

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



Highlights of MATES Pilot Experiences

"Training Seminar on Additive Manufacturing and Risk Management in the Shipbuilding and Ship-Repair Sectors"

Layman Report January 2022

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 projectmates.eu.

Document information						
Short description	This report presents an overview of the "Training Seminar on Additive Manufacturing and Risk Management in the Shipbuilding and Ship- Repair Sectors" Pilot Experience, its achieved results and guidelines for developing similar trainings in the future in close consultation with key public and private relevant stakeholders at national level that will support the transition of the shipping sector into a more sustainable future.					
Next steps	These results present a solid foundation for the Maritime Technologies Skills Strategy and the long-term Action Plan and sustainability.					
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Lead authors	George Tsafonias, Vasiliki-Maria Perra, Boile Maria, Sdoukopoulos Eleftherios					
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1. Context

Worldwide efforts to enhance the environmental performance of shipping have been intensified over the last few years, in order to be aligned with market requirements and comply with all relevant global and European policies and regulations¹. The corresponding implications for the shipbuilding value chain are therefore significant, with shipyards concentrating increased efforts into 'greening' their operations.

The shipping industry is currently focusing on the integration of new technologies into its value chain in order to tackle the current environmental challenges that deal with (i.e. mitigation of climate change impacts; successfully meeting the new regulations' requirements and reduction targets that have been set)². Key green and digital technologies (e.g. alternative fuels, digital twins, additive manufacturing, robotics, etc.) are increasingly affecting the shipbuilding and ship-repair activities, raising concerns about their present and future impact on the skills and training needs of the industry and its employees. Thus, employees need to develop a better understanding of how the sector is changing.

To this end this Pilot Experience is addressed to those shipbuilding and ship-repair professionals with a technical background who wish to upskill or reskill their current skillsets, as well as to unemployed people who are interested in gaining valuable knowledge on new technologies.

Challenges addressed

- 1. Supply the labour market with highly-qualified technical personnel able to address the emerging business trends and practices.
- 2. Standardize the procedure of the identification of skill shortages in the sector and addressing them through technical training seminars.
- 3. Enhance all relevant public and private stakeholders' collaboration to jointly design these trainings and ensure its acceptance.
- 4. Support the certification of these training seminars to guarantee that the learning outcomes and competences are formally recognized across different contexts and countries.

¹ The European Green Deal. Available at: <u>https://eur-lex.europa.eu/legal-content/EN/TXT/?qid=1576150542719&uri=COM%3A2019%3A640%3AFIN</u>

² International Convention for the Prevention of Pollution from Ships (MARPOL). Available at: https://www.imo.org/en/About/Conventions/Pages/International-Convention-for-the-Prevention-of-Pollution-from-Ships-{MARPOL}).

2. Overview of the "Training Seminar on Additive Manufacturing and Risk Management in the Shipbuilding and Ship Repair Sectors"

The <u>"Training Seminar on Additive Manufacturing and Risk Management in the Shipbuilding and Ship Repair</u> <u>Sectors</u>" Pilot Experience organized by the Centre for Research and technology Hellas (CERTH) and WEGEMT, builds upon the MATES skills intelligence analysis conducted for the shipbuilding sector³ and aims to develop and implement an effective method for addressing the identified current and future skills gaps and shortages. Its particular emphasis is put upon **technical training** since such programmes were found to be missing across the European context.

This Pilot Experience's main goal and objectives are the following:

- a) to standardize the procedure of exploiting the results of a skills intelligence analysis in the shipbuilding sector in order to better inform current and future technical training programmes in close consultation with all key public and private stakeholders at national or even European level
- b) to support the sector's growth by facilitating the building of technical know-how related to the transition of the shipping sector towards a more sustainable future

The "Training Seminar on Additive Manufacturing and Risk Management in the Shipbuilding and Ship Repair Sectors" was held online, due to the restrictions of the COVID-19 pandemic, on the 10th and 11th of June 2021. It was delivered in Greek and reached 60 attendees. A brief description of the participant is provided in **Figure 1** below.



