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

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About this Report

This document was developed through the EC-funded Erasmus+ project **MATES: Maritime Alliance for fostering the European Blue Economy through a Marine Technology Skilling Strategy.**

The objective of the MATES project is to develop a skills strategy that addresses the main drivers of change in the maritime industries, 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.

Duration: January 2018 – April 2022 (52 months)

More information on the project is available at www.projectmates.eu

Document information	
Short description	This document is a result of the Pilot Experience named Green Move. It aims to share the results of the Experience in order to upgrade the mobility programmes in the maritime sectors through greener technologies. It has been released as an extraordinary deliverable, in order to facilitate the use of these guidelines among other interested stakeholders.
Next steps	To be part of the transferrable package of WP4-Pilot Experiences, and the dissemination and outreach activities of WP6 as well. Recommendations obtained from this Experience are to be gathered together with the other project results and transferred to the WP5- Long-term Action Plan and sustainability to feed the Maritime Technologies Skills Strategy.
Work Package	4 - Pilot Experiences
Task	T4.4.Implementation and monitoring
Deliverable	This is an added deliverable of WP4 named MATES Guidelines: mobility programmes in maritime sectors through greener technologies
Dissemination level	Public
MATES website link	https://www.projectmates.eu/pilotexperience/green-move/
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Contents

Glossary & Acronyms

This glossary does not provide official definitions but explanations based on recognized information sources.

Energy storage	Set of methods and technologies used to store various forms of energy. The implementation of energy storage can provide further benefits to the offshore renewables sector. It can ensure the development and improvement of grid integration, as well as the integration of offshore renewables in energy network infrastructures. In addition, it supports the sector´s growth by facilitating the wide installations of large-scale offshore facilities contributing to the reduction of their operational costs.
European Qualifications Framework (EQF)	Common European reference Framework whose purpose is to make qualifications more understandable and readable across different countries and their educational systems. The core of the EQF lies in its 8 reference levels, which are defined in terms of learning outcomes, i.e. knowledge, skills and autonomy-responsibility. Learning outcomes express what individuals know, understand and are able to do at the end of a learning process. Many countries have developed National Qualifications Frameworks (NQFs) to implement the aims of the EQF.
European Quality Assurance Reference Framework for Vocational Education and Training (EQAVET)	The Framework is an instrument for improving the quality of VET systems. It provides a European-wide system to help Member States and stakeholders to document, develop, monitor, evaluate and improve the effectiveness of their VET provision and quality management practices. It can be applied at both system and VET provider levels adapted to the different national systems and used in accordance with national legislation and practice. It complements the work of the European Qualifications Framework (EQF) and the European Credit System for VET (ECVET).
European Credit System for VET (ECVET)	A tool that supports lifelong learning and flexibility in learning pathways, including EU Mobility. It relies on a series of common goals, principles and technical components that foster transparency and comparability in VET. Its most important aspect is the focus on Learning Outcomes to show what a learner knows, understands and is able to do upon completion of a learning process.
Exploitation of alternative fuels and renewable energy sources	Use of alternative fuels (a term embracing all the different substances which may be used as a replacement of conventional fossil fuels that serve today as the main power source for propulsion and power generation in shipping). The most relevant nowadays is the Liquefied Natural Gas (LNG) which has the widest applicability. In addition to this there are also other vessels using other sources for energy, such as electrification which has attracted increased interest as relevant projects are being implemented.
Green retrofitting	Any type of upgrade of an existing structure that is wholly or partially occupied with improving energy and environmental performance. The most important change in current regulations affecting global shipping is expected to address the

	maximum limit of sulphur contents in marine fuels which is to drop from 3.50% to 0.5%.
Green technologies	Refers to a continuously evolving group of methods and materials, from techniques for generating energy to non-toxic cleaning products.
Greenhouse Gas emissions (GhG)	Greenhouse gases (water vapour (H_2O), carbon dioxide (CO_2), methane (CH_4), nitrous oxide (N_2O), and ozone (O_3)) vented to the Earth's atmosphere because of humans: the greenhouse effect of their 50 billion tons a year causes climate change. The vast majority of anthropogenic CO_2 emissions come from the combustion of fossil fuels: coal, oil, and natural gas. Electricity generation and transport are large emitters. Deforestation and other changes in land use also emit CO_2 and CH_4.
Higher Education (HE)	Also called post-secondary education or third-level or tertiary education, it is an optional final stage of formal learning that leads to the award of academic degree. It represents levels 6, 7 and 8 of the 2011 version of the International Standard Classification of Education structure.
Industry 4.0	The digital transformation of manufacturing/production and related industries and value creation processes. Industry 4.0 is used interchangeably with the fourth industrial revolution and represents a new stage in the organization and control of the industrial value chain. In other words, it focuses on automation and data exchange in manufacturing technologies, including cyber-physical systems, the Internet of things, cloud computing and cognitive computing and creating the smart factory.
Lines of Action (LoA)	Lines of Action are those more relevant engagements that have been identified through the work of the MATES Project to address skills gaps in the shipbuilding and offshore renewable energy sectors.
Maritime technologies	Technologies for the safe use, exploitation, protection of, and intervention in the marine environment. In the MATES project there are two fields in which maritime technologies are of great importance: shipbuilding, a sector being updated by the use of alternative fuels and autonomous vessels, and Offshore Renewable Energies, which are now adapting more renewable energies to be used, such as solar energy or wave energy. Specific use in the MATES project as the Shipbuilding and ORE sectors.
Ocean literacy	Understanding the ocean´s influence on human beings and their influence on the ocean.
Offshore Renewable Energy (ORE)	Includes the offshore wind, wave and tidal energy, osmotic and OTEC (Ocean Thermal Energy Conversion). Generally used to designate Offshore Wind energy - MATES also uses the term to refer to Ocean Renewable Energy, which includes four different energy segments: wave and tide, usually known as Marine

	Renewable Energy (MRE), as well as osmotic and OTEC, and even offshore solar energy.
Pilot Experiences (PEs)	Planned actions to test the addressing of gaps in the skills of the workforces of the shipbuilding and offshore renewable energy industries.
Shipbuilding	Building of ships and floating structures, including pleasure and sporting boats, repair and maintenance of ships and boats, and manufacture of marine equipment and marine machinery.
Skills ecosystem	Clusters of high, intermediate or low-level competencies in a particular region or industry shaped by interlocking networks of firms, markets or institutions.
Transversal skills	Blend of content knowledge, specific skills, expertise and literacies which students must master to succeed in work and life. They are also referred to as soft skills, key competencies or 21st Century skills, depending on the classification framework considered. The MATES project has used the P21 framework for 21st Century skills https://files.eric.ed.gov/fulltext/ED519462.pdf and then adopted the ESCO taxonomy in 2020 (Transversal Skills) which are organised in five areas: Language skills and competences; Thinking (cognitive) skills and competences; Self-management skills and competences; Social and communication skills and competences; Life Skills and competences.
Vessel automation, vessel autonomy and advanced robotics	Group of terms referring to the modernization of the vessels based on the development and application of automated systems on ships. This kind of technology will be able to reduce the number of crew members needed to operate a ship, increase the amount of cargo transported at a lower cost and develop more sophisticated information systems based on sensors, cameras and radars.
Vocational education training (VET)	Sometimes simply called vocational training or VET. It is the training in skills and teaching of knowledge related to a specific trade, occupation or vocation in which the student or employee wishes to participate. Vocational education may be undertaken at an educational institution, as part of secondary or tertiary education, or may be part of initial training during employment, for example as an apprentice, or as a combination of formal education and workplace learning.
Work-based learning	Acquisition of knowledge and skills through carrying out, and reflecting on, tasks in a vocational context, either at the workplace or in an education or training institution.

Executive summary

The MATES project carried out eleven Pilot Experiences in order to bridge the gap between educational offers and the demands of the shipbuilding industry and the Offshore Renewable Energy skill needs. One of these Experiences, the Green Move, has demonstrated that blended mobility is an efficient way to provide solutions to the green economy, since it enhances the knowledge exchange between different education levels and worker profiles or institutions.

The essence of the experience can be summarised in three basic principles in order to organise successful exchanges to boost sustainability in the Shipbuilding (SB) and Offshore Renewable Energy (ORE) sectors:

- Results oriented in line with the strategic lines of the participating organisations
- Integration of different countries, institutions, profiles or education level
- Flexibility in the application of funds to carry out the activities needed for a fast response enabling the required skills to be acquired and to be informed about innovative and cutting-edge techniques.

