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DOORS Masters Proposition and pathway for enhanced Black Sea academic connectivity

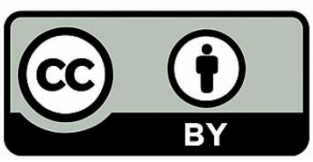


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Related Document **ID**	**Document**
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DOORS D7.6	Manousiadi, E., Flerianou, A., Potamousis S., Scarrott, R., Gannon, C. (2025) DOORS: Improved and tailored MSc and Life-Long Training Opportunities Courses. Deliverable 7.1 under the Horizon 2020-funded DOORS project, E.U. Grant no. No 101000518.

Executive Summary

This document presents a Masters programme proposition, for Black Sea universities and partners to implement, on subjects concerning Marine Activity Planning for the Black Sea. The programme proposed here addresses a lack of interdisciplinary training that integrates technical knowledge with practical application in the Black Sea's marine education arena.

Comprised of 11 core and 11 optional modules, the programme has been co-designed with academics across the DOORS consortium to provide a flexible set of Masters-level learning pathways in the areas of Marine Sciences, Marine Governance, and Blue Economy. Core modules establish the knowledge foundations in three thematically-focused areas. They also establish the skillsets and knowledge base needed to innovate, research, protect, and commercialise. Optional modules then enable students to specialise in one of the three areas, with advanced theory and practice provided as options, alongside opportunities to connect theory to practice through work-based placements.

The Masters programme capitalises on the Black Sea's unique and complex history, oceanography, cultural and socio-economic characteristic to provide a rich and rewarding foundation for learning globally-relevant principles and practices. In return, the course bridges the gap between existing, standardised curricula across the Black Sea, and international best practices established by Europe through the ERASMUS Mundus programme.

The key to delivering on the promise of this Masters programme is connectivity - building connections and understanding across disciplines and highly-regarded HEIs across the region and Europe. As such, the academic partnerships and collaborations established under DOORS are the bedrock of a natural partnership to take it forward, noting that this information is publicly available for others to take up should this not occur. Such connectivity and understanding takes time, as does academic accreditation processes across different HEIs. Recognising this, the work undertaken here also proposes the use of micro-credentials and Blended Intensive Programmes (BIPs) running in parallel, to enable interim successes in content creation and collaboration building.

Finally, this document also contains a summary of the consolidated needs analysis that underpinned Masters programme development. Full details of the underpinning analysis and survey are contained in the formal deliverable from DOORS Work Package 7 (D7.6), where this information is contained in Part 1 of the document.

This document is a summary for DOORS university partners. It is structured as follows: Section 1 gives some background and context to the proposition. Section 2 outlines the development approach, highlighting where and how needs were identified and perspectives were gathered. Section 3 presents a summary of the needs analysis and perspectives-gathering, providing the context for the Masters and pathway proposition. Section 4 contains the pathway to the full Masters implementation, outlining opportunities such as micro-credentials and Blended Intensive Programmes (BIPs) and how they can contribute. Finally, Section 5 contains the Masters proposition itself, presented as a detailed account of the 11 core and 11 option modules tailored to equip students with critical skills, and empower them with career-focused specialisation pathways.

Contents

Executive Summary *5*

1. Background and context *7*

2. Approach/Methodology: Designing improved and tailored Masters Programmes and implementation pathways *9*

2.1. DOORS Training Gap Analysis **9**

2.2. Needs Assessment to identify Blue Economy needs for knowledge and skills **10**

2.3. WP7 Stirling workshop on course and module options **12**

2.4. Combining perspectives and defining the course. **13**

3. Consolidated findings and Masters context: *14*

3.1. Training Gap Analysis **14**

3.2. Needs Assessment (Training Skills Survey) **15**

3.3. WP7 Stirling workshop recommendations **16**

3.4. Other perspectives **17**

4. Pathway to a Masters – Micro-credentials and BIPS *18*

4.1. Micro-credentials implementation **18**

4.2. Blended Intensive Programmes **20**

4.2.1 An early example of DOORS success: Sustainable Blue Economy BIP 20

4.3. Erasmus Mundus - The DOORS Masters programme proposition. **21**

5. The DOORS Masters programme proposition. *23*

5.1 Core Modules: **24**

5.2 Optional Modules **37**

5.3 Pathway to an ERASMUS Mundus Joint Masters programme **49**

Annexes *54*

Annex 1 - Methodological Record of Human-AI co-development process **54**

A1.1. Purpose of the Appendix 54

A1.2 Context and analysis rationale 54

A1.3 Approach 55

A1.4 Outcomes and Usage 59

A1.5 Final reflections 59

1. Background and context

The development of an MSc program tailored to the Black Sea and its Blue Economies is a crucial step towards fostering innovation, academic excellence and workforce development across blue economy sectors. This proposition seeks to bridge educational gaps, enhance collaboration between higher education institutions (HEIs), and align training with industry demands. The goal is the implementation of a comprehensive and multidisciplinary program designed to equip professionals with the necessary skills and knowledge for sustainable maritime activities. Through the integration of best practices from existing European programs and leveraging regional expertise, the MSc proposition described here, and the pathway suggested to achieving it, is carefully designed to strengthen the academic landscape while supporting economic growth and environmental stewardship in the Black Sea region.

In developing the MSc program, multiple educational pathways were explored to ensure a comprehensive and flexible approach to academic training in the Black Sea region, and acknowledge the long lead-in times for academic programme implementation, and ensuring the entire journey results in collaboration building, inter-institutional dialogues, and international connectivity. The proposed pathway for developing the MSc program includes four key elements – Blended Intensive Programmes, Micro-credentials, Stand-alone masters, and ERASMUS+ Mundus Masters. The development of these, while presented as a sequence, can easily occur in parallel, noting that progress in one helps progress all.

The initial stage focuses on connectivity and mobility, with the creation of *Blended Intensive Programmes (BIPs)*. These BIPs are a relatively new type of short-term mobility initiative in higher education, introduced as part of the Erasmus+ programme by the European Union. The courses themselves are short and intense, often centred around a specific topic or theme.

The next natural progression focuses on the universities themselves, and the creation of *micro-credentials*. These are short, accredited courses designed for vocational learners or those seeking flexible learning options, allowing them to acquire specific skills and knowledge quickly. Implemented by third-level institutions, discussions are ongoing in Europe about how these micro-credentials can be stackable across institutions, even across countries, ultimately making them combinable into larger qualifications such as a diploma or a degree. Note that there is also interest in using BIPs as opportunities to gather micro-credentials, whereby a short, intensive mobility-based programme can lead to a certified learning outcome that counts towards a larger goal, or professional/academic certification.

It is critical to note that both micro-credentials and BIPs form key components of the pathway to a maximally impactful Black Sea Masters programme focused on the marine and Blue Economy. Both enable the development of regionally-tailored content on advanced subjects within the regional context. In parallel BIPs, foster inter-institutional connectivity, collaboration, and administrative harmonisation/alignment.

The third stage builds on the content being generated by the micro-credentials and BIPs, or content developed by institutes themselves as in-house content. This stage envisions the consolidation of a Masters programme, tailored to the specific needs of the Black Sea region. The modules needed for such a programme to address the Black Sea's Blue Economy and marine science needs are outlined in this document. Such a programme could be implemented in full by a single institute independently, noting that this would simply compound the siloed character of institutes, and have little internationalisation benefits to the implementing institute. Ideally, the Masters program would be delivered with as a collaboration between universities and secure Erasmus Mundus accreditation, enhancing its prestige and impact within the Black Sea region, and globally. Such a programme would build on the collaborations and administrative harmonisation created through the BIPs processes, and consolidate industry-relevant content offered through micro-credentials.

Critically, it would enable institutes across the region to contribute their individual strengths to the programme, while harnessing the best the region and Europe has to offer in all course areas.

The development and implementation of an Erasmus Mundus is a path that cannot be rushed. Best case scenarios indicate a 2.5 to 3 year development journey from initial concept to the first students arriving to be taught. The challenges to be overcome include consortium formation and identification of potential associate partners; clear definition of the academic focus, mobility pathways and whether a joint or multiple degree awarding set up is needed; and often a considerably challenge, the informal alignment of curricula and gaining institutional commitment. The pathway outlined here, provides continuous benefits to participating universities throughout the process, fostering the development of an active educational ecosystem.

Presented here is a proposition for a comprehensive Masters program that any Black Sea university can adopt and implement, ideally in collaboration with other Black Sea and non-Black Sea universities. The program itself is designed to emphasize the importance of collaboration across disciplines and sectors as well as skills development and industry relevance.

2. Approach/Methodology: Designing improved and tailored Masters Programmes and implementation pathways

This activity built upon the gap analysis delivered in DOORS deliverable 7.1[1] (D7.1), a summary of which is provided here. This was supplemented with an analysis reviewing E.U. programs that could serve as best practices was carried out, along with a stakeholder survey capturing input from universities, research institutions, and industry representatives. This identified key knowledge and skill gaps in the maritime and blue economy sectors. Additionally, best practices in established European programs were analysed to ensure alignment with successful methodologies and educational models. By integrating these insights, the proposed Masters, and pathway using micro-credentials and Blended Intensive Programmes (BIPs), is targeted to address regional skill shortages, foster inter-university collaboration, and follow a structured pathway towards a fully operational, internationally recognized master's program. The development workflow that led to the Version 1.0 Masters programme outlined in this report is shown in Figure 1.

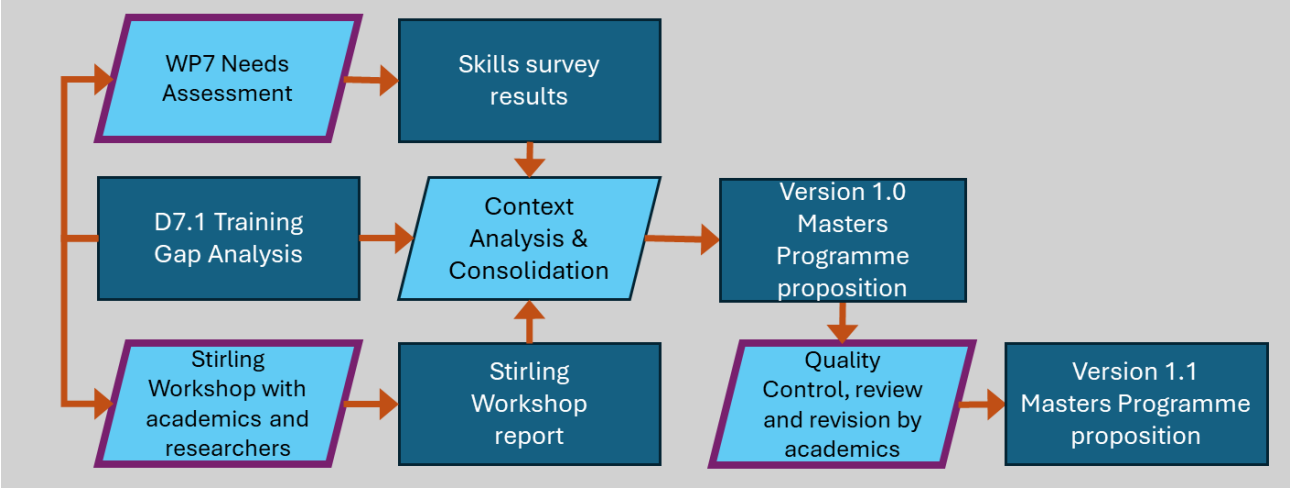


Figure 1. Actions taken to develop the Version 1.0 Masters programme presented in this report. Dark boxes show inputs and outputs of analysis activities. Light blue boxes with a purple outline show key activities which involved users and stakeholders through consultations, surveys or reviews.

2.1. DOORS Training Gap Analysis

The DOORS Training Gap Analysis (Deliverable 7.1) provides a comprehensive assessment of the current state of training resources and identifies key deficiencies that must be addressed to develop a robust and effective MSc program for the Black Sea region.

The study identified strengths, weaknesses, and recommendations for further development in the Black Sea region. The analysis sought to assess the current status and provide guidance to ensure that universities and their training offerings align with priority sectors. It aimed to delineate the strengths and weaknesses of each country and the Black Sea region in terms of their educational offering. The report outlines the available Master's Programmes in Black Sea countries, with Ukraine having the most programmes, particularly in

[1] Vanblaere, S., Pade, N. DOORS: Gap and Opportunities Assessment. Deliverable 7.1 Report under the H-2020 DOORS Project, E.U. Grant agreement no. 101000518.

marine-related fields, followed by Türkiye, Romania, Georgia, and Bulgaria (with Moldova not offering any reported training).

The insights gained from the training gap analysis report help to identify and build the MSc programme proposition. By understanding the current landscape of Master's Programmes in the Black Sea region, we identify areas of strength to build upon and weaknesses or gaps that need to be addressed. In addition, emphasizing sectors that are currently underrepresented or emerging within the blue economy ensures that graduates are well-equipped to drive regional growth and sustainability. The analysis highlights the countries and institutions with robust marine-related programmes and those lacking in such offerings. This helps in pinpointing specific needs and opportunities for new programmes. Understanding the distribution and focus areas of existing programmes allows us to design a curriculum that complements and enhances the existing educational framework.

2.2. Needs Assessment to identify Blue Economy needs for knowledge and skills

The primary aim of this literature review was to analyze existing European Union (EU)-based interdisciplinary Master's programmes in marine sciences, maritime robotics, marine biotechnology, and related fields to inform the development of a new Master's programme focusing on the Black Sea region. By identifying key elements, we ensure the proposed programme incorporates successful structures, mobility schemes, and thematic areas that align with international academic standards.

WP7 partners suggested the EU programmes for comparative review, established criteria for selecting candidate universities to deliver the MSc programme, and agreed on the filters for selecting the Erasmus Mundus Consortia. Following this, a comparative review of the Black Sea MSc programmes against EU programmes was conducted.

The comparison with European programmes such as IMBRSea provides a benchmark for quality and scope. Best practices can be adopted from these programmes to ensure the proposed MSc meets international standards and incorporates innovative and effective learning methods that have already been tested. The comparative review of European interdisciplinary Master's programmes in marine and maritime sciences provides insights into key design features that could inform the development of a new Black Sea-focused Master's programme. Programmes like IMBRSea and MIR exemplify the benefits of structured mobility, interdisciplinary learning, and practical internship opportunities, all of which are essential for a programme that aims to tackle marine environmental issues in the Black Sea region. Additionally, the importance of strong partnerships, a diverse academic network, and robust financial support mechanisms are clear takeaways that will help shape the new programme.

We selected a set of relevant Master's programmes that focus on marine sciences, environmental sustainability, marine robotics, and blue biotechnology. These programmes were identified from EU institutions and their specific components (e.g., duration, mobility, language, thematic focus). The following programmes were reviewed:

- IMBRSea (International Master in Marine Biological Resources)
- MER+EMJMD (MER2030) (Marine Ecosystem-Based Management)
- ECT+ (European Coastal and Marine Environmental Master)
- ERASMUS Mundus Master in REM (Renewable Energy and Marine Environment)
- EU CONEXUS (Innovation in Marine Biotechnology)
- MIR (Marine and Maritime Intelligent Robotics)

A comparison framework, using key criteria, was devised to ensure the above programs were compared systematically. These were:

- Programme Structure: this included the duration of the program, the course format (e.g., 1-year, 2-year), the thematic focus and specializations available, the course format (online, face-to-face, or blended)
- Language of Instruction: the primary language(s) used in instruction
- Mobility and Internships: e.g., students studying at multiple universities, internships in different countries, or internships in different institutions – research, industry or governmental bodies)
- Partnerships and Institutions: the number and diversity of partner universities and institutions involved and the contribution of international and local partners
- Admission Requirements: including the academic qualifications, application procedure (e.g., online application, documents required, professional experience, motivation letters, and recommendation letters)
- Key Outcomes and Competencies: including the learning outcomes from the programmes, such as research competencies, industry skills, and practical knowledge relevant to the Black Sea region's needs.