Figure 1: Summary of the training seminars' participants

³ Sdoukopoulos et al. (2021). Baseline Executive Report on Present Skills Gaps in Shipbuilding and Offshore Renewables Value Chains. Available at: https://www.projectmates.eu/wp-content/uploads/2021/01/MATES-D2.1-Baseline-Executive-Report-Jan-2021-1.pdf

During **Day 1**, there were two sessions dedicated to:

- a) Additive Manufacturing: In this session, the profession of Additive Manufacturing Specialist was presented through an in-depth analysis of its current status, the future trends and the necessary skills and knowledge regarding this occupation. The lack of corresponding standards and institutional frameworks received particular attention. Then, the training focused on the 3D Printing process with additional information about 3D printed spare parts for the shipping industry. The latter were introduced through detailed presentations of relevant case studies. The session concluded with information about the Additive Manufacturing process in shipping covering all aspects from the Part Design to the Approval and Certification processes for 3D printed parts for ships as well as details on Additive Manufacturing facilities.
- b) **Introduction to Risk management processes**: This session put emphasis on the introduction of new technologies in industrial manufacturing and how to develop a *Risk management plan* considering relevant implications on the manufacturing process.

Day 2 was focused on *Risk Management* and more specifically on subjects like (i) *Risk identification*; and (ii) *Monitoring and control* and how these processes are affected by the adoption of new technologies.



Figure 2: Indicative training provided during the seminar

3. Achievements

3.1 Results of the consultation process

3.1.1. An innovative methodological approach for designing training seminars

To develop a commonly accepted methodological approach for designing and implementing technical training programmes, the methodological steps that were followed, are summarized below:

- a) All the key 'green technologies' that already have an impact on the shipbuilding sector or are expected to do so in the near future, were identified, grouped into broad categories and, then matched with technical occupational profiles, as indicated through the MATES project^{4,5}. Therefore, the impact of each technology on each technical occupational profile was assessed and it was highlighted which of them should be prioritised through a technical training.
- b) The results of the aforementioned matching exercise were presented in a series of workshops with key public and private stakeholders relevant to the shipbuilding and ship-repair sectors in Greece (i.e. the Greek Ministry of Maritime Affairs and Insular Policy, relevant chambers and industry associations, individual enterprises, etc.), who validated them.
- c) The aforementioned stakeholders pointed out the most prominent technological trends for which a specific technical training seminar should be developed based on the current upskilling and reskilling needs of the sector's workforce. During this process, the recent plans for reviving the shipbuilding industry in Greece were also taken into due consideration.
- d) The training seminar and its corresponding training materials were prepared and the delivery of the Pilot seminar was realized. Several stakeholders attended the seminar (i.e. technical professionals; unemployed people with relevant educational / professional background; public sector actors; etc.), who then provided useful recommendations that should be taken into account for the seminar's future replication not only in Greece, but in other European countries as well. These recommendations deal mostly with the appropriate formatting of the seminar, the future topics that should be covered, the necessity of a certification to be awarded, etc.

