

INTERNATIONAL JOINTLY DESIGNED HIGHER VET CURRICULA FOR DIGITAL-ECO INNOVATION IN THE AM SECTOR

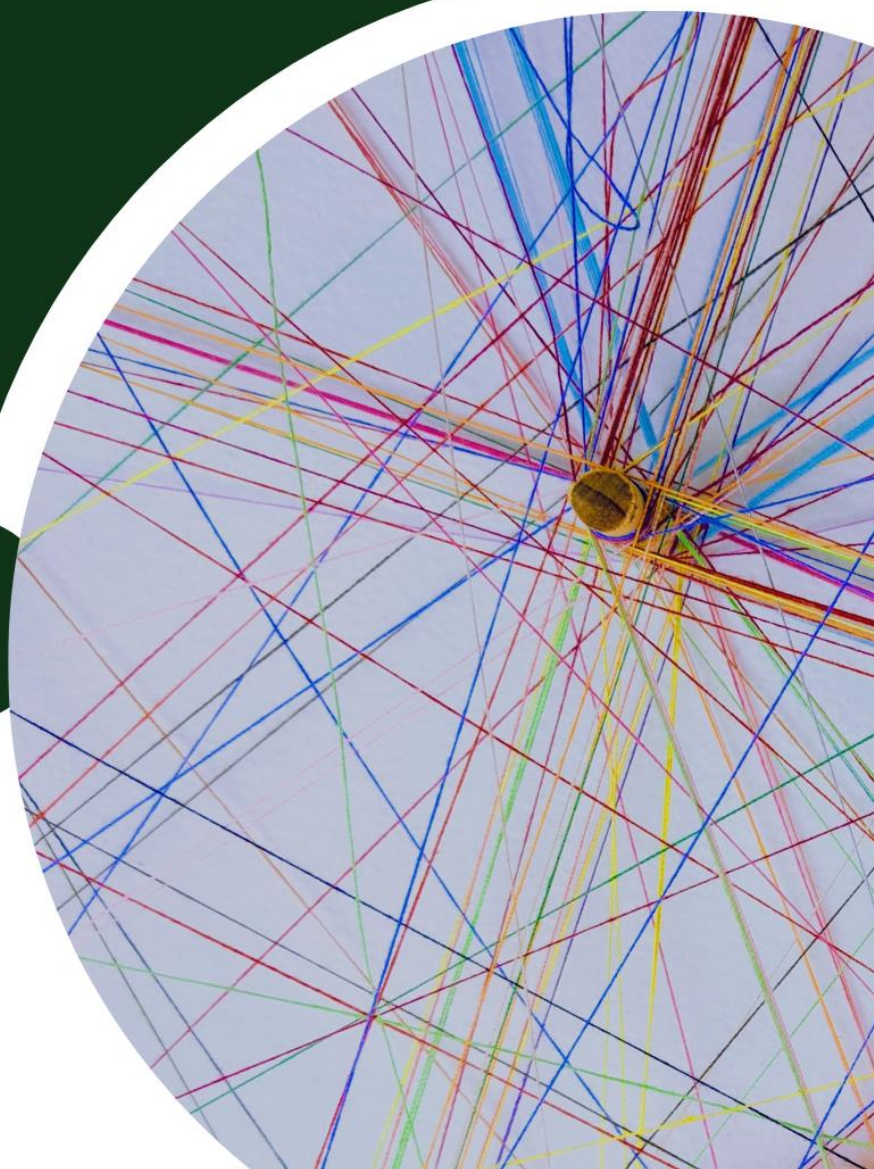


EXCEED
Excellence in green and
digital manufacturing



Co-funded by
the European Union

www.exceed-cove.eu



ABSTRACT

The Excellence in Green and Digital Manufacturing project aims at preparing the Advanced Manufacturing sector for the disruptive changes caused by the green and digital twin transitions. EXCEED assumes the synergic and mutual benefitting application of digital and green as powerful leverages to accelerate innovation in Advanced Manufacturing. The project will provide competencies needed in this new environment, developing a joint international and individualized lifelong learning offer, as well as developing and updating curricula for higher Vocational Education and Training.



