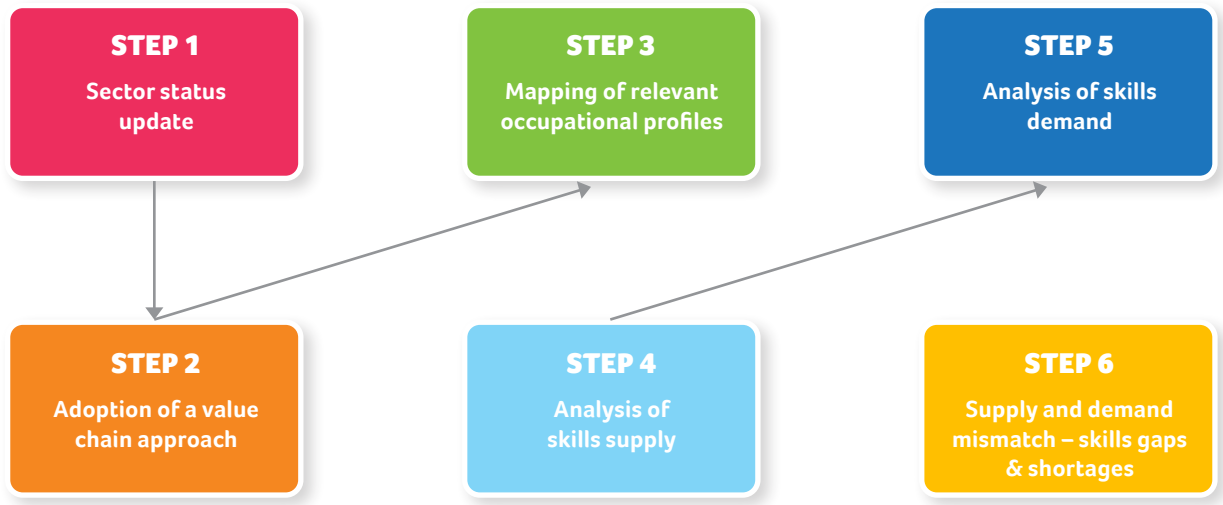

Figure 10. Methodological framework steps for the identification of current skills gaps

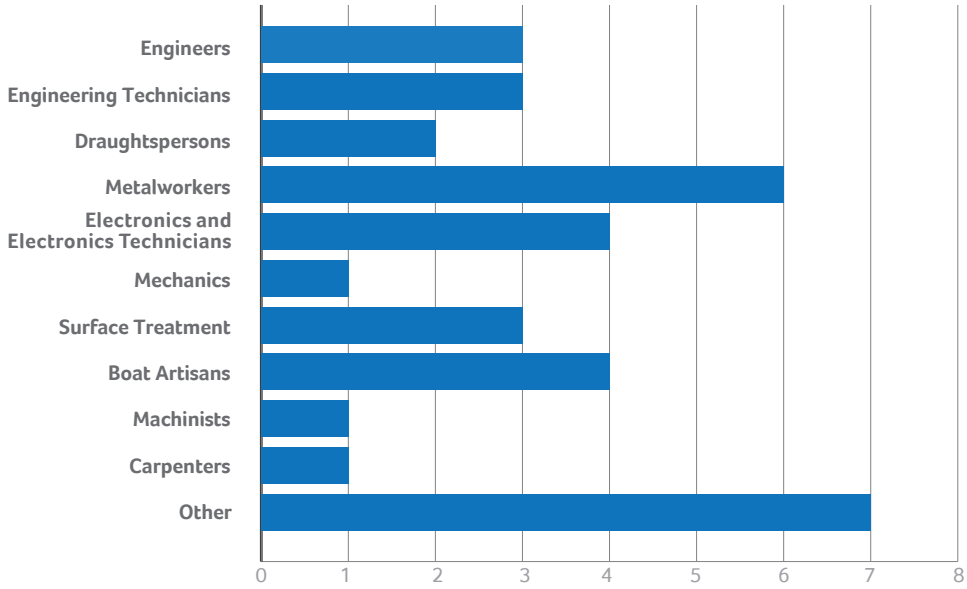

Figure 11. Number of Shipbuilding primary occupational profiles per group

Mapping Shipbuilding Occupational Profiles

35 primary occupational profiles were selected based on their relative impact in the Shipbuilding value chain (see Figure 11). Complementing them, 25 supporting occupational profiles were also identified.

'Other' refers to occupations related to inspection, vessel assembly, scaffolding and crane operations.

The complete list of occupations is available in Annex 2.

Mapping and assessment of relevant E&T programmes across Europe

482 Education and Training programmes currently available (2018-2019) in 17 EU countries were identified and assessed (See Figures 12, 13 and 14). The EU countries accounting for the largest productivity shares were included in the analysis.

All these trainings have been included in the Marine Training portal, classified by EQF level, country and language: **marinetraining.eu/mates-records**

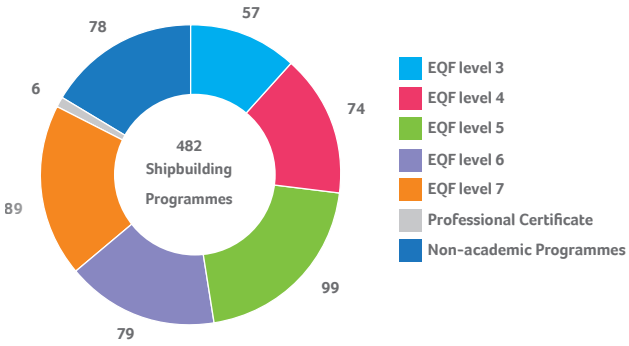

Figure 12. Type and number of E&T programmes available within the EU[5]

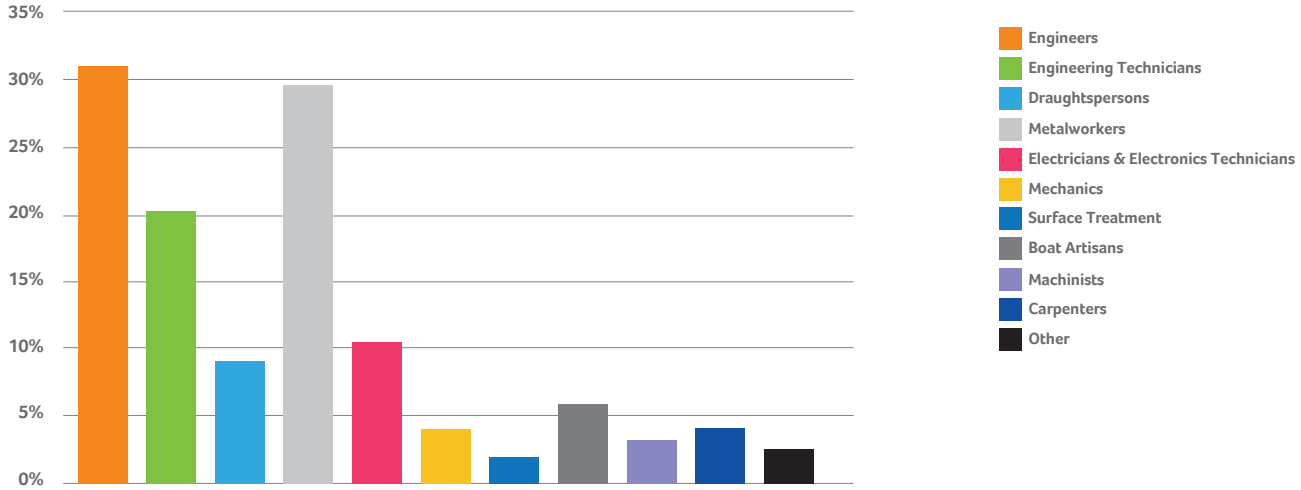

Figure 13. Percentage of E&T programmes addressing each group of Shipbuilding occupational profiles

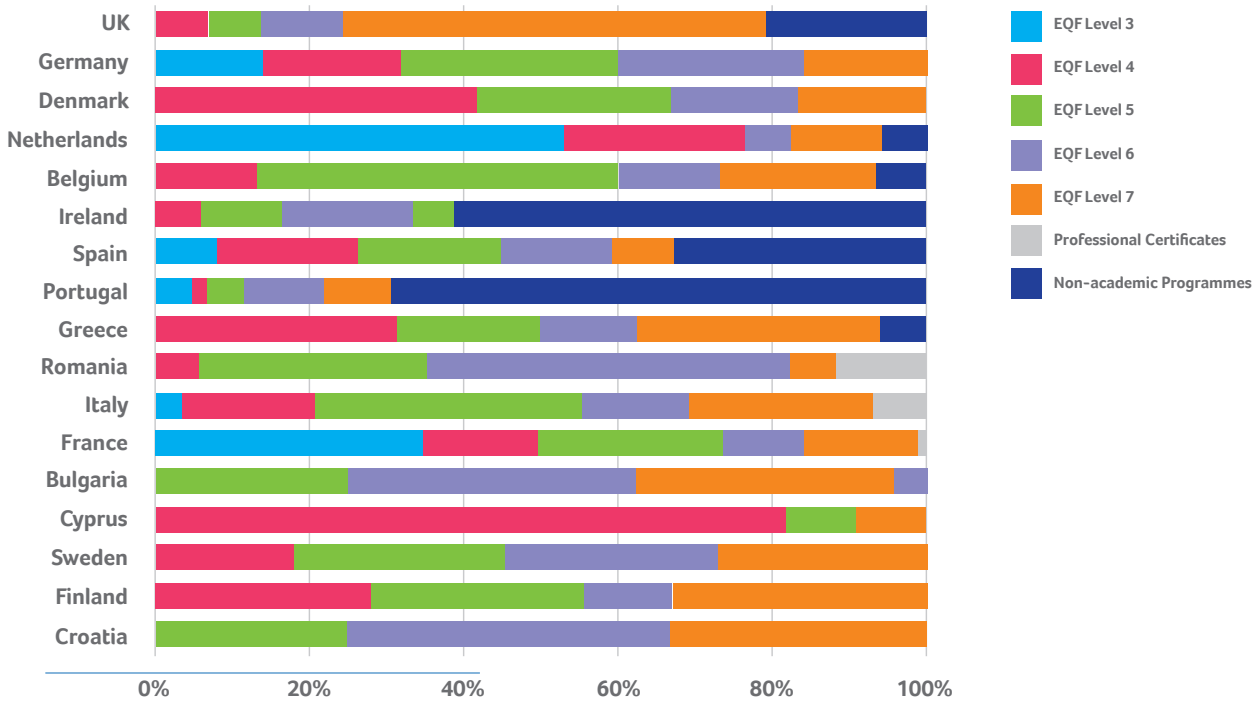

Figure 14. Distribution of identified programmes addressing Shipbuilding per EU country and EQF level

[5]EQF- The European Qualifications Framework is an 8-level, learning outcomes-based framework for all types of qualifications that serves as a translation tool between different national qualifications frameworks. **europa.eu/europass/en/european-qualifications-framework-eqf**

Key skills gaps, shortages & recommendations for the Shipbuilding sector

Table 3 below summarizes and groups the key gaps and shortages that were identified in the Shipbuilding sector for both hard and soft or transversal skills.

Table 3. Key skills gaps, shortages & recommendations for Shipbuilding

Skills Group	Gaps and Shortages
Hard skills	
Engineering	Electronic & electrical engineering skills; Skills in automation (application of automated systems on ships, advanced robotics and sensors); Engineering design skills; Skills in marine engineering.
Business Management	Knowledge of business management tools; Lean and quality management; Knowledge to efficiently coordinate different projects / works and take informed decisions; Team building and management techniques; Skills for communicating technical knowledge and work guidelines (especially for inter-disciplinary teams); Holistic perspective of Shipbuilding projects.
Project Management	Knowledge of the life cycle of Shipbuilding projects; Project planning and organisation; Resources planning and monitoring; Knowledge and efficient exploitation of available financial instruments; Design and optimisation of production processes; Logistics and supply chain organisation.
Design	Knowledge of design software (e.g. CAD computer-aided design); 3D design; Data-based modelling; Knowledge of different production processes; Knowledge of all safety and regulatory parameters; Knowledge of any changes in relevant regulations and possible implications in workflows and conditions.
Technical	Welding techniques; Composite materials manufacturing, application and surface finishing; Assembly and installation of engines of new type; Knowledge of cryogenic and overpressure technology (such as hydrogen); Electrical and electronic systems assembly and installation; Handling of cranes, CNC (Computer Numerical Control) machines and robots.
Digital	Digitalisation and optimisation processes for improving operations; (Big) Data analytics; Handling of ERP (Enterprise Resource Planning) and MRP systems (Material Requirements Planning); Programming and handling of CNC machines and robots; Data management and Data quality assurance; IoT (Internet of Things); AI (Artificial Intelligence), Robotics and Digital Twins.
Green Skills	Skills and knowledge for the exploitation of alternative fuels (methanol, liquefied biogas, hydrogen…) and renewable energy sources: energy efficiency, innovative infrastructure design…Improvement of energy and environmental performance: environmental impact, waste management processes, compliance with environmental legislation…
Soft or Transversal Skills[6]	
Communication & Collaboration	Ability to communicate in different languages (mostly English) and in inter-disciplinary teams; Ability to establish and manage horizontal and vertical relationships.
Leadership & Responsibility	Ability to take informed and evidence-based decisions; Ability to lead inter-disciplinary teams and effectively distribute roles and responsibilities.
Critical Thinking & Problem-Solving	Knowledge of problem-solving techniques; Quick and efficient solution finding; Quick decision-making capability.
Creative Thinking and Innovation	Monitoring of technical and technological advancements and quick adaptation to workflows and conditions.
Knowledge Management & Transfer	Ability to efficiently manage and use new knowledge acquired through different means (E&T programs, practical experiences, etc.); Ability to transfer acquired knowledge to others (e.g. new employees).
Foreign Languages	Ability to communicate fluently in the English language; Reading and understanding of engineering drawings, technical specifications and user manuals; Knowledge of other languages (e.g. Italian, Spanish, Chinese) for supporting international collaboration.

[6]Also referred to as key competencies, depending on the classification framework considered. MATES project has used the P21 framework for 21st Century skills during the skills intelligence phase. The ESCO taxonomy started to integrate them as transversal skills in 2020, and since then MATEs is adopting this term.


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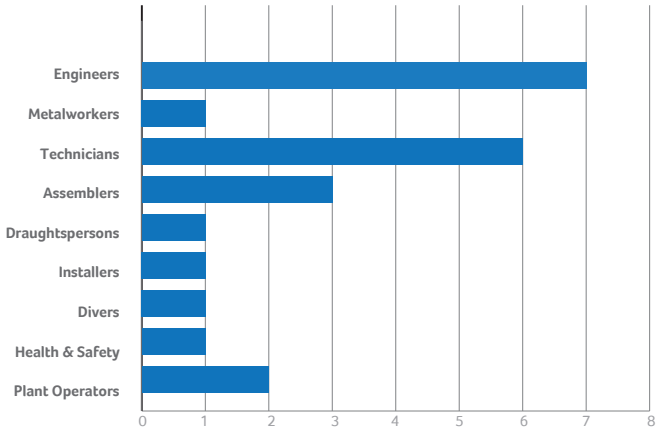


Mapping Offshore Renewable Energy Occupational Profiles

23 primary occupational profiles were selected based on their relative impact in the Offshore Renewable Energy sector (see Figures 15 and 19). Complementing them, 43 supporting occupational profiles were also identified.

The complete list of occupations is available in Annex 2.

Figure 15. Number of Offshore Renewable Energy primary occupational profiles per group

Mapping and assessment of relevant E&T programmes across Europe

551 E&T programmes currently available (2018-2019) in 12 EU countries were identified and assessed. The EU countries accounting for the largest productivity shares were included in the analysis.

All these trainings have been included in the Marine Training portal, classified by EQF level, country and language:

marinetraining.eu/mates-records

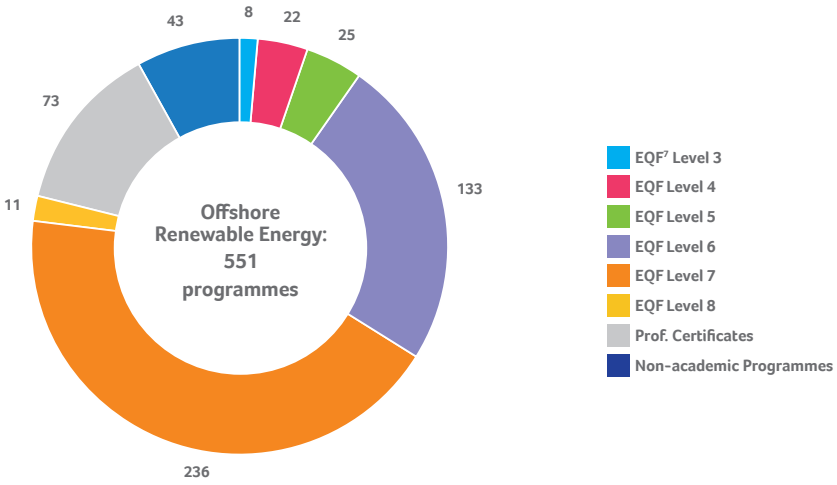


Figure 16. Relevant E&T programmes available within the EU

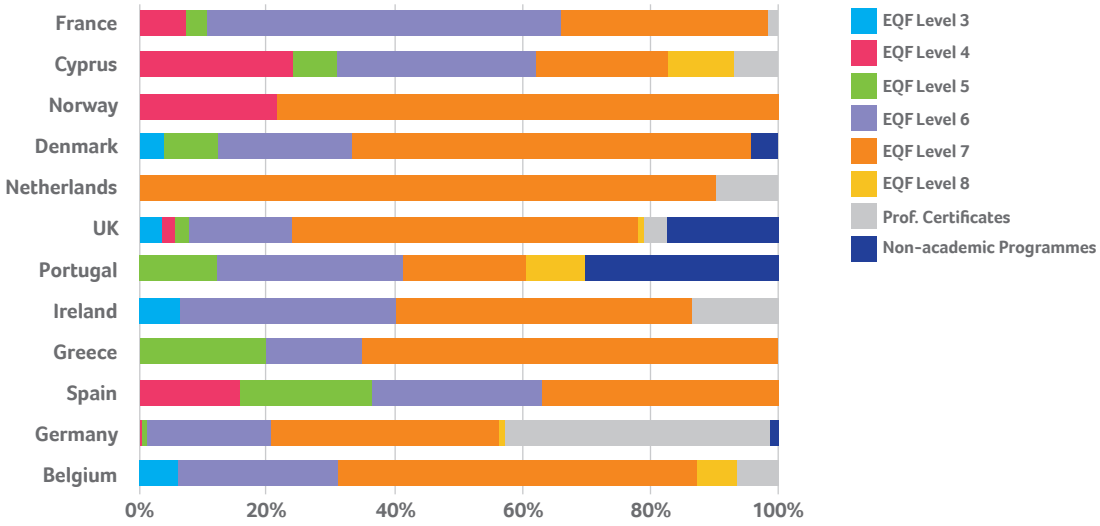


Figure 17. Distribution of identified programmes addressing Offshore Renewable Energy per EU country and EQF

[7]EQF- The European Qualifications Framework is an 8-level, learning outcomes-based framework for all types of qualifications that serves as a translation tool between different national qualifications frameworks. **europa.eu/europass/en/european-qualifications-framework-eqf**

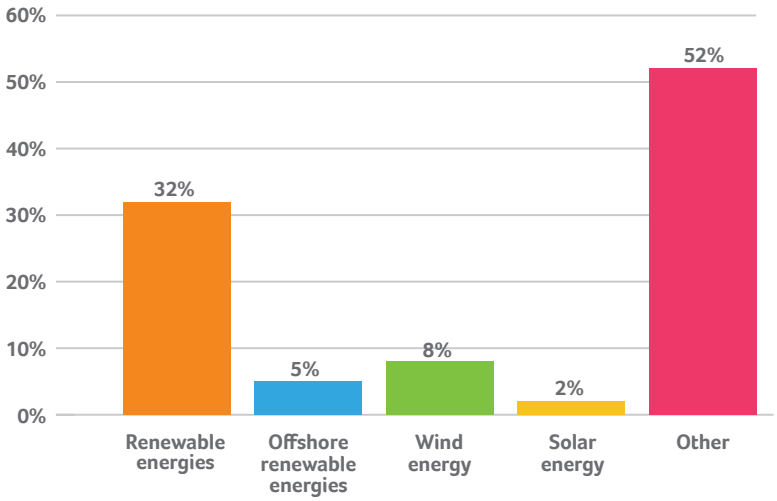


Figure 18. Distribution of education and training programs per specialisation

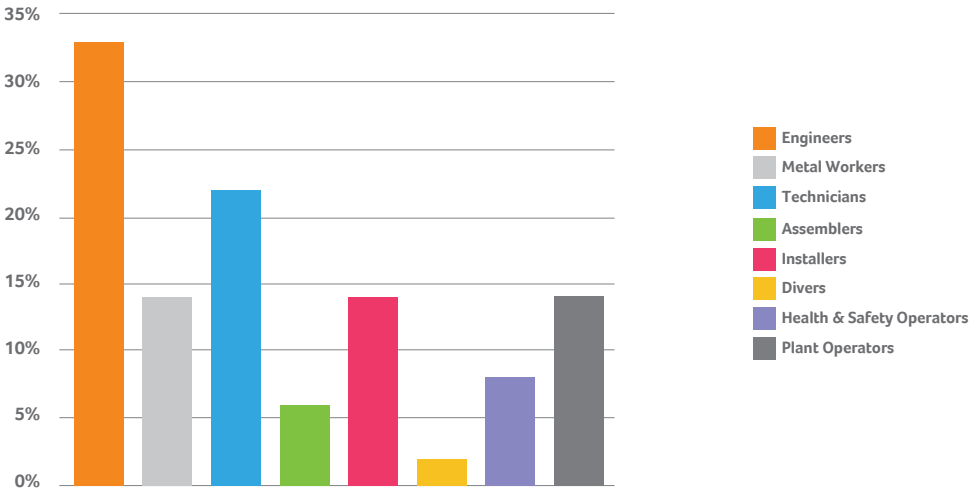


Figure 19. Percentage of E&T programmes addressing each group of Offshore Renewable Energy occupational profiles

Key skills gaps, shortages & recommendations for the Offshore Renewable energy sector

Table 4 below summarises and groups the key gaps and shortages that were identified in the Offshore Renewable Energy sector for both hard and soft or transversal skills.