As a result, the Green Move Experience has identified and selected key messages and recommendations that can contribute to upgrading the mobility programmes in the maritime sectors through greener technologies. These outputs have been organised in a guidelines format to facilitate the replication of similar activities among interested stakeholders such as education centres, maritime companies and even policy makers who are willing to promote mobility schemes to boost technical and transversal skills in these two sectors: the Shipbuilding and Offshore Renewable Energy (ORE).

The following guidelines are organised into 4 main parts:

- Introduction, where the objectives of the Pilot Experience are presented
- Methodology, to learn about the protocol and steps suggested to implement mobility programmes for a greener maritime industry
- Results with information about the impact and lessons learnt
- Main conclusions and recommendations which include the key messages to keep in mind when replicating and/or promoting similar actions.

In conclusion, these guidelines constitute a practical tool for those aiming to develop mobilities in the maritime sector.

Introduction

Mobilities have traditionally been considered as efficient tools for personal and professional development of students and workers, enhancing their employability through the acquisition of new skills and competences. Knowledge exchange, language and communication improvements, intercultural-intersectoral dialogue and a better understanding of other educational systems are also important elements of these activities. However, when facing up to 21st Century challenges for the Shipbuilding and ORE sectors certain barriers were soon detected which prevented or at the least impeded the running of courses for these skills, as described in MATES State of the Art Report. The main impediments/constraints can be summarized in three essential groups:

- Those related to funding and the **lack of flexibility** to establish tailor-made agreements with institutions that can provide useful cutting-edge insights for interested partners
- Those existing because of the fragmentation between occupational profiles, countries, levels of education (blue and white collars) and different roles and activities within the value chain.
- And finally those due to the technical characteristics of the sectors that require high-tech solutions for lengthy manufacturing periods and are still working to find solutions to reduce GhG emissions and catch up with Industry 4.0 processes.

In this context, the general objective of this Pilot Experience (PE) is to promote professional mobility (including exchanges and technical visits) of students and workers to encourage the use of green technologies, developed locally, nationally or internationally. Since the Shipbuilding (SB) is a traditional sector, though sharing a niche with the Offshore Renewable Energies (ORE) sector, this PE expects to break down barriers to allow different profiles to work together for the development of clear products resulting from the mobility programmes.

In more detail, the specific objectives are:

- To respond to the identified needs and barriers and promote a better match of trainings to current needs in the application of green technologies to the SB and ORE sectors.
- To foster innovation in training related to the main identified Lines of Actions tackling climate change impact for the SB and ORE industries.
- To build bridges and enhance knowledge transfer between the education community and the industry, as well as between different types of students (VET, HE) and workers (blue-collar, white-collar and pink-collar).
- To prove the benefits of mobility schemes at two levels, personal and institutional, addressing the skills intelligence[1] with special attention to the active involvement of learners and transversal skills.
- To attract people to the industry.
- To overcome problems of standard and rigid mobility programmes and align the training offer to current industry needs and medium-term strategic plans of the interested participants.

[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. (CEDEFOP: https://www.cedefop.europa.eu/en)

Methodology

The methodology of this set of experiences and mobilities is based on the 'European Credit System for Vocational Education and Training' (ECVET), which underpinned the importance of supporting mobility in two binding documents for the partners on the sending and hosting sides as well as for the learners – the Memorandum of Understanding (MoU) and the Learning Agreement (LA)[2].

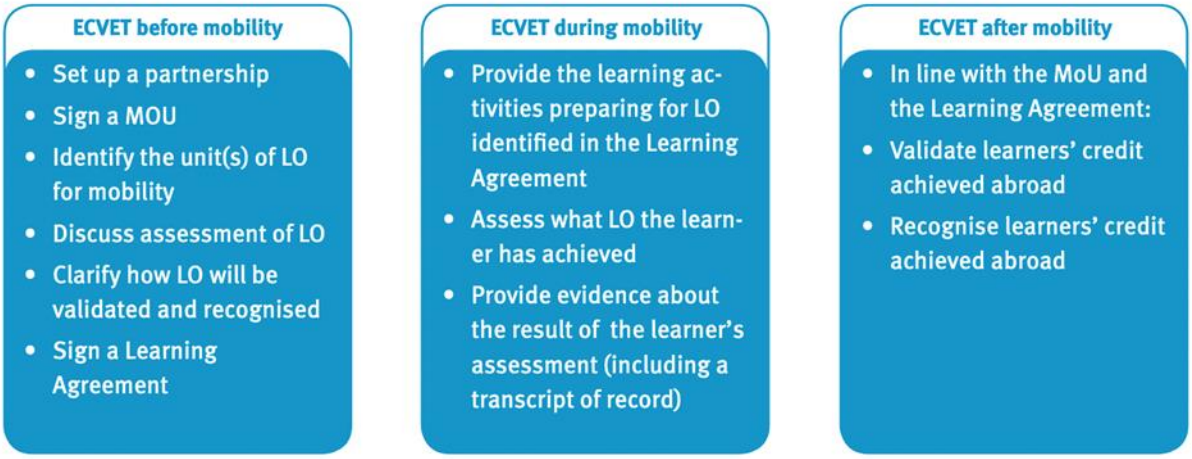

Figure 1: Key issues to be taken into account before, during and after mobility for ECVET, which inspired the Green move in Maritime Technologies.

These, used as a means of promoting green technologies in the maritime sector, are suitable instruments to meet the needs of those organizations with the flexibility to organize the funding for the type of mobility most appropriate to the specific green Line of Action. Hence, the mobilities developed within this Pilot Experience are designed to meet the Blue Circular economy and the Green Deal objectives.

The MATES project prioritized the most relevant Lines of Actions for a Maritime Skills Strategy (Deliverable 3.2 Baseline Strategy identifying priorities, Action Lines and how Pilot Experiences will contribute to the Strategy). For this Pilot Experience the most suitable Lines of Actions to frame the mobilities and exchanges to be implemented were chosen, based on the promotion of green skills and the strategic needs of the participants (educational centres and companies). Those are:

SB3: Minimising environmental impact

SB4: Decontamination and recycling of vessels
SB5: Better matching of trainings to current needs in technical disciplines
SB8: Promoting STEM women in SB
SB9: Skills ecosystems

ORE3: Synergies among sectors with significant similarities SB6: Transversal skills
ORE4: Skills diversification from parallel sectors
ORE5: Multi-disciplinary skills outside of specialization
ORE7: Offshore economics
ORE8: Skills that are not yet standardized
ORE9: Legislation, guidelines and policies
ORE10: Transversal skills
ORE11: Ocean Literacy
ORE12: Promoting STEM women in ORE

[2] http://eu-mobility.eu/documents/

The different activities undertaken in the Green Move Experience address a wide range of the European Qualifications Framework (EQF) levels, from Level 3 to Level 8 (Figure 2).