Following the recommendation of DOORS D7.1, (to assess the training needs and skills requirements within the Black Sea Blue Economy), an online survey was curried out to identify gaps in current educational offerings and align them with market needs. Recognizing the strategic importance of the Black Sea for marine research, economic activities, and sustainable development, this aimed to gather valuable insights from two primary target groups: businesses operating in the Blue Economy sectors and academia engaged in marine sciences and related disciplines. By gathering first-hand perspectives from these stakeholders, the survey aimed to identify gaps in current training programs, highlight areas requiring improvement, and support the development of tailored educational and capacity-building initiatives. The ultimate goal was to enhance knowledge-sharing, improve the state of blue skills in the region, and equip future professionals with the expertise necessary for responsible marine resource management.

Designed for individuals over 18, the survey took approximately 5-10 minutes to complete and was conducted over the course of a month. The process of developing and distributing it was carefully structured to ensure broad participation across all Black Sea countries. The survey questions were initially developed by the WP6 and WP7 partners , as it had to be relevant for the business community as well, using insights from previous studies, regional priorities, and industry needs. Once finalized, the questionnaire (see DOORS D7.6 Appendix 1) was uploaded to the official European platform, EUSurvey. A consent form was attached, requiring participants to check a box confirming they had read and agreed to the terms.

The DOORS Country Leaders from all Black Sea countries were first invited to review the surveys, make improvements and then translated the survey into their local languages to ensure clarity and accessibility for respondents by eliminating language barriers. They then disseminated the survey to relevant academic institutions and businesses within their countries, encouraging engagement from a diverse range of stakeholders, including university lecturers, professors, researchers, entrepreneurs, and industry professionals.

Despite the well-structured distribution process, the sample size varied considerably across countries, with some nations providing a more limited number of responses. Nonetheless, meaningful conclusions were drawn from the data, as even a smaller sample provided critical insights into the existing educational and industry needs. The collected responses were categorized, resulting in a set of results that included separate analyses for academia and businesses in each Black Sea country. This distinction allowed for a more detailed understanding of the differences in training requirements between educational institutions and industry professionals, facilitating more targeted recommendations.

2.3. WP7 Stirling workshop on course and module options

On January 16th, 2024, DOORS WP7 and WP6 held a workshop (Figure 2) to discuss the Masters Programme the DOORS consortium would propose. There was general agreement that it is feasible to have an Erasmus Mundus proposition formulated by the end of the DOORS project. This would be accompanied by an active and enthusiastic core of proposing University partners.



Figure 2: Photos from the Masters proposition workshop, held in Stirling, UK on .January 16th 2024.

Facilitated by UCC and KANTOR, the workshop began with a presentation on the obligations on the consortium to develop an Masters programme proposition. The KANTOR-led analysis that built on the findings of D7.1 was then presented, along with the path for the DOORS consortium to get to a course and partnership proposition. It was generally agreed that the ideal scenario would be for an application to be in active submission for evaluation by the time DOORS closes, an idea which later proved to be infeasible given timelines associated with university accreditation processes. Participants then had the chance to explore why the Black Sea region is the perfect place for a Masters Programme in Maritime Activities, with the uniqueness of the Black Sea in terms of ecosystems, history, enclosed basin characteristics, geopolitics, political transformation and policy diversity being amongst many aspects which only a Black Sea-based MSc. programme could offer. Note that it was seen as critical that the proposed Masters contribute to the overall SRIA by enabling "*a healthy and productive Black Sea*". Further details are available in DOORS D7.6 (Appendix 3).

The structured conversation led by UCC, then moved to the structure of a course, in terms of thematic modules, and the key skills these modules deliver overall. Academic, industry and research partners explored options, highlighted critical thematic content, and together defined the division between what could be considered a core module, and what could be considered an optional. The outputs of the process were then summarised, distributed to partners post-even, and integrated into the Masters programme definition presented here.

The conversation then turned to delivery of the course, and the practical aspects. Participants highlighted the challenges that need to be overcome with regard to National Accreditation procedures in the different countries. This could be a particular challenge as the course is fundamentally multi-disciplinary, while National Authorities tend to be for tightly discipline-focused. The make-up of the proposing consortium was also broached. It was clear that a European champion partner is needed to lead. Representation of 5 countries is seen as optimal, noting that 6-7 non-EU countries are also eligible to participate (Azerbaijan, Georgia, Ukraine, the United Kingdom and Turkey amongst others). The consortium should include 2-3 Black Sea regional Universities, bringing in the best specialists to teach the various topics. Initial regional partners include KTU, BFU and OSENU.

2.4. Combining perspectives and defining the course.

Combined, the gap analysis, workshop and survey provided a nearly overwhelming wealth of information to guide and shape the DOORS Masters proposition. The iterative development approach with the university consortia interested in delivering such a programme began at the Stirling workshop. A 1st draft outline of the course was delivered to the university partners for feedback. Given the wealth of information and wide range of disciplines the course intended to engage with and teach, a generative AI (Artificial Intelligence) was used to identify linkages and gaps that may have been missed by the draft author. This assist ensured the course modules (module title, goal, outline and learning objectives) the university partners received to critique were coherent, less biased (though not entirely – see Annex 1 of this document), and presented a consolidated offering for academics to critique and revise. The AI also assisted in the identification of module dependencies, and potential specialisation avenues for students, suggesting some useful linkages which. Ensuring quality control of the suggested amendments was undertaken in two ways. The first involved the human author, who quality controlled the process, vetted and examined suggestions, while also instructing the AI to analyse the interactive process to identify biases which could have arisen. For full details see Annex 1 of this document. Secondly, the academic review of draft 1 also formed part of the quality control process. Academics in the DOORS consortium were given a week and openly invited to review, revise, critique and suggest amendments to the draft proposition, following which their feedback was integrated into the course proposition and deliverable 7.6.

3. Consolidated findings and Masters context:

3.1. Training Gap Analysis

The review of the Masters programme reveals that most of the programmes were structured over 2 years (4 semesters), with an emphasis on compulsory mobility. For instance, both IMBRSea and MIR require students to spend time at multiple universities across Europe, ensuring broad exposure to different academic cultures and research environments. ECT+ also emphasized mobility, with students required to visit at least 3 universities across 2 different EU countries. The MER+EMJMD programme had a tailored curriculum allowing students to mix modules from different universities, enhancing flexibility. All programmes used English as the primary language of instruction, though some institutions offered modules in local languages like French, Spanish, Basque, and Portuguese. Therefore, students could specialised in certain languages or take the full course in English, ensuring broad accessibility for international students.

Mobility is a key feature in most programmes, designed to promote international cultural exchange and development of soft skills. For example, IMBRSea and MIR integrate mobility into their course design, allowing students to work in diverse settings in countries across Europe and beyond. Internships are a common feature, with programmes such as MIR offering a 6-month internship as part of the Master's Thesis and IMBRSea providing Professional Practice placements with international partners. All reviewed programmes are based on a collaborative model involving multiple academic partners. For instance, IMBRSea works with institutions such as Ghent University, University of Algarve, and University of Oviedo. Similarly, MIR has partners like University of Toulon, NTNU (Norway), and UJI (Spain), ensuring that students have access to a wide network of expertise. This type of collaboration ensures that students benefit from various international perspectives and research environments. Finally, all programmes require students to have a strong academic background in marine science, environmental studies, or related fields, with additional requirements for motivation letters, reference letters, and language proficiency documentation. Programmes like MER+EMJMD and MIR also emphasize the scientific quality of the institutions where applicants obtained their undergraduate degrees, indicating the high academic standards expected from applicants.

The Training Gap Analysis highlights the misalignment between existing academic offerings and the skill sets required for careers in the Blue Economy. A critical issue is the lack of interdisciplinary training that integrates technical knowledge with practical application. Current programs in the Black Sea countries tend to focus on traditional disciplinary boundaries, leaving significant gaps in areas such as marine spatial planning, sustainable aquaculture, coastal resilience, and digital ocean technologies.

Another major shortcoming of the analysis is the absence of standardized curricula that align with international best practices. While some institutions in the Black Sea region offer specialized marine and maritime courses, there is no cohesive framework ensuring consistency across universities. The study also emphasizes the need for stronger partnerships between academia and industry, as current programs often lack direct engagement with key stakeholders. These disconnects limits graduates' preparedness for employment in critical blue economy sectors and reduces opportunities for applied research and innovation.

The document further identifies the necessity of scalable and flexible learning models. Many existing programs do not accommodate mid-career professionals seeking to upskill, nor do they offer micro-credentialing options that could provide targeted training in specific competencies. Additionally, training methodologies need modernization, with a greater emphasis on digital learning tools, practical fieldwork, and interdisciplinary collaboration. The findings of D7.1 underline the urgent need for a consolidated MSc

framework that integrates best practices from leading European programs while addressing the specific gaps identified in Black Sea countries.

3.2. Needs Assessment (Training Skills Survey)

The survey results provide valuable insights into the country-specific needs, challenges, and priorities for workforce development in the maritime sector of the Black Sea region. Detailed results are presented in DOORS D7.6 (Appendix 2). The survey highlights the essential skills that students in maritime-related courses should develop, categorized into soft skills, environmental competencies, technical expertise, and business and management skills. Across all countries, communication, collaboration, leadership, and problem-solving are consistently recognized as critical skills. Environmental awareness, sustainability, and climate change knowledge are widely regarded as essential for protecting marine ecosystems. Romania, Georgia, and Moldova specifically emphasize marine environment protection, logistics, and research skills, while Moldova and Romania highlight the increasing role of artificial intelligence and digital tools in maritime applications. Business and management skills, including marine business operations and port management, are particularly relevant in Georgia and Moldova.

From the perspective of businesses, technical and technological skills remain a top priority, with a strong focus on digitalization, ship stability, and regulatory compliance. Environmental and sustainability competencies are valued, particularly in Georgia, Moldova, and Türkiye, where businesses stress the importance of marine conservation and aquaculture management. Resource management skills are particularly relevant to the fisheries and aquaculture sectors, especially in Georgia. Additionally, planning, development, and capacity-building skills feature prominently in Türkiye and Bulgaria, highlighting the need for structured industry growth. Safety skills, including compliance with maritime regulations, are emphasized in Moldova and Türkiye, underlining the necessity of ensuring workplace safety and adherence to international standards.

The comparison between academic and business perspectives underscores a crucial gap: while academia focuses on foundational knowledge and research, businesses prioritize industry-specific applications and workforce readiness. Addressing this disconnect requires a harmonized approach that integrates theoretical education with hands-on, industry-driven training.

Respondents also identified additional priority areas and sectors that should be incorporated into maritime training programs. Environmental protection and sustainable practices emerged as a common theme across countries, with Romania, Moldova, Türkiye, and Bulgaria emphasizing pollution control and environmental restoration. Conservation and biodiversity protection were highlighted in Moldova, Georgia, and Türkiye. Sustainable coastal and marine management, including tourism, spatial planning, and fisheries, was widely recognized, particularly in Romania, Türkiye, and Georgia. Maritime and port management, including ship and port operations, was deemed essential in Moldova, Türkiye, and Ukraine. Additionally, research, innovation, and digitalization were emphasized, with Moldova calling for greater integration of data science and technology, while Bulgaria highlighted the need for technological advancement in the maritime sector.

To bridge the gaps in knowledge, respondents identified several key topics for knowledge transfer and training. Environmental management and conservation, including waste management and biodiversity protection, remain central to achieving sustainability goals. Technological innovation, particularly the integration of AI, marine modelling, and biotechnology, is crucial for enhancing maritime efficiency and resilience. Education and capacity-building initiatives must focus on strengthening maritime training programs while incorporating both soft and technical skills.

3.3. WP7 Stirling workshop recommendations

Some of the recorded discussions on the day of the Stirling workshop are shown in Figure 3, with a more detailed output presented in DOORS D7.6 (Appendix 3). Overall, a two-tier approach was seen to be the best approach to structuring the Masters programme – comprising core modules, and optional modules for students to undertake. This would enable students to undertake directed learning, coupled with the ability to produce a range of graduates specialised in different aspects of Coastal and Marine systems, and Blue Economy. The programme should enable students to graduate with an Masters degree with either an academic, or more private-sector-professional focus overall, depending on their specialisation.

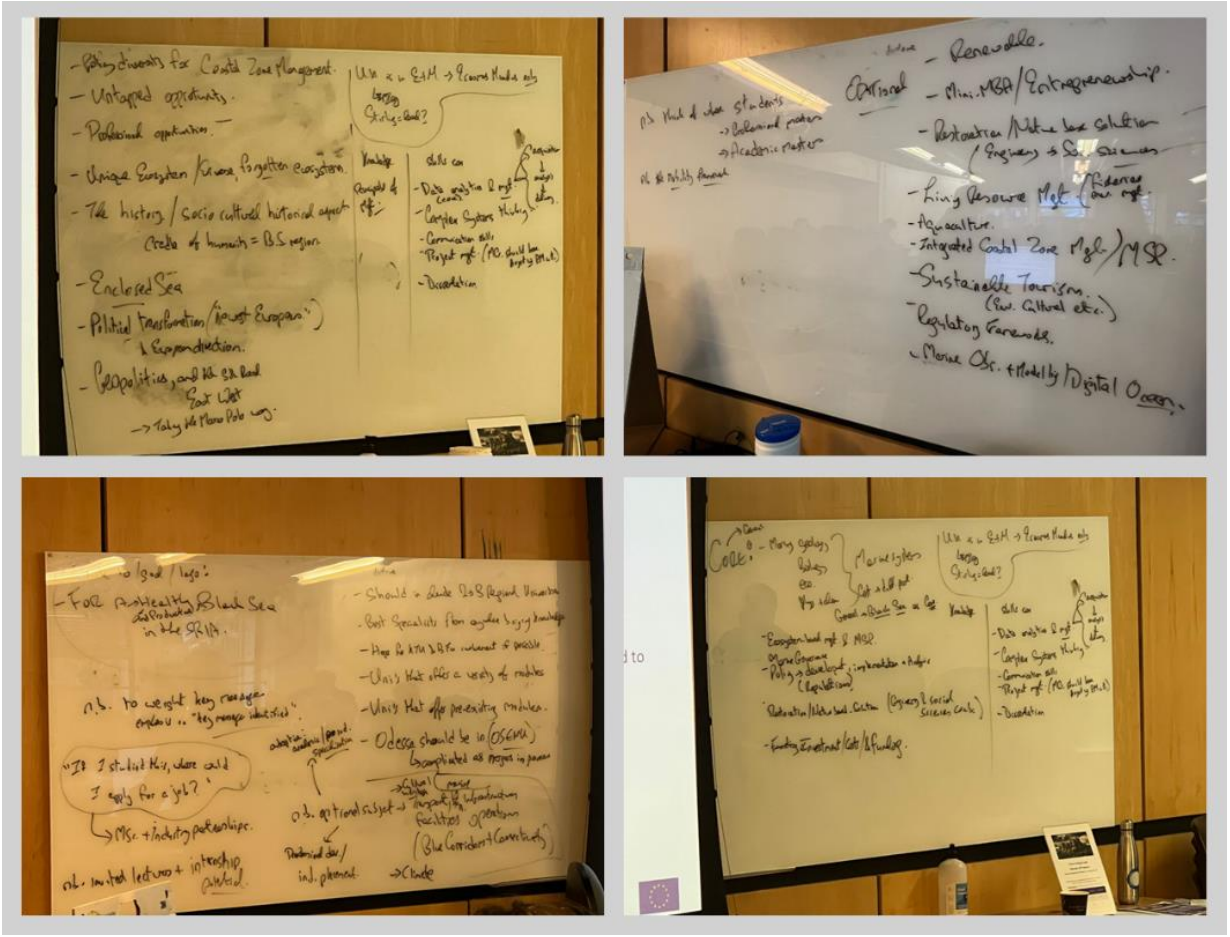


Figure 3. Some of the outputs of the Stirling workshop, including the rational for the Black Sea as a focus area, Core and Optional module discussions, and discussions on the more practical aspects of implementing a Masters course.