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Project id n. 101103982
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LEARN MORE ABOUT PROJECT





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Project Full Title	Excellence in Green and Digital Manufacturing
Project Acronym	EXCEED
Project. Ref no	101103982
Funding Scheme	ERASMUS-EDU-2022-PEX-COVE (Partnership for Excellence - Centres of Vocational Excellence)
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REVISION SHEET			
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v.02	09/07/2024	Improving the first draft	Centofom SRL IT

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TEMPLATE FOR THE EXCEED EQF 4 AND 5 NEW HIGHER VET CURRICULA DESIGN FOR DIGITAL-ECO INNOVATION IN THE AM SECTOR

General Description of the training programme/curriculum

Training initiative (title) <i>(ex. Expert in an eco-design for circular economy in the textile and fashion industries)</i>	Decarbonization Expert in the Shipping Sector
EQF Level	4-5
Proficiency level <i>(foundation/basic, intermediate, advanced, high specialized level)</i>	Intermediate
Expected learning outcomes <i>(By the end of this course, the learners will acquire)</i>	<ul style="list-style-type: none"> • Understanding and basic knowledge of the terminology of climate change, sustainability, circular economy • Deep knowledge on regulatory framework towards decarbonization of shipping • Deep knowledge of fuels considered for maritime use towards net-zero carbon emissions • Broad knowledge of energy efficiency and energy saving technologies applied in shipping sector • Understanding and basic knowledge of Advanced Manufacturing in Shipping, especially in Shipbuilding sector
Overall duration/training time (in hours)	800
Training Methodologies	eLearning, Case studies, On-the-job training
Mode of Learning <i>(Blended, online, onsite)</i>	Blended
Assessment <i>(ex. test)</i>	Multiple Choice questions, Assignments
Certification and recognition	Certificate of Participation
Targets	Familiarization with the general overview of the initiative of “Decarbonization in Shipping” and get acquainted with strategical planning, rules and regulations, alternative fuels, energy efficiency technologies, Advanced Manufacturing.
Delivery Language/s	English



Modules of the training initiative

Module N.	Title of the Module/s	Learning/training hours (total)
MODULE 1	Climate Change & Sustainability	70 (8.75 %)
MODULE 2	Generic Marine Engineering Theory	150 (18.75 %)
MODULE 3	Alternative Fuels for Sustainable Shipping	110 (13.75 %)
MODULE 4	Decarbonization Technologies in Shipping	110 (13.75 %)
MODULE 5	Advanced Manufacturing in Shipping	360 (45 %)



Module's detailed description

MODULE 1

Title of the module: Climate Change and Sustainability

Main objectives of the module

This introductory module builds foundational understanding of the global sustainability transition, focusing on the science, policy, and economics of climate change with emphasis on circularity, systems innovation, biodiversity, and marine environmental impact. It prepares learners to contextualize the challenge of decarbonization in the shipping industry within a broader policy, regulatory and socio-technical framework.

Contents/subjects of the module

Topic 1. Understanding Sustainability & Global Frameworks

- Introduction to Sustainable Development
- The Policy Framework for the Transition to Sustainability

Topic 2. Climate Change & Opportunities

- Climate Change Challenges, Adaptation and Mitigation
- Climate Change: Risks and Opportunities
- Understanding the Relations Between Climate Change, Sustainable Development and Biodiversity- NEXUS topics, Marine ecosystems

Topic 3: Legal and Governance Frameworks

- Environmental Law
- Legal Aspects of the Energy Union and Climate Action
- Social Impact & Social Sustainability
- ESG & SDGs – Metrics and Dashboards

Topic 4: Economic Instruments for Sustainability- Sustainable Finance and ESG Metrics

- Environmental and Natural Resource Economics
- Energy Economics (MSc)

Topic 5: Circular Economy Models & Innovation

- Circular Economy
- Circular Economy KPIs
- Circular Business Models: From Linear to Circular
- Circular Economy Game / Towards Circularity



Topic 6: Systems Thinking & Innovation

- Systems Innovation Approach for Sustainable Transformations
- Digital Transition for Sustainability
- Innovation Incubation & Acceleration

Topic 7: Marine and Blue Sustainability (9hrs)

- Sustainable Blue Economy: ESG and the Global Ocean
- Sustainable Shipping and Ports
- The MENA Maritime Accelerator