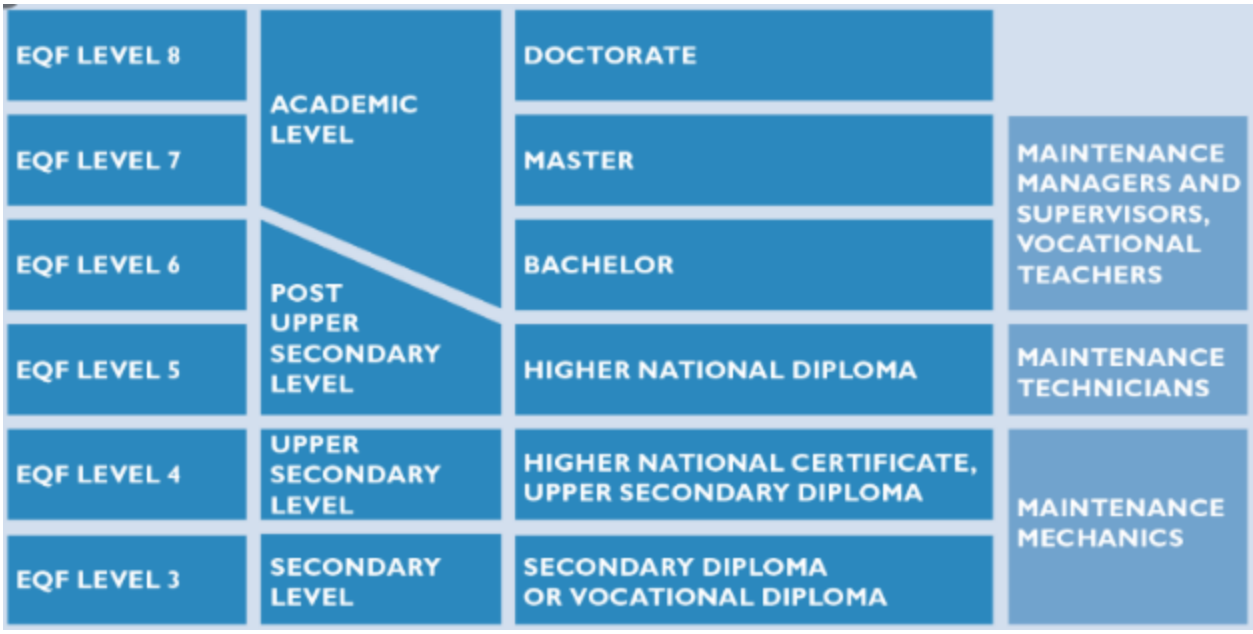

Figure 2: European Qualifications Framework (EQF) Level: Level 3 to Level 8

Finally, an Action Plan was designed to carry out the MATES Green Pilot Experience in 6 phases as shown in Figure 3:

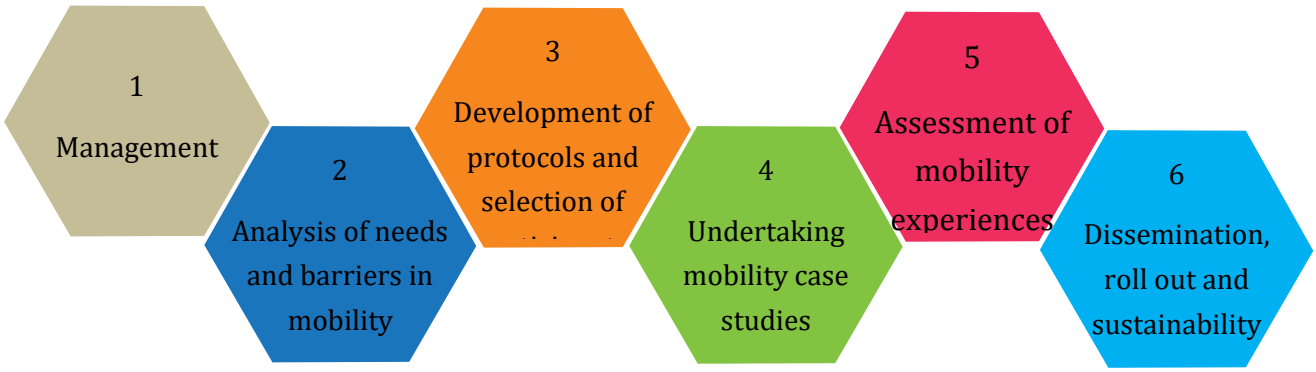

Figure 3: Action Plan for the Pilot Experience Green Move

STEPS to ORGANISE A GREEN MOVE ACTIVITY

Additionally, the "Ten steps protocol" was created to facilitate the organization and implementation of each exchange visit and mobility, with a clear orientation towards the well-known concept "learning by doing".

STEPS BEFORE MOBILITY

1. Choose the main interest point of the mobility

Choose the General Theme: e.g. green maritime technologies, energy storage, alternative fuels and renewable energy sources, green retrofitting, vessel automation, vessel autonomy and advanced robotics, industry 4.0

Choose the Transversal topics: e.g. gender balance, ocean literacy, digitalisation, governance, VET standards...

2. Establish your stakeholder network

List the potential stakeholders in your thematic area of interest (nationally and internationally)

Select and contact potential stakeholders to evaluate their interest

3. Get a better knowledge of the selected stakeholder

Prepare a questionnaire for education and training centres /companies about their interest in green move actions to define the:

- Profile required: student, teacher, blue collar-white collar worker.

- Length of the exchange (how long they would like to have an internship).

- Specific mission/task to be accomplished in the education centre, the department, or the company (e.g. identify measures on minimising environmental impacts, decontamination and recycling of decommissioned vessels, skills diversification)....

- Specific knowledge and skills that the participant will acquire.

4. Confirm that the selected stakeholder meets your general and specific criteria

General criteria refer to matters related with the exchange itself, e.g. contact person, period of the exchange, etc.

Specific criteria in Green Move to check the viability of focusing on a particular Line of Action such as for ORE9: Legislation, guidelines and policies: to share information about how the institution addresses green policies (CO2 emissions reduction, contamination, etc.), ORE3: Synergies among sectors with significant similarities, or ORE4: Skills diversification from parallel sectors.

5. Design the mobility/exchange protocol and select the participants

Map the roles and responsibilities with the stakeholder/partner and agree on the terms of reference, Memorandum of Understanding, contracts, etc. making clear the Learning Outcomes, the type of assessment.

A proposal for the person/institution interested in mobility should be submitted. In the case of the Green Move it should focus on green technology related events/courses/activities with specific contents on ocean literacy.

Proposals/CV/profiles should be evaluated to select the participants.

6. Organise an online meeting/workshop with the partner and the participant/s

It can be useful to review the necessary steps and adjust the necessary details for success and to pilot the mobility before the launching.

Gain and maintain the trust of these partners and participants.

STEPS DURING MOBILITY

7. Develop the activity/mobility

Welcome and accompanying meetings during the conference, visit, internship, etc. should take place.

Both learners and institutions need to make the most of the experience, not losing sight of the Learning Outcomes and the strategic needs of the receiving institution.

A report in English is required at the end of the internship, including recommendations to improve the mobility before, during and after (“*before”* also includes education programmes or activities followed before the mobility programme itself: e.g. contents at the school, VET or university courses).

8. Assess and document learner’s achievements

Monitoring and assessment documents should be recorded (learning results, satisfaction surveys…), and some material for the post-activity dissemination (pictures, videos, news, articles…).

STEPS AFTER MOBILITY

9. Certification

A diploma, certificate or official accreditation of the mobility must be provided, including the name of the participant, the duration, the Learning Outcomes, the EQF levels and the marks or distinctions if any.

10. Transfer the acquired knowledge

- It is expected that the lessons learned through the exchange will be transferred to the education centre/workplace.

- Specific products should be made available regarding a given mobility/internship: e.g. report on the key technical knowledge learnt, brochure to promote the use of green technologies in ORE and SB industries; solution to a defined problem of the industry; recommendation for a policy in green technologies for ORE/SB

Lessons learnt and Recommendations

Lessons learnt from Green Move exchanges	Recommendations
• **Work-based non-formal training** motivates students. • **Professional development** is attractive for teachers and workers. • Joint training activities such as visits, internships, conferences…, addressing **both teachers and students** where possible.	• **Stakeholders' involvement in the contents design of the mobilities and early promotion of the activity.** • Support modularity in educational offer to boost lifelong learning and upskilling processes. • Tailor concrete curricula for specific training needs of the maritime technologies sectors.
• The interaction between companies and students/teachers has proved useful to **increase the students' knowledge and skills on new green technologies to meet the industry needs for the green challenges** of the sector. This encourages students, teachers and workers to develop a **multidisciplinary interest/view**.	• Mobilities in SB and ORE should be oriented to problem-solving and promotion of green technologies through sharing knowledge and Project-based learning. • Since Covid-19 has modified the mobility paradigms, especially in the case of technical and practical visits by students, **Guidelines for blended educational mobility programmes in maritime sectors through greener technologies** are needed.
• Remote activities are less valued than the face-to-face ones: the l**earning curve is slower and it** is more difficult to generate strong collaboration networks. • Virtual exchanges (**save time and resources**): **expand** the scope of the activities and allow exchanges with a greater number of students and companies. • Blended/virtual mobility structure can be **easily applied and transferred.**	• Attention should be paid to the organisation details of the activities **to avoid** virtual members being relegated to **secondary participants.** • Objectives and scope of the meeting should promote the advantages but also take limitations into account. • Promotion of intercultural, inter-sectoral and inter-profiles exchanges and blended mobilities through funds destined to fulfil the strategic plans of the educational and industrial organizations.
• Mismatch between the consenting and licensing regime that may make the advancement of the industry and certification-recognition processes difficult.	• The consenting and licensing regime for ORE should advance at the same rate in order to be a streamlined and risk-based process. It is important that as these sectors progress, these mobilities can find solutions to these challenges.