In addition to the thematic information the modules would deliver, the programme would equip graduates with key skills in Data Analytics & Management Skills, Complex Systems Thinking, Communication Skills, Project Management, and Dissertation-focused research skills. In terms of subjects, core modules would have to cover the topics of: Marine Systems & Parameters (geology, biology, ecology, physics and chemistry), Blue Economy and Environmental Economics, Regional Context (political, historical, biological, geophysical), Marine Governance (Marine Spatial Planning; Ecosystem-based management; Policy development, implementation & analysis), Restoration (Nature-based solutions; Engineering context; Social Sciences context), Blue Economies & Financial Resourcing (Economic fundamentals, Cost quantifying, Funding sources, Investment approaches).

The workshop recommended that optional modules should ensure students are presented with a wide range of specialisation paths, which allow for adaptive academic/industry tailoring. The optional modules initially proposed in the workshop comprise: Regional Heritage & Culture (History, biological heritage, regional archaeology, conservation approaches); Regional Marine transport and connectivity (Maritime transport; Maritime facilities; Maritime operations; Regional networks, blue corridors & connectivity); Regional Climate and Adaptation (Status; Regional change; Risk & vulnerability, Adaptation), Industry placement and private sector professional development (Private sector processes, Blue Economy theory application, Innovation & research commercialisation, Entrepreneurship), Living Resource Management (fisheries, aquaculture, eco-tourism), Sustainable tourism (environmental, cultural etc.), Coastal and Marine Policy and Regulatory Frameworks (ICZM, MSP, Governance) Marine Observation, modelling and Digital Oceans (Data collection methods, modelling and systems thinking, Information Technology Solutions, data acquisition and storage standards).

3.4. Other perspectives

Over the course of this information gathering, options beyond the narrow scope of Masters programmes were encountered. Amongst these options were Micro-credentials, and Blended Intensive Programmes. Independent review of Task 7.2 (the DOORS Work Package task underpinning this deliverable) by the European Commission reviewers, and partner feedback from within WP7, highlighted the need to consider such interim/complementary education options, to establish connectivity and content development during the development period of the Masters programme (during which it is refined, submitted, evaluated, and established).

4. Pathway to a Masters – Micro-credentials and BIPS

4.1. Micro-credentials implementation

On 16 June 2022, the Council of the European Union adopted a Recommendation on a European approach to micro-credentials for lifelong learning and employability[2]. This initiative aims to support the development, implementation, and recognition of micro-credentials across institutions, businesses, sectors, and borders. Micro-credentials are short, targeted learning experiences that certify specific skills or competencies, offering a flexible and inclusive way for individuals to adapt to the evolving demands of the labour market and society.

In an era of rapid technological advancement and economic transformation, fostering a culture of lifelong learning is essential. Micro-credentials provide learners with the opportunity to acquire, update, and improve their knowledge and skills in a way that is both accessible and tailored to their needs. Unlike traditional qualifications, micro-credentials are designed to be modular, allowing individuals to build personalized learning pathways that align with their career goals and personal development.

The European approach to micro-credentials seeks to address the growing demand for flexible, learner-centered education and training. By establishing common standards for quality, transparency, and recognition, the initiative aims to ensure that micro-credentials are portable and comparable across borders. This will enable learners to showcase their competencies effectively, whether they are seeking new employment opportunities, transitioning between careers, or simply enhancing their skill sets.

Moreover, micro-credentials have the potential to reach a wider audience, including disadvantaged and vulnerable groups, by offering accessible and targeted learning opportunities. They are particularly relevant in the context of the green and digital transitions, where new skills are urgently needed to drive innovation and sustainability.

The European Commission's support for micro-credentials is a key component of its vision to achieve a European Education Area by 2025. Within DOORS, the Masters programme study highlighted that Higher Education Institutions (HEIs) have the opportunity to develop micro-credentials across a wide range of subjects that align with current and future labour market needs. These subjects can span interdisciplinary areas, combining technical, digital, green, and entrepreneurial skills. The EU-CONEXUS Micro-credentials scheme serves as a case study, showcasing how targeted, flexible learning opportunities can address real-world challenges in urban coastal sustainability. It is an initiative aimed at providing Bachelor students with short-duration, labour market-oriented courses in the field of Smart Urban Coastal Sustainability (SmUCS). These micro-credentials are designed to equip students with specific skills and competencies that are highly relevant to the challenges of urban coastal environments, such as climate change, sustainability, and digital transformation.

The EU-CONEXUS micro-credentials are organized into 6 sectors and 48 thematic areas, covering a wide range of topics related to urban coastal sustainability. Each micro-credential is worth 1 ECTS (25-30 hours of workload) and is delivered online, making it compatible with students' existing study programs. The courses are developed by professors from EU-CONEXUS universities and are structured to include:

- **Live online classes**: Synchronous sessions where students interact with professors and peers.

[2] Retrieved from https://education.ec.europa.eu/education-levels/higher-education/micro-credentials [Last accessed 6th March 2025].

- **Individual or group assignments**: To reinforce learning and practical application of skills.
- **Optional consultations**: Weekly sessions with professors for additional support.

The implementation of the EU-CONEXUS micro-credentials is highly flexible and student-centered. Students can choose from three different itineraries:

- **Individual**: Complete one micro-credential and receive a certificate from the host university.
- **Interdisciplinary**: Complete six micro-credentials (one from each sector) and receive a certificate in Smart Urban Coastal Sustainability.
- **Expertise**: Complete six micro-credentials within a single sector and receive a certificate in that specific sector.

The micro-credentials are offered in two semesters (Spring and Autumn), with courses starting in March, April, May, October, November, and December. Students are required to attend at least 60% of the classes to be eligible for certification.

The implementation of micro-credentials offers several benefits for both students and HEIs:

- **Enhanced Employability** - Micro-credentials provide students with up-to-date, labor market-relevant skills, making them more competitive in the job market.
- **Flexibility and Accessibility** - The short duration and modular nature of micro-credentials allow learners to integrate them into their existing schedules, making education more accessible to working professionals and non-traditional students.
- **Personalized Learning Pathways** - Learners can tailor their education to their specific needs, focusing on areas that align with their career aspirations or personal interests.
- **Inclusivity**: Micro-credentials can reach a broader audience, including those who may not have access to traditional higher education, such as disadvantaged or vulnerable groups.
- **Alignment with European Standards** - By adhering to common European standards, micro-credentials ensure recognition and portability across borders, enhancing their value for learners and employers alike.
- **Support for Lifelong Learning** - Micro-credentials encourage continuous skill development, helping individuals adapt to the demands of the green and digital transitions.

Additionally, they are cost-effective. Micro-credentials are free of charge for students, making them accessible to a wider audience.

However, despite the numerous benefits, there are several challenges associated with the implementation of micro-credentials:

- **Quality Assurance** - Institutions must balance flexibility with academic standards.
- **Recognition and Transferability** - Clear frameworks for recognition are essential.
- **Resource Allocation** - Institutions must invest in these areas to ensure successful implementation.
- **Student Engagement** - Strategies to enhance engagement, such as interactive content and flexible scheduling, are crucial.
- **Coordination Among Institutions** - Effective communication and collaboration are key to overcoming these challenges.
- **Student Dropout** - Institutions must provide adequate support to minimize dropout rates and ensure program success.

The European approach to micro-credentials represents a significant step forward in promoting lifelong learning and employability. By offering flexible, targeted learning opportunities, micro-credentials have the potential to empower individuals to thrive in an ever-changing world. In terms of future content, the Version 1.0 Masters programme outline lists a varied range of topics and subjects about which micro-credentials could be developed.

4.2. Blended Intensive Programmes

Blended Intensive Programmes (BIPs) are short-term mobility actions delivered by Higher Education Institutes (HEIs)[3]. Introduced under the European Union's ERASMUS+ programme, these intensive courses enable groups of HEIs to jointly develop blended mobility curricula and activities for students and staff (both academic and administrative). Accepted BIPS must include both a physical component and a virtual component, and involve the participation of at least three different ERASMUS+ programme countries or from the 3rd country associated with the programme. Courses comprise of a physical mobility element lasting between 5 and 30 days (excluding travel days), while there is no minimum duration for the virtual component which can be held before or after the physical mobility. Critically, a minimum of 3 ECTS credits should be awarded for blended mobility for studies. Meanwhile, participants can be eligible for organisational support (funding) if a minimum of 15 participants are accepted to the course. Additionally, a BIP should have added value compared to existing courses or trainings offered by the participating HEIs and can be multiannual.

4.2.1 An early example of DOORS success: Sustainable Blue Economy BIP

In April 2025, in support of the DOORS initiative and implementing key ambitions of the DOORS Knowledge Transfer and Training programme, the Faculty of Business Studies of Burgaski Svoboden Universitet (Burgas Free University, in Bulgaria) organised and hosted the Black Sea's first BIP on "Sustainable Blue Economy". The course was open to students in the areas of Business & Administration, Economics, Law and Information & Communications Technology. The 5 credit (ECTS) course focused on 'How Can Environmental, Social and Governance Standards Benefit Your Business?', with the following learning goals: To understand the core concepts of the Blue Economy and the Sustainability principles.

- To develop knowledge of Blue Economy and maritime sector framework and strategies.
- To understand the specifics of the growth in the BE sectors if sustainability and circularity approaches are applied.
- To provide practical skills for generating business ideas and their implementation in the sectors of the blue economy.



[3] Retrieved from https://wikis.ec.europa.eu/spaces/NAITDOC/pages/95553249/Blended+Intensive+Programmes [last accessed 17th April 2025].

Online teaching comprised 2 sessions:

- 1st online meeting – 02.04.2025 15:00-17:00 Ireland (17- 19 h Eastern European Time (EET) , which is UTC+2)
- 2nd online meeting – 07.04.2025 15:00-17:00 Ireland (17- 19 h Eastern European Time (EET) , which is UTC+2)

In-person teaching took place at Burgas Free University from the 11.04.2025 to the 15.04.2025. The daily workload was 8 hours, combining the theoretical teaching with workshops and cultural activities.

These included

- A Warm-Up Workshop and a tour of Burgas Free University;
- Workshops
- A variety of social events, including lunch and trips – e.g. a cultural trip to the ancient town of Nessebar, listed in the UNESCO World Heritage Sites;

The programme was open to students from the 1st, 2nd, and 3rd cycles, corresponding to:

- 1st cycle → Bachelor's (BSc, BA, etc.)
- 2nd cycle → Master's (MSc, MA, etc.)
- 3rd cycle → Doctoral (PhD, etc.)

Overall, BFU signed 5 agreements with universities across Europe, which underpinned the participation of 45 students from 20+ nationalities in the course. Students were primarily undergraduates, with both postgraduate (Masters) and 2 PhD candidates also participating. Funding was provided by Erasmus+ and partner institutions.

The BIP in Sustainable Blue Economy is an example of one BIP delivered within the Black Sea region, focused on subject matter of relevance to the SRIA. Similar to micro-credentials, further topics about which BIPs could be developed can be found in the Version 1.0 masters programme outline.

4.3. Erasmus Mundus - The DOORS Masters programme proposition.

An Erasmus Mundus Joint Master (EMJM) programme typically awards 120 ECTS credits over two academic years. Delivered by three or more institutions, typically each institution caters for a semester of approximately 30 credits. A masters thesis or research project is also a part of the student's learning journey, comprising 20-30 ECTS.

As of 2021, the Erasmus Mundus programme underwent significant structural modifications, introducing two distinct sub-actions: the Erasmus Mundus Joint Masters (EMJMs) and the Erasmus Mundus Design Measures (EMDMs). The EMJMs represent a continuation of the previous Erasmus Mundus Joint Master Degrees (EMJMDs), while the newly established EMDMs aim to support the development of innovative, high-quality, integrated transnational Master's programmes.

The EMJMs are prestigious, integrated international master's programmes collaboratively designed and delivered by consortia of Higher Education Institutions (HEIs) from different countries. These programmes aim to enhance the quality and global visibility of European higher education, fostering academic cooperation and cultural exchange. Specifically, they provide credit-based modules and require student mobility with mandatory relocation. The key features that make them stand out are a) International Collaboration, b) Comprehensive Curriculum and c) Joint Recognition.

EMJM programmes are jointly delivered by at least three institutions from different countries, with academic and non-academic partners. They include study, research, traineeships, and thesis preparation. They include

study, research, traineeships, and thesis preparation. Programmes last 1 to 2 years (60, 90, or 120 ECTS credits) and award either a joint degree (a single diploma from at least two institutions) or multiple degrees (separate diplomas from consortium institutions). Top-ranked students worldwide may receive full scholarships, covering participation costs, travel, visas, and a living allowance.

Some of the most crucial aspects of Erasmus Mundus masters are:

- **Fostering cooperation:** The Erasmus Mundus programme has evolved to place a stronger emphasis on institutional collaboration, with a significant aspect of this cooperation being the programme's influence on expanding student mobility, institutional partnerships, and international engagement. Studies indicate that Erasmus Mundus has led to an improved understanding of the European higher education landscape (76%), increased student mobility opportunities (62%), and strengthened international cooperation. At the programme level, this impact is seen in enhanced faculty exchanges (89%), the development of new partnership models (88%), and contributions to securing funding for additional joint programmes.
- **Fostering accreditation recognition and alignment:** Erasmus Mundus Master's programmes have also become key users of the European Approach for Quality Assurance of Joint Programmes, accounting for a significant portion of joint programmes utilizing this framework for accreditation or evaluation. Currently, 16 out of 33 joint programmes recorded in the Database of External Quality Assurance Results (DEQAR) are Erasmus Mundus beneficiaries, strengthening the integration and collaboration within learning and teaching, reinforcing the overall quality and coherence of joint programmes.
- **Inter-HEI agreements:** Over the course of four funding periods, HEIs have actively engaged in Erasmus Mundus Master's programmes through various forms of participation. In total, there have been 5,523 instances of HEI involvement, with 585 (11%) serving as coordinators, 2,334 (42%) as full partners, and 2,604 (47%) as associated partners. This translates into approximately 600 unique HEIs that have contributed as either coordinators or full partners in Erasmus Mundus Master's programmes and related projects over the past two decades. On average, each institution participated 4.9 times in Erasmus Mundus initiatives, demonstrating the sustained commitment of HEIs to international collaboration and joint programme delivery.

As joint degrees have become more widely accepted and increasingly sought after, relevant regulations have been progressively integrated across institutions. A significant institutional development has been the establishment of dedicated Erasmus Mundus working groups, bringing together representatives from International Offices, Student and Educational Affairs, and Legal/Institutional Affairs.