Table 4. Key outcomes of the skills demand analysis

Skills group	Gaps and shortages
Hard skills	
Project management	Contract management; Documentation and reporting; Adhering to timetables and successfully meeting milestones; Financial monitoring; Risk management; Logistics coordination.
Engineering	Instrumentation & control systems; 3D design; Good knowledge of the main principles of ORE technologies (especially of wind turbines including their foundations).
Digital	(Big) data management and analytics; Database design and management; Algorithm development and numerical modelling; Software programming and development; Information and Communication Technologies (ICT); Automation capabilities (e.g. used for offshore foundations, submarine cables installation, surveying and condition monitoring activities, etc.); Robotics and remote controlling (e.g. drones).
Offshore-specific	Good knowledge of the main principles of ORE technologies; Standardisation of installation and maintenance procedures; Non-invasive methods for condition monitoring (e.g. use of drones); Offshore access systems; Ability to work in harsh conditions, that the marine environment is often characterised by, as well as under water and at great depth (e.g. near the sea bottom); Knowledge of metocean conditions; Basic knowledge of vessel operations; Environmental awareness (i.e. knowledge of the impact of ORE projects on the marine environment and ecosystem); Floating component exchange platform operations.
Health and safety	Set-up and updating of relevant protocols; Standardisation of installation and maintenance procedures; Good knowledge of metocean conditions; Good knowledge of marine risks; Handling of heavy machinery (e.g. cranes).
Project design and planning	Engineering design; 3D design and visualisation; Good knowledge of metocean conditions; Efficient coordination of logistics activities; Good knowledge of all relevant policy frameworks (and the specifications and limitations these set); Proper preparation of all relevant documentation for both internal and external purposes.
Using and understanding numerical or statistical information	Efficient use and presentation of statistical information; Numerical modelling; Algorithm development.
Environmental (Green Skills)	Good knowledge of the impacts of ORE projects on the marine environment.
Soft or transversal skills[8]	
Creative thinking & innovation	Monitoring of technical and technological advancements and quick adaptation into workflows and conditions.
Critical thinking & problem-solving	Knowledge of problem-solving techniques; Quick and efficient solution finding; Quick decision-making capability.
Initiative & self-direction	Ability to undertaken initiatives for introducing further efficiencies into operations and other processes; Self-directed learning.
Communication & collaboration	Ability to efficiently transmit and explain work responsibilities and coordinate parallel or interdependent activities (especially in multi-disciplinary teams).

[8]Also referred to as key competencies, depending on the classification framework considered. MATES project has used the P21 framework for 21st Century skills during the skills intelligence phase. The ESCO taxonomy started to integrate them as transversal skills in 2020, and since then MATEs is adopting this term.

Foreign languages	Reading, writing and communicating in English; Understanding of international technical aspects / guidelines.
Knowledge management & transfer	Ability to efficiently manage and use new knowledge acquired through different means (E&T programs, practical experiences, etc.); Ability to transfer acquired knowledge to others (e.g. new employees).
Leadership & responsibility	Ability to take informed and evidence-based decisions; Ability to lead inter-disciplinary teams and effectively distribute roles and responsibilities.
Flexibility & adaptability	Easily understand and adapt to the conditions of the respective working environment (i.e. reduce adaptation time); Have an agile mind-set able to cope with different situations and circumstances.
Productivity & accountability	Enhance personal efficiency rate; Develop a high level of personal accountability (i.e. be resilient, resourceful and honest).

Future Scenarios: Delphi Questionnaire

The development of the MATES Foresight Scenario Report (Ergas and Smyrnakis, 2020) involved the following steps: 1) Information on relevant educational and training (E&T) programmes in Europe was reviewed. 2) Outcomes of the analysis were presented and discussed with experts during a series of five workshops. 4) Two rounds of Delphi questionnaires were launched, targeting companies (and especially SMEs).

The Delphi methodology is a method of aggregating 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** which 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.

In spring 2019, two rounds of Delphi questionnaires were deployed 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 and age. Figures 20-23 show the breakdown of characteristics of the participants.

The information retrieved from the shortlisted key paradigm shifters identified as most significant for the future includes 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

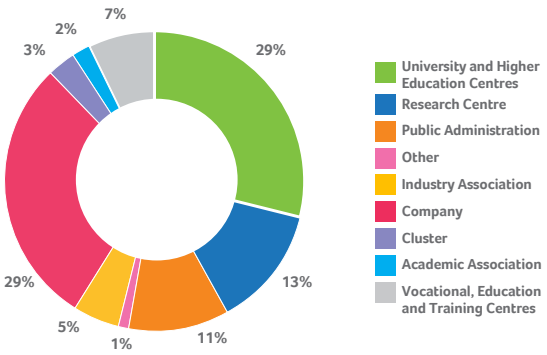


Figure 20. Type of organisation

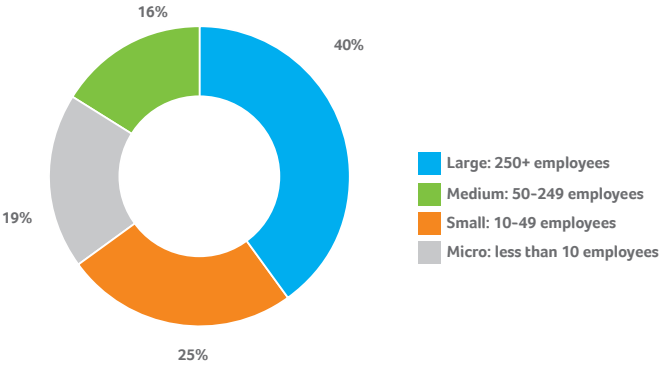


Figure 21. Size of organisation

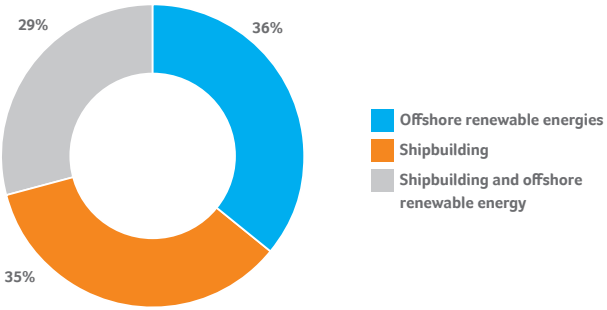


Figure 22. Sector of expertise

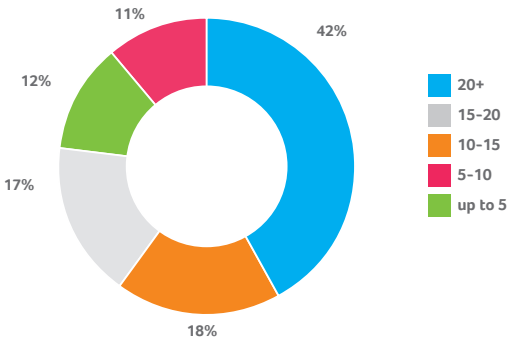


Figure 23. Years of experience of the experts

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. A total of 11 paradigm shifters were identified (six for Shipbuilding and five for Offshore Renewable Energy) and are explained below. Future scenarios were identified in the short, medium and long term (see Tables 5 and 6).

Shipbuilding

Digitalisation

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

Vessel automation, vessel autonomy and advanced robotics

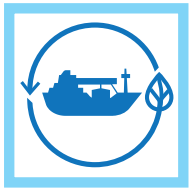
Modernisation of vessels based on the development and application of automated systems on ships, more sophisticated information systems, sensors, cameras and radars.

Exploitation of alternative fuels and renewable energy sources

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

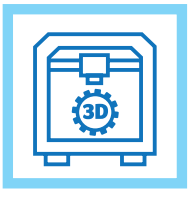
Drones

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



Green retrofitting

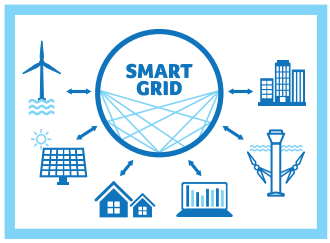
An upgrade to an existing structure to improve energy and environmental performance.



3D Printing

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

Offshore Renewable Energy



Smart grid & smart sensors

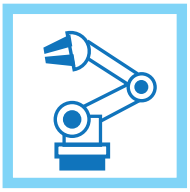
Optimisation of electricity generation, transmission and distribution by creating a highly interactive and responsive electricity grid that creates a balance between energy demand and supply.

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.

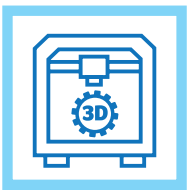
Energy storage

Management of energy supply and demand by storing the energy.



Automation & advanced robotics

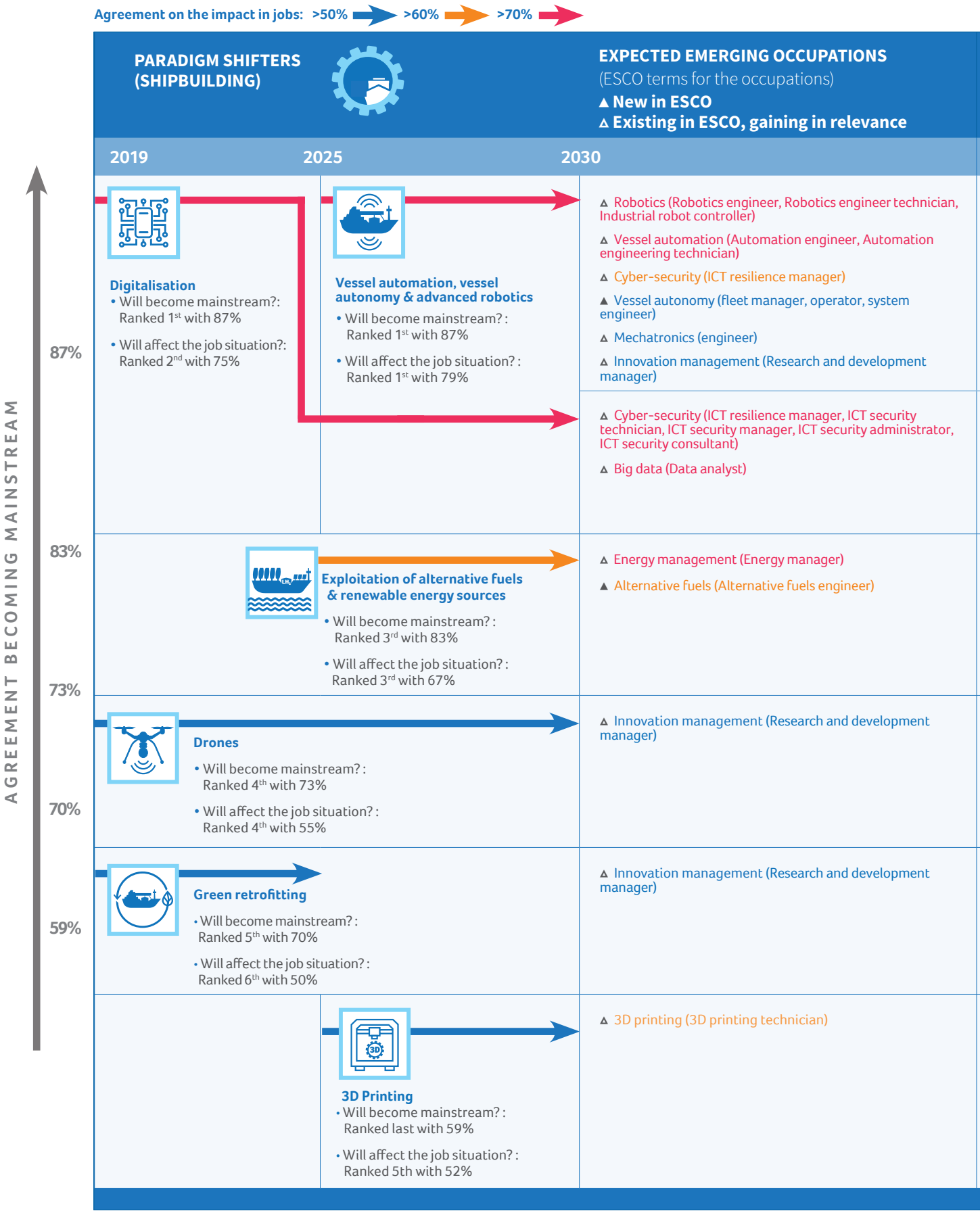
Development and application of automated and intelligent systems on equipment and processes.



3D printing

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

Table 5. Future scenarios of the Shipbuilding sector: Representation of the periods in which the experts 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 anticipated emerging occupations and main occupations considered to be affected, indicating if their demand is expected to increase or decrease. List of the most effective educational methods for the adaptation to each one of the paradigm shifters. Rankings based on the percentage of experts in agreement.

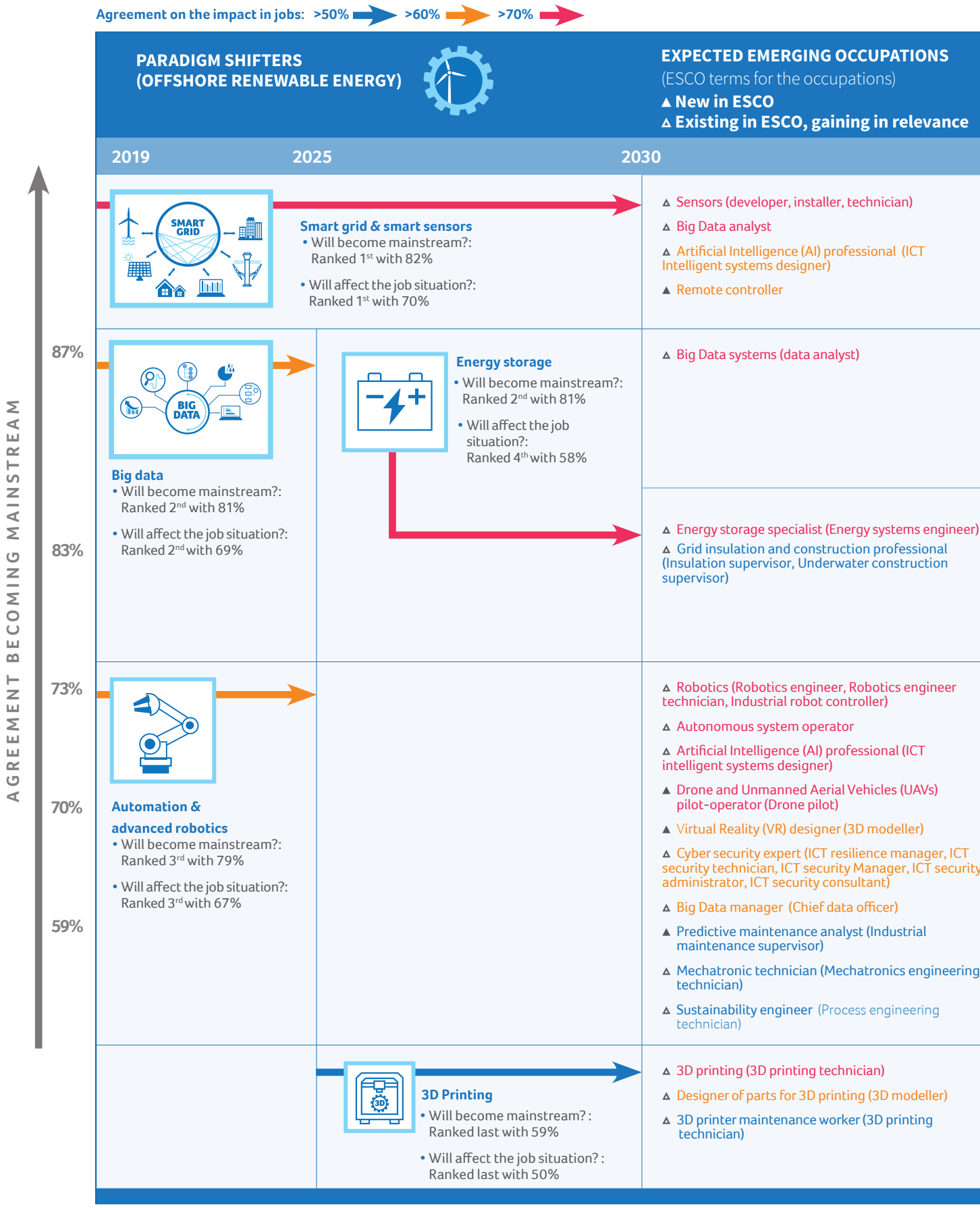


Scores for the expected emerging occupations and the most effective educational methods:

50-65% 65-75% 75-85% 85-95% 95-100%

LIST OF MAIN OCCUPATIONS AFFECTED **Bold - demand will increase** *Italics - demand will decrease* In both cases re-training will be necessary for the occupations update		MOST EFFECTIVE EDUCATIONAL METHODS
• **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*	• Lifelong learning • Webinars combined with training on the job • Blended apprenticeships (on-site and in-class including cross-country mobility) • Educational programs with industry placements • On the job training
• *Marine engineering drafter* • Electromechanical drafter • **Marine engineering technician** • **Marine engineer** • **Electromechanical engineering technician** • **Electronics engineering technician**	• **Electromechanical engineer** • **Marine engineering drafter** • **Marine electronics technician** • **Naval architect** • **Electromechanical equipment assembler** • **Electronic equipment assembler**	• Lifelong learning • On the job training • Webinars combined with training on the job • Massive Open Online Courses (MOOC) • Educational programs with industry placements
• **Marine engineering technician** • Marine engineering drafter • **Marine engineer** • **Naval architect** • **Vessel engine assembler**		• Lifelong learning • Webinars combined with training on the job • Blended apprenticeships (on-site and in-class including cross-country mobility) • Educational programs with industry placements • On the job training
• Vessel assembly supervisor • Vessel assembly inspector • Marine surveyor		• Lifelong learning • Webinars combined with training on the job • On the job training • Blended apprenticeships (on-site and in-class including cross-country mobility) • Educational programs with industry placements
• **Marine engineer** • **Naval architect** • **Marine engineering technician**		• Lifelong learning • Webinars combined with training on the job • Blended apprenticeships (on-site and in-class including cross-country mobility) • Educational programs with industry placements • On the job training
• **Electromechanical engineering technician** • **Vessel engine assembler** • **Electromechanical equipment assembler** • **Computer numerical control (CNC machine operator)** • *Welder* • *Shipwright* • *Boilermaker* • *Pipe welder (pipe fitter)* • *Boat rigger*		• Lifelong learning • Webinars combined with training on the job • Massive Open Online Courses (MOOC) • Blended apprenticeships (on-site and in-class including cross-country mobility) • Educational programs with industry placements

Table 6. Future scenarios of the Offshore Renewable Energy sector: Representation of the periods in which the experts consider that each paradigm shifter will become mainstream in the Offshore Renewable Energy sector, indicating if they consider that the employment landscape will be affected. List of anticipated emerging occupations and main occupations considered to be affected, indicating if their demand is expected to increase or decrease. List of the most effective educational methods for the adaptation to each one of the paradigm shifters. Rankings based on the percentage of experts in agreement.



Scores for the expected emerging occupations and the most effective educational methods:

50-65% 65-75% 75-85% 85-95% 95-100%

LIST OF MAIN OCCUPATIONS AFFECTED **Bold - demand will increase** *Italics - demand will decrease* In both cases re-training will be necessary for the occupations update		MOST EFFECTIVE EDUCATIONAL METHODS
• **Power distribution engineer** • **Electric power generation engineer** • **Maintenance and repair engineer**	• **Power production plant operator** • **Solar power plant operator**	• Lifelong learning • Webinars combined with training on the job • Educational programs with industry placements • Higher education new technology courses • Online courses on new technologies (i.e. Artificial Intelligence (AI) , Augmented reality, 3D applications)
• **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** • **Tide power technician**	• Lifelong learning • Online courses on new technologies (i.e. Artificial Intelligence (AI) , Augmented reality, 3D applications) • Webinars combined with training on the job • Blended apprenticeships (on-site and in-class including cross-country mobility) • Higher education new technology courses
• **Power production plant operator** • **Solar power plant operator** • **Power distribution engineer**	• **Electric power generation engineer** • **Maintenance and repair engineer**	• Lifelong learning • Online courses on new technologies (i.e. Artificial Intelligence (AI) , Augmented reality, 3D applications) • Webinars combined with training on the job • Blended apprenticeships (on-site and in-class including cross-country mobility) • Educational programs with industry placements
• **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**	• Lifelong learning • Webinars combined with training on the job • Blended apprenticeships (on-site and in-class including cross-country mobility) • Higher education new technology courses • Online courses on new technologies (i.e. Artificial Intelligence (AI), Augmented reality, 3D applications)
• *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**	• Lifelong learning • Webinars combined with training on the job • Blended apprenticeships (on-site and in-class including cross-country mobility) • Higher education new technology courses • Online courses on new technologies (i.e. Artificial Intelligence (AI) , Augmented reality, 3D applications)

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. See Pilot Experiences in Figure 24.