	• Attention should be paid to the contents of each activity in order to find policy solutions and effective regulations to reduce environmental impacts.
• Despite the fact that remote activities are less valued than face-to-face ones (the **learning curve is slower and it** is more difficult to generate strong collaboration networks) virtual exchanges **save time and resources**, **expand** the scope of the activities and allow exchanges with a greater number of students and companies.	• There is a **wide audience who benefit** from the educational nature mobility activities: **sharing knowledge and focusing on greener solutions** (industry: education centres, administrations responsible for education and training programmes at a European level and at national level as well). • Increase the use of virtual reality and simulators combined with mentoring and on-site practices.

Conclusions

In this PE, there is considerable potential for replication and/or upscaling. The blended model of mobility proposed can be easily transferred to other studies and locations and replication is already under consideration by project partners and stakeholders.

There is much to learn from regulators and other stakeholders and many data and lessons learnt can lead to transfer opportunities that will increase the likelihood of success for the industry.

The guidelines and the set of mobilities will benefit the targeted audience (educational centres, companies and administration) because of the educational nature of this Pilot Experience. However, the potential audience is not limited to administrations responsible for education and training programmes at a national or European level; in fact there is a broader opportunity for knowledge sharing and dissemination between more diverse groups of stakeholders and many other countries around the world: e.g. North America, South America, South East Asia, Japan and Australia.

The engagement of stakeholders to increase the impact of knowledge transfer and dissemination activities is extremely important in both the modernisation and greening of the SB sector and the growing ORE industry.

List of participants / institutions

Partners involved

CETMAR
UNIVERSIDADE DA CORUÑA
aquatera
CIFP Centros Integrados Formación Profesional SOMESO
IES Universidade Laboral
CIFP Ferrolterra
XUNTA DE GALICIA
CONSELLERÍA DE CULTURA, EDUCACIÓN E UNIVERSIDADE

External Collaborators

ALBAOLA
LA FACTORÍA MARÍTIMA VASCA
Tabsal
easo politeknikoa
Navantia
ACEBRON GROUP
Mercedes-Benz Louzao
ASINEC
MARINE ENERGY WALES
YNNI MOROL CYMRU
DTU Denmark Technical University
Televes
QUEST BORN TO ENGINEER
edp renewables
accenture
GAELSA
sonepar ibérica
grupo intaf
FUAC

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Annex I – MATES Mobility cases compilation

1) Round table to organize internships and mobilities in Europeans Masters in Naval and Ocean Engineering - Galicia (Spain)

Especially focused on the Erasmus Mundus Joint Master Degree "Sustainable ship and shipping 4.0"

Figure 1: Screenshot of the online meeting

Date: 5th & 12th March 2021.

Leader: University of A Coruña

Format: online through TEAMS platform

Duration: 4h each day

Participants: 96 students, 12 Professors from 5 Academic Institutions and 10 workers from 8 companies.

It focused on three topics:

a) Definition of evaluation methods for online activities

b) Definition of recommendations for blended mobilities in green technologies. The blended mobilities were to involve not only academia, but industry and other social partners.

c) Debate about how to address transversal skill through mobility actions.

There were three invited speakers presenting each of these topics, focusing on handicaps, proposals, lessons learned, etc.

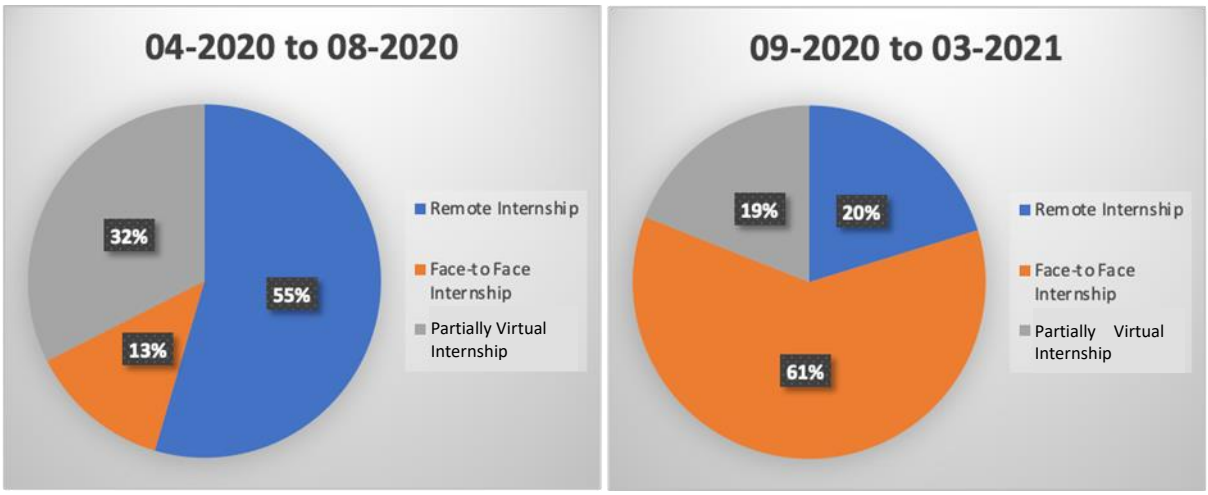

Figure 2. Evolution of preferences about remote or face-to-face internships with time. Plot on the left is during the covid-19 pandemic restrictions and the one on the right one year later.

2) Workshop in Sustainable ship and shipping 4.0 - Galicia (Spain)

Date: 21st May 2021

Leader: University of A Coruña

Format: online through TEAMS platforms

Duration: 4h

Participants: 10 (from 4 Universities & 2 VET Centres)

The main objective of the Workshop was to discuss the future of blended programmes for sustainable ship and shipping 4.0 and to define how to address transversal skills through mobility actions.

This exchange together with number 1 of this compilation, led to a series of recommendations:

- Direct communication between the tutor and the student is essential (virtual or face-to-face).
- Fully virtual practices only in large companies with the entire staff working remotely.
- Remote traineeship requires a longer adaptation period.

And ultimately it leads to the successful implementation of a new blended Master in Industry 4.0

3) Virtual Exchange to reduce environmental impact of marine renewable energy entitled "De-risking consenting of tidal energy arrays" - Scotland - UK

Date: 29th Jan 2021

Leader: Aquatera from the Marine Energy Wales online side event

Format: Online Workshop

Duration: 3.5 hours

Participants: over 70 across the UK, Europe, and North America representing industry (13 companies), academia (12 institutions), government and regulatory bodies, statutory advisors, NGOs and others from the tidal sector (including Scottish Government, Welsh Government or Statutory Nature Conservation Bodies such as Natural Resources Wales or environmental NGOs such as the Whale and Dolphin Conservation Group).

The objective was to share knowledge on the latest understanding of the environmental impacts of tidal energy arrays and to explore the remaining challenges and uncertainties within the environmental consenting of tidal energy projects under EU legislation.