Topic 8: Sustainable Transport & Infrastructure

- Sustainable Transportation
- Climate Change Adaptation and Mitigation in the maritime sector: Marine model

<p align="center">Learning Outcomes The Learner will</p> <p><i>(ex. Have a clear understanding of the concept of CE, its historic development, its definitions, its principles. Know key examples of CE in practice.)</i></p>	<p align="center">Assessment criteria: The learner can</p> <p><i>(ex. Define the concept of CE and provide relevant examples. Identify relevant supporting concepts related to CE.)</i></p>
<p>Topic 1 Understanding Sustainability & Global Frameworks</p> <p>Learners will understand foundational concepts of sustainable development and SDGs, international, EU, and national sustainability policy frameworks</p>	<p>Topic 1: Understanding Sustainability & Global Frameworks</p> <p>Define sustainable development and outline the main pillars (economic, social, environmental); list the 17 SDGs and their key targets/Compare international (e.g. Agenda 2030), EU (e.g. Green Deal, Fit for 55), and national policies; identify similarities and differences in approaches</p>



<p>Topic 2: Climate Change & Opportunities</p> <p>Learners will develop a comprehensive understanding of climate change impacts, regulations, and business strategies—enabling them to assess risks, calculate emissions, interpret climate disclosures, and set science-based targets.</p>	<p>Topic 2 Climate Change & Opportunities</p> <p>Explain key climate frameworks (e.g., TCFD, SBTi) and their business relevance</p> <p>Identify and classify climate risks and opportunities across value chains</p> <p>Apply GHG Protocol to measure Scope 1, 2, and 3 emissions</p> <p>Interpret and evaluate climate-related financial disclosures</p> <p>Compare carbon target types and outline the SBTi process for setting targets</p>
<p>Topic 3: Legal and Governance Frameworks</p> <p>Learners will understand the legal underpinnings of environmental and climate policy in the EU, how ESG aligns with SDGs, and the role of governance and metrics in advancing social and environmental sustainability.</p>	<p>Topic 3: Legal and Governance Frameworks</p> <p>Interpret key EU and international legal instruments on climate, energy, and the environment</p> <p>Explain the role of law and governance in supporting the Energy Union and the Paris Agreement</p> <p>Map ESG indicators to SDG targets and perform materiality assessments</p> <p>Analyze social impact within ESG frameworks using dashboards and standardized metrics</p> <p>Evaluate legal obligations and policy instruments driving sustainability reporting and action</p>
<p>Topic 4: Economic Instruments for Sustainability-Sustainable Finance and ESG Metrics</p> <p>Learners will gain an integrated understanding of ESG frameworks, their alignment with SDGs, financial impacts, disclosure practices, natural capital valuation, and hybrid ESG-financial metrics.</p>	<p>Topic 4: Economic Instruments for Sustainability-Sustainable Finance and ESG Metrics</p> <p>Differentiate ESG frameworks and explain their investment relevance</p> <p>Map ESG indicators to SDG targets and perform materiality assessments</p> <p>Analyze the link between ESG scores, controversies, and financial metrics (e.g., ROA, ROE, Sharpe Ratio)</p> <p>Detect greenwashing through reporting analysis and policy gaps Apply valuation techniques to ecosystem services and natural capital</p> <p>Use hybrid KPIs (e.g., EBITDA/CO₂ intensity) for investment decision-making</p>