	SHIP											SHIPYARD			
	Alternative fuels			Air Emissions		Energy management	Propulsion systems		Ship hull						
Green Technologies Occupational Profiles	Electrification	LNG Fueled engines	Batteries & fuel cells (hydrogen)	Sail and Kite Propulsion Systems	Scrubbers	Cold ironing	Waste heat recovery sytems	Advanced Rudder & Propeller Systems	Speed Nozzles	Composite materials and Sandwich plate system (SPS)	Hull air Iubrication technology	Non-toxic hull paint	Additive manufacturing / 3D printing	Shipbuilding Robotics	Digital twin
GROUP 1 - TECHNICIANS															
Group 1a - Engineering Technicians															
1. Marine engineering technicians	1	1	1	V	V	V	1	1	1	1					V
2. Vessel engine assemblers	1	1	1		1		1						1		~
 Electromechanical engineering technicians 	1	1	1		~	V	V	1	V						1
 Electromechanical equipment assemblers 	1	1	1		V			1	1						1
Group 1b - Green technology technicians 5. Ship and port environmental systems technicians (treatment and recycling of liquid and solid waste)					1										
 Technicians for solar-wind energy and desalination applications 	1		1	1											
Alternative fuel system technicians		1	V	V											
GROUP 2 - CRAFTSMEN															
Group 2a - Metal Craftsmen															
8. Shipwrights	1	1	V		V			1	1	V			1	V	1
9. Sheet-metal workers													1	V	
10. Pipefitters - Boilermakers													1	V	
11. Welders (TIG/MIG/MAG)													1	1	
12. Engravers operating electronic systems and computers													1	V	
Group 2b - Craftsmen for composite boats construction										1			1		
14 Made-un textile articles manufacturers				J											
Group 2c - Other craftsmen															
15. Scaffoldino craftsmen														1	-
16. Fire and accident prevention workers															
GROUP 3 - SURFACE TREATMENT		· · · · ·								-					-
17. Painters									1		1	1		1	
18. Sandblasters - Waterblasters											1			1	
19. Varnishers												1			
GROUP 4 - MACHINISTS															
20. Propeller repairmen - Foundry technicians													1	V	
21. Machinists - Machine tool operators - Turners													1	1	
22. High pressure systems plumbers														1	

Figure 3: Matching matrix of key 'green' technologies of the shipbuilding sector with technical occupational profiles

⁴ Sdoukopoulos, E. et al. (2021). Baseline Executive Report on Present Skills Gaps in Shipbuilding and Offshore Renewables Value Chains. Results of the MATES project. Available at: https://www.projectmates.eu/wp-content/uploads/2021/01/MATES-D2.1-Baseline-Executive-Report-Jan-2021-1.pdf 5 Ergas, I., and Smyrnakis, G. (2020). Foresight scenarios identifying future skills needs and trends. Results of the MATES project. Available at: https://www.projectmates.eu/wp-content/uploads/2021/01/MATES-D2.1-Baseline-Executive-Report-Jan-2021-1.pdf

3.1.2. Additive Manufacturing and Risk management course

Through the consultation process and the MATES project findings, the importance of Additive Manufacturing (3D printing) was highlighted considering that it is increasingly used by the industry at global scale and is one of the key digital and green skills' trends in the sector now and in the future.

Advantages of Additive manufacturing to the shipbuilding and ship repair sectors

Contributes significantly to the automation, mass customization and 'greening' of the shipbuilding and ship repair activities

Allows the timely and cost-effective production of ship components and spare parts

Allows shipyards to significantly reduce their waste & energy consumption, compared to the conventional manufacturing techniques

The on-demand production can lessen redundant stock parts and the corresponding transport needs and

Furthermore, based on the insights of the participating experts the importance of *Risk Management* was highlighted with reference to the impact of emerging technologies on decision-making, dynamic risk assessment, supply chain management, monitoring and control, and health & safety processes. These factors contribute significantly to the development of more competitive business models and to the adoption of a more proactive and efficient approach to managing risks associated with the shipbuilding and ship-repair activities.

Certification of attendance

One of the main goals through this Pilot Experience is its formal recognition and the provision of certification that officially proves the acquired knowledge and skills. To this end, the Port Training Institute "EXANTAS"⁶ that specializes in delivering training to employees in the port industry and related sectors, was involved in the whole process and awarded the attendees with a Certificate of Attendance.

Training material

The "Training Seminar on Additive Manufacturing and Risk Management in the Shipbuilding and Ship Repair Sectors" Pilot Experience generated useful training material which can serve as a reference base for those who wish to be introduced to the addressed topics. All the relevant material is available through the MATES project website and include:

Five presentations⁷ about the Additive Manufacturing process and the profession of Additive Manufacturing Specialist.