5. The DOORS Masters programme proposition.

Outlined over the following pages, are the subject modules and learning objectives of a of a Masters Programme for Marine Activity Planning, encompassing activities in marine science, marine policy, and Blue Economy. It has been developed to be fundamentally multi-disciplinary, flexible in terms of learning pathways, and structured to create connections between industry and academia. The course equips students for a variety of career paths in institutional academia, research, industry and entrepreneurship. It is designed to be delivered as a globally-relevant course, using the Black Sea region as a test bed for enquiry, discussion and learning. The modules are designed to foster networking, shared learning, local and global connectivity, scientific enquiry, and constructive critique. A visual overview of the course can be seen in Figure 4.

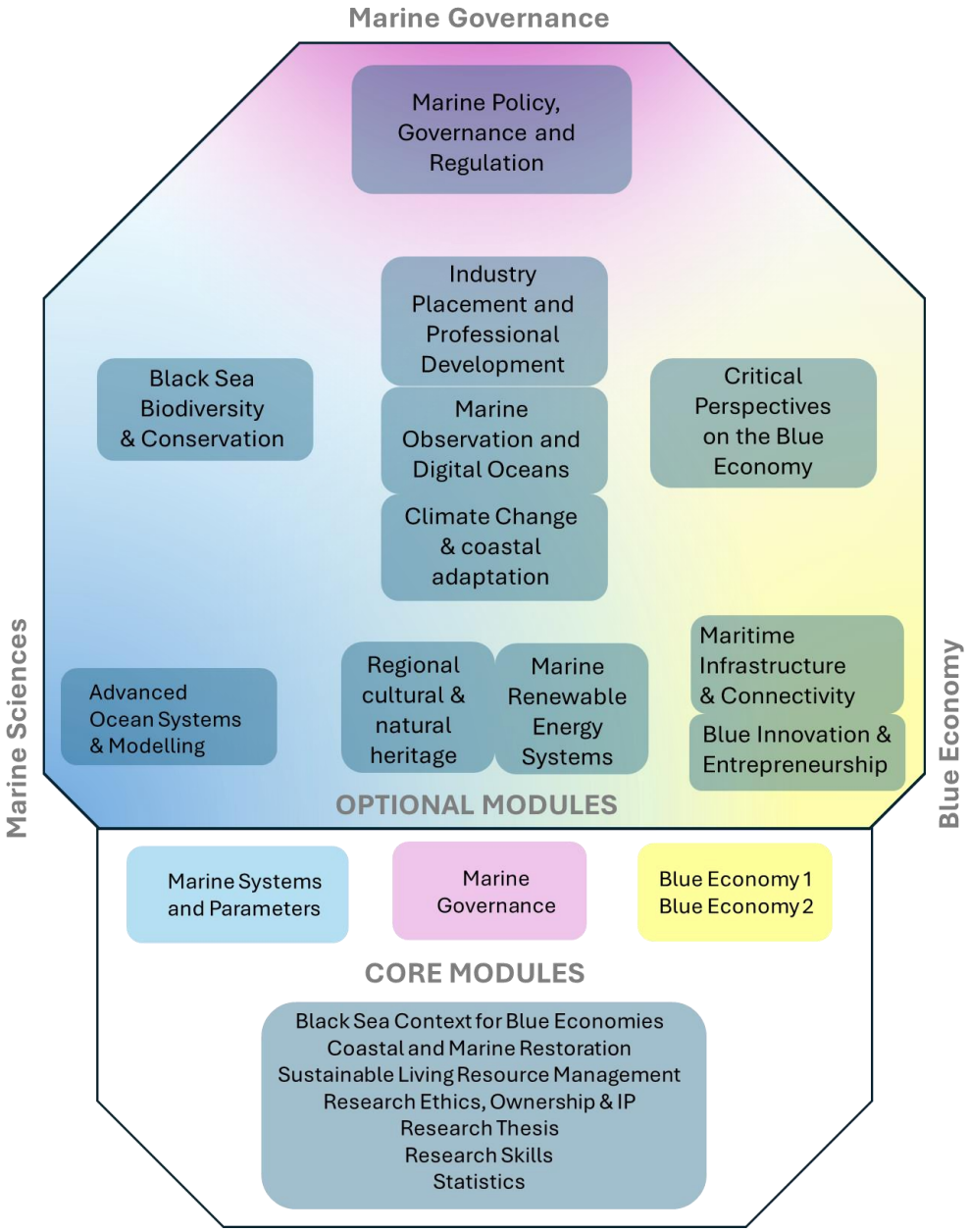


Figure 4. Subjects and positioning of modules in the DOORS proposed Masters programme.

The 120 European Credit Transfer and Accumulation System (ECTS) credit Masters Course is comprised of both core and optional modules to ensure flexibility, and it's ability to cater for students interested in policy, science, economics or entrepreneurship. The core component comprises 80 ECTS, with students available of 40 credits of optional modules to specialise and tailor their Masters certification. The course has been designed with the assistance of DOORS partner universities who are well suited to refine and deliver the course as a full Erasmus Mundus consortium. It is proposed openly for uptake by regional partners, and structured for further development. The learning objectives and course topics enable the programme to meet a key subset of the Blue Economy, marine science, and marine policy skills gaps in the Black Sea region and further afield, while consolidating thematic coverage around the Blue Economy challenge.

In the ideal situation, these modules would underpin an ERASMUS Mundus-funded programme. This will need to be developed by universities, who can use this proposition as a baseline for their discussions, negotiations and planning. The authors also recognise it may be more realistic for individual universities to integrate aspects of this joint Masters proposition into their individual offerings in terms of modules. The module descriptions can also be used to support such an action, providing clear guidance on what knowledge and skills need to be taught, underpinned by an extensive analysis of the Black Sea region.

5.1 Core Modules:

These core modules equate to 80 European Credit Transfer and Accumulation System (ECTS) credits. They equip students with critical research and analysis skills, and a broad knowledge foundation to support their specialisation using optional modules. Three broad specialisation dimensions are proposed here, noting that these will likely develop or change as the course is developed by the implementing consortium:

1) Marine governance, justice and social dimensions
2) Environmental systems and observation
3) Blue Economy development and innovation

The core modules proposed are listed in Table 1, along with the nominative specialisation pathway they support. Students would need to successfully complete all 80 credits worth of these core modules. A research dissertation here is considered a key component of the core modules. In terms of skills, the core modules address the critical skill gaps identified by the gap and survey analyses, and the consultation with the DOORS project partners and the skills survey.

The outlines following Table 1 outline the key details of each module, including the goal, content, and learning objectives. During the review process, academics and researchers suggested a number of valuable ways to teach and convey knowledge for some modules. These suggestions have also been captured in the module tables.

Table 1.: Core modules for students to specialise in, along with the proposed credit weighting and alignment under a draft specialisation pathway, and core skills developed in the module.

Module title	Credit weighting (ECTS credits)	Specialisation pathway			Core Skills developed						
		1. Marine Governance, justice, and social dimensions	2. Environmental Systems & Observation	3. Blue Economy Development & Innovation	Complex Systems Thinking	Data Analytics & Management	Project Management	Dissertation-focused research implementation	Research ethics applications	Intellectual Property	Communications
Marine Systems and Parameters	10		✓		✓	✓					✓
Blue Economy 1: Fundamentals and Environmental Economics	5			✓	✓						✓
Marine Governance	5	✓			✓						✓
Blue Economy 2: Advanced Perspectives and Financial Resourcing	5			✓	✓						✓
Black Sea Context for Blue Economies	5	✓	✓	✓	✓	✓					✓
Coastal and Marine Restoration	5	✓	✓	✓✓	✓	✓					✓
Sustainable Living Resource Management	10	✓	✓	✓	✓	✓					✓
Research Skills	5	✓	✓	✓			✓	✓			✓
Research Ethics, Ownership and Intellectual Property	5	✓	✓	✓					✓	✓	
Statistics	10	✓	✓	✓		✓					
Research Thesis	20	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓

Module 1 Name	*Marine Systems & Parameters*
Subject Area	Environmental Systems & Observation
Credit rating	10 credits *The notional student workload for 10 credits is 250 hours.*
Pre-requisite module	None
Complement module / Co-requesite module	None
Teaching methods	20 x 2 Hr(s) Lectures 10 x 2 Hr(s) Practicals and workshops

Module Goal

To introduce the core scientific disciplines underpinning marine systems, providing a foundational descriptive understanding of the ocean's physical, chemical, biological, geological, and ecological processes.

Module content

This module will provide a introduction to essential processes and disciplines in the area of marine science. It will cover a diverse range of environmental topics, including oceanography and coastal geophysics, chemistry, biology, geology and dynamics. It also provides an introduction to ecological processes, the land-sea dimension of inputs to marine systems, climate variability and drivers of change, invasive species, and unique basin-specific phenomena such as hypoxic zones and their variability under anthropogenic influences, completing participants awareness of the biogeochemical and upstream systems, global and regional processes that underpin sustainable Blue Economies. A specific focus is on the development of systems thinking approaches and how they apply within marine sciences.

Learning outcomes

On successful completion of this module, students should be able to:

1. Describe key physical, chemical, biological, geological, and ecological processes that structure marine environments, including the land-sea dimension.
2. Explain the interactions among marine system components across spatial and temporal scales.
3. Interpret basic oceanographic data and indicators related to temperature, salinity, currents, nutrient cycles, and biodiversity.
4. Apply interdisciplinary concepts and systems thinking to analyse real-world marine scenarios and challenges.
5. Assess real-world regional issues such as hypoxia drivers and invasive-species proliferation in this semi-enclosed sea.
6. Communicate marine science concepts using appropriate terminology and frameworks

Suggestions

- Consider using the *Mnemiopsis leidyi* invasion in the Black Sea as a case study to teach, highlighting its ecological impacts and cascading effects on regional fisheries
- Consider a practical analysis session where students analyse DANUBE River nutrient runoff data and model potential eutrophication hotspots.

Module 2 Name	*Blue Economy 1: Fundamentals and Environmental Economics*
Subject Area	Blue Economy Development & Innovation
Credit rating	5 credits *The notional student workload for 5 credits is 125 hours.*
Pre-requisite module	None
Complement module / Co-requesite module	None
Teaching methods	24 x 1 Hr(s) Lectures

Module Goal

To introduce foundational economic principles relevant to marine and coastal systems, examining core concepts in environmental economics and the Blue Economy.

Module content

This module provides an introductory over of the foundational principles of economics with a focus on their application to marine and coastal environments. Concepts covered include micro- and macroeconomics, market failure, natural resource valuation, ecosystem services, and cost-benefit analysis. The student will explore the foundations of Blue Economy, in terms of sustainability trade-offs, justice and equity. The module also examines the Blue Economy as an ever-changing policy and development framework, addressing sustainable growth, innovation incentives (e.g. market-driven, mission-driven etc.) ocean governance, and the integration of environmental and economic priorities. Real-world case studies illustrate the balance between economic opportunity and ecological limits in ocean-based industries.

Learning outcomes

On successful completion of this module, students should be able to:

1. Explain core economic concepts relevant to environmental and marine systems, including supply and demand, externalities, and public goods.
2. Elaborate on underlying value systems and policy assumptions in Blue Economy frameworks.
3. Apply environmental economic tools such as valuation methods and cost-benefit analysis to ocean and coastal contexts.
4. Critically evaluate the Blue Economy framework, its principles, and its implications for sustainability and governance.
5. Interpret and discuss economic-environmental trade-offs in marine policy and industry decision-making.
6. Communicate economic and Blue Economy concepts using appropriate terminology and frameworks.

Suggestions

- Use a case study, evaluating trade-offs between industrial fisheries and conservation within regional Blue Economies.
- Use a case study to show a trade-off, e.g. the collapse of the Black Sea anchovy stocks, the causes (e.g. overfishing and invasive species competition) and consequences (economic losses).
- A workshop could be done with students where they implement a cost-benefit analysis comparing invasive species mitigation (e.g. *Rapana venosa* removal) with mussel aquaculture.

Module 3 Name	*Marine Governance*
Subject Area	Marine governance, justice, and social dimensions
Credit rating	5 credits *The notional student workload for 5 credits is 125 hours.*
Pre-requisite module	None
Complement module / Co-requesite module	None
Teaching methods	20 x 1 Hr(s) Lectures 2 x 2 Hr(s) workshops

Module Goal

To provide a comprehensive understanding of marine governance frameworks, tools, and processes.

Module content

This module explores the structures and dynamics of marine governance at local, regional, and global scales. Emphasis is placed on understanding governance as a multi-level, interdisciplinary challenge, shaped by legal, political, ecological, and social factors. Key aspects such as jurisdiction, marine spatial planning (MSP), integrated coastal zone management (ICZM), ecosystem-based management (EBM) and community-based management models, alongside the processes of policy development, stakeholder engagement, and regulatory enforcement. Regionally-relevant development considerations such as regional responses to coastal erosion, litter pollution, eutrophication, regional-scale infrastructure planning, environmental licencing frameworks, and legal pluralities, will be discussed within this governance context. Through case studies and applied exercises, students will build the analytical skills needed to critically engage with policy design, implementation, and evaluation in support of sustainable ocean and coastal management.

Learning outcomes

On successful completion of this module, students should be able to:

1. Describe the predominant marine governance frameworks, institutions, and instruments operating at multiple scales;
2. Analyse the principles and application of marine spatial planning, ecosystem-based management, and integrated approaches to ocean governance;
3. Evaluate the policy development cycle, including agenda setting, stakeholder engagement, implementation, and policy impact assessment;
4. Assess the challenges and trade-offs in marine governance, particularly in balancing ecological, economic, and social objectives;
5. Apply governance concepts and tools to real-world marine management scenarios, with attention to equity, legitimacy, and effectiveness;
6. Critique governance frameworks for real-world issues such as transboundary pollution control and habitat protection in conflict-affected regions, or invasive species management strategies.

Suggestions

- Use a case study, exploring the Black Sea Commission's enforcement challenges under the Bucharest Convention, arising from post-2022 geopolitical shifts.
- Use a workshop to facilitate students in designing a regional invasive-species management strategy across adjacent EEZs.

Module 4 Name	*Blue Economy 2: Advanced perspectives & Financial Resourcing*
Subject Area	Marine governance, justice, and social dimensions Blue Economy Development & Innovation
Credit rating	5 credits *The notional student workload for 5 credits is 125 hours.*
Pre-requisite module	Module 2 - Blue Economy and Environmental Economics
Complement module / Co-requesite module	Module 3 - Marine Governance
Teaching methods	24 x 1 Hr(s) Lectures

Module Goal

To equip students with the financial literacy, strategic understanding and implementation tools needed to identify, evaluate, and mobilize funding sources for sustainable Blue Economy initiatives, with a focus on cost quantification, investment mechanisms, and the specific geopolitical and economic realities of regional contexts such as the Black Sea.

Module content

This module provides a deep understanding of the financial dimensions of the Blue Economy. Building on foundational economic principles, students will explore how to quantify economic costs and benefits, develop funding strategies, assess the viability of marine and coastal initiatives, and critique financial models that exist in the Blue Economy. Topics include public and private investment sources, blended finance, financial instruments for sustainable development, and risk assessment. Case studies from the Black Sea and beyond will illustrate how financial planning intersects with policy, ecology, and governance. Emphasis is placed on the financial tools necessary to advance sustainable, inclusive, and scalable Blue Economy projects or initiatives.

Learning outcomes

On successful completion of this module, students should be able to:

1. Quantify costs and benefits for marine and coastal projects using appropriate economic tools;
2. Identify and compare a range of financial instruments and funding sources relevant to the Blue Economy;
3. Assess financial feasibility and risks for Blue Economy initiatives, including investment-readiness;
4. Understand and evaluate the policy-finance interface in regional contexts such as the Black Sea;
5. Formulate basic financial strategies aligned with sustainability, scalability, and socio-economic impact.