<p>Topic 5: Circular Economy Models & Innovation</p> <p>Define key principles of the circular economy and their relevance to sustainable development contrast them with linear systems. The learner will be able to apply circular design frameworks like the Value Hill, Circularity Compass, and Circularity Grid.</p>	<p>Topic 5: Circular Economy Models & Innovation</p> <ul style="list-style-type: none"> -Define the circular economy and distinguish it from linear models of production and consumption. -Describe key CE concepts and frameworks (e.g., waste hierarchy, value loops, life-cycle thinking). -Select appropriate CE indicators or KPIs to measure performance and impact (e.g., resource productivity, circular material use rate). -Develop a basic CE strategy or intervention, using tools like circular business model canvas or systems mapping
<p>Topic 6: Systems Thinking & Innovation</p> <p>Learners will grasp systems thinking and systems innovation as applied to sustainability transitions, enabling them to analyze complex challenges, design participatory interventions, and apply systemic solutions through real-world case studies</p>	<p>Topic 6: Systems Thinking & Innovation</p> <p>Define, explain and apply systems thinking to sustainability challenges and use the systems innovation process (scope, mapping, visioning, backcasting, building)</p> <p>Identify innovation pathways to address "wicked problems" like the WEFE nexus</p> <p>Discuss innovation types (technological, social, policy) and explain how they interact to produce systemic change in shipping</p>
<p>Topic 7: Marine and Blue Sustainability</p> <p>Learners will understand the strategic importance of the Blue Economy within ESG frameworks, including sustainable ocean industries, ocean governance, blue finance, and cross-sector collaboration for ocean stewardship.</p>	<p>Topic 7: Marine and Blue Sustainability</p> <p>Explain key ESG challenges and opportunities across major ocean sectors (e.g., shipping, aquaculture, wind energy)</p> <p>Analyze how ocean industries interact with SDGs, marine spatial planning, and climate policy</p> <p>Identify blue finance platforms, impact metrics, and innovation ecosystems for sustainable ocean investment</p> <p>Evaluate risks, synergies, and governance approaches in shared marine environments</p> <p>Propose actions to align ocean business with sustainable development and ecosystem resilience</p>
<p>Topic 8: Sustainable Transport & Infrastructure</p> <p>Learners will understand sustainable infrastructure and transport systems, urban mobility planning, freight logistics, climate resilience, and smart technologies in the context of European and global policy frameworks.</p>	<p>Topic 8</p> <p>Describe the major impacts of climate change in shipping Describe key environmental risks associated with marine and port activities (e.g. pollution, emissions, biodiversity loss).</p>



<p>Understand sustainability principles in transport systems at EU and global level</p> <p>-Analyze transport impacts using forecasting tools and mobility KPIs</p> <p>-Design and evaluate strategic mobility solutions using SUMP/SULPs frameworks</p>	<p>Reflect on real world examples on adaptation and shipping Define sustainable transportation and link it with ESG and SDGs</p> <p>Analyze and propose freight logistics models and sustainability strategies generator, Evalog) for urban mobility planning</p> <p>Assess climate risks and develop resilience indicators for transport systems</p> <p>Recommend smart, tech-enabled solutions for mobility and logistics integration</p> <p>- Compare case studies (e.g. MENA Maritime Accelerator, NAV GREEN) that illustrate best practices in blue sustainability.</p> <p>-Discuss the alignment between shipping decarbonization efforts and global climate agreements (e.g. IMO targets, Paris Agreement).</p> <p>Use decision-making tools (e.g., SUM measure</p>
<p>Duration of the module (training hours) 70 (including assessment or including assessment and self learning)</p>	
<p>Training mode/s Online</p>	
<p>Training methodologies eLearning</p> <p>Assessment & Reflection</p> <ul style="list-style-type: none"> • Quizzes • Discussion-based group assignment • Individual written exam • Case study presentations • Application of concepts in local context (mini project) 	

MODULE 2



Title of the module: Generic Marine Engineering Theory

Main objectives of the module

More specifically, this module will be distributed into two submodules: Module 2A Marine Engineering Fundamentals, Module 2B Overview of Maritime Environmental Regulations.

- Provide a foundational understanding of marine engineering systems and how energy flows through a ship's machinery and propulsion components.
- Introduce core principles of ship design and performance, including hull resistance, propulsion, and main engine operation.
- Familiarize learners with the general layout and function of key onboard systems that influence energy efficiency and emissions.
- Offer a high-level overview of international and regional maritime environmental regulations, including IMO and EU frameworks.
- Promote awareness of the regulatory context in which technical and operational decisions are made for decarbonization in shipping.

Contents/subjects of the module

1. Introduction to ship structure and marine energy systems (layout, main components, energy flow)
2. Principles of hull resistance and propulsion (hydrodynamics, propeller function, propulsion efficiency)
3. Main and auxiliary engine operation (engine types, fuel usage, and energy conversion onboard)
4. Overview of international and regional regulatory bodies (IMO, EU, and their roles in environmental governance)
5. Introduction to key maritime environmental regulations (MARPOL Annex VI, EEXI, CII, EU ETS – scope and relevance)

Learning Outcomes

The Learner will

(ex. Have a clear understanding of the concept of CE, its historic development, its definitions, its principles. Know key examples of CE in practice.)