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 (see Tables 7 and 8).

Table 7. 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[9] 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

[9]Also referred to as soft skills, key competencies or transversal skills, depending on the classification framework considered. MATES project has used the P21 framework for 21st Century skills during the skills intelligence phase. The ESCO taxonomy started to integrate them as transversal skills in 2020, and since then MATEs is adopting this term.

Table 8. 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[10]: 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 self-direction, 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 aspects of Offshore Renewable Energy.	6.0
ORE 12	Promoting **STEM women** in Offshore Renewable Energy.	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 Offshore Renewable Energy.	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 analyses, such as Levelised Cost of Energy (LCOE) reduction, subsidy framework, etc.	4.6

[10]Also referred to as soft skills, key competencies or transversal skills, depending on the classification framework considered. MATES project has used the P21 framework for 21st Century skills during the skills intelligence phase. The ESCO taxonomy started to integrate them as transversal skills in 2020, and since then MATEs is adopting this term.

Ocean Pro.Tech Lab

Short-term course on knowledge exchange between workers from traditional sectors (including Shipbuilding/ship repair), entrepreneurs, trainers and early-career skilled youngsters. Promotion of attractiveness of maritime careers among youngsters through an educational challenge both "on board" and "on pier". **Participants*:** SE and VET students, industry, scientists

MOL2

Maritime on the Loop of Ocean Literacy: Engagement with educational and training centres with cross-curricular skills related to Shipbuilding and Maritime Technologies.

- **Course audio-visual materials** in the framework of a competition environment (Management, CAD, 3D printing, Electronics, Polyester, Wood, and Bamboo)
- Taking new technologies in shipbuilding to the classroom. **Participants*:** SE and VET students and teachers.

Green Move

Exchanges related to green technologies in the maritime sector in order to develop a methodology adapted to the strategic needs of the organisations. **Participants*:** VET and HE students and teachers.

Blended Transversal Learning

- **Attractiveness of maritime career**
- **Visibility of the maritime industry recommendations**

GOALS

DOP

- Recogn
identifi
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profess

Training Programmes

GOALS

- **Enhancing collaboration between academia & industry**
- **Innovation in training**
- **Improving trainers curricula**
- **Seeking for technical solutions**

Innovation Manager Course

Specialisation course on innovation management for Shipbuilding addressed to recently graduated university students. **Participants*:** HE students.

Additive Manufacturing & Risk Management in Shipbuilding & Ship Repair

Training seminar to support the sectors' workforce through upskilling and reskilling in green technologies. Growth and employment in the maritime sector are enhanced through focusing on the environmental and digital dimension of the sector. **Participants*:** Industry, HE and VET students.

ORE Short Courses

One course focused on **marine renewable energy** (wave and tide), while the other was a **Training Of Trainers** in offshore wind energy. **Participants*:** Industry, HE students and VET teachers

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

Pilot Experiences

ED²MIT

Education and Training for Data Driven Maritime Industry: Four courses on digital and data skills **1)** Introduction to Big Data and Data Management for Maritime Industry, **2)** Big data infrastructure Technologies for Data Analytics, **3)** Industrial Data Spaces, Organisational Data Management and Governance for the Maritime Sector, **4)** Introduction to Data Science & Analytics Foundations for the Maritime Sector
Participants*: Industry and HE students.

MOOC Shipyard 4.0

MOOCs on Industry 4.0 and the naval sector: Two Massive Online Open Courses. **1)** Shipbuilding and Industry 4.0, **2)** Integrated Logistic Support and Industry 4.0
Participants*: Industry, HE and VET students.

Online Training Materials

- **Providing latest methodology for training, reskilling/ upskilling workforce to facilitate the use of new technologies**
- **Developing training materials in line with new EU recommendations, experience-sharing**

GOALS

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GOALS

Simulation of Industrial spaces

- **Simulation of industry spaces in VET centres and building innovative devices for training purposes**

Freeboard

Design, construction, painting and equipment of training space in a VET centre to simulate a shipyard working environment and using innovative devices.
Participants*: VET students.

The Magnus Effect

For wind and marine energy. Building an offshore wind jacket in order to promote industry-led techniques among VET students.
Participants*: VET students.

DOP

Definition of new Occupational Profiles: Update and definition of occupations and skills emerging from the evolving technologies in the Offshore Renewable Energy and the Shipbuilding sectors, following ESCO taxonomy. Development of a protocol to facilitate the contributions of external experts to the ESCO community, bridging language barriers and unfamiliarity with these collaborative tools. **Participants*:** Industry, VET and HE teachers.

Figure 24. Eleven Pilot Experiences to test the strategy in consistency with the Action Lines

Barriers and Further Insights

The complexity of the Maritime Technologies environment - particularly the Shipbuilding and Offshore Renewable Energy sectors that combine multiple industries, technologies, skills, and academic domains - makes the design of a participatory approach for developing a strategy very challenging. However, the MATES consortium's experience and the involvement of different types of entities housing a large pool of experts with many complementary backgrounds are the major strengths of MATES and a fundamental basis on which robust results can be produced.

There are several disparate data sources on skills requirements and, to date, a systematic way of mapping the current skills in the industry and any new skills required has not been realised. The language barrier is one of the many impediments identified by the skills intelligence analysis conducted by MATES. Moreover, skill developments in maritime technologies can be a challenge if long-term sustainable funds are not secured, especially in times of drastic technological changes, growing automation, and use of robotics and Artificial Intelligence (Industry 4.0) that affect competence models and curricula.

Impact of the COVID-19 Pandemic

The MATES consultation on skills gaps and shortages in the maritime technology industry (Sdoukopoulos et al., 2020) highlighted some concerns surrounding the COVID-19 crisis. The impact of the pandemic on Europe's maritime technology sector has led to redundancies and adjustments due to cost-cutting. Although many shipyards have kept investing in upskilling and reskilling their employees, a lower prioritisation of training is being observed in many other cases. The cruise Shipbuilding companies for example, which represent a vital part of the sector in Europe, are still feeling the pressure as the cruise industry ceased operations for almost 18 months. A slowdown in new constructions will undoubtedly lead to a reduction of the workforce in these shipyards, requiring workers to transfer to other maritime sectors.

The offshore wind energy sector, which has been resilient (Ramirez et al., 2021) and active (Pouliakas et al., 2020) despite COVID-19, was identified as an industry with real potential as training spaces. The Offshore Renewable Energy (ORE) sector was identified as an industry that could accommodate some of these workers, with offshore test sites showing real potential as important training spaces. The ORE is expected to continue growing, revitalising coastal communities that historically served Shipbuilding, fishing and the oil & gas sectors (Ocean Energy Europe, 2020), increasing the number of projects and requiring an expanded workforce for those projects already in place.

There are still many uncertainties about the progress of the pandemic and the extent of its impact. While the education community recalls the importance and effectiveness of traditional (face to face) and hands-on learning to acquire knowledge, digital skills and transversal skills have proved to be vital for adapting to crises and changing environments, strategic planning, communication, and dissemination.

Thanks to the rapid developments of online conferencing tools and virtual reality, companies and educational centres have experienced exciting advancements in the provision of webinars and interactive online events to address the priorities of the market or sectoral training needs, with satisfactory participatory results. Therefore, blended learning approaches have been integrated in many cases, and it is foreseen that remote training will be retained and applied when necessary. A better-aligned education system would offer the students the opportunity to take new qualified and certified courses rapidly.

To create a resilient maritime sector, not only should education and training centres and industry, but also policymakers/authorities be transformed and become more flexible, in order to enable and recognise alternative approaches for training, certification and compliance. Innovative ways of achieving the required skills are needed. An illustrative example is for instance the situation of seafarers whom certificates expired and could not attend the required training because of COVID-19. Despite some administrations extended the certificates for a limited period they finally found alternative solutions in online virtual trainings. However, educators and training providers need to develop alternative approaches to achieve all the learning outcomes and the assessment techniques in a robust manner when operating remotely.

The sector should then break the remaining barriers and promote, on the one hand, digitalisation, automation, IOT and robotics, and on the other hand, health and safety protocols in line with current circumstances

Maritime Technologies Skills Strategy

The MATES project aims to contribute to a more resilient labour market, capable of adapting to new scenarios, to help safeguard the well-being of present and future maritime-reliant communities and the overall competitiveness of the industry.

Stakeholders, actors and facilitators

Main stakeholders and target audiences for the Maritime Technologies Skills Strategy in order to increase the availability and quality of maritime technologies professionals

- **Policy makers:** Public sector bodies, such as the European Commission, EU agencies, Member States, National governments, Regional and Local administrations.
- **Standardisation bodies:** International, National and regional standard organisations addressing capacity building.
- **Social Partners and Professional Bodies:** Trade Unions, Industrial associations, Clusters, Academic associations.
- **Education and training providers:** Universities, Higher Education Institutions, Vocational training (VET) organisations, Online training providers.
- **Employers:** Large companies and SMEs, as well as organisations which require professionals, such as the Research community, Knowledge brokers and others.

Figure 25 provides an overview of the stakeholder model involved in education, training and skills management. Industry, public administration and research centres are usually the employers and act on the **demand** side whereas education and training organisations provide the offer and act on the **supply** side. The Supply-Demand chain of skills and capacity building brings to market a qualified workforce demanded by employers to fulfil their tasks and sustain the business.

Relations between the three main groups: educated/trained workforce, education and training providers, and employers are mainly regulated by market relations and gaps caused between:

- the potential workforce's (professionals and students) expectations, and training providers' offer, and
- training provider and employer needs.

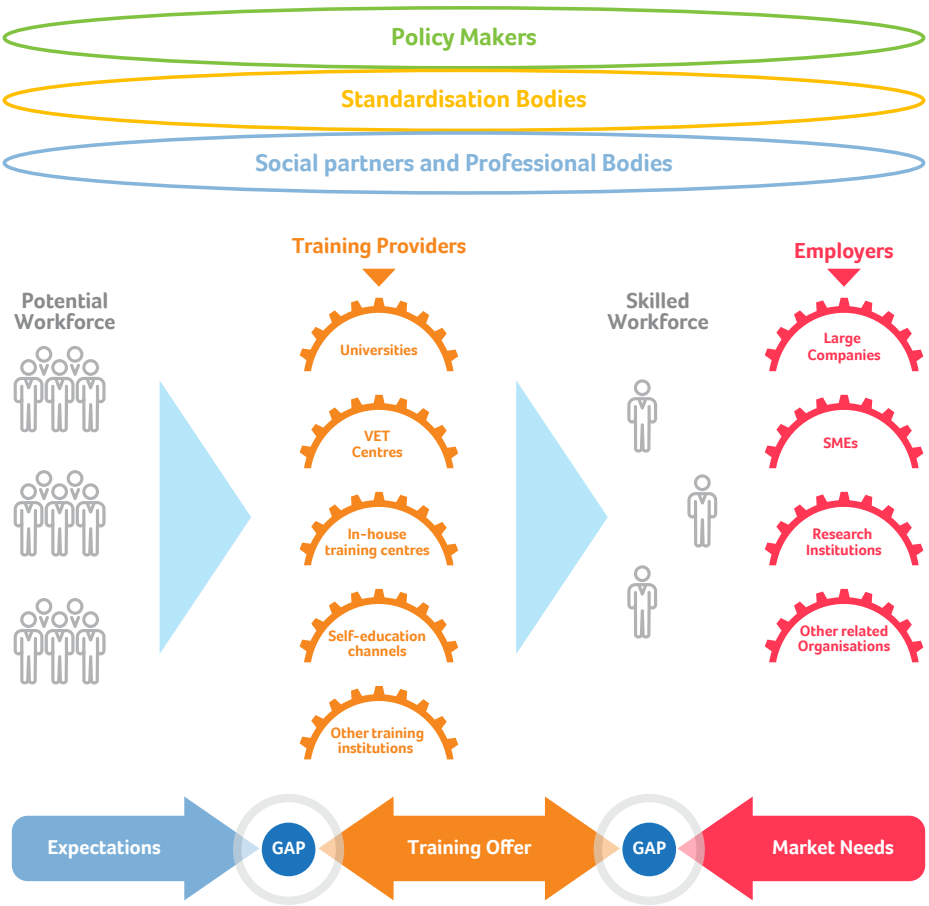


Figure 25. Stakeholders and actors in skills and capacity management in on the job market.

Maritime Technologies Sectoral Strategic Recommendations

The results from MATES allow us to identify preliminary trends:

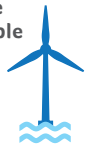
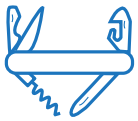
- There is a need to strengthen existing education provision and expertise in the maritime fields, and to develop new capacities and specialised training offers appropriate to the specific features of the industry. The Shipbuilding sector is in urgent need of updated educational and training programmes in the digital domain, green technologies and soft skills, all adapted to the specific requirements of, and developed in collaboration with, the sector.
- The marine Offshore Renewable Energy sector could be boosted through the stimulation of a dedicated training offer, to promote re-skilling and up-skilling of the workforce, availability of training itineraries which intersect with other sectors, suiTable preparation for new staff, and a clear contribution to promoting strong labour standards.
- The maritime technologies sectors must attract new talent while also implementing generational replacement systems. The targets for increasing Offshore Renewable Energy and the growing demand for specialised jobs may constitute an opportunity for this.
- The maritime industry could also benefit from efforts towards specialised Digital Literacy and Data Literacy training for white collar workers and managers in particular. This could be underpinned by the availability of modern education and training infrastructure and a platform to ensure access to data-driven technologies and facilities to be used in the education and training.
- Advancements in the acceptance and integration of the common competences/skills model will be essential to develop a well-defined curriculum facilitating adjustments to new requirements.
- Raising the level of Ocean Literacy would increase the visibility of professional opportunities from the maritime industry, attracting more young people 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.

Stakeholders

P	**Policy makers:** Public sector bodies, such as the European Commission, EU agencies, Member States, National governments, Regional and Local administrations.
S	**Standardisation bodies:** International, National and regional standard organisations addressing capacity building.
SP	**Social Partners and Professional bodies:** Trade Unions, Industrial associations, Clusters, Academic associations.
T	**Education and training providers:** Universities, Higher Education Institutions, Vocational training (VET) organisations, Online training providers.
E	**Employers:** Large companies and SMEs, as well as organisations which require professionals, such as the Research community, Knowledge brokers and others.

Table 9. Short presentation of the Maritime Technologies Sectoral Strategic Recommendations, indicating the stakeholders groups addressed. See Annex 1 for full description.

	Recommendation	Stakeholders
Boost Cooperation 	Enhancing education-industry-policy makers' cooperation	P SP T E
	Recognising the efforts to increase Industry-education collaboration.	P S SP T E
Attract Talent 	Increasing attractiveness of maritime careers - Ocean Literacy	P SP T E
	Encouraging the participation of women in maritime technologies.	P SP T E
	Improving knowledge-transfer among senior and junior employees.	SP E
	Integrating the values of the Just Transition to attract talent.	SP E
	Contributing to the specialisation of temporary employees	T E

	Recommendation	Stakeholders
Promote Skills Intelligence 	Boosting specific funding for sectoral skills development	P
	Continuing to promote key results of Sectoral Skills projects: open access repository.	P
	Establishing a maritime technologies jobs and skills observatory	P S SP T E
	Using job standard descriptors .	P S SP T E
	Involving experts with multiple background in the skills intelligence.	S
	Improving the coordination of recognition of professional certifications.	S
	Furthering regular updating of qualification schemes.	S T E
Improve Training Offer 	Increasing the number of accredited courses in Shipbuilding and Offshore Renewables	P T
	Retaining skills capacity building in research and development project calls.	P
	Updating Occupational Profiles with the new green, digital & transversal competences.	S
	Delivering lifelong learning in engineering, digital and offshore operations skills.	SP T E
	Integrating green skills content in trainings.	SP T E
Offshore Renewable Energy 	Exploiting test sites for training in offshore renewable energy	P SP T E
	Developing specific training in energy storage.	SP T E
	Upskilling Shipbuilding managers in offshore renewable energy technologies.	SP E
Digitalisation 	Developing Digital and Data competence frameworks for maritime industry	P S SP T
	Promoting ICT skilling programmes adapted for the maritime sector.	P SP
	Providing training in digitalisation for companies.	SP E
Multi-Purpose Skills 	Underpinning skills transferability & recognition between maritime sectors.	P S SP E
	Developing multi-disciplinary skills outside specialisations: flexible opportunities for training.	E
Active Learning 	Providing short trainings and support modularity in educational offers.	SP T E
	Promoting active involvement of learners.	SP T E
	Including transversal skills contents in trainings.	SP T E
Mobility 	Increasing mobility and dual technical programmes.	P T E
	Using blended learning options in mobility and event-planning.	P SP T E

Conclusions

The MATES project has undertaken a collaborative approach to better align educational opportunities and labour market needs in all European sea basins, increasing the maritime careers attractiveness. Furthermore, the project is widening perceptions of Ocean Literacy initiatives by embedding an appropriate industrial perspective. The Maritime Technologies Skills Strategy addresses the major challenges identified when stating the objectives for the project :

- MATES created a **European network of experts and enhanced innovation ecosystems** around the maritime technologies, assembling of over 200 stakeholders from Industry, Academia and Research. Their views and insights contributed to enrich the strategy building process.
- A detailed **skills analysis is provided as a basis for greater alignment of educational opportunities and the labour market:** present training offers and skills gaps have been identified together with the future trends and their impact on capacities' needs. As a result, a set of Lines of Action have been prioritized to bridge the gap.
- **11 Pilot Experiences** were developed (and adapted to the COVID19 pandemic), to launch the lines of action in different regional contexts. The results of the pilot activities themselves created valuable results in the form of education curricula and training materials, educational platforms and tools, methodologies and contribution to European standardisation on occupations and skills definition.
- A critical revision of all project activities resulted in a **comprehensive set of recommendations to implement the MATES Maritime Technologies Skills Strategy** providing a blueprint for coordinated activity of all groups of stakeholders in the active job market: policy makers, social partners, standardisation bodies, education and training providers, and employers.

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Annex 1

Description of the Skills Strategy Recommendations organised by Stakeholder

<table>
<tr><th colspan="3">POLICY MAKERS (P)</th></tr>
<tr><th>Group</th><th>Recommendations</th><th>Stakeholder</th></tr>
<tr><td rowspan="2"> 
Boost Cooperation

Rationale:
• Cooperation between education and industry will help focusing on long term objectives and continuous courses updates with the new technology developments. Setting up mechanisms capable of taking on the task of creating long-term collaborations is essential if the sustainability of these multi-stakeholder communities to be secured. Education institutions must be involved in the competence centres creation to facilitate tighter cooperation with industry.
• Recognition and reward to universities collaborating with industry will facilitate cooperation and responsiveness of university to critically demanded professions and competencies.</td><td>Enhancing education-industry cooperation.

Description:

- Facilitate and promote cooperation and experience exchange between policy-makers, industry, social partners and education and training providers.
- Boost the creation of multi-stakeholder expert groups.
- Set up mechanisms capable of taking on the task of creating long-term collaborations, essential if the sustainability of these multi-stakeholder communities is to be secured.</td><td>P SP T E</td></tr>
<tr><td>Recognising the efforts to increase Industry-education collaboration.

Description:
- Include within official recognition schemes the efforts dedicated to creating collaborations between academia, industry and policy makers.
- Develop protocols (for individuals and also organizations) to recognise and reward the efforts dedicated to creating collaborations between academia and industry and policy makers.
- Offer solutions such as Open Badges as digital credentials* (connected to the personal CV).</td><td>P S SP T E</td></tr>
<tr><td> 
Attract Talent

Rationale:</td><td>Increasing the attractiveness of maritime careers - Ocean Literacy.

Description:
- Promote opportunities in the maritime technologies in Europe, developing Ocean Literacy actions to increase the attractiveness and visibility of maritime careers, especially for young people and women.
- Involve key stakeholders such as education and training providers, social partners, technology clusters, but also job search services and companies.</td><td>P SP T E</td></tr>
</table>

• High transferability of digital skills provides an extended range of choices for graduates from the maritime programmes, not all of them will work in the maritime industry. Professional bodies and regional competence centres can make necessary changes to increase the attractiveness of maritime career for graduates by promoting Ocean literacy. • Encouraging the participation of women in maritime will provide significant reserve of the future maritime workforce. Women are underrepresented, both in the training concerning maritime industrial sectors and as the workforce. New professions related to and based on digitalisation, data and automation provide new possibilities to women.	**Encouraging the participation of women in the maritime technologies.** **P** **SP** **T** **E** **Description:** - **Encourage** the participation of women in the maritime technologies at all levels, by making visible the experience of those already involved in the sector and recognising their achievements. **Stimulate** women´s involvement in STEAM (Science, Technology, Engineering, Arts and Maths) education and training activities to promote their involvement in the maritime technologies.
 **Promote Skills Intelligence** **Rationale:** • Proper funding for organisations and companies to address priority skills demand is essential in building sustainable skills strategy for the maritime industry. Funding opportunities must be available for all stakeholders in skills management ecosystems. The following represents non exhaustive list of existing funding opportunities: Erasmus + / EMFF (Blue careers) for the definition of new programs and joint developments in VET; National and regional funding programs for the organisation of training targeting staff, unemployed and VET trainees; Private investment, already very relevant, would maximise its impact being complemented with the rest of key enablers. • Promoting results of Sectoral Skills projects is an important mechanism of sharing best practices and skills intelligence in the maritime sector. It should involve social partners, use social media, and open access repository for publishing the results of the projects and best practices that all will contribute to ensuring community awareness and continuity in European sectoral skills policy, management, transferability and individual career management. The outcome and results of the numerous European sectoral skills projects represent value for the whole European community. Open access repositories such as Open Research Europe (ORE, https://open-research-europe.ec.europa.eu)	**Boosting specific funding for sectoral skills development.** **P** **Description:** - **Promote funding opportunities** to support the investments of companies in up- and re-skilling activities for their employees, in order to maximise their impact. **Maintain existing mechanisms** to address the maritime technologies skills strategy, such as Erasmus+ / EMFF (Blue careers) for the definition of new programmes and joint developments in VET; National and regional funding programmes for training targeted staff, unemployed people and VET trainees (such as ESF+). - **Promote funding opportunities to effectively support the large scale partnerships under the EU Pacts for Skills**. **Continuing to promote the key results of Sectoral Skills projects: open access repository.** **P** **Description:** - **Continue to organise and facilitate experience-sharing,** best practices and training materials which address: • Digital and data management, automation and robotics. • Green skills: use of alternative fuels, energy storage and green retrofitting. • Transversal skills: communication & collaboration, leadership, critical thinking, innovation & problem-solving… - **Promote results** of the **Sectoral Skills projects.**

provided by the European Commission or Zenodo managed by OpenAIRE are commonly recognised and widely used by European Research and Education.