This training unit allowed attendees to learn about:

- The basics of 3D printing and how it can be applicable for the production of maritime spare parts.
- The Qualifications and Certification processes of Additive manufacturing parts for marine and offshore applications.
- The main trends and concepts of additive manufacturing and how they influence changes on the current and future occupational profiles, so that they can understand what new skills and qualifications will be necessary for 3D printing.

3D Printing of Maritime Spare Parts Results and follow up pilot project



⁶ The Port Training Institute "EXANTAS" is a Level 2 Lifelong Learning Centre certified by the National Organization for Certification of Qualifications & Vocational Guidance (EOPPEP).

7 http://marinetraining.eu/node/3406

Two presentations about the Risk Management process and additional training material⁷.



This training unit introduced attendees to the Risk Management process by:

- Getting them familiar with the new technologies' impact on risk management.
- Analysing the structure of a risk management plan and the steps that should follow for its implementation.
- Explaining the identification and management of risks.
- Focusing on the monitor and control of risks that challenge the shipbuilding and ship-repair sector.

3.2 Main Impact

The "Training Seminar on Additive Manufacturing and Risk Management in the Shipbuilding and Ship Repair Sectors" Pilot Experience was supported by the Greek Ministry of Maritime Affairs and Insular Policy with the Deputy Minister addressing an opening statement at the first day of the seminar. In order to determine if this kind of support was decisive for attendees to attend the training as well as assess the overall impact of this Pilot Experience and facilitate its achieved results uptake, a questionnaire was developed to collect the participants' feedback about the seminar. The results of this survey are presented below.

Figure 3 highlights that 63% of the attendees found the training very useful and 53% answered that it can help them in their professional career in the shipbuilding and ship-repair sectors. 97% would recommend the training and the main topics they would be more interested in future editions are Robotics and Electrification in Shipping.



Figure 3: Results of the training satisfaction survey

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Figure 4 shows that 80% of the attendees think that the balance between theory and practice was right and appreciate the fact that the training was supported by an institutional body. 97% considered it important to receive a certificate of completion and are interested in upgrading their knowledge on that topic.



Figure 4: Results of the training satisfaction survey



"Congratulations for this training seminar. Innovative ideas, technological achievements as well as exchange, creation and transmission of know-how are platforms that enable the development of key actions aiming to revitalise the shipbuilding and shiprepair sectors. Piraeus Chamber of Commerce and Industry will always support such initiatives."

> VASSILIS KORKIDIS, President of Piraeus Chamber of Commerce and Industry



"I must congratulate you for this initiative and emphasize that the existing framework of cooperation between research, industry and public actors constitutes a key enabler that can further support several economic activities on the maritime domain. We are glad to participate in this effort together with Industry representatives which support the great deal of knowledge we hold on the shipbuilding and ship repair sectors."

KONSTANTINOS KATSAFADOS, Deputy Minister of Shipping of Greece

4. The European added value

The "Training Seminar on Additive Manufacturing and Risk Management in the Shipbuilding and Ship Repair Sectors" Pilot Experience aimed to provide professionals and unemployed people that have a technical background related to the Shipbuilding and Ship-repair industry, with non-formal training. The seminar focused on Additive Manufacturing and Risk Management, (a) thus addressing a key European and global digital and green trend in the sector and (b) supporting the sector's further growth at national and European level through the upskilling and reskilling of its attendees.

The methodological approach adopted for designing and delivering the Pilot Experience, engaged all relevant stakeholders, **industry and the education and training providers**. In addition, **the seminar focused on the main current and prospective skills needed by the industry**.

This training is aligned with key European policy frameworks, regarding both the promotion of Life Long Learning (LLL⁸), especially in the areas of 'green' technology and digital competences, and the environmental challenges that the European shipbuilding and ship-repair industries are dealing with^{9, 10}.