Assessment criteria:

The learner can

(ex. Define the concept of CE and provide relevant examples. Identify relevant supporting concepts related to CE.)

- Demonstrate a foundational understanding of marine engineering principles, including the structure, function, and interaction of key shipboard systems.
- Describe the components and operation of a vessel's energy system, with emphasis on hull resistance, propulsion mechanisms, and main engine configurations.
- Identify how marine engineering systems contribute to energy efficiency and influence emissions in maritime operations.
- Recognize the role of international and regional regulatory bodies in shaping maritime environmental standards.
- Summarize the key features and objectives of major maritime environmental regulations, including MARPOL Annex VI, EEXI, CII, and the EU ETS, within the context of decarbonization.

- Identify and describe the main components of a vessel's energy system, including propulsion and auxiliary systems.
- Explain basic marine engineering concepts, such as hull resistance, propulsion efficiency, and engine operation.
- Interpret simplified ship diagrams to recognize how energy is produced, transferred, and used onboard.
- Recognize the roles of international and regional bodies (e.g., IMO, EU) in maritime environmental regulation.
- Summarize the purpose and scope of key maritime environmental regulations, including MARPOL Annex VI, EEXI, CII, and EU ETS.



Duration of the module (training hours) 150
Training mode/s Online
Training methodologies eLearning, Case studies

MODULE 3	
Title of the module: Alternative Fuels for Sustainable Shipping	
<i>Main objectives of the module</i>	
<ul style="list-style-type: none"> • Understand the role of fuel choice in shipping decarbonization. • Description of conventional and alternative marine fuels. • Compare fuel options based on decarbonization potential. • Explain the concept of Well-to-Wake and Tank-to-Wake emissions (LCA approach). • Discuss challenges in the adoption of low- and zero-carbon fuels. • Link fuel selection to compliance strategies. 	
<i>Contents/subjects of the module</i>	
<ol style="list-style-type: none"> 1. Introduction to Marine Fuels and Decarbonization 2. Conventional Marine Fuels (HFO, MDO, MGO) 3. Alternative and Low-carbon fuels (LNG, LPG, Methanol, Ammonia, Hydrogen, Biofuels) 4. Fuels Pathways (biofuels, Syntetic fuels (e-fuels) 5. Emissions Assessments methods (WtW, TtW, Lifecycle GHG analysis) 6. Fuel comparison and evaluation criteria (fuel selection and compliance) 7. Challenges and Future Outlook 	
Learning Outcomes The Learner will <i>(ex. Have a clear understanding of the concept of CE, its historic development, its definitions, its principles. Know key examples of CE in practice.)</i>	Assessment criteria: The learner can <i>(ex. Define the concept of CE and provide relevant examples. Identify relevant supporting concepts related to CE.)</i>
<ul style="list-style-type: none"> • Understand the environmental impact of marine fuels and their role in the decarbonization of shipping. • Identify and describe conventional and alternative marine fuels, including their key characteristics, benefits, and limitations. • Compare different fuels based on emissions, energy content, cost, infrastructure, and safety. • Explain the concepts of Well-to-Wake and Tank-to-Wake emissions and their relevance to fuel sustainability. • Relate fuel choices to regulatory requirements (fuel storage, fuel bunkering, ship design) and future trends in maritime decarbonization. 	<ul style="list-style-type: none"> • Identify and describe the conventional and alternative marine fuels used in the shipping industry. • Compare fuels based on key factors such as emissions, energy content, availability, cost, and safety. • Explain the difference between Well-to-Wake and Tank-to-Wake emissions • Assess the suitability of different fuels for compliance with current maritime decarbonization regulations. • Recognize key challenges and trends related to the adoption of low- and zero-carbon fuels in shipping.