- Sectoral Jobs and Skills Observatories are an important instrument in providing sector wide job and skills intelligence. The job market is affected by multiple factors and observatories provide an integral picture of the demanded professions, competences and skills. Monitoring job market is important to get a better understanding of professional education and training in specific sectors.

Establishing a maritime technologies jobs and skills observatory. P S SP T E

Description:
- **Develop a market observatory** to analyse the training needs and offers in the maritime technologies, based on existing information such as platforms for job opportunities.

Using job standard descriptors. P S SP T E

Description:
- **Develop an effective competences and skills management framework** to support the main stages in the job market and career management: job vacancy design, applications and CV assessment and matching, and the mobility of workers across Europe.
- **Use available standards such as ESCO** and European Committee for Standardization (CEN) enhanced best practices.
- **Include shorter courses and innovative learning approaches** such as MOOCs in the recognition schemes; the micro-credential scheme can support this action.

Improve Training offer

Rationale:
- Education and training in both Shipbuilding (SB) and Offshore Renewable Energy (ORE) sectors can be improved by offering the number of accredited courses. Shipbuilding is experiencing a digital transformation with the implementation of new digital and data technologies. ORE is a new fast growing sector with the high level of digitalization and automation. There is limited availability of certified and/or accredited courses addressing new digital, data and automation/robotics competences and skills. The increasing number of certified or accredited courses will help establish common industry standards on competences and skills. Rising digital and data competences of the workforce will also facilitate and provide more possibilities for experience sharing between sectors, education organisations and facilitate workforce and students/learners mobility.

- The complexity of solutions and products produced by research and innovation projects funded by European, national and sectoral programmes require special skills and new

Increasing the number of accredited courses in Shipbuilding (SB) and Offshore Renewables (ORE). P T

Description:
- **Increase the number of VET/University courses** directly addressing:
  - SB technical profiles (i.e. electro-mechanical drafters, assemblers), preferably accredited by an appropriate awarding professional body.
  - ORE technical profiles, in particular those focusing on emerging ocean energy technologies (wave, tidal and offshore solar).

Retaining Skills capacity building in R&D project calls P

Description:
- Retain **skills management and capacity building** in the research project funding requirements.
- **Promote** the provisioning of **training materials** for new products and services.

organisational roles, especially connected to digital and data driven transformation. To ensure successful implementation of new technologies, training for new competences must be addressed at the stage of new products or services development. Including skills management and capacity building activities and tasks into the research project funding requirements is an important measure to facilitate new technologies adoption and avoid skills shortage in new technologies and products implementation. Additional measures should include the provisioning of training materials for new products and services.	
 **ORE** **Rationale:** • ORE is a new fast developing high technology sector with high demand for new skills that should include both theoretical and practical aspects. Creating test sites and using them for practical training will improve workforce skills and consequently reduce exploitation risk.	**Exploiting test sites for training in ORE.** **P** **SP** **T** **E** **Description:** - **Facilitate the use of test sites** for training purposes to simulate the ORE working environment, reducing costs and risks by simplifying regulations for this use. **Promote the combination** of work-based learning with virtual reality materials.
 **Digitalisation** **Rationale:** • Digital and data competences are rapidly becoming necessary elements in almost all maritime technology areas, from shipbuilding to vehicles operation and to navigation. Wide implementation of digital and data driven technologies courses will require both well-developed of instructional methodologies and teachers and instructors preparation/ (self) education. Priorities should be established to develop effective Digital and Data competence frameworks for maritime industry, create new and revise existing	**Developing Digital and Data competence frameworks for maritime industry.** **P** **S** **SP** **T** **Description:** - **Promote the development** of effective **Digital and Data competence frameworks for the maritime industry**, based on European instruments such as the E-competence Framework or DigComp. - **Boost the revision of existing curricula** and courses to ensure the inclusion of Digital and Data skills in the curricula for specialised courses, professional qualifications or workplace alignment courses. **Promoting ICT skilling programmes adapted for the maritime sector.** **P** **SP**

curricula and courses. It is recommended to include them into curricula as specialised courses or as part of professional qualifications or workplace alignment courses. • Promoting ICT skilling programs adapted for the maritime sector should include all stakeholders of the maritime job market and skills ecosystem. This activity should involve the cooperation of ICT experts and maritime sectoral experts facilitating knowledge and skills transfer. Awareness campaigns should be planned to reach the professional community, engineers, and managers.	**Description:** - **Promote knowledge and skills transferability** from the ICT (Information and Communication Technologies) domain to the maritime sector. - **Boost education, training and re-skilling** programmes which assemble ICT experts and maritime sectoral experts. - **Organise awareness campaigns** on the benefits from common ICT methods and tools for different maritime sectors.
 **Multipurpose Skills** **Rationale:** • Well defined framework for skills transferability and qualification recognition will attract more young people and career starters to maritime sectors with critical demand for new skills, with the possibility to move to other sectors at the next career stages. A special focus should be given to emerging subsectors, such as the ORE.	**Underpinning skills transferability & recognition between maritime sectors.** **P** **S** **SP** **E** **Description:** - **Underpin the creation of synergies** among maritime sectors by identifying common skills needs, promoting staff mobility, and providing crash courses. - **Facilitate the identification of career opportunities** and training paths by developing guidelines and promotional material. These actions will promote skills transferability in the maritime technologies, and provide a basis for the recognition of qualifications from other sectors. Special attention should be paid to emerging sectors, such as Offshore Renewables (ORE).
 **Mobility** **Rationale:** • Mobility and effectiveness of many common professions such as ecologists, safety and health workers can be improved significantly by creating conditions and facilitating their training and self-education to follow continuous technological development, business/ financial aspect. Providing advice and guidance from management and HR departments will facilitate this process. Apprenticeship and dual study programs are essential to increase workplace adaptation and necessary skills development among graduates and career starters. • **Hybrid learning approaches and experience exchanges in hybrid teams** can reach a wider audience by providing more flexibility and adapt to diverse learning styles. They can **prepare for hybrid work,** which can also **solve staffing problems** for occupations	**Increasing mobility and dual technical programmes.** **P** **T** **E** **Description:** - **Support apprenticeships and dual study programmes**, which combine VET education and internships within a company. - **Facilitate frameworks** to organise and incentivise them to increase their numbers. **Involve workers, students and teachers** to build capacity and boost the adoption of cutting-edge technologies. **Using blended learning options in mobility and event-planning.** **P** **SP** **T** **E** **Description:** - **Organise blended activities, in-presence and on-line**, to facilitate participation, promoting inclusiveness and possibilities for interaction. - **Avoid treating** virtual participants as secondary participants. - **Adapt activities to mobility restrictions** if requested (as occurred during the COVID19 pandemic). When organising online meetings, bear in mind that they are useful for transmitting

that can allow remoted work. The experience and best practices from the COVID19 pandemic online education and remote work will be very valuable. Effective tools have been developed both for online teaching and for remote work. Many education and training courses have been re-designed for multiple formats: face-to-face/on-campus, fully online, and blended. This should be effectively used in solving workforce mobility and transferability in the maritime sector.	information but the learning curve is slower and they might be limited in their ability to create and stimulate collaboration networks. - **Consider using integration tools** or combining fully virtual and face-to-face meetings, at different times.

STANDARDISATION BODIES (S)

Group	Recommendation	Stakeholder
 **Boost Cooperation** **Rationale:** • Recognition and reward to universities collaborating with industry will facilitate cooperation and responsiveness of university to critically demanded professions and competences.	**Recognising the efforts to increase Industry-education collaboration.** **Description:** - **Include within the official recognition schemes** the efforts dedicated to creating collaborations between academia, industry and policy makers.	P S SP T E
 **Promote Skills Intelligence** **Rationale:** • Sectoral Jobs and Skills Observatories are an important instrument in providing sector wide job and skills intelligence. The job market is affected by multiple factors and observatories provide an integral picture of the demanded professions, competences and skills. Monitoring job market is important to get a better understanding of professional education and training in specific sectors.	**Establishing a maritime technologies jobs and skills observatory.** **Description:** **Develop a market observatory**, to analyse the training needs and offers in the maritime technologies, based on existing information such as platforms for job opportunities. **Involving experts with multiple background in skills intelligence.** **Description:** - **Promote the involvement of maritime technology experts**, from industry, research and training providers, in the revision and updating of the occupational profiles addressing this sector.	P S SP T E S

<table>
<tr>
<td>• Using the standard framework, common vocabulary for competences, skills, occupations will increase the effectiveness of organisational skills management, improve skills transferability and career management. Companies' HR departments can adopt ESCO, e-CF and other relevant standards in working with job vacancies, candidates assessment and career management.</td>
<td>
<table>
<tr><td>Using job standard descriptors.</td><td>P S SP T E</td></tr>
<tr><td colspan="2">Description:
- Develop an effective competences and skills management framework to support the main stages in the job market and career management: job vacancy design, applications and CV assessment and skills matching, and the mobility of workers across Europe.
- Improve the connections among different VET standards – such as Entrecomp, Europass and ESCO – and facilitate their use with userfriendly applications and interfaces.
- Include shorter courses and innovative learning approaches such as MOOCs in the recognition schemes; the micro-credential scheme can support this action.</td></tr>
<tr><td>Improving the coordination in the recognition of professional certifications.</td><td>S</td></tr>
<tr><td colspan="2">Description:
- Improve the coordination processes for the recognition of professional certifications in the maritime technologies, minimising the differences across countries.
- A European professional body for the recognition of professional certifications could underpin this action.</td></tr>
<tr><td>Furthering the regular updating of qualification schemes.</td><td>S T E</td></tr>
<tr><td colspan="2">Description:
- Further regular updates of qualification schemes.
- Avoid delays in the updating of training curricula, especially for new emerging professions and skills, facilitating the process of content revision and adaptation.</td></tr>
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<tr>
<td> 
Improve Training offer

Rationale:
Industry trends on adopting digital technologies, focus on green and sustainable technologies requires new digital and green skills that need to be included in the occupational profiles and curricula. These skills (digital and green) are complex skills and</td>
<td>
<table>
<tr><td>Updating Occupational Profiles with the new green, digital & transversal competences.</td><td>S</td></tr>
<tr><td colspan="2">Description:
- Update the Occupational Profiles within recognised frameworks and standards (such as ESCO), to include new competences, knowledge and occupations which address green technologies, digitalisation, data management, smart industry, automation and robotics.
- Integrate transversal skills in the Occupational Profiles descriptions.</td></tr>
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</td>
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</table>

can be considered as a kind of technology oriented transversal skills that should be addressed across the whole curriculum both as specialized skills and as transversal skills to increase the required effect. Developing well defined approaches to adding green aspects in the whole curriculum and in individual courses will ensure educating the new generation of the green aware workforce and specialists.	
 **Digitalisation** **Rationale:** • Digital and data competences are rapidly becoming necessary elements in almost all maritime technology areas, from shipbuilding to vehicles operation and to navigation. Wide implementation of digital and data driven technologies courses will require both well-developed of instructional methodologies and teachers and instructors preparation/ (self) education. Priorities should be established to develop effective Digital and Data competence frameworks for maritime industry, create new and revise existing curricula and courses. It is recommended to include them into curricula as specialised courses or as part of professional qualifications or workplace alignment courses.	**Developing Digital and Data competence frameworks for the maritime industries.** **P** **S** **SP** **T** **Description:** - **Develop effective Digital and Data competence frameworks for the maritime industries**, based on European instruments such as the E-competence Framework or DigComp. - **Further the revision of existing curricula** and courses to ensure the inclusion of Digital and Data skills-in the curricula for specialised courses, professional qualifications or workplace alignment courses.
 **Multipurpose Skills** **Rationale:** • Well defined framework for skills transferability and qualification recognition will attract more young people and career starters to maritime sectors with critical demand for new skills, with the possibility to move to other sectors at the next career stages. A special focus should be given to emerging subsectors, such as the ORE.	**Underpinning skills transferability & recognition between maritime sectors.** **P** **S** **SP** **E** **Description:** - **Promote skills transferability** in the maritime technologies so as to provide a basis for the recognition of qualifications from other sectors. Special attention should be paid to emerging sectors, such as the ORE.

SOCIAL PARTNERS & PROFESSIONAL BODIES (SP)		
Group	**Recommendation**	**Stakeholder**
 **Boost Cooperation** **Rationale:** • Cooperation between education and industry will help focusing on long term objectives and continuous courses updates with the new technology developments. Setting up mechanisms capable of taking on the task of creating long-term collaborations is essential if the sustainability of these multi-stakeholder communities to be secured. Education institutions must be involved in the competence centres creation to facilitate tighter cooperation with industry. • Recognition and reward to universities collaborating with industry will facilitate cooperation and responsiveness of university to critically demanded professions and competences.	**Enhancing education-industry cooperation.** **Description:** - **Facilitate and promote cooperation** and **experience exchange** between the policy agencies, industry, social partners and VET institutions, creation of expert groups. - **Setting up mechanisms** capable of taking on the task of creating long-term collaborations, essential if the sustainability of these multi-stakeholder communities is to be secured.	P SP T E
	Recognising the efforts to increase Industry-education collaboration. **Description:** - **Develop protocols** (for individuals and also organizations) to recognise and reward the efforts dedicated to creating collaborations between academia and industry and policy makers. **Offer solutions** such as Open Badges as digital credentials* (connected to the Personal CV).	P S SP T E
 **Attract Talent** **Rationale:** • High transferability of digital skills provides an extended range of choices for graduates from the maritime programmes, not all of them will work in the maritime industry. Professional bodies and regional competence centres can make necessary changes to increase the attractiveness of maritime career for graduates by promoting Ocean literacy. • Encouraging the participation of women in maritime will provide significant reserve of the future maritime workforce. Women are underrepresented, both in the training concerning maritime industrial sectors and as the workforce. New professions related	**Increasing the attractiveness of maritime careers - Ocean Literacy.** **Description:** - **Promote opportunities in the maritime technologies** in Europe, developing Ocean Literacy actions to increase the attractiveness and visibility of maritime careers, especially for young people and women. - I**nvolve key stakeholders** as Universities, VET training Centres, Social partners, Technology Clusters, but also job search services and companies.	P SP T E
	Encouraging the participation of women in the maritime technologies. **Description:** - **Encourage the participation of women** in the maritime technologies at all levels, by making visible the experience of those that are already involved in the sector and recognising their achievements.	P SP T E

to and based on digitalisation, data and automation provide new possibilities to women. • Workforce aging and young workforce mobility create problems in knowledge transferability among senior and junior employees in traditional occupations/professions and new digital technologies based. Increased range of occupations in the maritime industry facilitated by new technologies creates problems for companies to keep capacity in traditional professions while extending capacity in new occupations related to digital technologies. Exchanging experience and find the best way of such knowledge exchange. • Just Transition: is a framework developed by the trade union movement to encompass a range of social interventions needed to secure workers' rights and livelihoods when economies are shifting to sustainable production, primarily combating climate change and protecting biodiversity. This is becoming an important aspect of the current investor practice in the investment decision-making process that increasingly adopts the ESG framework considering Environmental, Social and Governance factors alongside financial factors. It has been endorsed internationally by governments in different arenas, including the International Labour Organization (ILO), the United Nations Framework Convention on Climate Change (UNFCCC) in the Paris Agreement, and the Katowice Climate Conference (COP24) and the European Union.	- **Stimulate the involvement of women** in STEAM (Science, Technology, Engineering, Arts and Maths) education and training activities to promote their involvement in the maritime technologies. - **Endorse the implementation of gender-responsive policies**, ensuring equal employment opportunities and equal pay for work of equal value. **Improving knowledge-transfer among senior and junior employees.** **SP** **E** **Description:** - **Support actions to improve the knowledge-transfer** mechanisms within the companies in order to accelerate the learning curve of new professionals, who would then be able to get a good grasp of the **experience and lessons that older employees** have gained over the years. **Integrating the values of the Just Transition* to attract talent.** **SP** **E** **Description:** - **Integrate the values** of the Just Transition as a key element to attract talent to the maritime industry, maximising the benefits of climate action while minimising hardships for workers and their communities. - **Ensure that working conditions are good and attractive** for young people. Democratic consultation of social partners and other stakeholders is one of the pillars supporting a Just transition.
 **Promote Skills Intelligence** **Rationale:** • Sectoral Jobs and Skills Observatories are an important instrument in providing sector wide job and skills intelligence. The job market is affected by multiple factors and observatories provide an integral picture of the demanded professions, competences and skills. Monitoring job market is important to get a better understanding of professional education and training in specific sectors.	**Establishing a maritime technologies jobs and skills observatory.** **P** **S** **SP** **T** **E** **Description:** - **Recommend and facilitate in-company** proactive management of capacity- building processes. - **Retrieve and share** internal information on skills needs and offers. - **Promote the use** of complementary analyses issued by external sources such as BlueSkill projects, Pact for Skills partnerships, sectoral or regional competence centres and job market monitors. **Using job standard descriptors.** **P** **S** **SP** **T** **E** **Description:** - **Recommend that company HR departments use EU VET and capacity standard**s and frameworks in working with job vacancies, candidate assessment and career management.

	European instruments such as Europass, the EQF, ECTS, ECVET, the ESCO taxonomy or the E-competence Framework, EntreComp, among others, provide a common language to describe competences, skills, knowledge and occupations. - The USWE Project delivered a common taxonomy for shipbuilding occupations in the different EU languages in order to support the mutual understanding of sectoral actors across Europe (Brochure on Shipbuilding Sectoral Profiles, 2020). Using this taxonomy would be advisable.
 **Improve Training offer** **Rationale:** • Industry trends on adopting digital technologies, focus on green and sustainable technologies requires new digital and green skills that need to be included in the occupational profiles and curricula. These skills (digital and green) are complex skills and can be considered as a kind of technology oriented transversal skills that should be addressed across the whole curriculum both as specialized skills and as transversal skills to increase the required effect. Developing well defined approaches to adding green aspects in the whole curriculum and in individual courses will ensure educating the new generation of the green aware workforce and specialists.	**Delivering lifelong learning in engineering, digital and offshore operations skills.** SP T E **Description:** - **Promote workforce specialisations** by encouraging the increase of LLL courses which address the SB and ORE sectors: • SB technical profiles (i.e. electro-mechanical drafters, assemblers), preferably accredited by an appropriate awarding professional body. • ORE technical profiles, in particular those focusing on emerging ocean energy technologies (wave, tidal and offshore solar). - **Recommend that special efforts be made** in specialisations in **engineering skills** (electrical & mechanical), **digital skills** (control & instrumentation, data management) & **offshore-operations specific** skills. **Integrating green skills content in trainings.** SP T E **Description:** - **Support the use of technologies minimising environmental impact** in the maritime technologies: sustainable practices, reduction of polluting emissions, ship-recycling, construction materials and antifouling systems. - **Promote actions to integrate capacity-building** in those competences at all levels.
 **ORE** **Rationale:** • Special training should be developed in Energy storage to increase the efficiency of ORE generation facilities/sites.	**Developing specific training in Energy storage.** SP T E **Description:** - **Endorse the increase of technical knowledge in energy storage** by supporting actions to develop training and teaching materials.

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<td>
• Building/installation of ORE sites will require cooperation with the shipbuilding and fleet. To improve the efficiency of such cooperation, the Shipbuilding managers should be upskilled in ORE technologies.
• ORE is a new fast developing high technology sector with high demand for new skills that should include both theoretical and practical aspects. Creating test sites and using them for practical training will improve workforce skills and consequently reduce exploitation risk.
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Upskilling Shipbuilding (SB) managers in ORE technologies. SP E

Description:
- Upskill SB managers in ORE technologies in order to attract ORE projects to their business.
- Identify the necessary competences, develop a set of training materials and provide LLL (Lifelong learning).
Flexible and non-formal training approaches such as shadow mentoring and technical visits are recommended for this purpose.