Module 5 Name	Black Sea Context for Blue Economies
Subject Area	Marine governance, justice, and social dimensions Environmental Systems & Observation Blue Economy Development & Innovation
Subject Area	Regional Context
Credit rating	5 credits *The notional student workload for 5 credits is 125 hours.*
Pre-requisite module	None
Complement module / Co-requesite module	Module 1 - Marine Systems & Parameters Module 2 - Blue Economy and Environmental Economics Module 3 - Marine Governance
Teaching methods	20 x 1 Hr(s) Lectures 2 x 2 hr class workshops

Module Goal

To demonstrate how global principles and frameworks manifest in a complex, geopolitically and ecologically unique region.

Module content

This module will provide a general introduction to the historical and physical context of the Black Sea region, and how it shapes the socio-economic state of the Sea's riparian countries. It includes topics such as the region's history, physical environment and governance characteristics. The coastal socio-economic systems, local-to-global environmental pressures, regional cooperation mechanisms and connectivity challenges are also examined. There will be a focus on how Blue Economy strategies and opportunities progress within policy and cooperation dynamics, and geopolitical realities the region faces, examining how this context shapes the Blue Economies in the region.

Learning outcomes

On successful completion of this module, students should be able to:

1. Elaborate broadly on characteristics of the Black Sea that shape the region's Blue Economies, it's environment, history, societies, cultures, and governance structures;
2. Identify and analyse the roles of different stakeholders (government, industry, civil society, academia) in the governance and development of the Blue Economy in the Black Sea region;
3. Evaluate regional policies, international cooperation frameworks, and governance mechanisms related to sustainable ocean and coastal management in the Black Sea context;
4. Understand the complex geopolitical interactions that shape Blue Economy developments in the Black Sea region, and the role of entities such as the European Union, the United Nations, the Russian Federation and other both historical and current entities;
5. Apply concepts of the Blue Economy to real-world case studies from the Black Sea, assessing their sustainability, scalability, and socio-political feasibility.

Module 6 Name	*Coastal and marine restoration*
Subject Area	Marine governance, justice, and social dimensions Environmental Systems & Observation Blue Economy Development & Innovation
Credit rating	5 credits *The notional student workload for 5 credits is 125 hours.*
Pre-requisite module	Module 1 - Marine Systems & Parameters Module 3 - Marine Governance
Complement module / Co-requesite module	None
Teaching methods	24 x 1 Hr(s) Lectures

Module Goal

To examine environmental restoration as a key enabler of sustainable Blue Economies, examining ecological, engineering, and social science perspectives, and highlighting potential feedback loops that enhance long-term economic and environmental resilience.

Module content

This module introduces students to environmental restoration in marine and coastal systems in terms of intervention and repair. It covers theory and practice across disciplines. The module examines nature-based solutions and their coupling with coastal engineering solutions, ecological engineering, and socio-cultural drivers of restoration efforts. Students will analyse how restoration initiatives can generate Blue Economy value—through ecosystem services, economic revitalisation, and improved community well-being—and how financial and policy frameworks support or hinder this process. A key focus will be on feedback loops: how ecological improvement may unlock further investment or economic activity, and vice versa. Students will work with real-world examples to assess opportunities, limits, and best practices, with regional examples such as Danube Delta restoration efforts used to link theory to practice.

Learning outcomes

On successful completion of this module, students should be able to:

1. Describe key ecological, engineering, and social science foundations of marine and coastal restoration;
2. Evaluate the role of nature-based solutions in delivering both environmental and economic benefits;
3. Analyse feedback loops between ecosystem recovery and Blue Economy development;
4. Apply restoration principles to real-world contexts, considering ecological feasibility, stakeholder needs, and policy support;
5. Apply nature-based solution design to a restoration challenge concerning degraded habitats in eutrophic systems;
6. Critically assess the potential for restoration to act as a catalyst for long-term sustainability in marine systems.

Suggestions

- Use a workshop to have students design a seagrass replanting initiative aimed at sediment stabilization and nurseries for juvenile fish.
- Use a case study example on Danube Delta restoration, looking at nutrient-load reduction, and native sturgeon restocking.

Module 7 Name	*Sustainable Living Resource Management*
Subject Area	Blue Economy Development & Innovation
Credit rating	5 credits *The notional student workload for 5 credits is 125 hours.*
Pre-requisite module	Module 1 - Marine Systems & Parameters Module 2 - Blue Economy and Environmental Economics Module 3 - Marine Governance
Complement module / Co-requesite module	None
Teaching methods	24 x 1 Hr(s) Lectures

Module Goal

To develop students' capacity to critically assess, plan, and implement sustainable practices in the management of living marine resources, with a focus on fisheries, aquaculture, and eco-tourism. The module equips learners with scientific, governance, and socio-economic tools for integrated, ecosystem-based approaches to resource use that support long-term economic and environmental sustainability.

Module content

This module examines the sustainable use and management of living marine resources through an interdisciplinary Blue Economy lens. Students will explore resource dynamics, management regimes, regulatory frameworks, and the socio-cultural dimensions of marine livelihoods. Key topics include: Fisheries systems (including principles of ecosystem -based management, stock assessment fundamentals, IUU fishing and enforcement challenges); Aquaculture systems; Marine eco-tourism; socio-economic valuation of resource-dependent sectors; local resource use conflict, spatial tools for living resource governance; certification schemes and market-based incentivisation for sustainability; role of traditional knowledge and local practices in resource management; climate change impacts and adaptive responses; and stakeholder engagement in resource governance and diversifying livelihoods. The module will be delivered with a focus on both extractive and non-extractive activities, such as fisheries, aquaculture, and marine eco-tourism, with case studies from the Black Sea region and further afield used to examine successes, trade-offs, and systemic challenges.

Learning outcomes

On successful completion of this module, students should be able to:

1. Identify and describe key concepts and tools used in the sustainable management of marine living resources, comparing the ecological, economic and social dimensions of different Blue Economy sectors reliant on such resources;
2. Assess sustainability challenges and trade-offs in different living resource contexts using an ecosystem-based approach;
3. Engage effectively with, and work with the fisheries, aquaculture and marine eco-tourism sectors;
4. Evaluate the role of policy, regulation, and certification schemes in enabling responsible production and consumption;
5. Propose strategies for enhancing sustainability, equity, and resilience in marine resource-dependent communities.

Suggestions

- Use a case study example examining IUU sturgeon fishing in the Black Sea and CITES enforcement challenges
- Use a workshop developing a "dolphin-safe" certification scheme to show how international certification approaches can be tailored to regional market and cultural contexts.
- Use a case study of mussel farms versus seagrass beds as an example of a local resource use discussion

Module 8 Name	*Research skills*
Subject Area	Marine governance, justice, and social dimensions Environmental Systems & Observation Blue Economy Development & Innovation
Subject Area	Research
Credit rating	5 credits *The notional student workload for 5 credits is 125 hours.*
Pre-requisite module	None
Complement module / Co-requesite module	None
Teaching methods	• 9 x 1 Hr(s) Lectures • 9 x 2 Hr(s) Laboratory/Workshop Session

Module Goal

To introduce students to the variety of skills needed to execute and present their own research project in the context of Blue Economy and underpinning environmental and socio-economic systems.

Module content

This module will provide insights and skills development in the areas of (i) critical thinking (distinguishing fact from interpretation; the scientific method; critical evaluation of scientific papers); (ii) experimental design (replication, treatments, factors, covariates, confounding effects and bias); (iii) software tools and approaches for analysis (spreadsheets, data management, data handling using pivot tables and other functions); and (iv) Communications and presentation of results (science communication fundamentals, basic principles of scientific writing, key issues of style and grammar, effective production of graphs and diagrams with complex variables and differences among groups, and approaches to dealing with multiple variables).

Learning outcomes

On successful completion of this module, students should be able to:

1. Think critically and understand the scientific method;
2. Formulate research questions and objectives, designing experiments to test hypotheses, for both qualitative and quantitative investigations;
3. Use software to store, manipulate, explore, analyse and present data effectively;
4. Understand the science communication needs of a research activity, and develop tailored communications approaches to meet those needs;
5. Identify target audiences, writing and reporting results concisely, correctly and effectively in an appropriate scientific style.

Module 9 Name	Research Ethics, ownership and Intellectual property
Subject Area	Marine governance, justice, and social dimensions Environmental Systems & Observation Blue Economy Development & Innovation
Credit rating	5 credits *The notional student workload for 5 credits is 125 hours.*
Pre-requisite module	Module 7 - Research skills
Complement module / Co-requesite module	None
Teaching methods	• 9 x 1 Hr(s) Lectures • 9 x 2 Hr(s) Workshop

Module Goal

To equip students with the ethical, legal, and intellectual property frameworks necessary to conduct responsible research, assess the societal, legal and potential commercial implications of their work, and make informed decisions about the ownership, protection, and use of research outputs in marine, coastal and Blue Economy contexts.

Module content

This module introduces students to the ethical and legal aspects of research within the environmental and marine sciences, and Blue Economy. Topics include the foundations of research ethics, the design of ethically sound studies, plagiarism, navigating ethics application processes, and compliance with data protection legislation (e.g. GDPR). Students will explore concepts of research ownership, including foreground and background intellectual property, and how to determine and manage ownership of outputs. Core intellectual property mechanisms—copyright, patents, and licensing—are covered alongside practical tools for mapping and managing IP in research and applied settings. The module prepares students for independent research with an emphasis on accountability, transparency, and impact.

Learning outcomes

On successful completion of this module, students should be able to:

1. Evaluate whether a proposed research activity is ethically sound, legally compliant, and socially responsible;
2. Prepare the necessary documentation and justification for research ethics applications;
3. Understand the intellectual property they create through research, differentiate between foreground and background intellectual property, and map ownership across research projects;
4. Explain key intellectual property mechanisms, including copyright, patents, and licensing options, in the context of marine and environmental research in the Blue Economy;
5. Make informed decisions about how to manage, protect, or share research outputs based on ethical, legal, and strategic considerations.

Module 10 Name	Statistics
Subject Area	Marine governance, justice, and social dimensions Environmental Systems & Observation Blue Economy Development & Innovation
Subject Area	Research
Credit rating	10 credits *The notional student workload for 5 credits is 250 hours.*
Pre-requisite module	Module 7 - Research skills
Complement module / Co-requesite module	None
Teaching methods	• 9 x 1 Hr(s) Lectures • 9 x 2 Hr(s) Workshop /Practical Sessions

Module Goal

To equip students with an understanding of fundamental notions of Probability and Statistics for marine and coastal research in science and economics.

Module content

This module will equip students with the skills and capability to choose and use appropriate statistical approaches within their scientific, social or economic research into the coastal and marine realm. It will introduce uncertainty and variability, with applications, building understanding in key statistical concepts such as (i) data types, characteristics and statistical decision trees, (ii) qualitative and quantitative research needs and approaches, (iii) key concepts of probability (such as conditional probability and Bayes' Theorem, random variables and probability distributions, discrete and continuous data, and applications), (iii) parametric and non-parametric data and approach decisions, (iv) hypotheses, data summarisation and analysis methods for data (v) populations, variability, and sampling issues, (vi). Introduction to statistical inference, including interval estimation and hypothesis testing, (vii) statistical modelling fundamentals, (viii) data preparation for models and platforms, and (ix) communicating statistical findings.

Learning outcomes

On successful completion of this module, students should be able to:

1. Assess a dataset for testing, and determine the path needed to statistically analyse it;
2. Be able to choose an appropriate statistical test to meet the needs of the research hypothesis;
3. Perform basic statistical analyses (e.g. tests for normality, parametric tests and their non-parametric equivalents, paired tests, multivariable tests, and basic statistical modelling);
4. Interpret and choose between alternate measures of centrality and spread, explaining, with the use of examples, the fundamental concepts of probability;
5. Apply probability axioms and rules including Bayes theorem and the law of total probability;
6. Summarise data distributions using frequency tables and graphs;
7. Describe and apply the concepts of discrete and continuous probability distributions;
8. Make inferences regarding population parameters based on sample estimates, including the provision of confidence interval estimates, and the testing of statistical hypotheses;
9. Use software such as SPSS, Excel and R statistical software to conduct basic statistical activities, and build basic statistical models;
10. Interpret, report and present statistical analyses in scientific communications.

Module 11 Name	*Research thesis*
Subject Area	Marine governance, justice, and social dimensions Environmental Systems & Observation Blue Economy Development & Innovation
Subject Area	Research
Credit rating	20 credits *The notional student workload for 20 credits is 500 hours.*
Pre-requisite module	Module 7 - Research skills Module 8 - Research Ethics, ownership and Intellectual property Module 9 - Statistics for marine and coastal research
Complement module / Co-requesite module	All
Teaching methods	1 x 4 Month(s) Research Training/Independent Enquiry
Module Goal	
To develop independent research skills	
Module content	
This project-based research module requires students to research an area of interest in Blue Economy, or any of the underpinning systems or approaches covered by their course modules. They must plan and execute a programme of investigative qualitative or quantitative analysis, designing (with the support of their supervisor(s)) and implementing an appropriate research approach to answer a targeted research question. They will propose the work to their peers, demonstrate reflection and refinement, implement the research, write a dissertation and present the work in the form of a seminar. The project will be completed under the supervision of a staff member, and may also include one or more co-supervisors in thematic topics of interest.	
Learning outcomes	
On successful completion of this module, students should be able to: 1. Co-design with their supervisor a project of independent research, structuring their design around a research question and conducted in line with attainable S.M.A.R.T objectives; 2. Lead (with supervisory support) in undertaking and delivering a research project by independent research, implementing fundamental project management principles; 3. Acquire, interrogate and critique relevant material from the scientific literature; 4. Write a coherent thesis to describe the background, the methodologies employed and the conclusions of the research study; 5. Present the findings of the project to a specialist audience; 6. Apply learnings in legal and ethical issues associated with the implementation of research, and the collection, use, analysis and storage of data.	

5.2 Optional Modules

These optional modules equate to 40 European Credit Transfer and Accumulation System (ECTS) credits. A suggestion would be to consider collating module options into two 20 ECTS credit groups from which the students select their preferred option.

They ensure that students are presented with a wide of potential specialisation paths, which allow for adaptive academic/industry tailoring. Three broad specialisation dimensions are proposed here, noting that these will likely develop or change as the course is developed by the implementing consortium:

4) Marine governance, justice and social dimensions
5) Environmental systems and observation
6) Blue Economy development and innovation

The optional modules proposed are listed in Table 2, along with the nominative specialisation pathway. Students would need to successfully complete 40 credits worth of these optional modules, consolidated within a specialisation pathway, to complete their MSc. Degree programme.

Table 2: Optional modules for students to specialise in, along with the proposed credit weighting and alignment under a draft specialisation pathway.