Duration of the module (training hours) 110
Training mode/s Online
Training methodologies eLearning, Case studies

MODULE 4	
Title of the module: Decarbonization Technologies in Shipping	
<i>Main objectives of the module</i>	
<ul style="list-style-type: none"> • Introduce key technologies that support decarbonization and energy efficiency in shipping. • Explore energy-saving solutions for both newbuilds and existing vessels. • Explain the role of digital tools and energy management systems in reducing fuel consumption and emissions. • Present all energy saving solutions Understand the challenges and considerations in implementing decarbonization technologies 	
<i>Contents/subjects of the module</i>	
<ol style="list-style-type: none"> 1. Introduction to Decarbonization Technologies in Shipping 2. Overview of Energy Efficiency Measures (technical, operational etc) 3. Integration into Ship Design and Retrofitting 4. Challenges and Barriers to Implementation 5. Innovation and Future Outlook 	
Learning Outcomes The Learner will <i>(ex. Have a clear understanding of the concept of CE, its historic development, its definitions, its principles. Know key examples of CE in practice.)</i>	Assessment criteria: The learner can <i>(ex. Define the concept of CE and provide relevant examples. Identify relevant supporting concepts related to CE.)</i>
<ul style="list-style-type: none"> • Understand the function and importance of technologies that support decarbonization and energy efficiency in shipping. • Identify and describe key energy-saving technologies, including those related to hull design, propulsion, and onboard systems. • Explain the use of digital tools and energy management systems in monitoring and optimizing vessel performance. • Assess the main challenges and considerations in selecting and implementing decarbonization technologies on ships. 	<ul style="list-style-type: none"> • Identify and describe key technologies used to reduce emissions and improve energy efficiency in shipping. • Explain the function and benefits of specific energy-saving solutions, such as air lubrication, waste heat recovery, or hull optimization. • Describe how digital tools and energy management systems contribute to monitoring and reducing fuel consumption. • Compare different low- and zero-emission propulsion options, outlining their advantages, limitations, and suitable applications. • Assess practical challenges related to the implementation of decarbonization technologies, including technical, financial, and operational factors.



Duration of the module (training hours) 110
Training mode/s Online
Training methodologies eLearning, Case studies

MODULE 5	
Title of the module: Advanced Manufacturing in Shipping	
<i>Main objectives of the module</i>	
<ul style="list-style-type: none"> • Introduce the role of advanced manufacturing technologies in modern shipbuilding and their contribution to improved efficiency and decarbonization. • Present the principles and applications of Additive Manufacturing (AM), including 3D printing techniques and the use of advanced materials in ship components. • Explain the concept and benefits of Digital Twins and Mixed Reality, and how they support design optimization, simulation, and remote operations in the maritime sector. • Explore the use of automation and robotics in shipbuilding processes, including welding, inspection, and assembly, to improve precision, reduce waste, and enhance safety. • Introduce predictive maintenance technologies, showing how data-driven automation systems can reduce downtime, increase asset life, and optimize performance. 	
<i>Contents/subjects of the module</i>	
<p>5.1 Additive Manufacturing</p> <ul style="list-style-type: none"> • Introduction to additive manufacturing in shipbuilding • 3D printing processes (FDM, SLS, DED, etc.) and maritime applications • Advanced materials: composites, corrosion-resistant alloys, high-performance polymers • Use cases in repair, spare parts, and custom components • Environmental benefits and relation to decarbonization (e.g., reduced waste, localized production) <p>5.2 Digital Twins and Mixed Reality</p> <ul style="list-style-type: none"> • Definition and concept of a digital twin • Applications in ship design, simulation, monitoring, and optimization • Real-time data integration for system performance and predictive insights • Introduction to Mixed Reality (MR), Augmented Reality (AR), and Virtual Reality (VR) • Use of MR/AR in crew training, remote inspections, and maintenance support • Benefits for reducing errors, improving design efficiency, and minimizing energy consumption <p>5.3 Automation & Robotics</p> <ul style="list-style-type: none"> • Overview of robotics in shipbuilding: welding, painting, inspection • Autonomous and semi-autonomous systems in shipyards • Introduction to predictive maintenance: sensors, data analytics, AI models • Applications in machinery health monitoring, failure prediction, and performance optimization • Impact on lifecycle efficiency and sustainability 	
Learning Outcomes The Learner will	Assessment criteria: The learner can