Exploiting test sites for training in ORE. P SP T E

Description:
- Encourage the use of test sites for training purposes to simulate the ORE working environment, reducing costs and risks by simplifying regulations for this use.
- Promote the combination of work-based learning with virtual reality materials.
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Digitalisation

Rationale:
• Digital and data competences are rapidly becoming necessary elements in almost all maritime technology areas, from shipbuilding to vehicles operation and to navigation. Wide implementation of digital and data driven technologies courses will require both well-developed of instructional methodologies and teachers and instructors preparation/ (self) education. Priorities should be established to develop effective Digital and Data competence frameworks for maritime industry, create new and revise existing curricula and courses. It is recommended to include them into curricula as specialised courses or as part of professional qualifications or workplace alignment courses.
• Promoting ICT skilling programs adapted for the maritime sector should include all stakeholders of the maritime job market and skills ecosystem. This activity should involve the cooperation of ICT experts and maritime sectoral experts facilitating
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<td>
Developing Digital and Data competence frameworks for maritime industry. P S SP T

Description:
- Establish priorities in developing effective Digital and Data competence frameworks for the maritime industry, based on European instruments such as the E-competence Framework or DigComp.
- Recommend that company HR departments use EU VET and capacity standards and frameworks in working with job vacancies, candidate assessment and career management.
- Further the revision of existing curricula and courses to ensure the inclusion of Digital and Data skills-in the curricula for specialised courses, professional qualifications or workplace alignment courses.

Promoting ICT skilling programmes adapted for the maritime sector. P SP

Description:
- Promote knowledge and skills transferability from the ICT (Information and Communication Technologies) domain to the maritime sector.
- Boost education, training and re-skilling programmes assembling ICT experts and maritime sectoral experts.
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<td>knowledge and skills transfer. Awareness campaigns should be planned to reach the professional community, engineers, and managers.

• Targeted training in digitalization should be provided for all major actors in the maritime industry. Large companies are recognizing the importance of the digital and data training and tend to allocate dedicated efforts and funding for such training. SMEs are hardworking and committed industry actors. SMEs often don't have sufficient resources for mastering technologies that are outside of their main activities. Providing targeted training for SMEs is an important factor for increasing the adoption of new technologies.</td>
<td>- Organise awareness campaigns on the benefits from common ICT methods and tools for different maritime sectors.

Providing training in digitalisation for companies. SP E

Description:
- Provide targeted training opportunities for companies to boost the use of up-to date digitalisation technologies. Special efforts should be made to adapt the training offers to SMEs needs, taking into consideration content and training formats.
- Be prepared to consider on-line training provision, MOOCs and blended learning.</td>
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Multipurpose Skills

Rationale:
• Well defined framework for skills transferability and qualification recognition will attract more young people and career starters to maritime sectors with critical demand for new skills, with the possibility to move to other sectors at the next career stages. A special focus should be given to emerging subsectors, such as the ORE.</td>
<td>Underpinning skills transferability & recognition between maritime sectors. P S SP E

Description:
- Underpin the creation of synergies among maritime sectors by identifying common skills needs, promoting staff mobility, and providing crash courses.
- Facilitate the identification of career opportunities and training paths by developing guidelines and promotional material.
These actions will promote skills transferability in maritime technologies and provide a basis for the recognition of qualifications from other sectors. Special attention should be paid to emerging sectors, such as the ORE.</td>
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Active Learning

Rationale:
• Life-long learning should be a common approach and practice in the maritime industry experiencing, like other sectors, digital transformation that creates new organizational roles/occupations and causes continuous changes in existing occupations demanding new knowledge and skills. To facilitate life-long and active learning and easy learning/training path adaptation, education and training should be offered in modular/(micro)modular form. Active learning should be supported by advice and guidance from HR departments and instructional methodology experts.</td>
<td>Providing short trainings and supporting modularity in educational offers. SP T E

Description:
- Provide short trainings and support modularity in educational offers to boost life-long learning and upskilling processes.
- Tailor robust curricula for the specific training needs of the maritime technology sectors and the continuous updating of trainers, promoting knowledge progression along the career path of jobholders.

Promoting active involvement of learners. SP T E

Description:
- Promote a new education model based on the active involvement of learners at all EQF levels.</td>
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• Workplace oriented learning included in traditional curricula will increase workplace adaptation of graduates. The use of work based learning, project based activities and the involvement of the professional and practitioner community will promote meaningful learning (Summer placement is excellent way of enforcing this). Creating synergies among groups of experts in active learning, innovative pedagogy and maritime technology training providers will boost the development of new educational models for the maritime sector. • In current conditions of fast developing and changing technologies, the abilities of learners/students to adopt to changing work environment is becoming very important. Transversal skills (also called 21st Century Skills) include such skills as creativity, design thinking, complex problem solving, team work, and service orientation. Different approaches and models need to be investigated and tried how to integrate transversal skills elements into university and VET institutions.	- **Boost the use of work-based learning,** project-based activities and involve the student community in purposeful learning. - **Create synergies among groups of active learning experts**, innovative pedagogy and maritime technology training providers in order to feed this process. **Including transversal skills contents in trainings.** **SP** **T** **E** **Description:** - **Adapt existing methodologies** and create new training sets for teaching transversal skills. - Smooth their progress towards a flexible approach to adoption and **integration into curricula** by HE and VET institutions.
 **Mobility** **Rationale:** • **Hybrid learning approaches and experience exchanges in hybrid teams** can reach a wider audience by providing more flexibility and adapt to diverse learning styles. They can **prepare for hybrid work,** which can also **solve staffing problems** for occupations that can allow remoted work. The experience and best practices from the COVID19 pandemic online education and remote work will be very valuable. Effective tools have been developed both for online teaching and for remote work. Many education and training courses have been re-designed for multiple formats: face-to-face/on-campus, fully online, and blended. This should be effectively used in solving workforce mobility and transferability in the maritime sector.	**Using blended learning options in mobility and event-planning.** **P** **SP** **T** **E** **Description:** - **Organise blended activities**, in-presence and on-line, to facilitate participation, promoting inclusiveness and possibilities for interaction. - **Avoid treating virtual participants as secondary participants**. - **Adapt activities to mobility restrictions** if requested (as occurred during the COVID19 pandemic). When organising online meetings, bear in mind that they are useful for transmitting information but the learning curve is slower and they might be limited in their ability to create and stimulate collaboration networks and soft skills for interaction and leadership. Further measures might be needed to rectify the limitations. - **Consider using integration tools** or combining fully virtual and face-to-face meetings, at different times.

EDUCATION & TRAINING CENTRES (E&T)		
Group	**Recommendation**	**Stakeholder**
 **Boost Cooperation** **Rationale:** • Cooperation between education and industry will help focus on long term objectives and continuous courses updates with the new technology developments. Setting up mechanisms capable of taking on the task of creating long-term collaborations is essential if the sustainability of these multi-stakeholder communities to be secured. Education institutions must be involved in the competence centres creation to facilitate tighter cooperation with industry. • Recognition and reward to universities collaborating with industry will facilitate cooperation and responsiveness of university to critically demanded professions and competences.	**Enhancing education-industry cooperation.** **Description:** - **Promote cooperation of industry and social partners** for maritime skills monitoring, syllabus design and teaching activities. - **Setting up mechanisms** capable of taking on the task of creating long-term collaborations, essential if the sustainability of these multi-stakeholder communities is to be secured. **Recognising the efforts to increase Industry-education collaboration.** **Description:** - **Develop protocols** (for individuals and also organizations) to recognise and reward the efforts dedicated to creating collaborations between academia, industry and policy makers. **Offer solutions** such as Open Badges as digital credentials* (connected to the Personal CV).	P SP T E P S SP T E
 **Attract Talent** **Rationale:** • High transferability of digital skills provides an extended range of choices for graduates from the maritime programmes, not all of them will work in the maritime industry. Professional bodies and regional competence centres can make necessary changes to increase the attractiveness of maritime career for graduates by promoting Ocean literacy. • Encouraging the participation of women in maritime will provide significant reserve for the future maritime workforce. Women are underrepresented, both in training	**Increasing the attractiveness of maritime careers - Ocean Literacy.** **Description:** - **Promote opportunities in the maritime technologies** in Europe, developing Ocean Literacy actions to increase the attractiveness and visibility of maritime careers, especially for young people and women. - **Involve key stakeholders** as Universities, VET training Centres, Social partners, Technology Clusters, but also job search services and companies. **Encouraging the participation of women in the maritime technologies.** **Description:** - **Encourage the participation of women** in maritime technologies at all levels, by making visible the experience of those that are already involved in the sector and recognising their achievements.	P SP T E P SP T E

concerning maritime industrial sectors and as the workforce. New professions related to and based on digitalisation, data and automation provide new possibilities to women.

- Temporary employees provide a valuable resource for existing/short-term workforce shortage and create a resource for the future workforce for the maritime industry. Short training and specialisation of temporary employees will increase benefits for organisations and increase future employability of temporary employed.

- **Stimulate the involvement of women** in STEAM (Science, Technology, Engineering, Arts and Maths) education and training activities to promote their involvement in maritime technologies.

Contributing to the specialisation of temporary employees. T E

Description:

- **Develop training materials and tools** (such as short and self-tuition courses, mobilities, and guidelines) to promote the specialisation of temporary employees.
- **Explore better options to contribute to increasing the levels of experience** and specialisation of the workforce in contexts of continuous adjustments of the staff, as short-term industrial contracts that lead to temporary employment.

These investments will contribute to the availability of a prepared workforce for periods of higher demand.

Promote Skills Intelligence

Rationale:

- Sectoral Jobs and Skills Observatories are an important instrument in providing sector wide job and skills intelligence. The job market is affected by multiple factors and observatories provide an integral picture of professions, competences and skills in demand. Monitoring job market is important to get a better understanding of professional education and training in specific sectors.
- Using the standard framework, common vocabulary for competences, skills, occupations will increase the effectiveness of organisational skills management, improve skills transferability and career management. Companies' HR departments can adopt ESCO, e-CF and other relevant standards in working with job vacancies, candidates assessment and career management.

Establishing a maritime technologies jobs and skills observatory P S SP T E

Description:

- **Contribute to the skills intelligence processes** by retrieving and sharing information on training offers.
- **Promote the use of analyses of skills needs** to better align new and existing education and training offers.

Using job standard descriptors. P S SP T E

Description:

- **Use EU VET and capacity standards and frameworks** in the training provision, raising awareness among educators and students. European instruments such as Europass, the EQF, ECTS, ECVET, the ESCO taxonomy or the E-competence Framework, EntreComp, among others, provide a common language to describe competences, skills, knowledge and occupations.
- The USWE Project delivered a common taxonomy for shipbuilding occupations in the different EU languages in order to support the mutual understanding of sectoral actors across Europe (Brochure on Shipbuilding Sectoral Profiles, 2020). Using this taxonomy would be advisable.

	Furthering the regular updating of qualification schemes. S T E **Description:** - **Perform regular revision of curricula and courses**, based on information from Job Intelligence monitor, especially for new emerging professions and skills.
 **Improve Training offer** **Rationale:** • Education and training in both Shipbuilding (SB) and Offshore Renewable Energy (ORE) sectors can be improved by offering a number of accredited courses. Shipbuilding is experiencing a digital transformation with the implementation of new digital and data technologies. ORE is a new fast-growing sector with a high level of digitalization and automation. There is limited availability of certified and/or accredited courses addressing new digital, data and automation/robotics competencies and skills. The increasing number of certified or accredited courses will help establish common industry standards on competences and skills. Rising digital and data competences of the workforce will also facilitate and provide more possibilities for experience sharing between sectors, education organisations and facilitate workforce and students/learners mobility. • Industry trends on adopting digital technologies, focus on green and sustainable technologies requires new digital and green skills that need to be included in the occupational profiles and curricula. These skills (digital and green) are complex skills and can be considered as a kind of technology-oriented transversal skills that should be addressed across the whole curriculum both as specialized skills and as transversal skills to increase the required effect. Developing well-defined approaches to adding green aspects in the whole curriculum and in individual courses will ensure educating the new generation of the green aware workforce and specialists.	**Increasing accredited courses in the Shipbuilding and ORE sectors.** P T **Description:** - **Increase the number of VET/University courses** directly addressing: • SB technical profiles (i.e. electro-mechanical drafters, assemblers), preferably accredited by an appropriate awarding professional body. • ORE technical profiles, in particular those focusing on emerging ocean energy technologies (wave, tidal and offshore solar). **Delivering lifelong learning on engineering, digital and offshore operations skills.** SP T E **Description:** - **Deliver lifelong learning offers** to increase specialisations in **engineering skills** (electrical & mechanical), **digital skills** (control & instrumentation, data management) & **offshore-operations specific** skills. **Integrating green skills contents in trainings.** SP T E **Description:** - **Develop sets of competences for training**, re- and up-skilling the workforce in the use of technologies minimising environmental impact in the maritime technologies: sustainable practices, reduction of polluting emissions, circular economy, construction materials and antifouling systems. - Include training for those competences in the curricula.

ORE

Rationale:

- Special training should be developed in Energy storage to increase the efficiency of ORE generation facilities/sites.
- ORE is a new fast developing high technology sector with high demand for new skills that should include both theoretical and practical aspects. Creating test sites and using them for practical training will improve workforce skills and consequently reduce exploitation risk.

Developing specific training in Energy storage. SP T E

Description:

- **Endorse the increase of technical knowledge in energy storage** by developing training and teaching materials.
- **Identify the necessary competencies,** develop a set of training materials and deliver LLL (Lifelong learning) actions for up- and re-skilling.

Exploiting test sites for training in ORE. P SP T E

Description:

- **Explore the use of test sites for training purposes** to simulate the ORE working environment reducing costs and risks.
- **Promote the combination of work-based learning** with virtual reality materials.

Digitalisation

Rationale:

- Digital and data competences are rapidly becoming necessary elements in almost all maritime technology areas, from shipbuilding to vessel operation and to navigation. Wide implementation of digital and data driven technologies courses will require both well-developed of instructional methodologies and teachers and instructors preparation/ (self) education. Priorities should be established to develop effective Digital and Data competence frameworks for the maritime industry, create new and revise existing curricula and courses. It is recommended to include them into curricula as specialised courses or as part of professional qualifications or workplace alignment courses.

Developing Digital and Data competence frameworks for maritime industry. P SP T E

Description:

- **Establish priorities in developing effective Digital and Data competence** frameworks for the maritime industry.
- **Consider European instruments** such as the E-competence Framework or DigComp, among others, to provide a common language for describing competences, skills, knowledge and occupations.
- **Revise existing curricula and courses** to ensure the inclusion of Digital and Data skills in the curricula for specialised courses, professional qualifications or workplace alignment courses.

Active Learning

Rationale:

- Life-long learning should be a common approach and practice in the maritime industry experiencing, like other sectors, digital transformation that creates new organizational roles/occupations and causes continuous changes in existing occupations demanding new knowledge and skills. To facilitate life-long and active learning and easy learning/training path adaptation, education and training should be offered in modular/(micro)modular form. Active learning should be supported by advice and guidance from HR departments and instructional methodology experts.
- Workplace oriented learning included in traditional curricula will increase workplace adaptation of graduates. The use of work based learning, project based activities and the involvement of the professional and practitioner community will promote meaningful learning. Creating synergies among groups of experts in active learning, innovative pedagogy and maritime technology training providers will boost the development of new educational models for the maritime sector.
- In current conditions of fast developing and changing technologies, the abilities of learners/students to adopt to changing work environment is becoming very important. Transversal skills (also called 21st Century Skills) include such skills as creativity, design thinking, complex problem solving, team work, and service orientation. Different approaches and models need to be investigated and tried how to integrate transversal skills elements into university and VET institutions.

Providing short trainings and supporting modularity in educational offer. SP T E

Description:

- **Provide short trainings** and support modularity in educational offer to boost life-long learning and upskilling processes.
- **Tailor robust curricula** for the specific training needs of the maritime technologies sectors and the continuous update of trainers, promoting the knowledge progression along the career path of jobholders.

Promoting active involvement of learners SP T E

Description:

- **Promote a new education model** based on the active involvement of learners at all EQF levels.
- **Boost the use of work-based learning,** project-based activities and involve the industry whole industry value chain in leading purposeful learning.
- **Create synergies among groups of experts in active learning**, innovative pedagogy and maritime technology training providers to feed this process.

Including transversal skills contents in trainings SP T E

Description:

- **Adapt existing methodologie**s and create new training sets for teaching transversal skills.
- Smooth out their progress towards a flexible approach for adoption and **integration into curricula** by HE and VET institutions.

Mobility

Rationale:

- **Hybrid learning approaches and experience exchanges in hybrid teams** can reach a wider audience by providing more flexibility and adapt to diverse learning styles. They can **prepare for hybrid work,** which can also **solve staffing problems** for occupations

Using blended learning options in mobility and event-planning. P SP T E

Description:

- **Organise blended activities**, in-presence and on-line, to facilitate participation, promoting inclusiveness and possibilities for interaction.
- **Avoid treating virtual participants** as secondary participants.
- **Adapt activities to mobility restrictions** if requested (as occurred during the COVID19 pandemic). When organising online meetings, bear in mind that they are useful for transmitting information but the learning curve is slower and they might be limited in their ability to create and stimulate collaboration networks.

that can allow remoted work. The experience and best practices from the COVID19 pandemic online education and remote work will be very valuable. Effective tools have been developed both for online teaching and for remote work. Many education and training courses have been re-designed for multiple formats: face-to-face/on-campus, fully online, and blended. This should be effectively used in solving workforce mobility and transferability in the maritime sector. • Mobility and effectiveness of many common professions such as ecologists, safety and health workers can be improved significantly by creating conditions and facilitating their training and self-education to follow continuous technological development, business/ financial aspect. Providing advice and guidance from management and HR departments will facilitate this process. Apprenticeship and dual study programs are essential to increase workplace adaptation and necessary skills development among graduates and career starters.	- **Consider using integration tools** or combining fully virtual and face-to-face meetings, at different times.
	Increasing mobilities and dual technical programmes. **P** **T** **E**
	Description: - **Increase the number of apprenticeships** and dual study programmes, which combine VET education and internships within a company. - **Involve workers, students and teachers** to build capacity and boost the adoption of cutting-edge technologies.

EMPLOYERS (E)		
Group	**Recommendation**	**Stakeholder**
 **Boost Cooperation** **Rationale:** • Cooperation between education and industry will help focus on long term objectives and continuous courses updates with the new technology developments. Setting up mechanisms capable of taking on the task of creating long-term collaborations is essential if the sustainability of these multi-stakeholder communities to be secured. Industry should actively support schools and universities with engaging in the strategy and curricula development and providing opportunities for practice elements of the work. • Industry should be proactive and engaged in booster cooperation. Recognition and reward to staff collaborating with education institutions will facilitate cooperation and responsiveness of companies to critically demanded professions and competences.	**Enhancing education-industry cooperation.**	P SP T E
	Description: - **Encourage social dialogue** and collaboration with educational centres for maritime skills´ monitoring, syllabus design and teaching activities. - **Set up mechanisms** capable of taking on the task of creating the **long-term collaborations** is essential if the sustainability of these multi-stakeholder communities is to be secured.	
	Recognising the efforts to increase Industry-education collaboration	P S SP T E
	Description: - **Develop protocols** (for individuals and also organizations) to recognise and reward the efforts dedicated to creating collaborations between academia and industry and policy makers. - **Offer solutions** such as Open Badges as digital credentials* (connected to the Personal CV).	
 **Attract Talent** **Rationale:** • High transferability of digital skills provides an extended range of choices for graduates from the maritime programmes, not all of them will work in the maritime industry. Professional bodies and regional competence centres can make necessary changes to increase the attractiveness of maritime career for graduates by promoting Ocean literacy. • Encouraging the participation of women in maritime will provide significant reserve of the future maritime workforce. Women are underrepresented, both in the training concerning maritime industrial sectors and as the workforce. New professions related	**Increasing the attractiveness of maritime careers - Ocean Literacy.**	P SP T E
	Description: - **Promote opportunities in the maritime technologies** in Europe, developing Ocean Literacy actions to increase the attractiveness and visibility of maritime careers, especially for young people and women. - **Involve key stakeholders** such as Universities, VET training Centres, Social partners, Technology Clusters, but also job search services and companies.	
	Encouraging the participation of women in the maritime technologies.	P SP T E
	Description: - **Encourage the participation of women** in the maritime technologies at all levels, by implementing gender-responsive policies.	

to and based on digitalisation, data and automation provide new possibilities to women. • Workforce ageing and young workforce mobility create problems in knowledge transferability among senior and junior employees in traditional occupations/professions and new digital technologies based. The increased range of occupations in the maritime industry facilitated by new technologies creates problems for companies to keep capacity in traditional professions while extending capacity in new occupations related to digital technologies. Exchanging experience and finding the best way of such knowledge exchange. • Just Transition: is a framework developed by the trade union movement to encompass a range of social interventions needed to secure workers' rights and livelihoods when economies are shifting to sustainable production, primarily combating climate change and protecting biodiversity. This is becoming an important aspect of the current investor practice in the investment decision-making process that increasingly adopts the ESG framework considering Environmental, Social and Governance factors alongside financial factors. It has been endorsed internationally by governments in different arenas, including the International Labour Organization (ILO), the United Nations Framework Convention on Climate Change (UNFCCC) in the Paris Agreement, and the Katowice Climate Conference (COP24) and the European Union. • Temporary employees provide a valuable resource for existing/short-term workforce shortage and create a resource for the future workforce for the maritime industry. Short training and specialisation of temporary employees will increase benefits for organisations and increase future employability of temporary employed.	- **Ensure equal employment opportunities and equal pay** for work of equal value. **Improving knowledge-transfer among senior and junior employees.** **SP** **E** **Description:** - **Improve the knowledge-transfer mechanisms within companies** to accelerate the learning curve of new professionals, who would then be able to get a good grasp of the **experience and lessons that older employees** have gained over the years. **Integrating the values of the Just Transition* to attract talent.** **SP** **E** **Description:** - **Integrate the values of the Just Transition as a key element** to attract talent to the maritime industry, maximising the benefits of climate action while minimising hardships for workers and their communities. - **Ensure that working conditions are good and attractive** for young people. Democratic consultation of social partners and other stakeholders is one of the pillars supporting a just transition. **Contributing to the specialisation of temporary employees.** **T** **E** **Description:** - **Help temporary employees to acquire specializations**, by facilitating training opportunities, giving access to training materials and information on those specialisations that will contribute to their continuous learning. - **Explore the best options** for increasing the levels of experience and specialisations of the workforce in the contexts of continuous adjustments of the staff, as short-term industrial contracts that lead to temporary employment. These investments will contribute to the availability of a workforce prepared for periods of higher demand.