Module title	Credit weighting	Specialisation pathway		
		1. Marine Governance, justice, and social dimensions	2. Environmental Systems & Observation	3. Blue Economy Development & Innovation
Regional cultural and natural heritage	5 ECTS credits	✓	✓	
Maritime Infrastructure and Connectivity	5 ECTS credits	✓		
Climate Change and coastal adaptation	5 ECTS credits	✓	✓	
Industry Placement and Professional Development	10 ECTS credits	✓	✓	✓
Marine Policy, Governance and Regulation	5 ECTS credits	✓		
Marine Observation and Digital Oceans	5 ECTS credits	✓	✓	✓
Advanced Ocean Systems and Modelling	10 ECTS credits		✓	
Marine Renewable Energy Systems	5 ECTS credits		✓	✓
Blue Innovation and Entrepreneurship	5 ECTS credits			✓
Critical Perspectives on the Blue Economy	5 ECTS credits	✓		✓
Black Sea Biodiversity and Conservation	5 ECTS credits	✓	✓	

Module 12 Name	*Regional Cultural and Natural Heritage*
Subject Area	Marine governance, justice, and social dimensions Environmental Systems & Observation
Credit rating	5 credits *The notional student workload for 5 credits is 125 hours.*
Pre-requisite module	Module 5 – Black Sea context for Blue Economies
Complement module / Co-requesite module	None
Teaching methods	18 x 1 Hr(s) Lectures 3 x 4 Hr(s) Workshops/Field excursion(s)
Module Goal	
To explore the interlinkages between regional cultural and biological heritage in coastal, marine and Blue Economy settings, equipping learners with the knowledge to critically engage with cultures, histories, conservation practices, and the socio-ecological values that underpin heritage management within the Blue Economy.	
Module content	
This module examines the diverse elements of marine and coastal heritage, including regional histories, biological diversity, archaeological traces, and conservation frameworks. It explores into how cultural and natural heritage shape regional identity, influence governance, and support sustainable development. Key topics include: historical maritime and coastal narratives; regional biological heritage and ecosystem significance; marine and coastal archaeology; community-based and institutional conservation practices; heritage in policy and planning contexts (e.g., MSP, ICZM); and interdisciplinary approaches to heritage valuation and protection. Case studies will be used to explore both historical legacies and contemporary strategies for heritage conservation.	
Learning outcomes	
On successful completion of this module, students should be able to: 1. Describe key concepts and frameworks in cultural and biological heritage relevant to coastal and marine regions and their Blue Economies; 2. Analyse the role of history, archaeology, and biodiversity in marine policy and regional identity; 3. Evaluate conservation approaches and their application to regional contexts; 4. Apply interdisciplinary perspectives to heritage-related challenges and opportunities in Blue Economy development.	

Module 13 Name	Maritime Infrastructure and Connectivity
Subject Area	Marine governance, justice, and social dimensions
Credit rating	5 credits *The notional student workload for 5 credits is 125 hours.*
Pre-requisite module	Module 5 – Black Sea context for Blue Economies
Complement module / Co-requesite module	Module 2 – Blue Economy and environmental economics
Teaching methods	24 x 1 Hr(s) Lectures

Module Goal

To provide learners with a foundational understanding of maritime infrastructure, operations, and connectivity within coastal and regional systems, with an emphasis on their role and importance in supporting sustainable Blue Economy growth and regional integration.

Module content

This module explores the critical role of maritime infrastructure and connectivity in coastal and marine development. It introduces learners to the physical and operational dimensions of maritime transport systems and how these interact with environmental, economic, and governance frameworks. Key topics covered include: Maritime transport systems and logistics; maritime facilities design and function; procedures, safety and efficiency in maritime operations; regional maritime networks and transboundary connectivity; conceptualisation and design of blue corridors; environmental impacts, sustainability opportunities and challenges in infrastructure planning; governance, regulation and regional cooperation mechanisms that support maritime mobility. Case studies focused on the Black Sea region will be used to illustrate these concepts and approaches.

Learning outcomes

On successful completion of this module, students should be able to:

1. Identify key components and functions of maritime infrastructure and transport systems;
2. Assess the role of maritime connectivity in supporting regional development and Blue Economy objectives;
3. Evaluate the sustainability and environmental implications of maritime operations and infrastructure expansion;
4. Analyse case studies of regional maritime networks, including examples of cross-border and ecological connectivity (e.g., blue corridors);
5. Apply systems thinking to the design and integration of maritime infrastructure within regional policy and planning frameworks.

Module 14 Name	*Climate Change and coastal adaptation*
Subject Area	Marine governance, justice, and social dimensions Environmental Systems & Observation
Credit rating	5 credits *The notional student workload for 5 credits is 125 hours.*
Pre-requisite module	Module 1 – Marine systems and parameters Module 5 – Black Sea context for Blue Economies
Complement module / Co-requesite module	Module 2 – Blue Economy and environmental economics Module 6 – Coastal and marine restoration
Teaching methods	20 x 1 Hr(s) Lectures 1 x 4 Hr(s) Field excursion

Module Goal

To equip learners with a critical understanding of climate change impacts on coastal and marine systems, particularly within the Black Sea region, and to build their capacity to assess regional vulnerabilities and formulate adaptation strategies that support resilience in Blue Economy planning and governance.

Module content

This module investigates the dynamic interplay between climate change and coastal environments, focusing on observed and projected changes, socio-ecological vulnerabilities, and adaptive responses. Through regional analysis, learners will explore both scientific assessments, tools and information sources, and policy responses, with a particular emphasis on the Black Sea as a case study of a semi-enclosed sea vulnerable to multiple stressors. Key topics include: Physical and ecological manifestations of climate change in coastal and marine systems; critical concepts for adaptation (risk, exposure, impact and vulnerability) within the context of coastal communities and ecosystems; regional climate change projections, monitoring systems, and information sources; adaptation pathways, governance mechanisms, policy frameworks, and financing instruments to support regional adaptation. The module frames these concepts and approaches within the context of Black Sea case studies, including wetland loss, coastal erosion, fisheries displacement, and urban coastal risk planning.

Learning outcomes

On successful completion of this module, students should be able to:

1. Describe climate change processes and their implications for coastal and marine systems, particularly within the context of the Black Sea;
2. Assess regional vulnerabilities and risks associated with climate impacts on communities, ecosystems, and Blue Economy sectors;
3. Evaluate adaptation approaches and their suitability in different environmental, economic, and cultural settings;
4. Interpret climate-related data, projections, and risk assessments to inform policy and decision-making;
5. Formulate integrated adaptation strategies that link science, policy, and practice in the context of sustainable coastal development;
6. Communicate Climate Change, and climate adaptation concepts and their relevance to Blue Economies, using appropriate terminology and frameworks.

Module 15 Name	*Industry Placement and Professional Development*
Subject Area	Marine governance, justice, and social dimensions Environmental Systems & Observation Blue Economy Development & Innovation
Credit rating	10 credits *The notional student workload for 10 credits is 250 hours.*
Pre-requisite module	Module 7 - Research skills Module 8 - Research Ethics, ownership and Intellectual property
Complement module / Co-requesite module	Module 10 - Research thesis
Teaching methods	5 x 1 Hr(s) Mentoring/Coaching, Reflective report
Module Goal	
To provide an opportunity for students to develop career-relevant transferable skills through work experience in a cultural or commercial environment of Blue Economy relevance.	
Module content	
Students will be placed in a relevant work environment for 12 weeks to increase their employability and prepare their entry into the knowledge economy. They will be expected to develop their skill set and broaden their education under the supervision of work-place and university personnel. In this module, students are obliged to actively participate in the Work Placement Programme, and are required to prepare a final report on their placement.	
Learning outcomes	
On successful completion of this module, students should be able to: 1. Work in a collaborative environment; 2. Deploy principles of project and time management; 3. Demonstrate an awareness of transferable skills and their applicability to non-academic settings; 4. Initiate and sustain networks and relationships that may foster employment opportunities; 5. Comprehend intellectual property and knowledge exchange issues; 6. Gain awareness of the roles of innovation and entrepreneurship in wider industrial sectors; 7. Reflect critically on work experience and act positively on it.	

Module 16 Name	*Marine Policy, Governance and Regulation*
Subject Area	Marine governance, justice, and social dimensions
Credit rating	5 credits *The notional student workload for 5 credits is 125 hours.*
Pre-requisite module	Module 3 - Marine Governance
Complement module / Co-requesite module	Module 8 - Research Ethics, ownership and Intellectual property Module 11 - Regional Cultural and Natural Heritage Module 12 - Maritime Infrastructure and Connectivity
Teaching methods	24 x 1 Hr(s) Lectures

Module Goal

To critically examine the policy instruments, legal frameworks, and regulatory processes that shape marine and coastal governance, with an emphasis on practical application, institutional dynamics, and integration across governance systems, particularly within the context of the Black Sea and adjacent regional systems.

Module content

This module provides advanced awareness of marine governance by focusing on policy development, legal instruments, planning implementation, and regulatory oversight. It explores both mainstream "Western" and long-standing community-based, place-based, or culturally-embedded governance frameworks, as well as key planning approaches such as Integrated Coastal Zone Management (ICZM), Marine Spatial Planning (MSP), and cross-sectoral coordination. Key topics covered include: Governance and regulatory frameworks, and legal mechanisms; governance structures and regional/national inter-institutional dynamics; ICZM and MSP (design, implementation, and integration challenges); indigenous and traditional marine governance approaches; policy coherence, trade-offs, and enforcement dynamics; stakeholder engagement and participatory development processes; evaluation of governance in practice. Case studies will focus on governance and regulatory practices within the Black Sea region, with comparative examples drawn from global contexts.

Learning outcomes

On successful completion of this module, students should be able to:

1. Interpret legal and policy instruments relevant to marine and coastal governance at regional and national scales;
2. Critically analyse planning and regulatory processes, including ICZM and MSP, and their real-world application;
3. Evaluate interaction dynamics between governance institutions, stakeholders, and regulatory bodies in shaping marine outcomes;
4. Compare governance systems, and their potential applicability within a region's Blue Economy;
5. Apply governance tools to simulate or evaluate policy and planning interventions in specific marine or coastal contexts;
6. Design potential enforcement strategies for transboundary marine protected areas
7. Elaborate on policy co-creation and participatory processes in governance.

Suggestions

- Use case studies to highlight the impact of weaknesses in penalties or the use of legal loopholes (e.g. The consequences of of weak penalties for illegal dredging in Danube Delta protected areas).
- Use a workshop to task students with drafting a regional policy to reduce dolphin bycatch in turbot fisheries.

Module 17 Name	*Marine Observation and Digital Oceans*
Subject Area	Marine governance, justice, and social dimensions Environmental Systems & Observation Blue Economy Development & Innovation
Credit rating	5 credits *The notional student workload for 5 credits is 125 hours.*
Pre-requisite module	Module 1 - Marine Systems & Parameters
Complement module / Co-requesite module	Module 3 - Marine Governance Module 9 - Statistics for marine and coastal research
Teaching methods	10 x 2 Hr(s) Lectures 5 x 2 Hr(s) Practical sessions

Module Goal

To develop an applied understanding of marine observation systems and the digital tools that underpin data-driven ocean research, governance, planning, and innovation. Learners will gain insight how data are generated, managed, interpreted, and applied within the Blue Economy, both in research and governance.

Module content

This module explores the scientific and technological foundations of ocean data collection, modelling, and digital transformation. It equips students with practical and theoretical knowledge of how marine data are acquired, stored, processed, and mobilised to support scientific investigation and evidence-based decision-making in coastal and ocean management. Topics covered include Marine observation systems data collection methods in the physical, chemical and biological domains; Data availability and access platforms (e.g. Copernicus Service platforms); Information Technology (IT) solutions in ocean monitoring and forecasting; systems thinking for ocean and coastal processes; oceanographic modelling basics; data acquisition, management, and FAIR data standards; digital twins, interoperable platforms, and decision-support tools; Data for science versus Information for governance; integration of observation data as information in governance frameworks (e.g., for MSP, risk assessment).

Learning outcomes

On successful completion of this module, students should be able to:

1. Explain core principles of marine observation systems and their function in ocean science and management;
2. Distinguish between key data collection methods across physical, chemical, and biological domains;
3. Discover, interrogate and access globally available datasets through open data portals (such as through Copernicus Services);
4. Interpret the role of observation, modelling and digital platforms and their potential to support marine policy and planning;
5. Evaluate the implications of data standards, interoperability, and accessibility in marine digitalisation.

Module 18 Name	*Advanced Ocean Systems and Modelling*
Subject Area	Environmental Systems & Observation
Credit rating	10 credits *The notional student workload for 5 credits is 250 hours.*
Pre-requisite module	Module 1 - Marine Systems & Parameters Module 9 - Statistics for marine and coastal research Module 16 - Marine Observation and Digital Oceans
Complement module / Co-requesite module	None
Teaching methods	18 x 2 Hr(s) Lectures 9 x 2 Hr(s) Practical sessions

Module Goal

To provide students with advanced knowledge and practical skills in marine and ecosystem dynamics, modelling techniques, and emerging marine observation technologies, enabling them to analyse, simulate, and interpret complex ocean processes at multiple spatial and temporal scales. The module prepares learners to integrate oceanographic data with system modelling for research, environmental assessment, and policy support.

Module content

This module offers a deep dive into the physical, chemical, and biological processes driving ocean systems, from coastal margins to the deep sea. It combines theoretical understanding with technical competence in modelling and observation, emphasising both natural science and applied Blue Economy dimensions. Key topics include: Coastal and marine ecosystem modelling and approaches; Biogeochemical processes and cycles; deep-sea and open-ocean system characteristics, pressures, and monitoring approaches; modelling tools, approaches and platforms; advanced marine monitoring technologies; error analysis, uncertainty, and data assimilation; data integration; model output applications into research, planning, management and climate adaptation. Practical components will include simulation exercises, toolkits for model configuration, and case-based data interpretation, using real-world freely-available datasets.

Learning outcomes

On successful completion of this module, students should be able to:

1. Describe the key physical, chemical, and biological processes that shape ocean and coastal systems, including deep-sea environments;
2. Design, develop and implement models to help understand systems of relevance to the Blue Economy, applying systems thinking to the development process;
3. Apply modelling tools to simulate ocean dynamics and assess environmental conditions;
4. Critically evaluate model limitations, data uncertainties, and the implications of modelling choices in applied marine science contexts;
5. Analyse and interpret data from advanced observation technologies, including remote and autonomous systems, and open-access data platforms such as those provided by the Copernicus Services;
6. Integrate observation and modelling approaches to inform marine management, policy-making, and climate resilience strategies;
7. Design and communicate evidence-based scenarios that support further research investigations, environmental governance, or Blue Economy advancement.

Module 19 Name	*Marine Renewable Energy Systems*
Subject Area	Environmental Systems & Observation Blue Economy Development & Innovation
Credit rating	5 credits *The notional student workload for 5 credits is 125 hours.*
Pre-requisite module	Module 1 - Marine Systems & Parameters Module 2 - Blue Economy and Environmental Economics Module 3 - Marine Governance
Complement module / Co-requesite module	Module 12 - Maritime Infrastructure and Connectivity
Teaching methods	18 x 1 Hr lectures 3 x 2 Hr workshops/practical sessions
Module Goal	
To provide an interdisciplinary understanding of marine renewable energy systems, including their technological foundations, environmental and socio-economic contexts, governance challenges, and the socio-political dynamics of development and deployment.	
Module content	
This module introduces students to the science, technology, and practicalities of marine renewable energy (MRE) systems, such as offshore wind, wave, tidal, and others. It explores both the physical generation of energy and the infrastructure necessary to connect marine energy to terrestrial grids. In parallel, it addresses the planning, regulatory, and stakeholder dimensions essential to sustainable MRE development. Key topics include: Principles of energy generation, conversion, transmission, and integration with terrestrial grids; sources for Marine Renewable Energy (offshore wind, wave, tidal, solar, and others); site selection, resource assessment, and environmental constraints; infrastructure considerations; governance, regulation, and various policy frameworks for MRE; Planning and permitting for energy developments; environmental impacts and risk assessment for marine ecosystems; stakeholder engagement strategies and the social license to operate; transboundary considerations; industry trends, innovation pathways, and the future of ocean energy in climate adaptation and mitigation; Case studies on successful and failed MRE deployments (including regional Black Sea examples where possible).	
Learning outcomes	
On successful completion of this module, students should be able to: 1. Elaborate on the range of marine renewable energy sources and technologies, including functional principles and operational requirements, and their systemic position in energy provision; 2. Frame analyses of the physical, environmental, and infrastructural considerations necessary for effective MRE site selection and deployment; 3. Evaluate regulatory, policy, and planning frameworks applicable to the development of MRE projects, particularly within planning and governance systems; 4. Critically interpret assessments of the potential environmental and socio-economic impacts of MRE systems; 5. Apply stakeholder mapping and engagement methodologies to anticipate and address conflict, ensure transparency, and foster inclusive project design; 6. Critically reflect on the role of MRE in the wider Blue Economy, its contribution to climate action and energy transitions, and the challenges faced in development and deployment.	