<p><i>(ex. Have a clear understanding of the concept of CE, its historic development, its definitions, its principles. Know key examples of CE in practice.)</i></p>	<p><i>(ex. Define the concept of CE and provide relevant examples. Identify relevant supporting concepts related to CE.)</i></p>
<ul style="list-style-type: none"> • Understand the role of advanced manufacturing technologies in modern shipbuilding and their contribution to sustainability and efficiency. • Describe the principles and applications of additive manufacturing, including 3D printing processes and the use of advanced materials. • Explain the concept and functionality of digital twins and mixed reality, and how they enhance ship design, operation, and training. • Identify key applications of automation and robotics in shipbuilding processes and recognize their benefits for quality and productivity. • Understand the basics of predictive maintenance systems and how they improve operational performance and reduce equipment failures. 	<ul style="list-style-type: none"> • Describe the role and benefits of advanced manufacturing technologies in improving efficiency and reducing environmental impact in shipbuilding. • Identify and explain key 3D printing processes and advanced materials used in additive manufacturing applications within the maritime sector. • Explain how digital twins and mixed reality technologies are applied in ship design, simulation, and crew training. • Recognize the main uses of automation and robotics in shipyard operations, including welding, inspection, and assembly. • Describe the function and value of predictive maintenance systems, and how they support performance optimization and equipment reliability.
<p>Duration of the module (training hours) 360</p>	
<p>Training mode/s Blended</p>	
<p>Training methodologies On-the-job training, eLearning, Case studies</p>	



Achievements

Module 1: Climate Change and Sustainability		
Knowledge	Skills	Competencies
<i>(Means the body of facts, principles, theories and practices that is related to a field of work or study. It is described as theoretical and/or factual knowledge)</i>	<i>(Means the ability to apply knowledge and use know-how to complete tasks and solve problems. They are described as cognitive (logical, intuitive, and creative thinking) or practical (involving manual dexterity and the use of methods, materials, tools and instruments)</i>	<i>(Means the proven ability to use knowledge, skills and personal, social and methodological abilities in work or study situations and in professional and personal development. It is described in terms of responsibility and autonomy)</i>
At the end of this unit the participant will know:	At the end of this unit the participant will be able to:	At the end of this unit, the participant will have acquired the responsibility and autonomy to:
ATHENA RESEARCH CENTER	ATHENA RESEARCH CENTER	ATHENA RESEARCH CENTER
<p>The foundations of sustainable development, the SDGs, and global/regional sustainability policy frameworks (e.g. Agenda 2030, EU Green Deal)</p> <p>Key scientific, economic, and legal aspects of climate change, including adaptation and mitigation strategies</p> <p>Core principles and models of the circular economy, systems thinking, and innovation for sustainability transitions</p> <p>ESG frameworks, sustainable finance instruments, and the metrics used to evaluate environmental and social impact</p> <p>Challenges and opportunities related to marine sustainability, shipping decarbonization, and the Blue Economy</p>	<p>Apply frameworks like TCFD and SBTi to assess climate-related risks, set targets, and interpret disclosures</p> <p>Measure GHG emissions using the GHG Protocol (Scopes 1, 2, 3) and evaluate climate risks across value chains</p> <p>Design circular economy interventions using KPIs, value loops, and business model tools</p> <p>Analyze systemic sustainability problems using systems thinking methods (e.g. mapping, backcasting)</p> <p>Assess marine sustainability practices, sustainable transport strategies, and ESG impacts in shipping and ports</p>	<p>Integrate social, environmental, legal, and economic considerations into strategic decisions in marine and sustainability contexts</p> <p>Lead and participate in sustainability reporting, circular innovation, and climate governance initiatives</p> <p>Contribute to the development of climate-resilient infrastructure and blue finance ecosystems</p> <p>Collaborate across disciplines and sectors to drive systemic change in line with climate targets and SDG alignment</p> <p>Promote responsible innovation and sustainability action within maritime industries and urban mobility systems</p>
Module 2: Generic Marine Engineering Theory		
Knowledge	Skills	Competencies
At the end of this unit the participant will know:	At the end of this unit the participant will be able to:	At the end of this unit, the participant will have acquired the responsibility and autonomy to:



Basic principles of marine engineering (hull, resistance, propulsion, energy flow)	Identify components of ship energy and propulsion systems	Apply fundamental marine engineering knowledge to support technical decisions in ship operations.
Operating fundamentals of main engines	Understand basic ship magnitudes	Collaborate effectively with technical and regulatory teams in operational or planning contexts.
IMO and EU regulatory frameworks	Identify ship-specific regulatory requirements	Demonstrate awareness of how ship design and machinery impact energy efficiency and emissions.
Maritime environmental regulations (MARPOL Annex VI, EEXI, CII)	Use environmental reporting tools	Contribute to discussions on compliance with environmental regulations in a maritime context.
Emission monitoring and reporting systems (MRV, DCS)	Compare international and regional policies	Operate with responsibility in tasks requiring basic engineering understanding within regulated environments.