Promote Skills Intelligence

Rationale:

- Sectoral Jobs and Skills Observatories are an important instrument in providing sector-wide job and skills intelligence. The job market is affected by multiple factors and observatories provide an integral picture of the demanded professions, competences and skills. Monitoring job market is important to get a better understanding of professional education and training in specific sectors.
- Using the standard framework, common vocabulary for competences, skills & occupations will increase the effectiveness of organisational skills management, improve skills transferability and career management. Companies' HR departments can adopt ESCO, e-CF and other relevant standards in working with job vacancies, candidates' assessment and career management.

Establishing a maritime technologies jobs and skills observatory. P S SP T E

Description:

- **Implement in-company proactive management** of capacity-building processes.
- **Gather internal information on skills needs and offers** and complement this with external sources such as reports issued by BlueSkill projects, Pact for Skills, sectoral or regional competence centres and job market monitors.

Using job standard descriptors. P S SP T E

Description:

- **Use EU VET and capacity standards and frameworks in recruiting processes**, candidate assessment and career management. European instruments such as Europass, the EQF, ECTS, ECVET, the ESCO taxonomy or the E-competence Framework, EntreComp, among others, provide a common language to describe competences, skills, knowledge and occupations.
- The USWE Project delivered a common taxonomy for shipbuilding occupations in the different EU languages in order to support the mutual understanding of sectoral actors across Europe (Brochure on Shipbuilding Sectoral Profiles, 2020). Using this taxonomy would be advisable.

Furthering the regular updating of qualification schemes. S T E

Description:

- Revise skills needs and existing trainings on a regular basis, especially for new emerging professions and skills.

Improve Training offer

Rationale:

- Industry trends on adopting digital technologies, focus on green and sustainable technologies requires new digital and green skills that need to be included in the occupational profiles and curricula. These skills (digital and green) are complex skills and can be considered as a kind of technology-oriented transversal skills that should be addressed across the whole curriculum both as specialized skills and as transversal skills to increase the required effect. Developing well-defined approaches to adding

Delivering lifelong learning on engineering, digital and offshore operations skills. SP T E

Description:

- Promote workforce specialisations by increasing the number of LLL courses which directly address:
  - SB technical profiles (i.e. electro-mechanical drafters, assemblers), preferably accredited by an appropriate awarding professional body.
  - ORE technical profiles, in particular those focusing on emerging ocean energy technologies (wave, tidal and offshore solar).
- **Special efforts should be made in specialisations in engineering skills** (electrical & mechanical), **digital skills** (control & instrumentation, data management) & **offshore-operations specific** skills.

green aspects in the whole curriculum and in individual courses will ensure educating the new generation of the green aware workforce and specialists.	**Integrating green skills contents in trainings.** **SP** **T** **E** **Description:** - **Support the use of technologies minimising environmental impact** in the maritime technologies: sustainable practices, reduction of polluting emissions, ship-recycling, construction materials and antifouling systems… - **Provide training for re- and up- skilling the workforce** in those competences and integrate them in the preparatory training for new staff.
 **ORE** **Rationale:** • ORE is a new fast developing high technology sector with high demand for new skills that should include both theoretical and practical aspects. Creating test sites and using them for practical training will improve workforce skills and consequently reduce exploitation risk. • Special training should be developed in Energy storage to increase the efficiency of ORE generation facilities/sites.	**Exploiting test sites for training in ORE.** **P** **SP** **T** **E** **Description:** - **Explore the use of test sites for training purposes** to simulate the ORE working environment reducing costs and risks. - **Promote the combination of work-based learning** with virtual reality materials. **Developing specific training in Energy storage** **SP** **T** **E** **Description:** - **Endorse the increase of technical knowledge in energy storage** by developing training and teaching materials. - **Identify the necessary competences,** develop a set of training materials and deliver LLL (Lifelong learning) actions for up- and re-skilling. **Upskilling Shipbuilding (SB) managers in ORE technologies.** **SP** **E** **Description:** - **Upskill SB managers in ORE technologies** in order to attract ORE projects to their business. - **Identify the necessary competences**, develop a set of training materials and provide LLL (Lifelong learning). Flexible and non-formal training approaches such as shadow mentoring and technical visits are recommended for this purpose.

Digitalisation

Rationale:

- Targeted training in digitalization should be provided for all major actors in the maritime industry. Large companies are recognizing the importance of the digital and data training and tend to allocate dedicated efforts and funding for such training. SMEs are hardworking and committed industry actors. SMEs often don't have sufficient resources for mastering technologies that are outside of their main activities. Providing targeted training for SMEs is an important factor for increasing the adoption of new technologies.

Providing training in digitalisation for companies, and allocating funding opportunities for companies to be able to adapt to digitalisation and provide digital skills (suggestion from Sea Europe)**.**	**SP**	**E**

Description:

- **Provide targeted training opportunities for companies** to boost the use of up-to date digitalisation technologies.
- **Special efforts should be made to adapt training offers to SMEs needs,** taking into consideration content and training formats.
- **Be prepared to consider on-line training provision**, MOOCs and blended learning.

Multipurpose Skills

Rationale:

- Provide opportunities for skills diversification from parallel sectors e.g. fisheries, aquaculture, and marine operations. Particular skills that can benefit from cross-sector cooperation are ROVs, health and safety, marine operations.
  Powered by modern digital technologies, automation and Artificial Intelligence, parallel sectors use similar machines, operation methods and algorithms. Defining similarities and specifics between different sectors will help workforce adaptability, diversification and mobility, for the benefit of the whole maritime industry.
- Well defined framework for skills transferability and qualification recognition will attract more young people and career starters to maritime sectors with critical demand for new skills, with the possibility to move to other sectors at the next career stages. A special focus should be given to emerging subsectors, such as the ORE.

Developing multi-disciplinary skills outside specialisations: flexible opportunities for training.	**E**

Description:

- **Motivate and provide opportunities** for developing multi-disciplinary skills outside specialisations. e.g., ecologists should also have skills in technological development, business/ financial aspects of ORE.
- **Special efforts should be made to allocate sufficient "training-time"** and flexibility for workers to be able to access and benefit from training offers.

E-learning, which allows learning at your own pace, might be a path to achieve this goal.

Underpinning skills transferability & recognition between maritime sectors and between EU countries (suggestion from Sea Europe)**.**	**P**	**S**	**SP**	**E**

Description:

- **Provide opportunities for skills diversification from parallel sectors** e.g. fisheries, aquaculture, and marine operations, particularly skills in ROVs, health and safety.

Active Learning

Rationale:

- Life-long learning should be a common approach and practice in the maritime industry experiencing, like other sectors, digital transformation that creates new organizational roles/occupations and causes continuous changes in existing occupations demanding new knowledge and skills. To facilitate life-long and active learning and easy learning/training path adaptation, education and training should be offered in modular/(micro)modular form. Active learning should be supported by advice and guidance from HR departments and instructional methodology experts.
- Workplace oriented learning included in traditional curricula will increase workplace adaptation of graduates. The use of work-based learning, project-based activities and the involvement of the professional and practitioner community will promote meaningful learning. Creating synergies among groups of experts in active learning, innovative pedagogy and maritime technology training providers will boost the development of new educational models for the maritime sector.
- In current conditions of fast-developing and changing technologies, the abilities of learners/students to adapt to changing work environment is becoming very important. Transversal skills (also called 21st Century Skills) include such skills as creativity, design thinking, complex problem solving, team work, and service orientation. Different approaches and models need to be investigated and tried how to integrate transversal skills elements into university and VET institutions.

Providing short trainings and supporting modularity in educational offers.	**SP**	**T**	**E**

Description:

- **Provide short trainings and support modularity** in educational offers to boost life-long learning and upskilling processes.
- **Tailor robust curricula for specific training needs** of the maritime technologies sectors and the continuous update of trainers, promoting the knowledge progression along the career path of jobholders.

Promoting active involvement of learners.	**SP**	**T**	**E**

Description:

- **Promote a new education model** based on the active involvement of learners at all EQF levels.
- **Boost the use of work-based learning,** project-based activities and involve the whole industry value chain in leading purposeful learning.
- **Create synergies among groups of experts in active learning,** innovative pedagogy and maritime technology training providers to feed this process.

Including transversal skills content in trainings.	**SP**	**T**	**E**

Description:

- **Adapt existing methodologies** and create new training sets for teaching transversal skills.
- **Smooth out their progress towards a flexible approach** to adoption and integration into curricula by HE and VET institutions.

Mobility

Rationale:

- Mobility and effectiveness of many common professions such as ecologists, safety and health workers can be improved significantly by creating conditions and facilitating their training and self-education to follow continuous technological development,

Increasing mobility and dual technical programmes.	**P**	**T**	**E**

Description:

- **Increase the number of apprenticeships and dual study programmes**, which combine VET education and internships within a company.
- **Involve workers, students and teachers** to build capacity and boost the adoption of cutting-edge technologies.

business/ financial aspect. Providing advice and guidance from management and HR departments will facilitate this process. Apprenticeship and dual study programs are essential to increase workplace adaptation and necessary skills development among graduates and career starters. • **Hybrid learning approaches and experience exchanges in hybrid teams** can reach a wider audience by providing more flexibility and adapt to diverse learning styles. They can **prepare for hybrid work,** which can also **solve staffing problems** for occupations that can allow remoted work. The experience and best practices from the COVID19 pandemic online education and remote work will be very valuable. Effective tools have been developed both for online teaching and for remote work. Many education and training courses have been re-designed for multiple formats: face-to-face/on-campus, fully online, and blended. This should be effectively used in solving workforce mobility and transferability in the maritime sector.	**Using blended learning options in mobility and event-planning.**	**P**	**SP**	**T**	**E**
	Description: - **Organise blended activities**, in-presence and on-line, to facilitate participation, promoting inclusiveness and possibilities for interaction. - **Avoid treating virtual participants** as secondary participants. - **Adapt activities to mobility restrictions** if requested (as occurred during the COVID19 pandemic). When organising online meetings, bear in mind that they are useful for transmitting information but the learning curve is slower and they might be limited in their ability to create and stimulate collaboration networks. - **Consider using integration tools** or combining fully virtual and face-to-face meetings, at different times.				

**** Open Badges is the world's leading*** format ***for digital badges.*** *Open Badges is not a specific product or platform, but a type of digital badge that is verifiable, portable, and packed with information about skills and achievements. Open Badges can be issued, earned, and managed by using a certified Open Badges platform. Ref. https://openbadges.org/*

ANNEX 2 – List of occupational profiles identified by the MATES project

Taking the European Skills and Competences Occupations (ESCO v1.0) classification as a reference basis, all occupational profiles involved in each value chain of Shipbuilding and Offshore Renewable Energy sectors have been identified in the MATES Baseline Report on Current Skills Gaps (Sdoukopoulos et al., 2020). Considering their relative impact on the value chain, a distinction was made between primary and secondary occupations as well as supporting ones. (¡Error! No se encuentra el origen de la referencia. 2, 3 and 4).

Table 1: Primary occupational profiles and associated essential skills and competences in the shipbuilding sector, following ESCO v1.0 classification.

	Occupation	ISCO code	Essential skills and competences
		ENGINEERS	
1.	Naval architect	ISCO 2144 Mechanical engineers	Assess financial viability, ensure vessel compliance with regulations, execute analytical mathematical calculations, execute feasibility study, use maritime English
2.	Marine engineer	ISCO 2144 Mechanical engineers	Adjust engineering designs, approve engineering design, ensure vessel compliance with regulations, execute analytical mathematical calculations, perform scientific research, use maritime English, use technical drawing software
3.	Electromechanical engineer	ISCO 2151 Electrical engineers	Abide by regulations on banned materials, adjust engineering designs, analyse test data, approve engineering design, conduct literature research, design electromechanical systems, design prototypes, gather technical information, model electromechanical systems, monitor manufacturing quality standards, perform data analysis, perform scientific research, prepare production prototypes, record test data, report analysis results, test electromechanical systems, use technical drawing software
		ENGINEERING TECHNICIANS	
4.	Marine engineering technician	ISCO 3115 Mechanical engineering technician	Adjust engineering designs, ensure vessel compliance with regulations, execute analytical mathematical calculations, liaise with engineers, read engineering drawings, troubleshoot, use a computer
5.	Electromechanical engineering technician	ISCO 3113 Electrical engineering technician	Adjust engineering designs, align components, apply soldering techniques, assemble electromechanical systems, assist scientific research, fasten components, inspect quality of products, liaise with engineers, operate soldering equipment, perform test run, prepare pieces for joining, prepare production prototypes, read assembly drawings, read engineering drawings, read standard blueprints, record test data, test electromechanical systems, wear appropriate protective gear

	Occupation	ISCO code	Essential skills and competences
6.	Electronics engineering technician	ISCO 3114 Electronics engineering technicians	Adjust engineering designs, align components, apply soldering techniques, assemble electronic units, assist scientific research, conduct performance tests, configure electronic equipment, ensure finished product meet requirements, fasten components, inspect quality of products, interpret electronic design specifications, liaise with engineers, meet deadlines, prepare production prototypes, read assembly drawings, read engineering drawings, record test data, solder electronics, test electronic units, use testing equipment
DRAUGHTSPERSONS			
7.	Marine engineering drafter	ISCO 3118 Draughtspersons	Create technical plans, execute analytical mathematical calculations, liaise with engineers, read engineering drawings, use CADD software, use computer-aided engineering systems, use technical drawing software
8.	Electromechanical drafter	ISCO 3118 Draughtspersons	Create technical plans, customise drafts, design electromechanical systems, design prototypes, interpret electrical diagrams, liaise with engineers, model electromechanical systems, use CAD software use technical drawing software
METALWORKERS			
9.	Welding inspector	ISCO 3115 Mechanical engineering technicians	Adhere to organisational guidelines, analyse test data, ensure finished product meet requirements, ensure fulfilment of legal requirements, evaluate employees work, follow company standards, identify hazards in the workplace, inspect quality of products, liaise with quality assurance, operate welding equipment, perform sample testing, perform welding inspection, prepare samples for testing, recognise signs of corrosion, record production data for quality control, record survey measurements, record test data, report defective manufacturing materials, revise quality control systems documentation, set quality assurance objectives, spot metal imperfections, use a computer, write records for repairs, write work-related reports
10.	Welder	ISCO 7212 Welders and flamecutters	Align components, apply arc welding techniques, apply precision metalworking techniques, ensure correct metal temperature, ensure equipment availability, handle fuels, interpret 2D plans, interpret 3D plans, join metals, monitor gauge, operate oxy-fuel welding torch, operate welding equipment, perform metal active gas welding, perform metal inert gas welding, perform test run, perform tungsten inert gas welding, recognise signs of corrosion, remove inadequate workpieces, remove processed workpiece, select filler metal, smooth burred surfaces, spot metal imperfections, troubleshoot, wear appropriate protective gear
11.	Shipwright	ISCO 7214 Structural-metal prepares and erectors	Adjust engineering designs, align components, apply health and safety standards, ensure vessel compliance with regulations, fasten components, liaise with engineers, prepare pieces for joining,

	Occupation	ISCO code	Essential skills and competences
			read engineering drawings, read standard blueprints, use power tools, wear appropriate protective gear
12.	Boilermaker	ISCO 7213 Sheet-metal workers	Apply arc welding techniques, apply precision metalworking techniques, ensure correct metal temperature, ensure equipment availability, handle gas cylinders, operate oxy-fuel cutting torch, operate precision measuring equipment, operate soldering equipment, operate welding equipment, perform test run, read standard blueprints, record production data for quality control, select filler metal, smooth burred surfaces, troubleshoot, wear appropriate protective gear
13.	Pipe welder (pipefitter)	ISCO 7212 Welders and flame cutters	Apply health and safety standards, assemble manufactured pipeline parts, carry out measurements of parts, cooperate with colleagues, detect flaws in pipeline infrastructure, ensure regulatory compliance in pipeline infrastructures, follow up pipeline integrity management priorities, handle chemicals, operate soldering equipment, operate welding equipment, use measurement instruments, use metal bending techniques, use rigging equipment, use welding equipment, use wrenches, work with blacksmithing hand tools
14.	Sheet metal worker	ISCO 7213 Sheet-metal workers	Align components, apply arc welding techniques, apply spot welding techniques, clip sheet metal objects together, follow health and safety procedures in construction, follow safety procedures when working at heights, inspect construction supplies, interpret 2D plans, interpret 3D plans, operate handheld riveting equipment, recognise signs of corrosion tend metal sawing machine, use metalworking tools, use safety equipment in construction, use sheet metal shears, work ergonomically
ELECTRICIANS & ELECTRONICS TECHNICIANS			
15.	Marine electrician	ISCO 7421 Electronics mechanics and services	Apply health and safety standards, fasten components, install electrical equipment in vessels, perform test run, read standard blueprints, test electrical equipment, troubleshoot, use technical documentation, wear appropriate protective gear
16.	Marine electronics technician	ISCO 7421 Electronics mechanics and servicers	Align components, apply health and safety standards, apply soldering techniques, assemble electronic units, clean components during assembly, fasten components, read assembly drawings, solder electronics, use water navigation devices
17.	Electromechanical equipment assembler	ISCO 8212 Electrical and electronic equipment assemblers	Align components, apply health and safety standards, assemble electrical components, assemble electronic units, fasten components, install electrical and electronic equipment, operate electronic measuring instruments, perform test run, prepare pieces for joining, read assembly drawings, read engineering drawings, read standard blueprints, troubleshoot, use technical documentation, wear appropriate protective gear

	Occupation	ISCO code	Essential skills and competences
18.	Electronic equipment assembler	ISCO 8212 Electrical and electronic equipment assemblers	Photographic equipment assembler, printed circuit board assembler, electronic musical instrument maker, electromechanical equipment assembler, semiconductor processor, battery assembler
		MECHANICS	
19.	Vessel engine assembler	ISCO 8211 Mechanical machinery assemblers	Align components, apply health and safety standards, apply preliminary treatment to workpieces, bolt engine parts, ensure equipment availability, ensure vessel compliance with regulations, fasten components, read engineering drawings, read standard blueprints, troubleshoot, use power tools, use technical documentation, wear appropriate protective gear
		SURFACE TREATMENT	
20.	Surface treatment operator	ISCO 7132 Spray painters and varnishers	Apply health and safety standards, read engineering drawings, read standard blueprints, wear appropriate protective gear, work with chemicals
21.	Transport equipment painter	ISCO 7132 Spray painters and varnishers	Analyse the need for technical resources, apply colour coats, apply health and safety standards, apply preliminary treatment to workpieces, check paint consistency, clean painting equipment, dispose of hazardous waste, ensure equipment availability, fix minor vehicle scratches, follow control of substances hazardous to health procedures, handle chemical cleaning agents, inspect paint quality, keep records of work progress, maintain work area cleanliness, mix paints for vehicles, monitor painting operations, paint with a paint gun, prepare vehicles for application of paint, protect workpiece components from processing, troubleshoot, use colour matching techniques, use drying equipment for vehicles, use paint safety equipment, use painting equipment, use power tools, use technical documentation
22.	Abrasive blasting operator (sandblasting)	ISCO 8122 Metal finishing, plating and coating machine operators	Blast surface, ensure equipment availability, inspect construction supplies, remove inadequate workpieces, smooth burred surfaces, wear appropriate protective gear
		BOAT ARTISANS	
23.	Marine upholsterer	ISCO 7534 Upholsterers and related workers	Align components, apply health and safety standards, apply preliminary treatment to workpieces, fasten components, read engineering drawings, read standard blueprints, test electronic units, troubleshoot, use power tools, use technical documentation, wear appropriate protective gear
24.	Boat rigger	ISCO 7215 Riggers and cable splicers	Align components, apply health and safety standards, ensure vessel compliance with regulations, fasten components, read engineering drawings, read standard blueprints, recognise signs of

	Occupation	ISCO code	Essential skills and competences
			corrosion, troubleshoot, use power tools, use technical documentation, wear appropriate protective gear
25.	Fiberglass laminator	ISCO 8142 Plastic products machine operators	Apply health and safety standards, apply preliminary treatment to workpieces, consult technical resources, ensure vessel compliance with regulations, handle chemicals, protect workpiece components from processing, read engineering drawings, read standard blueprints, remove air bubbles from fiberglass, saturate fiberglass mat with resin mixture, select fiberglass, troubleshoot, use power tools, wear appropriate protective gear
26.	Made-up textile articles manufacturer (sail maker)	ISCO 7533 Sewing, embroidery and related workers	Assemble fabrics of large dimensions for outdoors, bundle fabrics, cut fabrics, decorate textile articles, distinguish accessories, distinguish fabrics, manufacture made-up fabrics for indoor usage, sew curtains
		MACHINISTS	
27.	Computer numerical control (CNC) machine operator	ISCO 7223 Metal working machine tool setters and operators	Consult technical resources, ensure equipment availability, monitor automated machines, operate precision measuring equipment, perform machine maintenance, perform test run, program a CNC controller, read standard blueprints, remove inadequate workpieces, remove processed workpiece, set up the controller of a machine, supply machine, supply machine with appropriate tools, troubleshoot, use CAM software, use automatic programming
		CARPENTERS	
28.	Marine Carpenter	ISCO 7115 Carpenters and joiners	Apply wood finishes, clean wood surface, create smooth wood surface, create wood joints, follow health and safety procedures in construction, identify wood warp, inspect construction supplies, install construction profiles, install wood elements in structures, install wood hardware, interpret 2D plans, interpret 3D plans, join wood elements, keep sawing equipment in good condition, keep track of wooden elements, snap chalk line, sort waste, transport construction supplies, use measurement instruments, use safety equipment in construction, work ergonomically
		OTHER	
29.	Vessel assembly supervisor	ISCO 3122 Manufacturing supervisors	Analyse the need for technical resources, coordinate communication within a team, create solutions to problems, ensure vessel compliance with regulations, evaluate employees work, keep records of work progress, liaise with managers, manage health and safety standards, oversee production requirements, provide department schedule for staff, read standard blueprints, report on production results, supervise staff, supervise work, train employees, wear appropriate protective gear