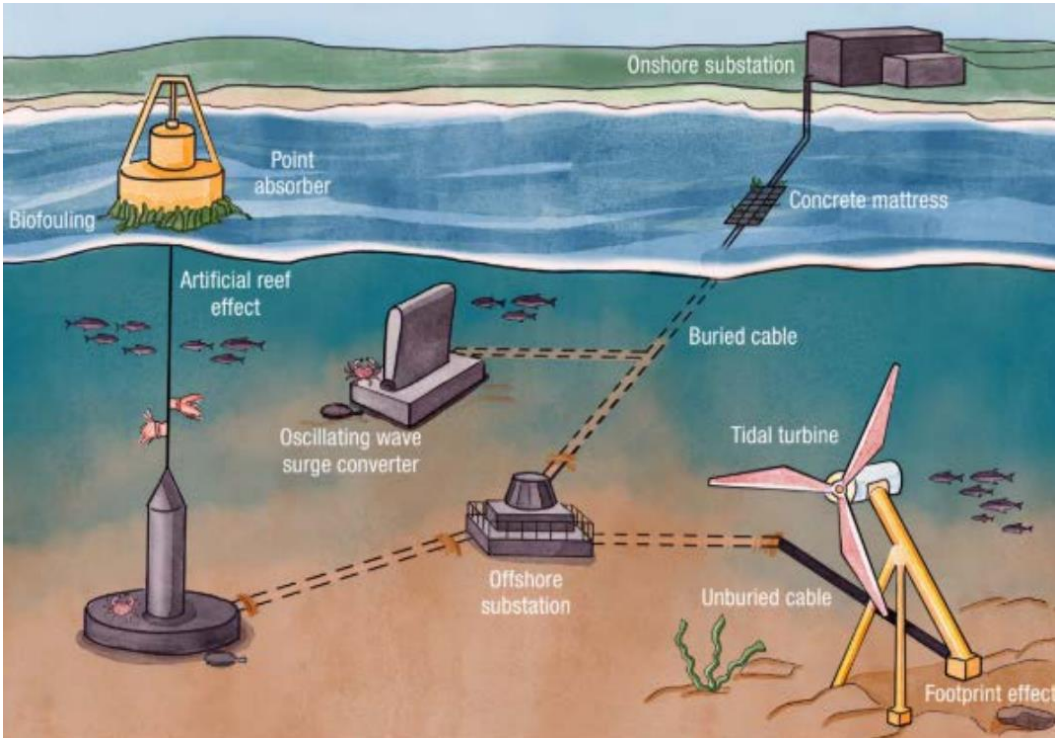

Figure 3. Plot showing the key elements of offshore deployments

Making sure that the ORE industry minimizes the environmental impact is key for its development. **The workshop promoted the use of green technologies developed internationally in Wales** through the targeted discussion of how to streamline the consenting and licensing process for tidal energy technologies. It was part of the continued effort to better disseminate knowledge and information and to provide an opportunity for knowledge exchange in relation to the current status of the environmental challenges that exist within the tidal energy industry. This included such things as:

a. Few tidal energy devices have been deployed for long durations, and only a handful of small arrays have been installed. This limits evidence from deployments to information collected at only a few sites, and often for short durations (with some exceptions). The Scottish Government's incremental 'Survey, Deploy, and Monitor' approach was noted as a helpful strategy for enabling developments to proceed. Accelerating consenting of further small-scale arrays could provide

opportunities to improve the evidence base and increase the reliability of monitoring tools and techniques, thus bringing costs down for individual developers.

b. The environmental evidence gaps associated with tidal energy developments are complex and multi-faceted. Research and monitoring technologies, techniques, and protocols must continue to be developed to grow the scientific evidence base for consenting, to improve the reliability of monitoring technologies and to enable the transfer of knowledge between development locations or tidal technologies, bringing down the cost of monitoring and Levelised Cost of Energy (LCOE). Research groups must collaborate across receptor types to enable simultaneous data collection to address multiple needs, while developers and regulators must be involved to enable testing and validation of new technologies in 'real world' environments, and to ensure that the data collected meet regulatory needs.

c. Data availability and transferability remain challenges across the tidal energy sector from the perspectives of researchers, developers, and regulators. Where data do exist, standardisation of data collection and sharing and storage protocols can assist with data transfer and comparison between development sites, and along with anonymization and omission of operational details, could also help to address some of the data-sharing challenges associated with intellectual property.

d. All breakout groups highlighted the need for better communication across stakeholder groups in the tidal energy sector to ease the process of knowledge transfer between sites and regions. Although there are still significant gaps, the scientific evidence base for tidal stream energy continues to grow, and it is important that the tidal energy community (regulators, academia, and industry) work together more closely to apply the evidence that is available to de-risk consenting.

4) Educational visit to learn and evaluate techniques and methodologies in construction, rebuilding, refurbishment and recycling of sustainable wooden boats - Basque Country (Spain)

Date: 8-10th June 2021

Leader: CIFP Ferrolterra (Culture and Education Regional Government of Galicia)

Format: In-presence visit

Duration: 3 days

Participants: 7 VET teachers and 2 VET students, 1 company (Tabsal) and 3 Vocational Training centres (Albaola , EASO Politeknikoa and the Labour University of Gijón)

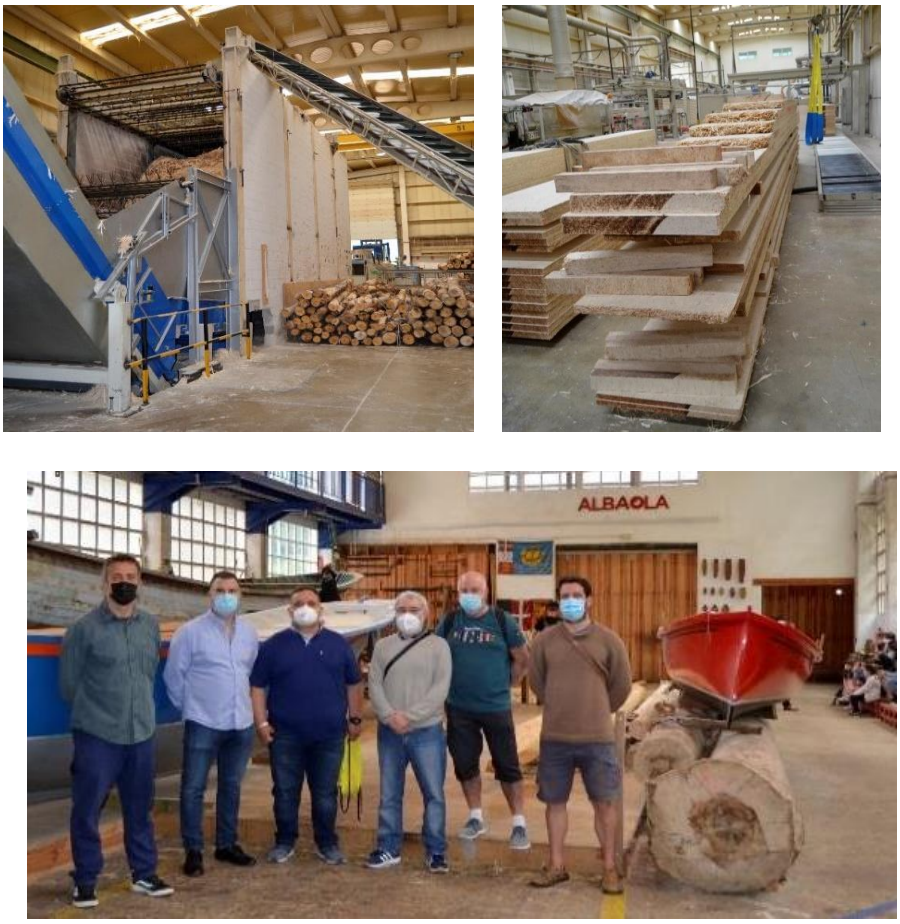

Figure 4. Photos of the visit. Up: Tabsal and down: Ferrolterra's VET teachers at the Albaola VET centre

The visit enabled knowledge exchange about different techniques of manufacturing, ecological construction materials and its use in the maritime industry of traditional and modern boats. The main outcome of visiting the Labour University of Gijón was an exchange about the process of digitizing plans of an American boat under construction reproduced with CNC technologies (this is like the automated industrialization process for any boat). This technique is going to be applied in Ferrolterra Education Centre.

In addition, two other topics were tackled: the role of women in carpentry projects in other education centres and the UNE-EN ISO 14001 environmental standard applied to carpentry studies.

5) Future prospects for offshore wind energy. Manufacturing processes related to offshore structures - Galicia (Spain)

Date: 28th May 2021

Leader: CIFP Someso (Culture and Education Regional Government of Galicia).

Participants: 10 students and 9 teachers from 2 VET Centres. 1 company Navantia – Fene Installations

Format: In-presence visit

Duration: 4 hours

The visit was useful to verify the promising prospects for offshore wind energy and to learn about the organization processes related to offshore structures manufacturing.

Figure 5. Photo of the students visiting Navantia's grounds

6) Attendance at the Conference on Ecopainting - Basque Country (Spain)

Date: 4-6th June 2019.

Leader: CIFP Someso (Culture and Education Regional Government of Galicia).

Format: In-presence visit

Duration: 3 days

Participant: 1 teacher from VET centre CIFP Someso

Link to the conference: https://bilbaoexhibitioncentre.com/en/eventos/polveri-ecocoating-2019/

The objectives were:

- To learn about more ecological and efficient ways of painting.
- To acquire necessary tools to transfer new sophisticated technologies to the VET centre students.

The knowledge acquired concerning the technologies in Eco painting was transferred to the students of the VET centre.

7) Attendance at the Automation and Robotics Workshop - Galicia (Spain)

Date: 14th September 2021.