Module 20 Name	*Marine Innovation and Entrepreneurship*
Subject Area	Blue Economy Development & Innovation
Pre-requisite module	5 credits *The notional student workload for 5 credits is 125 hours.*
Complement module / Co-requesite module	Module 2 - Blue Economy and Environmental Economics Module 4 - Blue Economies & Financial Resourcing Module 8 - Research Ethics, ownership and Intellectual property
Co-requesite	None
Teaching methods	24 x 1 Hr(s) Lectures
Module Goal	
To develop students' ability to transform scientific research, technological developments, and creative ideas into viable solutions within the Blue Economy, through applied knowledge of innovation processes, entrepreneurship, and commercialisation frameworks.	
Module content	
The module equips learners with an understanding of innovation ecosystems, business development approaches and intellectual property strategies relevant to marine and coastal sectors. It introduces the foundations of innovation and entrepreneurship coupling them with an enhanced awareness of business development. It builds on students' understanding of research ownership and intellectual property, expanding this to encompass the practical aspects of technology transfer, venture creation, and sustainable business development. Key topics covered include: Innovation pathways; technology readiness levels (TRLs) and innovation lifecycles; research commercialisation processes; intellectual property, technology transfer strategies and partnerships, entrepreneurship in the marine/coastal sectors; funding and support structures for innovation (e.g. incubators, accelerators, public-private financing); Innovation ecosystems in regional Blue Economy contexts (including the Black Sea); and regulatory and ethical considerations for marine innovation commercialisation. The module will couple this theoretical content with case studies of Blue start-ups, spin-offs, and innovation-driven SMEs from the Black Sea region and further afield.	
Learning outcomes	
On successful completion of this module, students should be able to: 1. Apply principles of innovation, entrepreneurship, and commercialisation within the marine and coastal Blue Economy context. 2. Identify and evaluate intellectual property strategies relevant to innovation in the Blue Economy. 3. Develop a concept pitch or basic business model for a Blue Economy-related innovation or enterprise. 4. Understand the role of technology transfer, partnerships, and support ecosystems in scaling innovation. 5. Reflect on the ethical, legal, and societal considerations involved in commercialising marine research or technologies.	

Module 21 Name	*Critical Perspectives on the Blue Economy*
Subject Area	Marine governance, justice, and social dimensions Blue Economy Development & Innovation
Credit rating	5 credits *The notional student workload for 5 credits is 125 hours.*
Pre-requisite module	Module 2 - Blue Economy and Environmental Economics Module 3 - Marine Governance
Complement module / Co-requesite module	Module 15 - Marine Policy, Governance and Regulation Module 20 - Blue Innovation and Entrepreneurship
Teaching methods	8 x 1 Hr(s) Lectures 8 x 2 Hr(s) workshops

Module Goal

To equip students with the ability to critically interrogate the theories, practices, assumptions and power dynamics embedded within existing Blue Economy frameworks. The module explores alternative lenses to foster balanced, reflective, and socially attuned analysis of Blue Economy implementation and discourse.

Module content

This module challenges students to think critically about the assumptions, priorities, and consequences of Blue Economy narratives and practices. Drawing on global and regional case studies, students will be empowered to apply critical theory in environmental governance, explore diverse knowledge systems and application approaches, and use advanced transdisciplinary methodologies in individual and collaborative reflection. Students will learn how the Blue Economy concepts are structured in general, and whose voices/perspectives shape the application. They will be challenged to identify and recognise regional realities when applying Blue Economy concepts, ascertaining whether complementary or cautionary perspectives from diverse stakeholders / alternative knowledge systems have the opportunity to re-shape or tailor the region's Blue Economy. Key topics will include participatory governance; justice, equity, and access in marine and coastal policy; power structures and politics in Blue Economies; tensions and synergies between community-led and technocratic solutions; varied philosophies governing humankind's relation with the ocean (e.g. identity, wellbeing economies, ocean stewardship); and approaches to challenge without devaluing. This highly reflective and discussive module will examine case studies drawn from Black Sea and global contexts where critical dynamics are visible in practice.

Learning outcomes

On successful completion of this module, students should be able to:

1. Interpret and apply critical theory in relation to Blue Economy governance, policy, and implementation.
2. Identify power dynamics and equity implications embedded within existing marine development frameworks.
3. Recognise and engage with different knowledge systems, including place-based, community-based, and other non-"Western" perspectives.
4. Evaluate the potential for pluralistic or regionally tailored models of Blue Economy that prioritise justice, wellbeing, and ocean stewardship.
5. Collaboratively reflect on tensions between multi-level and multi-actor approaches.
6. Communicate complex reflections with diverse audiences and stakeholders.

Module 22 Name*	*Black Sea Biodiversity and Conservation*
Subject Area	Marine governance, justice, and social dimensions Environmental Systems & Observation
Credit rating	5 credits *The notional student workload for 5 credits is 125 hours.*
Pre-requisite module	Module 1 - Marine Systems and Parameters Module 3 - Marine Governance
Complement module / Co-requesite module	Module 12 - Regional Cultural and Natural Heritage Module 14 - Climate Change and coastal adaptation Module 21 - Critical Perspectives on the Blue Economy
Teaching methods	12 x 1 Hr(s) Lectures 8 x 2 Hr(s) workshops/field trips

Module Goal

To advance students understanding of conservation, particularly in the area of biodiversity, with expanded insights into the Black Sea situation through examples.

Module content

This module provides learners with an appreciation and understanding of biodiversity in the Black Sea context; what it is, why it is important, the challenges that it faces, how these challenges can be addressed, and the interrelationship with Blue Economies. The module explores the tension between the need to conserve biodiversity and protect ecosystems and ecosystem services on one hand, and the need to secure sustainable prosperous futures for coastal societies on the other. It covers key topics such as fundamental biodiversity and conservation concepts; Black Sea ecosystems and ecosystem services; Methods to quantify and assess biodiversity at global, national and regional scales; Novel monitoring approaches (e.g. acoustic monitoring, citizen science approaches); Biodiversity loss, causes and conservation approaches; International legal frameworks, and their regional application.

Learning outcomes

On successful completion of this module, students should be able to:

1. Elaborate on key biodiversity, conservation, and relevant legal terms and concepts;
2. Explain how biodiversity is quantified and assessed, including both established and novel approaches;
3. Describe the role biodiversity plays in the delivery of important ecosystem services in the Black Sea, and the interrelationship between Blue Economy and biodiversity;
4. Critically assess the impact that Blue Economy activities have on biodiversity and develop strategies that allow biodiversity to co-exist with sustainably developing economies;
5. Explain key legislative and policy initiatives that impact marine and coastal biodiversity and understand the role of the organisations involved in conservation work in the Black Sea.

Suggestions

- Use Black Sea case studies to inform the design of invasive species early-warning systems,
- Broach the topic of cetacean acoustic monitoring
- Broach the topic of pollution remediation
- Integrate a fieldtrip to a sturgeon hatcheries in Türkiye, Romania, or Georgia.

**This module has been suggested during the Quality Review by academics, and may need to be enhanced further.*

5.3 Pathway to an ERASMUS Mundus Joint Masters programme

The DOORS project has developed a bespoke, globally-relevant yet regionally applicable Masters proposition, for implementation within the Black Sea region with wider European partners. This would ideally be made available as an ERASMUS Mundus Joint Masters. Clear guidance is provided here to indicate the next steps in Joint Masters programme development.

The implementation steps for establishing an EMJM program, include the following key phases:

- Consortium Formation
- Programme refinement and Accreditation
- Application for Funding
- Programme Implementation
- Awarding Degrees

The first design of this programme is consolidated here. However, following consortium development, it is expected and encouraged that this design is revisited and refined to best exploit the strengths of the participating institutions, and consolidate module clusters around the delivering institutions.

We propose the following structured steps (Figure 5), to ensure a robust and well-integrated EMJM initiative, meeting accreditation standards while fostering academic excellence and international collaboration.

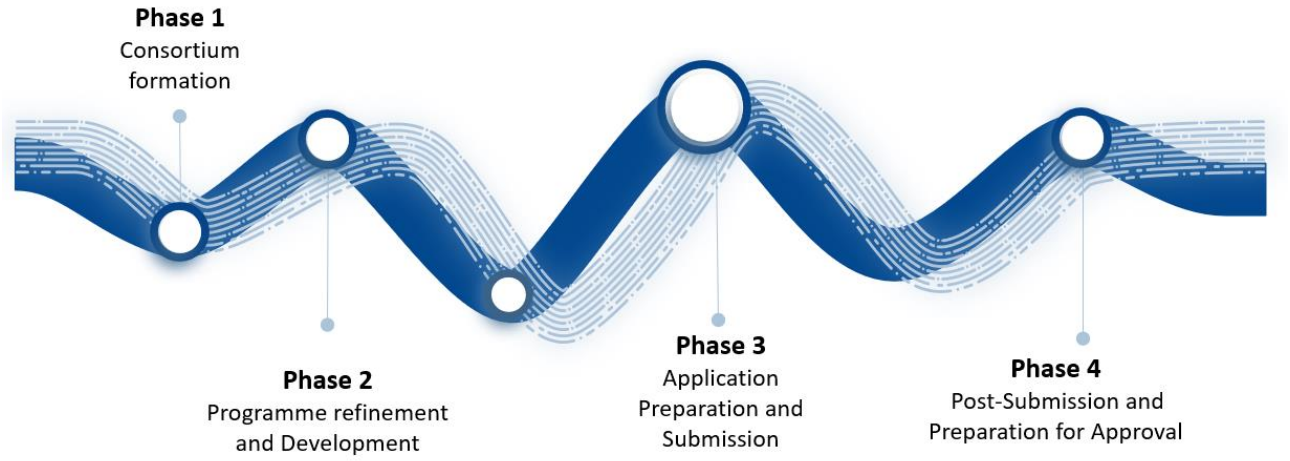


Figure 5. Recommended proposal development steps to develop this Masters proposition into a ERASMUS Mundus Joint Masters programme application (© KANTOR Management Consultants 2025).

Phase 1: Consortium formation

Partnerships with identified universities shall be formalised through Memoranda of Understanding (MoUs) and establish roles and responsibilities. At this stage, the consortium shall prepare the necessary documentation to outline the programme's compliance with accreditation requirements. While setting up the project, the consortium ensures that the proposed programme aligns with national and international accreditation standards.

Phase 2: Programme refinement and Development

1. Accreditation and Quality Assurance Preparation:

When preparing the application, the consortium need to ensure that the following requirements are fulfilled, as presented in Table 3.

Table 3. Key requirements underpinning acceptance of a Joint Masters proposition.

Requirement	Description / Aspects to be considered
Proposing a jointly designed and fully integrated curriculum adhering to the Standards for Quality Assurance of Joint Programmes	- Joint student admission requirements and application, selection, fee policy, monitoring, examination/performance evaluation rules/procedures; - Joint programme design and integrated teaching/training activities including a jointly agreed language policy and a joint process for recognition of study periods within the consortium; - Common services offered to students (e.g. language courses, visa support); - Joint promotion and awareness-raising activities in order to ensure worldwide visibility of the programme as well as of the Erasmus Mundus scholarship scheme. The promotional strategy includes an integrated and comprehensive specific website providing all the necessary information about the programme for students and other relevant stakeholders such as future employers; - Joint administrative and financial management by the consortium; - Provision of joint degrees, if national legislation allow
Composition of consortium of HEIs and, where relevant other educational and/or non-educational partners, established in an EMJM eligible countries	The consortium will involve at least three HEIs from three different countries, of which at least two must be EU Member States and third countries associated to the Programme.
Enrolment of excellent students	Student selection will be organised transparently, impartially and equitably. Among these students, a number may benefit from an EMJM scholarship.
Provision of compulsory physical mobility for all enrolled students	The mobility tracks and the mechanism for recognition of study periods among the partner institutions must have been agreed within the consortium at project application stage. EMJM must include compulsory physical mobility for all enrolled students consisting of a minimum of two study periods in two countries, of which at least one must be an EU Member State or third country associated to the Programme.
Exchange of staff and invited scholars	The purpose of this exchange is to contribute to teaching, training, research and administrative activities
Successful completion of the joint EMJM programme leading to the award of either a joint degree	The degree(s) awarded to graduates will belong to the higher education degree systems of the countries in which the HEIs are based. The degree(s) will be mutually recognised by all the awarding full partner HEIs. Consortia should provide students with a joint Diploma Supplement at the end of their studies, covering the entire content of the Master programme.

The application should also include the following key deliverables during programme implementation:

- Project website
- Promotion material
- Student Agreement template
- Degree template(s)
- Signed minutes of the selection meetings
- Internal / external quality review reports
- Sustainability /business plan.

2. Resource Planning:

The next stage of Phase 2 involves the identification and planning of the necessary resources, including faculty, laboratories, and online learning platforms. The preliminary support materials, including syllabi, learning objectives, and assessment methods will be developed under this task.

Phase 3: Application Preparation and Submission

1. *Erasmus Mundus Application Preparation*:
   At this stage, the consortium will compile the Erasmus Mundus application, detailing the programme's structure, learning outcomes, mobility options, and consortium partners. It is also proposed to include letters of support from industry partners and stakeholders to strengthen the application.
2. *Internal Review and Feedback*:
   An internal review of the application should be carried out by the EMJM consortium to ensure completeness and accuracy. The team should then address any feedback or additional requirements identified during the internal review.
3. *Submission and Follow-Up*:
   The application should be submitted to the European Education and Culture Executive Agency.

Phase 4: Post-Submission and Preparation for Approval

1. *Awaiting Approval*:
   While awaiting the decision from the Erasmus Mundus programme the consortium will prepare for potential approval by finalizing resource allocation and refining curriculum details based on feedback from the submission process.
2. *Consortium Coordination*:
   All consortium partners will maintain regular communication to ensure readiness for implementation upon approval.

6. A pathway to a Globally-targeted Black Sea Masters Programme.

The DOORS Masters Programme proposed here addresses a lack of interdisciplinary training that integrates technical knowledge with practical application in the Black Sea's marine education arena. It has been co-designed with academics across the DOORS consortium to provide a flexible set of Masters-level learning pathways in the areas of Marine Sciences, Marine Governance, and Blue Economy. The programme capitalises on the Black Sea's unique and complex history, oceanography, cultural and socio-economic characteristic to provide a rich and rewarding foundation for learning globally-relevant principles and practices. In return, the course bridges the gap between existing, standardised curricula across the Black Sea, and international best practices established by Europe through the ERASMUS Mundus programme.