	Occupation	ISCO code	Essential skills and competences
30.	Vessel assembly inspector	ISCO 7543 Product graders and testers (exluding foods and beverages)	Conduct performance tests, create solutions to problems, ensure vessel compliance with regulations, inspect quality of products, inspect vessel manufacturing, manage health and safety standards, operate precision measuring equipment, read engineering drawings, read standard blueprints, use technical documentation, use testing equipment, write inspection reports
31.	Marine surveyor	ISCO 3115 Mechanical engineering technician	Advise on maritime subjects, analyse ship operations, assess structural integrity of ship for maritime usage, assess vessel capability, comply with operational standards for vessels, determine cause of damage, ensure vessel compliance with regulations, ensure vessel security, inspect vessel, lead inspections, read engineering drawings, read standard blueprints, recognise signs of corrosion, write inspection reports
32.	construction scaffolder	ISCO 7119 Building frame and related trades workers not elsewhere classified	Build scaffolding, construct working platform, dismantle scaffolding, follow health and safety procedures in construction, follow safety procedures when working at heights, inspect construction supplies, interpret 2D plans, interpret 3D plans, position base plates, position guardrails and toeboards, position sole plates, recognise signs of corrosion, recognise signs of wood rot, use measurement instruments, use safety equipment in construction, work ergonomically, work in a construction team
33.	construction scaffolding supervisor	ISCO 3123 Construction supervisors	Coordinate construction activities, ensure compliance with construction project deadline, ensure equipment availability, evaluate employees work, follow health and safety procedures in construction, inspect construction supplies, inspect scaffolding, interpret 2D plans, interpret 3D plans, keep records of work progress, liaise with managers, manage health and safety standards, monitor stock level, plan resource allocation, plan scaffolding, plan shifts of employees, process incoming construction supplies, react to events in time-critical environments, recognise signs of corrosion, recognise signs of wood rot, supervise staff, use safety equipment in construction, work in a construction team, work safely with machines
34.	Mobile crane operator	ISCO 8343 - Crane, hoist and related plant operators	Drive mobile heavy construction equipment, follow health and safety procedures in construction, inspect construction sites, interpret 2D plans, interpret 3D plans, keep heavy construction equipment in good condition, operate GPS systems, operate mobile crane, react to events in time-critical environments, rig loads, secure heavy construction equipment, set up crane, use safety equipment in construction, work ergonomically.
35.	Production plant crane operator	ISCO 8343 - Crane, hoist and related plant operators	Apply various lifting techniques, determine crane load, determine the load's centre of gravity, follow safety procedures when working at heights, handle cargo, liaise with the transported goods' workers, operate cranes, operate lifting equipment, operate railway lever frames.

Table 2: Supporting occupational profiles and associated essential skills and competences in the shipbuilding sector, following ESCO v1.0 classification.

SUPPORTING OCCUPATIONAL PROFILES IN THE SHIPBUILDING SECTOR			
A/A	**Occupation**	**ISCO Classification**	**Essential skills and competences**
		ECONOMISTS	
1.	Investment analyst	ISCO 2413 – Financial analysts	Analyze economic trends, analyze financial performance of a company, analyze market financial trends, monitor stock market, obtain financial information, provide support in financial calculation, review investment portfolios.
		DATABASE AND SYSTEM ANALYSTS	
2.	Data analyst	ISCO 2511 – Systems analysts	Analyze big data, apply statistical analysis techniques, collect ICT data, define data quality criteria, establish data processes, execute analytical mathematical calculations, handle data samples, implement data quality processes, integrate ICT data, interpret current data, manage data, normalize data, perform data cleansing, perform data mining.
3.	ICT resilience manager	ISCO 2529 – Database and network professionals not elsewhere classified	Analyze business processes, analyze the context of an organization, comply with legal regulations, develop contingency plans for emergencies, develop information security strategy, execute ICT audits, identify ICT security risks, implement ICT recovery system, implement ICT risk management, lead disaster recovery exercises, manage IT security compliances, manage disaster recovery plans, manage system security, perform security vulnerability assessments.
		MANAGERS	
4.	Project manager	ISCO 1219 – Business services and administration managers not elsewhere classified	Apply conflict management, build business relationships, create project specifications, develop business plans, ensure compliance with legal requirements, ensure equipment availability, ensure equipment maintenance, establish daily priorities, estimate duration of work, follow company standards, identify legal requirements, liaise with managers, manage budgets, manage logistics, manage project information, manage staff, manage supplies, perform project management, perform resource planning, perform risk analysis, plan health and safety procedures, provide cost benefit analysis reports, strive for company growth, supervise daily information operations, train employees.
5.	Operation manager	ISCO 1321 – Manufacturing managers	Ensure equipment availability, ensure equipment maintenance, establish daily priorities, follow company standards, liaise with managers, manage budgets, manage logistics, manage staff, manage supplies, plan health and safety procedures, strive for company growth, supervise daily information operations.
6.	Construction safety manager	ISCO 3112 – Civil engineering technicians	Advise on safety improvements, apply safety management, follow health and safety procedures in construction, monitor construction site, prevent work accidents, supervise worker safety, use safety equipment in construction, write work-related reports.

ENGINEERS			
7.	Industrial engineer	ISCO 2141 – Industrial and production engineers	Adjust engineering designs, approve engineering design, perform scientific research, use technical drawing software.
8.	Mechatronics engineer	ISCO 2144 - Mechanical engineers	Adjust engineering designs, analyse test data, approve engineering design, conduct literature research, conduct quality control analysis, define technical requirements, design automation components, design prototypes, develop electronic test procedures, develop mechatronic test procedures, follow safety standards in industrial contexts, gather technical information, monitor manufacturing quality standards, perform data analysis, perform scientific research, prepare production prototypes, report analysis results, simulate mechatronic design concepts, test mechatronic units, use technical drawing software.
9.	Automation engineer	ISCO 2141 - Industrial and production engineers	Adjust engineering designs, analyse test data, approve engineering design, conduct literature research, conduct quality control analysis, define technical requirements, design automation components, design prototypes, develop electronic test procedures, develop mechatronic test procedures, gather technical information, monitor manufacturing quality standards, perform scientific research, prepare production prototypes, record test data, report analysis results, use technical drawing software.
10.	Robotics engineer	ISCO 3119 - Physical and engineering science technicians not elsewhere classified	Adjust engineering designs, approve engineering design, assess financial viability, design automation components, execute feasibility study, perform scientific research, use technical drawing software.
11.	Welding engineer	ISCO 2144 - Mechanical engineers	Adjust engineering designs, apply arc welding techniques, apply technical communication skills, approve engineering design, consult technical resources, define technical requirements, develop new welding techniques, draw design sketches, ensure fulfilment of legal requirements, liaise with managers, operate oxy-fuel welding torch, operate soldering equipment, operate welding equipment, perform scientific research, perform welding inspection, prepare production prototypes, research welding techniques, select filler metal, spot metal imperfections, use technical drawing software
12.	Electronics engineer	ISCO 2152 - Electronics engineers	Adjust engineering designs, approve engineering design, create technical plans, design electrical systems, design electronic systems, develop electronic test procedures, execute feasibility study, identify customer's needs, manage budgets, perform scientific research, use technical drawing software, write technical reports
13.	Telecommunications engineer	ISCO 2153 – Telecommunications engineers	Adjust ICT system capacity, analyze network bandwidth requirements, define technical requirements, design computer network, design process, estimate costs of installing telecommunication devices,

			interact with users to gather requirements, provide ICT system raining, support ICT system users, use session border controller.
		TECHNICIANS	
14.	Industrial engineering technician	ISCO 3119 – Physical and engineering science technicians not elsewhere classified	Adjust engineering designs, advise on manufacturing problems, analyze test data, collaborate with engineers, conduct routine machinery checks, create solutions to problems, perform maintenance on installed equipment, read engineering drawings, record test data, resolve equipment malfunctions, troubleshoot.
15.	Mechatronics engineering technician	ISCO 3115 – Mechanical engineering technicians	Adjust engineering designs, align components, assemble mechatronic units, assist scientific research, fasten components, follow safety standards in industrial contexts, inspect quality of products, install mechatronic equipment, liaise with engineers, perform test run, prepare production prototypes, read assembly drawings, read engineering drawings, record test data, simulate mechatronic design concepts, test mechatronic units.
16.	Automation engineering technician	ISCO 3119 – Physical and engineering science technicians not elsewhere classified	Adjust engineering designs, align components, assemble machines, assist scientific research, fasten components, inspect quality of products, install automation components, liaise with engineers, monitor automated machines, perform test run, prepare production prototypes, read engineering drawings, record test data, set up machine controls.
17.	Pneumatic engineering technician	ISCO 3115 – Mechanical engineering technicians	Adjust engineering designs, conduct routine machinery checks, create solutions to problems, liaise with engineers, perform maintenance on installed equipment, read engineering drawings, record test data, troubleshoot.
18.	Robotics engineering technician	ISCO 3119 – Physical and engineering science technicians not elsewhere classified	Adjust engineering designs, align components, assemble robots, assist scientific research, fasten components, follow safety standards in industrial contexts, inspect quality of products, liaise with engineers, monitor machine operations, perform test run, prepare production prototypes, read assembly drawings, read engineering drawings, record test data, set up automotive robot, set up machine controls, test mechatronic units.
19.	Power tool repair technician	ISCO 7412 – Electrical mechanics and fitters	Advise on equipment maintenance, apply company policies, assemble machines, calibrate electronic instruments, disassemble engines, disassemble machines, lift heavy weights, maintain customer service, maintain equipment, maintain records of maintenance interventions, perform test run, provide customer follow-up services, provide customer information related to repairs, repair power tools, replace defect components, use power tools, use repair manuals, use specialized tools in electric repairs, use wire hand tools.

20.	Industrial robot controller	ISCO 3139 – Process control technicians not elsewhere classified	Adjust manufacturing equipment, maintain control systems for automated equipment, maintain robotic equipment, monitor automated machines, perform machine maintenance, perform risk analysis, set up machine controls, set up the controller of a machine, wear appropriate protective gear.
21.	Pneumatic systems technician	ISCO 7233 – Agricultural and industrial machinery mechanics and repairers	Consult technical resources, install electrical and electronic equipment, install pneumatic systems, operate soldering equipment, operate welding equipment, perform test run, read standard blueprints, record test data, resolve equipment malfunctions, secure working area, use testing equipment.
METALWORKERS			
22.	Fitter and turner	ISCO 7223 – Metal working machine tool setters and operators	Carry out measurements of parts, cut metal products, fabricate metal parts, inspect quality of products, manipulate metal, operate drill press, operate metal fabricating machines, perform metal work, tend lathe, use technical documentation.
ASSEMBLERS			
23.	Mechatronics assembler	ISCO 8211 – Mechanical machinery assemblers	Align components, apply assembly techniques, apply soldering techniques, assemble mechatronic units, clean components during assembly, ensure conformity to specifications, follow safety standards in industrial contexts, install mechatronic equipment, maintain mechatronic equipment, meet deadlines, monitor machine operations, perform metal work, read assembly drawings, read standard blueprints, remove defective products, troubleshoot.
24.	Metal products assembler	ISCO 8219 – Assemblers not elsewhere classified	Assemble metal parts, ensure equipment availability, ensure public safety and security, fasten components, inspect quality of products, join metals, manipulate metal, perform pre-assembly quality checks, troubleshoot, use metalworking tools, use technical documentation.
25.	Metal furniture machine operator	ISCO 8219 – Assemblers not elsewhere classified	Apply a protective layer, assemble metal parts, cut metal products, fabricate metal parts, heat metals, join metals, maintain furniture machinery, monitor automated machines, operate furniture machinery, remove inadequate workpieces, remove processed workpiece, set up the controller of a machine, supply machine, supply machine with appropriate tools, use welding equipment.

NEW OCCUPATIONS EMERGING (AS suggested in the Delphi process)

The MATES Foresight Scenario Report (Ergas and Smyrnakis, 2020) identified 3 new occupations that were considered as emerging in the shipbuilding sector. One is proposed to be included as a new occupation, while the other two are proposed as specialisations of existing occupations:

- Alternative fuels engineer (new): which include skills and knowledge associated to the design and development of systems, components, motors, and equipment which replace the use of conventional fossil fuels as main power source for propulsion and power generation.
- Automation engineer: Automation engineers research, design, and develop applications and systems for the automation of the production process. An update of the existing profile in the ESCO database has been proposed, to include the required specialisation for the shipbuilding sector.
- Automation engineer technician (updated): Automation engineering technicians collaborate with automation engineers in the development of applications and systems for the automation of the production process. An update of the existing profile in the ESCO database has been proposed, to include the required specialisation for the shipbuilding sector.

All of them have been included in ESCO v1.1

Table 31: Primary occupational profiles, and essential skills and competences in the offshore renewable energy sector, following ESCO v1.0 classification

PRIMARY OCCUPATIONAL PROFILES			
A/A	**Occupation**	**ISCO code**	**Essential skills and competences**
		ENGINEERS	
1	Renewable energy engineer	ISCO 2149 – Engineering professionals not elsewhere classified	Adapt energy distribution schedules, adjust engineering designs, approve engineering design, carry out energy management of facilities, design wind turbines, ensure compliance with safety legislation, inform on government funding, make electrical calculations, manage engineering project, perform project management, perform scientific research, promote sustainable energy, provide information on geothermal heat pumps, provide information on solar panels, provide information on wind turbines, research locations for wind farms, use CAD software, use technical drawing software, use thermal management. [**Grouping**: Energy distribution, Engineering design, Energy management, Project Management, Project site selection, Wind turbines, Solar Panels, Health & Safety]
2	Energy systems engineer	ISCO 2149 – Engineering professionals not elsewhere classified	Adapt energy distribution schedules, adjust engineering designs, advise on heating systems energy efficiency, approve engineering design, carry out energy management of facilities, design electric power systems, draw blueprints, examine engineering principles, identify energy needs, inspect building systems, manage engineering project, perform risk analysis, perform scientific research, promote innovative infrastructure design, promote sustainable energy, troubleshoot, use technical drawing software. [**Grouping**: Energy distribution, Engineering design, Energy efficiency, Energy management, Energy demand, Electric power systems, Project management, Risk analysis]
3	Wind energy engineer	ISCO 2149 – Engineering professionals not elsewhere classified	Adjust engineering designs, approve engineering design, design wind turbines, develop test procedures, ensure compliance with safety legislation, inspect wind turbines, perform scientific research, provide information on wind turbines, record test data, report test findings, research locations for wind farms, test wind turbine blades, use technical drawing software. [**Grouping**: Engineering design, Project management, Solar energy systems, Maintenance of solar power systems, Adjust voltage]
4	Solar energy engineer	ISCO 2149 – Engineering professionals not elsewhere classified	Adjust engineering designs, adjust voltage, approve engineering design, conduct engineering site audits, create AutoCAD drawings, design solar energy systems, examine engineering principles, maintain concentrated solar power systems, maintain solar energy, systems, manage engineering project, perform scientific research, promote sustainable energy, provide information on solar panels, use technical drawing software, use thermal analysis. [**Grouping**: Engineering design, Wind turbines (including inspection), Wind farm location selection, Health & Safety]

PRIMARY OCCUPATIONAL PROFILES			
A/A	**Occupation**	**ISCO code**	**Essential skills and competences**
5	Power distribution engineer	ISCO 2151 – Electrical engineers	Approve engineering design, assess financial viability, change power distribution systems, develop electricity distribution schedule, ensure compliance with electricity distribution schedule, ensure compliance with environmental legislation, ensure compliance with safety legislation, ensure safety in electrical power operations, identify customer's needs, inspect overhead power lines, inspect underground power cables, make electrical calculations, manage electricity transmission system, perform scientific research, supervise electricity distribution operations, use technical drawing software. [**Grouping**: Engineering design, Power distribution systems, Electricity transmission system management, Inspection of underground power cables, Assessment of financial viability, Environmental legislation, Health & Safety]
6	Electric power generation engineer	ISCO 2151 – Electrical engineers	Adjust engineering designs, approve engineering design, design electric power systems, develop strategies for electricity contingencies, ensure compliance with electricity distribution schedule, ensure safety in electrical power operations, perform scientific research, promote sustainable energy, respond to electrical power contingencies, shift energy demands, use technical drawing software. [**Grouping**: Engineering design, Electric power systems, Health & Safety]
7	Maintenance and repair engineer	ISCO 2141 – Industrial and production engineers	Advise on efficiency improvements, conduct quality control analysis, conduct routine machinery checks, create solutions to problems, inspect industrial equipment, inspect machinery, maintain equipment, maintain machinery, manage budgets, perform machine, maintenance, perform test run, resolve equipment malfunctions, troubleshoot, use testing equipment, work safely with machines, write technical reports. [**Grouping**: Efficiency improvement, Maintenance, Repair, Quality control analysis, Routine machinery checks, Inspections, Health & Safety]
METALWORKER			
8	Welder	ISCO 7212 – Welders and flamecutters	Align components, apply arc welding techniques, apply precision metalworking techniques, ensure correct metal temperature, ensure equipment availability, handle fuels, interpret 2D & 3D plans, join metals, monitor gauge, operate oxy-fuel welding torch, operate welding equipment, perform metal active and inert gas welding, perform test run, perform tungsten inert gas welding, recognize signs of corrosion remove inadequate workpieces, remove processed workpiece, select filler metal, smooth burred surfaces, spot metal imperfections, troubleshoot, wear appropriate protective gear. [**Grouping**: Assembly, Arc welding, Metalworking, Oxy-fuel welding torch, Metal active and inert gas welding, Tungsten inert gas]
TECHNICIANS			

PRIMARY OCCUPATIONAL PROFILES			
A/A	**Occupation**	**ISCO code**	**Essential skills and competences**
9	Wind turbine technician	ISCO 7412 – Electrical mechanics and fitters	Arrange equipment repairs, ensure equipment maintenance, follow safety procedures when working at heights, inspect wind turbines, install electrical and electronic equipment, maintain electrical equipment, maintain electronic equipment, maintain hydraulic systems, maintain records of maintenance interventions, wear appropriate protective gear. [**Grouping**: Installation of electrical and electronic equipment, Maintenance, Repair, Inspection, Working at heights]
10	Solar energy technician	ISCO 7411 – Building and related electricians	Check compatibility of materials, comply with legal regulations, follow health and safety procedures in construction, follow safety procedures when working at heights, inspect construction supplies, inspect electrical supplies, install circuit breakers, install electrical and electronic equipment, interpret 2D plans, interpret 3D plans, mount photovoltaic panels, test procedures in electricity transmission, transport construction supplies, use measurement instruments, work ergonomically. [**Grouping**: Installation of electrical and electronic equipment and photovoltaic panels, Inspection, Working at heights, Health & Safety]
11	Hydropower technician	ISCO 3113 – Electrical engineering technicians	Adjust engineering designs, apply health and safety standards, design electric power systems, maintain electrical equipment, manage engineering project, monitor electric generators, operate scientific measuring equipment, perform risk analysis, promote innovative infrastructure design, troubleshoot, use technical drawing software. [**Grouping**: Engineering design, Electric power systems, Maintenance, Project management, Risk analysis, Health & Safety]
12	Tidal power technician	ISCO 3113 – Electrical engineering technicians	Adjust engineering designs, apply health and safety standards, design electric power systems, maintain electrical equipment, manage engineering project, monitor electric generators, operate scientific measuring equipment, perform risk analysis, promote innovative infrastructure design, troubleshoot, use technical drawing software. [**Grouping**: Engineering design, Electric power systems, Maintenance, Project management, Risk analysis, Health & Safety]
13	Wave power technician	ISCO 3113 – Electrical engineering technicians	Adjust engineering designs, apply health and safety standards, design electric power systems, maintain electrical equipment, manage engineering project, monitor electric generators, operate scientific measuring equipment, perform risk analysis, promote innovative infrastructure design, troubleshoot, use technical drawing software. [**Grouping**: Engineering design, Electric power systems, Maintenance, Project management, Risk analysis, Health & Safety]