Leader: CIFP Someso (Culture and Education Regional Government of Galicia).

Format: In-presence visit

Duration: 3 hours

Link to the event: https://mindtechvigo.com/en/workshop-automation-robotics/

Participant: 1 teacher from a VET centre

The objectives were:

- To complement previous activity and keeping up-to-date on robotic applications to efficient and intelligent shipbuilding techniques
- To acquire advanced knowledge and tools to transfer new techniques to the VET centre students.

This knowledge was directly transferred to the students of the Someso VET centre. Automated welding robotics is a valuable skill for the students looking for a job in the maritime industries such as Navantia.

8) Educational visit to an international fair and relevant coastal structures (Husum- Germany & the Delta Plan in Holland)

Date: 15-17th Sep 2021

Leader: CIFP Ferrolterra (Culture and Education Regional Government of Galicia).

Format: In-presence visit

Duration: 3 days

Participants: 3 VET teachers and 1 company HUSUM Wind Fair

The objective was to gain knowledge on offshore wind energy maintenance resources and operations, effects of storms on offshore wind farm installations and execution of large corrections on the high seas.

Additive manufacturing is already present in the wind power sector, for different reasons: the use of special materials, a great capacity to optimize the material and, therefore, the lower weight of the elements. They learnt about the application of the latest scanners, and the software used to facilitate the inclusion of this technology in wind power. The knowledge was directly applied in a 6-month specialization course for the students held in November 21 at CIFP Ferrolterra.

They also saw in the Fair the latest technological advances and made contacts e.g. with a company from Valencia that provides a large part of the hardware and non-welded fixed elements of wind farms, and that supplies and provides service during their execution.

Among the many fields from the wind sector shown in the Fair, they selected the most interesting to them and directly related to the modules taught in their VET Centre –area of Higher Technician in Industrial Mechatronics. This knowledge was transmitted to the students in the current school year and in future, as follows:

- **Mechanical systems and manufacturing processes: t**he production of machined parts, in special materials with high performance and subjected to great efforts. Machine tools for high tightening torques but with digital controls.
- **Systems integration and automated systems programming:** Visualization and control in the communication systems of a wind-power generator.
- **Machine elements.** Verification and control of the fatigue in some materials used in the wind power sector, especially in relation to blades.
- **Applications that would affect several modules of these studies and that are the most interesting ones in this professional family:**
  - *Stability control on the ship deck:* damping system to give a better stability to the boat, especially if work on it requires this condition, such as in the case of the construction of offshore wind farms.
  - *Inspection robots:* until today, when there was the possibility of an internal fissure in the blade, an operator had to get inside along the blade through a very small space in order to verify and check this possible fissure. In this new way, the operator avoids being subjected to the stress of confined spaces and is able to verify the inspection through the robot cameras.

Concerning inspection aids, two companies explained the latest developments, including a drone with a double helix and a lightweight carbon fibre structure. As a result of this visit, they discovered that there is an application to clean the blades of wind turbines with the help of drones, by means of an umbilical cord with water pressure. This is a very interesting point because, as a result of the good relationship with the University of A Coruña and specifically with the laser research team, some time ago they were talking about the possibility of being able to clean blades using lasers and with the help of a drone. One of the points made that was outside the field of their knowledge was the control by drone, but it seems that now this point has been already advanced and proved.

As a result of the networking in Delta Plan, the participants drew up a contact for the specific training of teachers and students in two different fields: on the one hand, being able to access a wind farm without the GWO courses (they are mandatory in Spain and, in some cases, even with these courses people are not allowed to access to the wind farm without permission from its owner), and, on the other hand, being able to see the operation of a biogas plant (a renewable energy that is widespread in The Netherlands although practically unknown in Spain). But the most important thing is that they could learn directly from technicians specializing in these two technologies and, moreover, could be on-site during the explanation, to understand how all its components work, their possible breakdowns, etc.

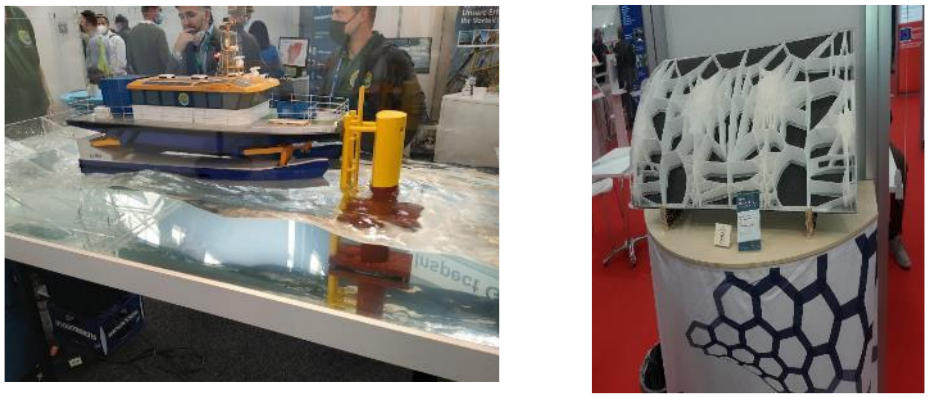

Figure 6. Photographs of the visit Top left: damping system for stability on the ship deck. Top right: Example of additive manufacturing. Middle: General view of Delta Plan, which is the largest defence project against the sea in the world. Bottom left: teachers at the Maeslant Barrier, one of the last mobile dikes to be built. Bottom right: One of the teachers at Delta Plan.

9) Conference on Generation and Sustainability - Galicia (Spain)

Date: 24 & 25th/11/2021.

Leader: CIFP Someso (Culture and Education Regional Government of Galicia).

Format: Blended conference

Duration: 2 days

Participants: Students and teachers from CIFP Someso, the Commerce Confederation of A Coruña and 5 companies: Iberdrola, Navantia, Acebrón and Louzao Mercedes Benz, ASINEC, 1 harbour (Porto de Ares) and 1 sailors' association (A02-velas). In total: 138 people (62 men and 12 women) on the 24th and 75 people (64 men and 11 women) on the 25th

Link to the video: https://www.youtube.com/watch?v=QHFlxsEcmjs

The objective was to learn the sustainable basis of the offshore wind energy generation, from the equipment maintenance and the electric motors until the energy storage and electric batteries. An introduction to solar energy and panel installation was also explained. Finally, information was transferred about the MATES project and different applications of these new technologies to the maritime sector.

10) Hybrid seminar on Shipbuilding: innovation and sustainability - Galicia (Spain)

Date: 18/11/2021.

Leader: CIFP Someso (Culture and Education Regional Government of Galicia).

Format: Blended conference

Duration: 4h

Participants: 58 Students and teachers from CIFP Someso (welding, metallic constructions and machining) streaming event and a teacher from Madrid Politechnical University.

Link to the video: https://youtu.be/8Xr3FCkXTuc. This event was published (in Spanish) at the regional government website: http://www.edu.xunta.gal/fp/node/18155. More info can be found at http://www.edu.xunta.gal/fp/proxecto-europeo-mates .

The objective was to get in-depth knowledge about the new challenges and approaches taken in the shipbuilding industry regarding innovation, as well as strengthening awareness about how important sustainability has become in the maritime industry.

The topics addressed:

- Origin, first steps and evolution of shipbuilding
- The first three industrial revolutions: what did they contribute to society?
- The fourth industrial revolution: revolution or evolution?
- The use of smartphones and tablets and QR codes in production
- Embodiment of design rules in a digital system
- Virtual reality in industry
- Laser scanning: reality in the virtual world
- The use of new materials
- Artificial intelligence

- Sustainability in heavy industry
- Conclusions and discussion.

11) Educational visit to Offshore wind production facilities and education centres in France

Date: 6-7th/12/2021.

Leader: CIFP Someso (Culture and Education Regional Government of Galicia).

Format: In-presence visit

Duration: 2 days

Participants: 5 teachers from 2 different departments of CIFP Someso (Mechanic manufacture and Management and Enterprises), companies NAVANTIA-Windar (Brest), IBERDROLA (Saint Brieuc) and 1 VET education centre Liceu Vauban (Brest)

The objective was to visit Navantia - Windar's production facilities in order to:

- **Understand and analyse** the production processes used by the UTE (Temporary Union of Companies)
- **Understand** the distribution and location of the workshops
- **Understand** the transport logistics of the production to Fene
- **Understand** the coordination among the UTE's production centres.