Module 3: Alternative Fuels for Sustainable Shipping

Knowledge	Skills	Competencies
<i>At the end of this unit the participant will know:</i>	<i>At the end of this unit the participant will be able to:</i>	<i>At the end of this unit, the participant will have acquired the responsibility and autonomy to:</i>
Conventional and alternative marine fuels (LNG, methanol, ammonia, hydrogen, biofuels)	Compare fuel types by emissions, cost, safety, and energy density	Recommend sustainable fuel solutions for ship operations
Emission factors and fuel sustainability	Evaluate fuel-related compliance strategies	Support fuel transition planning aligned with decarbonization goals
Well-to-Wake vs. Tank-to-Wake emissions	Analyze fuel lifecycle emissions	Work within fuel compliance frameworks with limited supervision
Fuel compatibility with regulatory schemes (IMO, EU ETS)	Select fuels for operational and regulatory needs	
	Apply fuel knowledge to retrofit and newbuild decisions	

Module 4: Decarbonization Technologies in Shipping

Knowledge	Skills	Competencies
<i>At the end of this unit the participant will know:</i>	<i>At the end of this unit the participant will be able to:</i>	<i>At the end of this unit, the participant will have acquired the responsibility and autonomy to:</i>
Energy efficiency technologies (e.g., air lubrication, hull coatings)	Identify and describe applicable decarbonization technologies	Support the integration of technologies into ship design or retrofits
Onboard energy management systems	Use digital tools to monitor ship performance	Participate in technical assessments for emission reduction



Emission reduction tools (digital optimization, automation)	Match technology options to operational and regulatory needs	Apply technical solutions to real-world operational scenarios with initiative
Low- and zero-emission propulsion (hybrid, electric, wind-assisted, fuel cells)	Evaluate the impact of technical modifications on energy use	
Module 5: Advanced Manufacturing in Shipping		
Knowledge	Skills	Competencies
<i>At the end of this unit the participant will know:</i>	<i>At the end of this unit the participant will be able to:</i>	<i>At the end of this unit, the participant will have acquired the responsibility and autonomy to:</i>
Additive manufacturing (3D printing) processes and materials	Apply basic 3D printing concepts and tools	Contribute to innovation in shipbuilding processes
Advanced materials used in ship components	Identify suitable materials for advanced manufacturing	Collaboration on the adoption of digital and automated solutions
Digital Twin and Mixed Reality technologies	Use or interpret digital twin models and simulation tools	Operate effectively in technology-enhanced shipbuilding environments
Automation, robotics, and predictive maintenance systems	Monitor data from automated and predictive maintenance systems	
	Support the implementation of robotics in shipyard operations	

Europass Digital Credentials for Learning (EDCs)

(To be completed after finalization of the training programme with the support of the WP3 leader (CIS) and co-leader (Centofom))

Connection with the ESCO Data Base to release the Europass Digital Credentials for Learning (EDCs)		
Modules	Learning Objectives	Link to ESCO descriptors
Module 1		
Module 2		
Module 3		



Module 4		
Module 5		



Deeping materials

1. D2.1 – International Observatory on AM <https://exceed-cove.eu/Project-results/d2-1-international-observatory-on-am/>
2. D3.1 – EXCEED JOINT TRAINING SUPPLY DESIGN PRINCIPLES <https://exceed-cove.eu/Project-results/d3-1-exceed-joint-training-supply-design-principles/>
3. D3.2 – METHODOLOGY FOR CURRICULUM DEVELOPMENT <https://exceed-cove.eu/Project-results/d3-2-methodology-for-curriculum-development/>



References

- ESCO database (renewable energy, electricity and energy, offshore renewable energy engineer/technician, renewable energy engineer, vessel fuels, alternative energy, ICT environmental manager, energy consultant, data engineer, environmental technician, environmental expert, environmental engineer)



EXCEED

Excellence in green and digital manufacturing

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