PRIMARY OCCUPATIONAL PROFILES			
A/A	**Occupation**	**ISCO code**	**Essential skills and competences**
14	Electromechanical engineering technician	ISCO 3113 – Electrical engineering technicians	Adjust engineering designs, align components, apply soldering techniques, assemble electromechanical systems, assist scientific research, fasten components, inspect quality of products, liaise with engineers, operate soldering equipment, perform test run, prepare pieces for joining, prepare production prototypes, read assembly drawings, read engineering drawings, read standard blueprints, record test data, test electromechanical systems, wear appropriate protective gear. [**Grouping**: Engineering design, Assembly, Inspection, Soldering]
ASSEMBLERS			
15	Electromechanical equipment assembler	ISCO 8212 – Electrical and electronic equipment assemblers	Align components, apply health and safety standards, assemble electrical components, assemble electronic units, fasten components, install electrical and electronic equipment, operate electronic measuring instruments, perform test run, prepare pieces for joining, read assembly drawings, read engineering drawings, read standard blueprints, troubleshoot, use technical documentation, wear appropriate protective gear. [**Grouping**: Installation of electrical and electronic equipment, Assembly, Health & Safety]
16	Electronic equipment assembler	ISCO 8212 – Electrical and electronic equipment assemblers	Apply through-hole technology manually, assemble printed circuit boards, coat printed circuit board, ensure conformity to specifications, ensure public safety and security, meet deadlines, operate insertion mount machine, prepare board for soldering, read assembly drawings, solder components onto electronic board. [**Grouping**: Assembly and coat of printed circuit boards, Operation of insertion mount machine, Soldering, Health & Safety]
17	Printed circuit board assembler	ISCO 8212 – Electrical and electronic equipment assemblers	Apply through-hole technology manually, assemble printed circuit boards, coat printed circuit board, ensure conformity to specifications, ensure public safety and security, meet deadlines, operate insertion mount machine, prepare board for soldering, read assembly drawings, solder components onto electronic board. [**Grouping**: Assembly and coat of printed circuit boards, Operation of insertion mount machine, Soldering, Health & Safety]
DRAUGHTSPERSONS			
18	Electromechanical drafter	ISCO 3118 – Draughtspersons	Create technical plans, customize drafts, design electromechanical systems, design prototypes, interpret electrical diagrams, liaise with engineers, model electromechanical systems, use CAD software, use technical drawing software. [**Grouping**: Electromechanical systems, Design, Technical planning, Customization of drafts]
INSTALLERS			

PRIMARY OCCUPATIONAL PROFILES			
A/A	**Occupation**	**ISCO code**	**Essential skills and competences**
19	Cable installer	ISCO 7413 – Electrical line installers and repairers	Inspect overhead power lines, inspect underground power cables, install power lines, repair overhead power lines, repair underground power cables, wear appropriate protective gear, work ergonomically. [**Grouping**: Installation, inspection and repair of overhead and underground power lines]
DIVERS			
20	Construction commercial diver	ISCO 7541 – Underwater divers	Check diving equipment, comply with legal requirements for diving operations, comply with the planned time for the depth of the dive, cope with decompression, follow health and safety procedures in construction, implement dive plans, inspect construction supplies, interrupt diving operations when necessary, keep records of work progress, maintain diving equipment, use lift bags, use rigging equipment, use safety equipment in construction, weld in hyperbaric conditions, weld underwater, work ergonomically. [**Grouping**: Welding underwater and in hyperbaric conditions, Interrupt diving operations when necessary, Rigging, Use of lift bags, Health & Safety]
HEALTH & SAFETY			
21	Health and safety officer	ISCO 2263 – Environmental and occupational health and hygiene professionals	Advise on conflict management, advise on risk management, communicate health and safety measures, draw up risk assessment, educate employees on occupational hazards, ensure compliance with environmental legislation, follow safety standards in industrial contexts, monitor legislation developments, present reports. [**Grouping**: Health & Safety, Education & Training of employees on occupational hazards, Risk and conflict management, Environmental legislation]
PLANT OPERATORS			
22	Power production plant operator	ISCO 3131 – Power production plant operators	Conduct routine machinery checks, ensure equipment maintenance, maintain electrical equipment, maintain power plant machinery, monitor automated machines, monitor electric generators, resolve equipment malfunctions, respond to electrical power contingencies, use remote control equipment, wear appropriate protective gear. [**Grouping**: Routine machinery checks, Remote control, Monitoring, Maintenance, Repair]
23	Solar power plant operator	ISCO 3131 – Power production plant operators	Apply health and safety standards, install concentrated solar power systems, install photovoltaic systems, maintain concentrated solar power systems, maintain electrical equipment, maintain photovoltaic systems, maintain records of maintenance interventions, monitor electric generators, respond to electrical power contingencies. [**Grouping**: Installation of solar power systems, Monitoring, Maintenance, Repair, Health & Safety]

Table 42: Supporting occupational profiles, and essential skills and competences in the offshore renewable energy sector, following ESCO v1.0 classification

SUPPORTING OCCUPATIONAL PROFILES IN THE OFFSHORE RENEWABLE ENERGY SECTOR			
A/A	**Occupation**	**ISCO Classification**	**Essential skills and competences**
		CONSULTANTS	
1	Renewable energy consultant	ISCO 2433 – Technical and medical sales professionals (excluding ICT)	Advise on heating systems energy efficiency, assess customers, develop professional network, identify energy needs, inform on government funding, perform market research, promote environmental awareness, promote sustainable energy, promote information on geothermal heat pumps, promote information on solar panels, promote information on wind turbines.
2	Environmental expert	ISCO 2143 – Environmental engineers	Advise on environmental remediation, advise on pollution prevention, analyze environmental data, assess environmental impact, carry out environmental audits, collect samples for analysis, conduct environmental surveys, create solutions to problems, develop environmental policy, develop environmental remediation strategies, investigate pollution, measure pollution, perform environmental investigations, report on environmental issues, report pollution incidents.
3	Solar energy sales consultant	ISCO 2433 – Technical and medical sales professionals (excluding ICT)	Advise on heating systems energy efficiency, assess customers, develop professional network, identify customer's needs, inform customers on energy consumption fees, inform on government funding, promote environmental awareness, promote sustainable energy, provide information on solar panels.
		MANAGERS	
4	Policy manager	ISCO 1213 – Policy and planning managers	Advise on efficiency improvements, develop company strategies, ensure compliance with policies, integrate strategic foundation in daily performance, monitor company policy.
5	Project manager	ISCO 1219 – Business services and administration managers not elsewhere classified	Apply conflict management, build business relationships, create project specifications, develop business plans, ensure compliance with legal requirements, ensure equipment availability, ensure equipment maintenance, establish daily priorities, estimate duration of work, follow company standards, identify legal requirements, liaise with managers, manage budgets, manage logistics, manage project information, manage staff, manage supplies, perform project management, perform resource planning, perform risk analysis, plan health and safety procedures, provide cost benefit analysis reports, strive for company growth, supervise daily information operations, train employees.
6	Operation manager	ISCO 1321 – Manufacturing managers	Ensure equipment availability, ensure equipment maintenance, establish daily priorities, follow company standards, liaise with managers, manage budgets, manage logistics, manage staff, manage supplies, plan health and safety procedures, strive for company growth, supervise daily information operations.

7	Industrial maintenance supervisor	ISCO 3115 – Mechanical engineering technicians	Check for damaged items, communicate problems to senior colleagues, coordinate communication within a team, create solutions to problems, delegate activities, ensure compliance with maintenance legislation, inspect data, liaise with managers, manage maintenance operations, oversee production requirements, perform data analysis, read standard blueprints, schedule regular machine maintenance, schedule shifts, wear appropriate protective gear.
ECONOMISTS			
8	Investment analyst	ISCO 2413 – Financial analysts	Analyze economic trends, analyze financial performance of a company, analyze market financial trends, monitor stock market, obtain financial information, provide support in financial calculation, review investment portfolios.
9	Energy trader	ISCO 3311 – Securities and finance dealers and brokers	Analyze energy market trends, create a financial plan, forecast energy prices, handle financial transactions, maintain financial records, manage financial risk, monitor stock market, obtain financial information, operate financial instruments, trade securities.
MARINE SURVEYORS			
10	Oceanographer	ISCO 2114 – Geologists and geophysicists	Apply scientific methods, apply statistical analysis techniques, execute analytical mathematical calculations, gather experimental data, operate scientific measuring equipment, perform scientific research, use measurement instruments, write scientific papers.
11	Hydrographic surveyor	ISCO 2165 - 2165 – Cartographers and surveyors	Adjust surveying equipment, calibrate electronic instruments, collect mapping data, compare survey computations, conduct underwater surveys, document survey operations, operate surveying instruments, perform surveying calculations, prepare surveying report, record survey measurements.
DATABASE AND SYSTEMS ANALYSTS			
12	Data analyst	ISCO 2511 – Systems analysts	Analyze big data, apply statistical analysis techniques, collect ICT data, define data quality criteria, establish data processes, execute analytical mathematical calculations, handle data samples, implement data quality processes, integrate ICT data, interpret current data, manage data, normalize data, perform data cleansing, perform data mining.
13	ICT resilience manager	ISCO 2529 – Database and network professionals not elsewhere classified	Analyze business processes, analyze the context of an organization, comply with legal regulations, develop contingency plans for emergencies, develop information security strategy, execute ICT audits, identify ICT security risks, implement ICT recovery system, implement ICT risk management, lead disaster recovery exercises, manage IT security compliances, manage disaster recovery plans, manage system security, perform security vulnerability assessments.
ENGINEERS			
14	Design engineer	ISCO 2149 – Engineering professionals not elsewhere classified	Assess financial viability, define technical requirements, execute analytical mathematical calculations, execute feasibility study, interpret technical requirements, manage engineering project, perform scientific research, present detailed design proposals, use technical drawing software.

15	Electrical engineer	ISCO 2151 – Electrical engineers	Abide by regulations on banned materials, adjust engineering designs, approve engineering design, perform scientific research, use technical drawing software.
16	Industrial engineer	ISCO 2141 – Industrial and production engineers	Adjust engineering designs, approve engineering design, perform scientific research, use technical drawing software.
17	Mechatronics engineer	ISCO 2144 – Mechanical engineers	Adjust engineering designs, analyze test data, approve engineering design, conduct literature research, conduct quality control analysis, define technical requirements, design automation components, design prototypes, develop electronic test procedures, develop mechatronic test procedures, follow safety standards in industrial contexts, gather technical information, monitor manufacturing quality standards, perform data analysis, perform scientific research, prepare production prototypes, report analysis results, simulate mechatronic design concepts, test mechatronic units, use technical drawing software.
18	Automation engineer	ISCO 2141 – Industrial and production engineers	Adjust engineering designs, analyze test data, approve engineering design, conduct literature research. conduct quality control analysis, define technical requirements, design automation components, design prototypes, develop electronic test procedures, develop mechatronic test procedures, gather technical information, monitor manufacturing quality standards, perform scientific research, prepare production prototypes, record test data, report analysis results, use technical drawing software.
19	Robotics engineer	ISCO 3119 – Physical and engineering science technicians not elsewhere classified	Adjust engineering designs, approve engineering design, assess financial viability, design automation components, execute feasibility study, perform scientific research, use technical drawing software.
20	Telecommunications engineer	ISCO 2153 – Telecommunications engineers	Adjust ICT system capacity, analyze network bandwidth requirements, define technical requirements, design computer network, design process, estimate costs of installing telecommunication devices, interact with users to gather requirements, provide ICT system raining, support ICT system users, use session border controller.
21	Welding engineer	ISCO 2144 – Mechanical engineers	Adjust engineering designs, apply arc welding techniques, apply technical communication skills, approve engineering design, consult technical resources, define technical requirements, develop new welding techniques, draw design sketches, ensure fulfilment of legal requirements, liaise with managers, operate oxy-fuel welding torch, operate soldering equipment, operate welding equipment, perform scientific research, perform welding inspection, prepare production prototypes, research welding techniques, select filler metal, spot metal imperfections, use technical drawing software
22	Electromechanical engineer	ISCO 2151 – Electrical engineers	Abide by regulations on banned materials, adjust engineering designs, analyze test data, approve engineering design, conduct literature research, design electromechanical systems, design prototypes, gather technical information, model electromechanical systems, monitor manufacturing quality

			standards, perform data analysis, perform scientific research, prepare production prototypes, record test data, report analysis results, test electromechanical systems, use technical drawing software.
		TECHNICIANS	
23	Industrial engineering technician	ISCO 3119 – Physical and engineering science technicians not elsewhere classified	Adjust engineering designs, advise on manufacturing problems, analyze test data, collaborate with engineers, conduct routine machinery checks, create solutions to problems, perform maintenance on installed equipment, read engineering drawings, record test data, resolve equipment malfunctions, troubleshoot.
24	Mechatronics engineering technician	ISCO 3115 – Mechanical engineering technicians	Adjust engineering designs, align components, assemble mechatronic units, assist scientific research, fasten components, follow safety standards in industrial contexts, inspect quality of products, install mechatronic equipment, liaise with engineers, perform test run, prepare production prototypes, read assembly drawings, read engineering drawings, record test data, simulate mechatronic design concepts, test mechatronic units.
25	Automation engineering technician	ISCO 3119 – Physical and engineering science technicians not elsewhere classified	Adjust engineering designs, align components, assemble machines, assist scientific research, fasten components, inspect quality of products, install automation components, liaise with engineers, monitor automated machines, perform test run, prepare production prototypes, read engineering drawings, record test data, set up machine controls.
26	Pneumatic engineering technician	ISCO 3115 – Mechanical engineering technicians	Adjust engineering designs, conduct routine machinery checks, create solutions to problems, liaise with engineers, perform maintenance on installed equipment, read engineering drawings, record test data, troubleshoot.
27	Robotics engineering technician	ISCO 3119 – Physical and engineering science technicians not elsewhere classified	Adjust engineering designs, align components, assemble robots, assist scientific research, fasten components, follow safety standards in industrial contexts, inspect quality of products, liaise with engineers, monitor machine operations, perform test run, prepare production prototypes, read assembly drawings, read engineering drawings, record test data, set up automotive robot, set up machine controls, test mechatronic units.
28	Power tool repair technician	ISCO 7412 – Electrical mechanics and fitters	Advise on equipment maintenance, apply company policies, assemble machines, calibrate electronic instruments, disassemble engines, disassemble machines, lift heavy weights, maintain customer service, maintain equipment, maintain records of maintenance interventions, perform test run, provide customer follow-up services, provide customer information related to repairs, repair power tools, replace defect components, use power tools, use repair manuals, use specialized tools in electric repairs, use wire hand tools.

29	Industrial robot controller	ISCO 3139 – Process control technicians not elsewhere classified	Adjust manufacturing equipment, maintain control systems for automated equipment, maintain robotic equipment, monitor automated machines, perform machine maintenance, perform risk analysis, set up machine controls, set up the controller of a machine, wear appropriate protective gear.
30	Pneumatic systems technician	ISCO 7233 – Agricultural and industrial machinery mechanics and repairers	Consult technical resources, install electrical and electronic equipment, install pneumatic systems, operate soldering equipment, operate welding equipment, perform test run, read standard blueprints, record test data, resolve equipment malfunctions, secure working area, use testing equipment.
31	Telecommunications technician	ISCO 7422 – Information and communications technology installers and services	Communicate with customers, estimate duration of work, install cable TV services, install electronic communication equipment, install low voltage wiring, install signal repeaters, operate aerial work platforms, operate call distribution system, operate digging construction equipment, operate electronic measuring instruments, operate private branch exchange, operate signal generator, operate two-way radio systems, repair wiring, seal wires, solder electronics, splice cable, upgrade firmware, use communication equipment, use session border controller.
METALWORKERS			
32	Fitter and turner	ISCO 7223 – Metal working machine tool setters and operators	Carry out measurements of parts, cut metal products, fabricate metal parts, inspect quality of products, manipulate metal, operate drill press, operate metal fabricating machines, perform metal work, tend lathe, use technical documentation.
ASSEMBLERS			
33	Mechatronics assembler	ISCO 8211 – Mechanical machinery assemblers	Align components, apply assembly techniques, apply soldering techniques, assemble mechatronic units, clean components during assembly, ensure conformity to specifications, follow safety standards in industrial contexts, install mechatronic equipment, maintain mechatronic equipment, meet deadlines, monitor machine operations, perform metal work, read assembly drawings, read standard blueprints, remove defective products, troubleshoot.
34	Metal products assembler	ISCO 8219 – Assemblers not elsewhere classified	Assemble metal parts, ensure equipment availability, ensure public safety and security, fasten components, inspect quality of products, join metals, manipulate metal, perform pre-assembly quality checks, troubleshoot, use metalworking tools, use technical documentation.
35	Metal furniture machine operator	ISCO 8219 – Assemblers not elsewhere classified	Apply a protective layer, assemble metal parts, cut metal products, fabricate metal parts, heat metals, join metals, maintain furniture machinery, monitor automated machines, operate furniture machinery, remove inadequate workpieces, remove processed workpiece, set up the controller of a machine, supply machine, supply machine with appropriate tools, use welding equipment.
HEALTH & SAFETY MANAGERS			
36	Construction safety manager	ISCO 3112 – Civil engineering technicians	Advise on safety improvements, apply safety management, follow health and safety procedures in construction, monitor construction site, prevent work accidents, supervise worker safety, use safety equipment in construction, write work-related reports.

CRANE OPERATORS			
37	Production plant crane operator	ISCO 8343 – Crane, hoist and related plant operators	Apply various lifting techniques, determine crane load, determine the load's center of gravity, follow safety procedures when working at heights, handle cargo, liaise with the transported goods' workers, operate cranes, operate lifting equipment, operate railway lever frames.
38	Mobile crane operator	ISCO 8343 – Crane, hoist and related plant operators	Drive mobile heavy construction equipment, follow health and safety procedures in construction, inspect construction sites, interpret 2D plans, interpret 3D plans, keep heavy construction equipment in good condition, operate GPS systems, operate mobile crane, react to events in time-critical environments, rig loads, secure heavy construction equipment, set up crane, use safety equipment in construction, work ergonomically.
SALES REPRESENTATIVES			
39	Renewable energy sales representative	ISCO 3322 – Commercial sales representative	Advise on heating systems energy efficiency, answers requests for quotation, assess customers, carry out sales analysis, identify customer's needs, identify energy needs, inform customers on energy consumption fees, inform on government funding, manage contracts, promote sustainable energy, promote information on geothermal heat pumps, promote information on solar panels, promote information on wind turbines
PLANT OPERATORS			
40	Electrical transmission system operator	ISCO 3131 – Power production plant operators	Adapt energy distribution schedules, coordinate electricity generation, develop strategies for electricity contingencies, ensure compliance with electricity distribution schedule, ensure safety in electrical power operations, manage electricity transmission system, respond to electrical power contingencies, test procedures in electricity transmission.
INSTALLERS AND REPAIRERS			
41	Electricity distribution worker	ISCO 7413 – Electrical line installers and repairers	Inspect overhead power lines, inspect underground power cables, install power lines, repair overhead power lines, repair underground power cables, wear appropriate protective gear, work ergonomically.
42	Communication infrastructure maintainer	ISCO 7422 – Information and communications technology installers and services	Assess telecommunication infrastructure issues, install electronic communication equipment, install low voltage wiring, monitor communication channels' performance, operate digging construction equipment, provide technical documentation.
43	Telecommunications equipment maintainer	ISCO 7422 – Information and communications technology installers and services	Assess telecommunication infrastructure issues, calibrate electronic instruments, install low voltage wiring, maintain radio communications equipment, operate remote broadcast equipment, operate two-way radio systems, repair wiring, solder electronics.

List of Offshore Renewable Energy occupational profiles identified

There are roles in ORE, for both primary and supporting activities, which were not covered by the occupational profiles defined in the ESCO v1.0, such as offshore engineers or offshore wind turbine technicians, creating gaps in profiling the occupations necessary for the deployment of ORE across the value chain. The following list includes occupation identified both in the MATES Baseline Report on Current Skills Gaps (Sdoukopoulos et al., 2020) and in the MATES Foresight Scenario Report (Ergas and Smyrnakis, 2020).

The additional primary occupations needed cover the following areas and profiles:

- *Offshore renewable energy engineer*, which includes skills, qualifications and competences associated with, offshore constructions and infrastructures, marine geotechnical engineering, marine engineering, offshore renewable energies technologies, combined with electromechanical engineering skills necessary to the sector, such as mechatronics, automation, etc.
- *Offshore renewable energy technician*, which include expertise in offshore wind energy technology, tidal stream and wave generators and the efficiency and behaviour of offshore energy systems, as well as the necessary skills for working at height and hazardous environments, such as the ocean.
- *Offshore renewable energy plant operator*, with similar skills, qualifications and competences to those of a power production plant operator and solar power plant operator but a specialty in offshore wind, wave or tidal farms.

In line with the aforementioned roles, the additional supporting occupational profiles necessary for the deployment of supporting activities of offshore renewables value chain correspond to the fields and profiles explained below:

- *Offshore renewables attorney*, who is specialized in marine environment and offshore renewable energies policies and legislation. This profile has been proposed to be included in the ESCO database as a specialisation of the existing occupations lawyer, corporate lawyer and legal consultant.
- *Hydrodynamics engineer* or *technician*, who has a specialty in hydrodynamics and is qualified in designing and evaluating the performance of offshore renewable energies devices as well as their anchoring system. After evaluation with ESCO team, this occupation has not been considered for inclusion in the database, due to the important similarities with the offshore renewable energy engineer.

- *MRE control and instrumentation engineer*, who has a specialty in MRE devices and is qualified in envisioning and designing equipment and systems for remote monitoring of the production sites and processes in order to facilitate the interface between the farm operators, the marine renewables devices and the production systems. This profile has been proposed to be included in the ESCO database as a specialisation of the existing occupation instrumentation engineer.
- *MRE control and instrumentation engineering technician*, who assist the MRE control and instrumentation engineer and is responsible for building, testing, monitoring, and maintaining of the technical equipment used in production process. This profile has been proposed to be included in the ESCO database as a specialisation of the existing occupation instrumentation engineering technician
- *Drone pilot*: Drone pilots remotely operate unmaned aerial vehicles (UAVs). They navigate the drone as well as activate other equipment as cameras, sensors as LiDARs to calculate distances, or any other instrumentation. This occupation does not exist in ESCO. It was proposed to be included as cross-sectoral, with some specific skills related to ORE.

All of them have been included in ESCO v1.1

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

www.projectmates.eu
DOI: 10.5281/zenodo.6676557