And to visit Vauban education centre in order to:

- **Get a deeper knowledg**e about the VET in France, specifically on mechanic manufacture and labour orientation.
- **Understand the management** (of human and material resources) and the development of training programmes of the education centre
- **Exchange best practices** between teachers and learn about sustainability practices in Someso and in Vauban education centres
- **Transfer the MATES projec**t in general and the Pilot Experience Magnus effect in particular. An important outcome of this transfer is the shared interest in Virtual Reality Simulators. Detailed information and materials were shared, a painting simulator for jackets from Someso VET centre and a productive simulator in a metal building workshop used by Vauban centre.

CONCLUSIONS

- Visualization of the training needs necessary to adapt to the situations of the different projects, during the visit to NAVANTIA and WINDAR RENOVABLES

- Knowledge transfer: the LICEU VAUBAN was interested in using the virtual reality tool developed by the CIFP Someso in the framework of the MATES project, called AIRLESS, which simulates the metallic structures painting. Likewise, the CIFP Someso will use the LICEU's assembly system of pipe structures.
- Training by projects. It was considered, both by the LICEU and by the assistant teachers, that training by developing specific projects was the best way currently to develop the abilities of the students
- Exchange on common training problems and solutions
- Agreement with WINDAR RENOVABLES for the inclusion of CIPF SOMESO students to carry out internships in their company and study the possibility of carrying out a DUAL FP.
- Accommodation of training plans.

Figure 7. Photographs of the Visit to Navantia in Brest (France)

Figure 8. Photographs of the Visit to the Charpente Marine du Légué (ship repair, especially for the fishing sector)

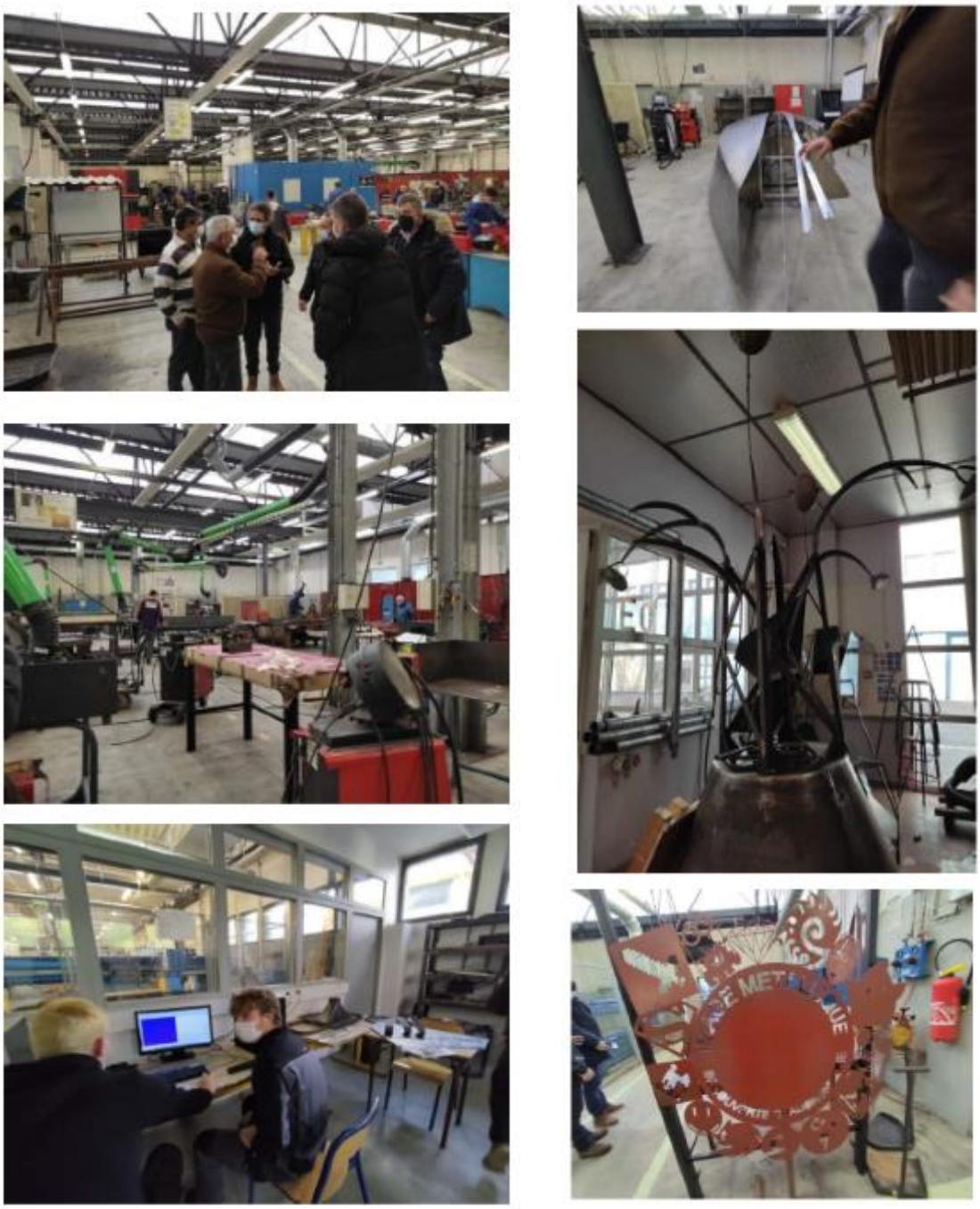

Figure 9. Photographs of the Visit to the Liceu Vauban

12) Workshop on digitalisation and BIM (Building Information Modelling) - Galicia - Spain

Date: 30th November and 1st December 2021.

Leader: CIFP Universidad Laboral (Culture and Education Regional Government of Galicia).

Format: In-presence workshop

Duration: 2 days

Participants: 5 Teachers and 9 students from Universidad Laboral

The objective was to train trainers in the use of a versatile tool, with which it is possible to digitize the current state of sites, using different digitization techniques to obtain point clouds and photogrammetric models. The knowledge acquired is applicable to multiple purposes as for example to survey the current state of installations in wind turbines or any other industry, in order to proceed with modifications to the facilities, using the point clouds that result from the field survey process and subsequently the treatment of these point clouds and their modelling using BIM (Building Information Modelling) methodology[3,4]. BIM has a strong development worldwide for both the development of projects with collaborative digital tools in the project phase and the exploitation of the asset.

Digitization with photogrammetry and 3D scanner equipment enables models faithful to reality to be obtained. This enables them to adapt to changes and to modify processes related to the design, installation or management of projects and assets, while obtaining an accurate inventory of the facilities allowing decisions to be made regarding its destination, state, reuse or recovery, necessarily going through the circular economy process that helps to reduce waste and optimize resources.

This workshop:

- **Established relations** between the main company in the sector and the educational centre
- **Allowed attendees to develop the necessary skills** to handle digitization equipment and tools useful for AEC (Architecture, Engineering and Construction) sectors as well as Shipbuilding and ORE sectors
- **Allowed attendees to develop data processing capabilities** such as photogrammetric and point cloud models
- **Served to develop the capabilities for modelling** the current state and obtaining digital twins
- Is useful **to develop strategies** for the generation of zero waste in the reforms of industrial facilities, because of the use of digital models
- **Contributes to the development of the concept of circular economy** applied to the AEC sectors; e.g. in activities related to the reform of ORE devices and industrial facilities

- **Learning and defining the application for ORE and SB**: This technology allows the three-dimensional (3D) survey of existing facilities that are difficult to access in order to develop BIM models that can be converted into Virtual Reality models, augmented or mixed. This allows real-time monitoring of costly and difficult-to-access offshore wind turbines that even the most veteran and most experienced engineers cannot access. This experience can be used from a control space so that operators with the appropriate physical shape to access the wind turbines can be directed or monitored in real time. In the case of shipbuilding, as in most industries, production processes are changing and this technology allows an exact survey of the state of a

[3] Poljansek, M., Building Information Modelling (BIM) standardization, EUR 28977 EN, Publications Office of the European Union, Luxembourg, 2017, ISBN 978-92-79-77206-1, doi:10.2760/36471, JRC109656

[4] Rabia Charef, Stephen Emmitt, Hafiz Alaka, Farid Fouchal, Building Information Modelling adoption in the European Union: An overview,Journal of Building Engineering, Volume 25, 2019, 100777, ISSN 2352-7102

manufacturing process to be able to replicate or even modify it in a BIM model. This also allows data to be processed to create models for the elaboration of digital twins

- **Sets the basis** for collaborative work in BIM processes
- **Allows the Learning Outcomes** of the Specialization Course in Building Information Modelling (relevant topic in European training programmes) to be achieved.
- Trained trainers who produced a multiplier effect, transferring knowledge to several groups of students from different specialities (Maintenance of facilities, Renewable Energies, Maintenance of ship facilities, etc. highlighting the Specialization in BIM), to be able to handle this equipment and the software tools to be at the forefront of the development of BIM models.
- During this workshop discussions about the role of wind energy as a key player to achieve climate neutral economy in Europe took place, as well as other related topics such as energy storage, hydrogen, etc. to join the conversation on how to build a clean economy, debating changes needed in policy, business models and technology to deliver the transition.
- Finally, this workshop enabled an application which is shortly to be developed: the digitization of the centre. Also the classroom or workshop are open to virtual users, which is very useful to organise activities or to find out where a new lecture or exam will be held. Links to relevant information about each classroom can also be included providing the user with all information needed in advance. So, the number of car trips may be reduced or optimized and the CIFP Universidade Laboral can be seen to be up front in the digitalization era.