This Pilot Experience was delivered considering the current needs for the revival of the shipbuilding and shiprepair sectors in Greece and in other European countries, following up emerging trends, and business practices. The standardization of the procedure followed for the realization of this PE (i.e. conducting a skills intelligence analysis – as performed in MATES, sharing results with key stakeholders and commonly designing properly certified training programmes) is expected to greatly benefit the sector. It may act as a self-learning cycle, where new information is integrated at each cycle so that available training programmes are properly informed and all the latest developments are integrated in a timely way. This is also its main innovative element, which is expected to make a significant contribution to the shipbuilding training in several European countries.

Methodology	Key stakeholder engagement							
In order to standardise this upskilling/reskilling training, the following steps have to be followed:	Industry, academy, and governmental bodies collaboration during the design phase of the technical							
1. carry out an updated skills intelligence analysis	training seminar ensures its quality & up-to-date structure. In addition, it facilitates its promotion to							
2. integrate the results into targeted E&T offers	interested, potential participants.							
3. engage relevant public stakeholders in all individual processes								
Balanced theoretical and practical knowledge	International expertise							
Based on the feedback received, this type of training should include both theoretical and practical content. The practical part of future training seminars/courses could include, <i>inter alia</i> , targeted visits to relevant facilities, workshops, use of simulators, etc.	Including international experts from well-known organisations/companies makes it more attractive and increases its attendance rates.							
Certified learning	Support of institutional bodies							
Officially recognised certificates of attendance attract participants for future seminars/courses since they guarantee a high-quality course and can also facilitate workforce mobilisation across different countries.	Such support is recommended to ensure the formal recognition, sponsorship and support of future seminars/courses by relevant institutional bodies in order to attract the interest of young graduates and professionals.							

For replicating these activities in other contexts, it is recommended that the following key learning elements should be taken into consideration:

⁸ European Council's Recommendation on Key Competences for Lifelong Learning. Available at: https://eur-lex.europa.eu/legal-content/EN/TXT/PDF/?uri=CELEX:32018H0604(01)&from=EN

⁹ European Skills Agenda. Available at: https://ec.europa.eu/social/BlobServlet?docId=22832&langId=en

¹⁰ The European Green Deal. Available at: https://eur-lex.europa.eu/legal-content/EN/TXT/?qid=1576150542719&uri=COM%3A2019%3A640%3AFIN

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All layman reports and education and training materials from all the MATES Pilot Experiences are available on the MATES website and include:

ED2MIT: Education and Training for Data Driven Maritime Industry projectmates.eu/pilotexperience/ed2mit
MOOCs on Industry 4.0 and the naval sector projectmates.eu/pilotexperience/mooc-training-course
Freeboard projectmates.eu/pilotexperience/freeboard
The Magnus Effect projectmates.eu/pilotexperience/the-magnus-effect
Innovation Manager in Shipbuilding Course projectmates.eu/pilotexperience/innovation-manager-course
Additive Manufacturing and Risk Management in the Shipbuilding and Ship Repairs Sectors projectmates.eu/pilotexperience/training-seminar
MOL ² Maritime on the Loop of Ocean Literacy projectmates.eu/pilotexperience/mol2
Offshore Renewable Energy Courses projectmates.eu/pilotexperience/renewable-energies-crash-courses
Ocean Pro.Tec Lab projectmates.eu/pilotexperience/ocean-pro-tec-lab
Green Move projectmates.eu/pilotexperience/green-move
Definition of New Occupational Profiles projectmates.eu/pilotexperience/dop-definition-of-new-occupational-profiles











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Contact

sign

Lead Author: George Tsafonias, <u>gtsafonias@certh.gr</u> Project coordinator: Lucía Fraga, <u>lfraga@cetmar.org</u> RISK MANAGEMENT PLAN

www.projectmates.eu