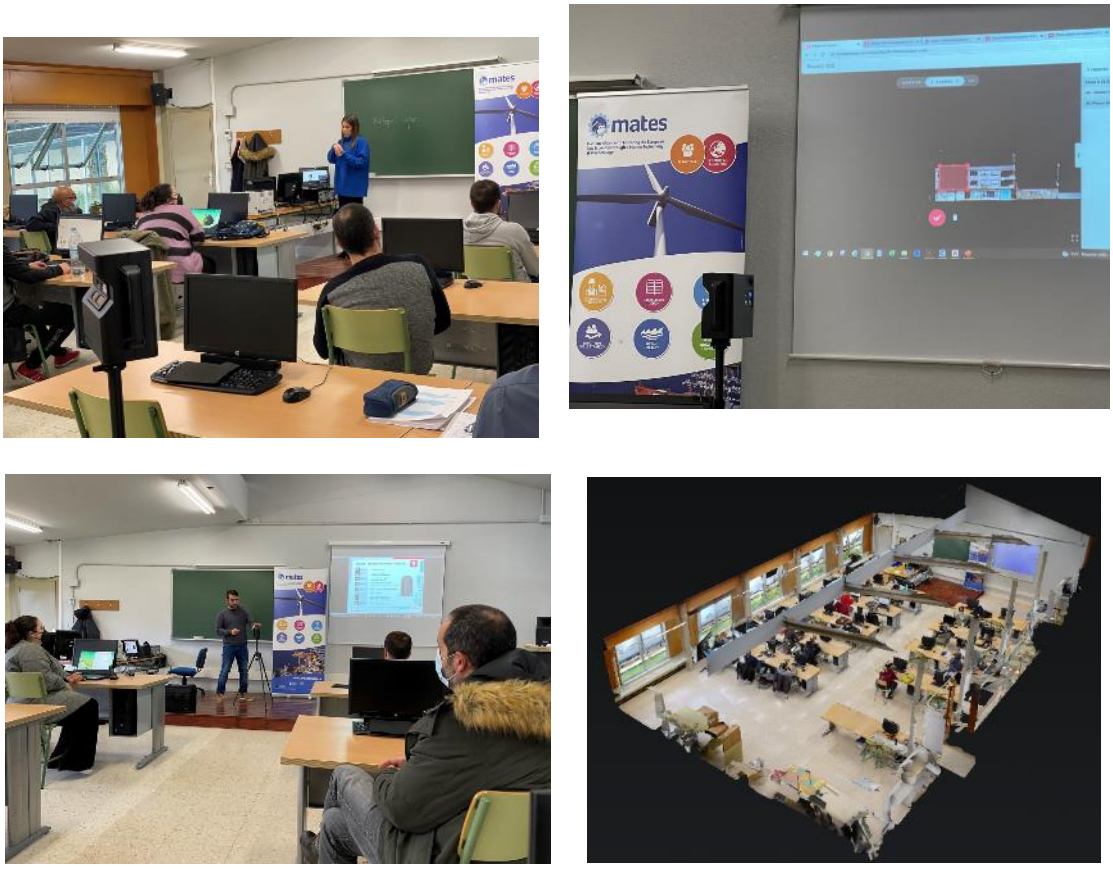

Figure 10. Photos of the classroom on the left and the BIM technology on the right


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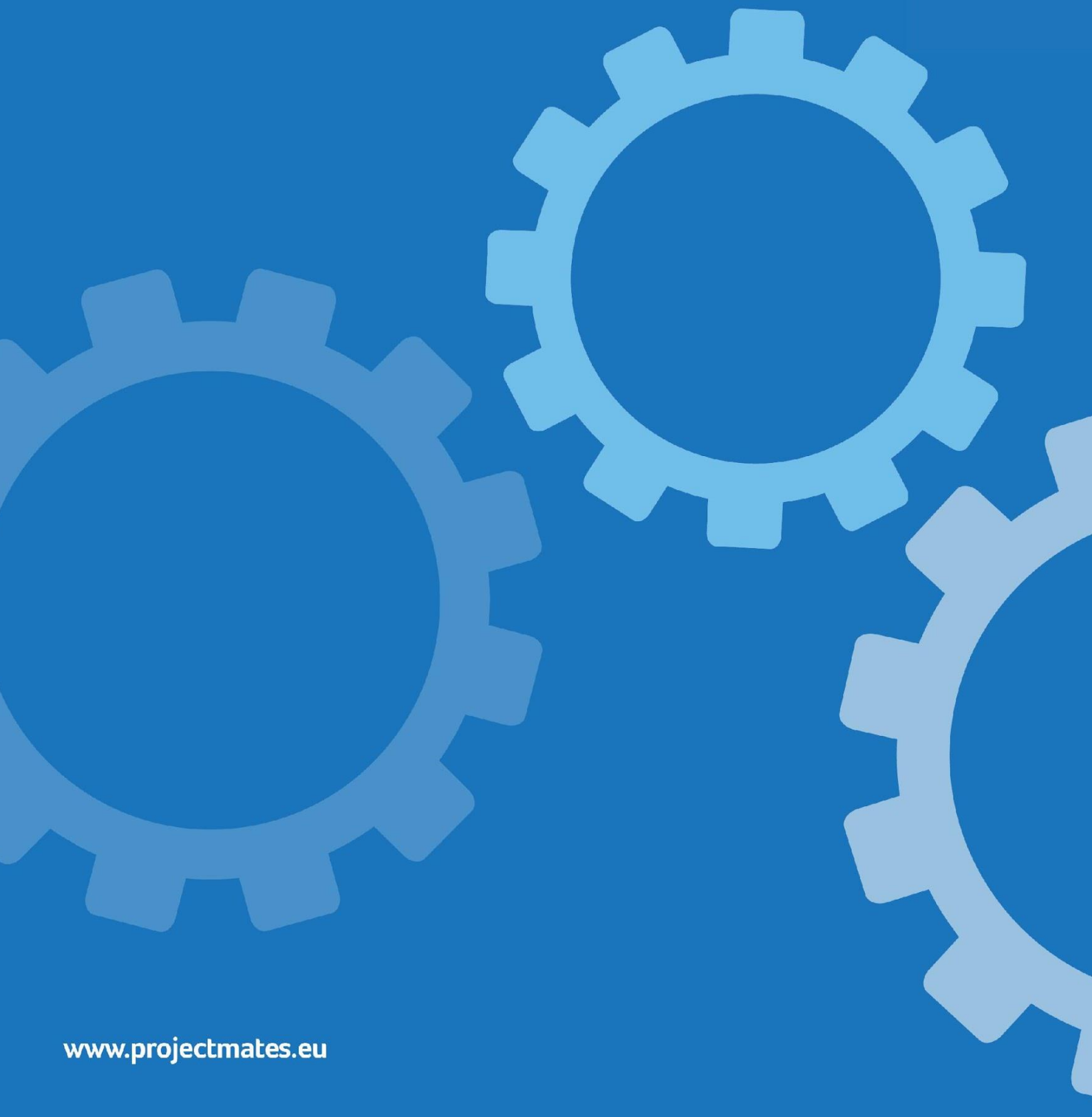

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