The key to delivering on the promise of this Masters programme is connectivity - building connections and understanding across disciplines and highly-regarded HEIs across the region and Europe. As such, the academic partnerships and collaborations established under DOORS are the bedrock of a natural partnership to take it forward, noting that this information is publicly available for others to take up should this not occur. Such connectivity and understanding takes time, as does academic accreditation processes across different HEIs. Recognising this, the work undertaken here also proposes the use of micro-credentials and Blended Intensive Programmes (BIPs) to enable interim successes in content creation and collaboration building. DOORS has also delivered a concrete example of such an interim step, with Burgas Free University leading the delivery of a BIP in Sustainable Blue Economy.

This is one small step on a longer, ambitious journey for HEIs in the Black Sea region, now equipped with a goal to aim towards. This document contains a consolidated needs analysis, along with an outline of what subjects and thematics need educational programmes, which can be delivered through micro-credentials, BIPs, and ultimately an ambitious consolidated ERASMUS Mundus Masters programme.

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Annexes

Annex 1 - Methodological Record of Human-AI co-development process

A1.1. Purpose of the Appendix

This record outlines a highly iterative and intensive collaborative Human-AI methodology used to co-develop and produce:

1) A draft module design within a 21-module Blue Economy curriculum, built from initial Human-developed content and context information and iteratively refined into clear goals, module content and learning objectives;
2) A module interdependency map (Task B), and
3) A bias assessment of biases introduced by both the AI and the human components.

This intensive human-AI collaboration incorporated curriculum design practices, iterative review and quality control processes, bias assessment and the use of digital tools (Generative artificial intelligence: ChatGPT, provided by OpenAI). It is provided to ensure that academic stakeholders who are set to revise and review and further develop the proposed course outline are fully aware of the biases inherent in the proposition, which may have arisen during this initial stage of the development process. It also provides a transparent reflection on an experimental venture pairing human creativity with the information access and processing potential of an AI.

A1.2 Context and analysis rationale

Under the DOORS project, Work Package 7 is tasked with proposing a Masters Programme for the Black Sea region of relevance to the operationalization of the Black Sea's Strategic Research and Innovation Agenda. Progressing this, DOORS has brought together a wide range of academic perspectives in areas such as marine sciences, modelling, coastal dynamics, economics, technology, data gathering methods and policy amongst others. It has also gathered a vast amount of information and data on the current education offerings within the Black Sea region, along with extensive survey data into the skills gaps, and knowledge needs of Blue Economy sectors throughout the region. Within this vast amount of context information and disciplinary priorities, DOORS is tasked with proposing a Masters programme, that addresses in someway, the needs of the Black Sea region. Additionally to the above, in 2022, a workshop was held in Stirling, UK, with academic representatives to identify the core and optional subjects and skills which should be delivered within a Masters Programme, proposed by the DOORS project. It was decided that ultimately, the Masters should focus on three main yet very different elements – marine sciences, Blue Economy, and governance. It was also clear that an Erasmus MUNDUS masters programme should be the end-goal of this masters definition process. This could be viewed as challenging given the high-profile and ambitious nature of such a proposition, but also optimal, as it enables the proposing consortium to harness the established expertise of not just one university, but multiple universities.

As has been repeatedly demonstrated within DOORS, providing stakeholders with something to feedback on, rather than offer blind suggestions is a best practice way to focus minds, and invite constructive critique. To this end, the course development leaders (KANTOR and UCC) intended to provide academics across the DOORS consortium with a tangible, consolidated course for them to review, critique and take forward beyond DOORS. However, despite their considerable expertise and experience, staff in these two entities lack the thematic breadth of experience in all of the subject areas proposed in the Stirling workshop, nor in teaching the full range of skills demanded by the workshop and survey results.

The solution proposed was technology based. A Human-AI chat construct would be used to iteratively build module descriptions, and ensure academic stakeholders could be presented with a coherent draft course outline for critique and revision. For the Human-AI collaboration, ChatGPT was the AI engine that best suited the needs of the endeavor. It is freely available, and importantly, could ingest versions of the excel spreadsheet tables the Human author was used to working with in his more qualitative research. The human author (Dr. Rory Scarrott) was curious about reflectively exploring the use of Artificial Intelligence, building on his experiences within a previous strategic project funded by the European Space Agency (ESA-Blue Economy). As a consequence, a Human-AI chat construct was initiated in ChatGPT, and the below methodology implemented. While an output was the draft programme for rigorous academic scrutiny and critique, the goal was a reflection on the use of Human-AI chat constructs to develop thematically diverse, yet contextually over-informed solution propositions.

A1.3 Approach

A1.3.1 Contributors and Roles

Role	**Contributor**
Lead Author & Subject-Matter Expert	Rory Scarrott (Human Co-author) — Responsible for providing initial materials, thematic intent, disciplinary context and logic, review and revision decisions, and final oversight of module coherence and academic/context alignment.
AI Co-Developer	ChatGPT (OpenAI) — Responsible for structuring, formatting, summarising, cross-referencing, and proposing draft materials, sequencing, and identifying patterns based on inputs and iterative review and direction from the lead author.

A1.3.2 Task A — Drafting and Refinement of Module Content

"Task A" involved the initial and iterative co-development of each module's content, including: module goals, summary descriptions, key topics, and learning outcomes. Key subjects to be taught, context, titles, intention were input with the human-AI collaboration used to identify missing subject matter, cross-reference emerging module text with previous and subsequent course sections, and reduce redundancy. Note the human element provided the prompt, context and initial content, summarising the results from DOORS context analyses (D7.1, KANTOR's survey analysis and the Stirling workshop) into discrete Module-focused content and refinement requests. The AI was instructed to process the request, consolidating the information in it (e.g. title, subject matter to be taught, initial content, credit weighting, context information) into a draft goal, module content blurb and set of draft learning outcomes. These were then revised by the human author, and iteratively developed with the AI and human colleagues to correct and refine the draft definitions. Modules were developed in sequence, from module 1 – 10 (the core modules) and on through modules 11-21 (the optional modules). As modules were developed, it was evident that the AI element was actively building on previous module development material, meaning that while Module 2 could only benefit from the pre-existence of module 1, Module 21 could benefit from the existence of 20 previous modules. To counteract this development bias, a reverse analysis was then conduct of each of the optional modules (21-11) in reverse order, to identify weaknesses in the initial core modules (1-10) which could be addressed to enhance their role within the overall 21 module course, reduce redundancy and improve the learning journeys of potential future students. Modules 1-10 were then re-assessed, and amended to take on board AI suggestions, noting that many of these were rejected by the author as they did not fully align with their

vision, or experiential contextual knowledge (e.g. their awareness of the survey results, the D7.1 gap analysis, or the expertise they had encountered within the Black Sea over the course of the DOORS project).

A1.3.3 Final Master Table v2.0 Creation

Once 21 draft modules had been defined and quality controlled, the information was prepared for further analyses to identify inter-module linkages and thematic learning avenues, which may not have been immediately apparent to the human author. This required a final master table to be present within the Human-AI chat construct for analysis. Exploratory queries revealed the need to clearly designate within the chat what data to consider, lest the AI inadvertently integrate earlier iterations, musings and queries into it's analysis, and to explicitly direct the AI to avoid summarising, inputted data. To address this, clear instructions were input to ensure that earlier versions were retired in favour of building a final version from the ground up, and the AI was instructed to build the table precisely and accurately. Each finalised draft module text was then uploaded individually into the Human-AI chat construct, reviewed, and incorporated into a clean, filterable table. Testing ensured the upload had proceeded in a way that only precise and accurate information had been integrated into the AI chat's master table, and the AI's algorithms had not amended or edited the information in any way during the inputting process.

A1.3.4 Task B — Module Interdependency Mapping

This task identified pre-requisite and co-requisite relationships between modules to inform curriculum sequencing and support learner pathways. Note here that *Pre-requisite* meant a module that should be completed before another, while *Co-requisite* meant a module that may be taken concurrently or is closely aligned thematically. Separate to the human-ai chat, modules had been appended with information on pre-requisite and co-requisite modules within the 21-module course. A "Task B" was defined within the human-AI chat, to instruct it to identify pre-requisite and co-requisite module suggestions within those modules described in the master table. This was then compared and contrasted to the independent links identified by the human author, noting that while overall, the two (the Human, and the Human-AI chat construct) identified many similar linkages, there were considerable differences in the links identified and the importance of those links (pre- versus co-requisite).

The full list of modules, and descriptive elements is available in the draft course proposition sent to academic partners within DOORS. A copy is available from the UCC author upon request.

A1.3.5 Bias assessment

A query was structured to interrogate the Human-AI chat construct, and appraise it for sources of bias (5 from the Human, and 5 from the AI: Table A1.1 and Figure A1.1), and clarify actions taken in the development process to address bias (Table A4.2).

Table A1.1: Bias assessment generated by the AI within the Human-AI chat construct following conclusion of the development process.

Participant	Bias Type	Description
Human author	Confirmation Bias	Reinforcing previously held assumptions about module linkages, relevance, or emphasis.
	Goal-Oriented Framing	Steering prompts to align outcomes with intended deliverables (e.g., Blue Economy framing).
	Authority Bias	Leaning on perceived expertise (yours or external references) to guide "correct" structuring.

	Consistency Bias	Preferring internally consistent module formatting, even at the expense of topic diversity.
	Survivorship Bias	Ignoring discarded module versions or earlier conceptions that could offer unique insight.
AI author	Coherence Bias	Producing uniformly styled content that can downplay necessary tension or nuance.
	Alignment Bias	Adapting to the user's tone and priorities, potentially narrowing scope.
	Availability Bias	Drawing from the most immediately relevant or repeated parts of the conversation.
	Task Completion Bias	Prioritizing clean, conclusive outputs—sometimes at the cost of exploratory or conflicting views.
	Predictability Bias	Favouring familiar linkages or structures from prior training data when gaps appear in prompts.

Table A1.2: 5 Actions taken over the course of the collaborative Human-AI development process to address developing biases and ensure transparency in the outputs (generated by ChatGPT in response to a Human request for review of the collaboration chat).

Action Taken	**How It Addressed Bias**
Structured Iteration & Controlled Uploads	Broke uploads into individual parts and explicitly referenced only the final master Version 2.0 table, reducing contamination from older drafts.
Prompting Independent Evaluation (Task B)	Introduced Task B to systematically analyze module dependencies, avoiding assumption-driven linkages.
Invited Counterbalance and Transparency	Proactively asked for bias review from both parties and insisted on transparency with co-authors.
Clustering, Not Just Ranking	Recognized and encouraged co-requisite or cluster-aligned modules, challenging hierarchical or siloed bias.
Requested Bias Audit + Visualization	Sought a formal and visual audit of biases, shifting from passive recognition to documented accountability.

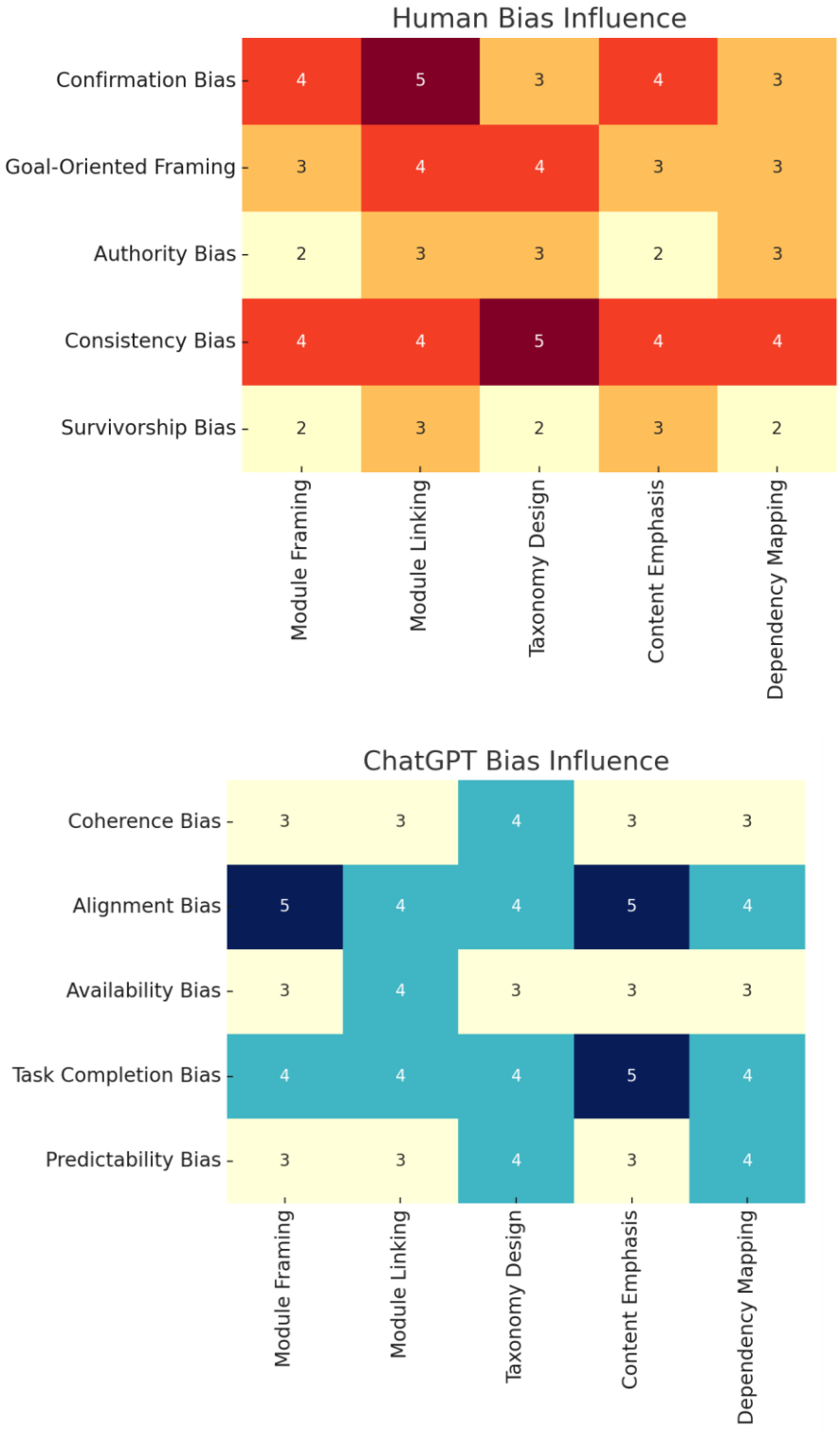


Figure A1.1: Heatmap of bias influence, on 5 facets of the course development process. Note these heatmaps were produced by the ChatGPT engine following a request to assess the biases within the Human-AI chat construct at the conclusion of the development process.

This bias assessment was then made available to academic reviewers of the course proposition so they could understand the perspectives which may have become ingrained in the proposed course outline, for amendment, or not.

A1.4 Outcomes and Usage

The developed Final Master v2.0 Table and Task B Mapping serve as a draft course content map for the proposed Black Sea Masters programme. It proposes a draft curriculum design, sequencing, and collection of learning objectives which address the skills and knowledge gaps identified by DOORS stakeholders. However, this is a draft proposition. It is not intended as a final proposition, more as food-for-thought to the Masters course proposers, or proposing consortium, to be taken, revised and refine

A1.5 Final reflections

1) This methodology report provides full transparency for co-authors, curriculum designers, academic reviewers, and ultimately users of this analysis' outputs. The approach is replicable for future programmes involving Human-AI co-design, noting that a Human-AI chat construct is deeply shaped by the human element within it, and should not be considered as objective.
2) Attribution and authorship are explicitly shared, with decision-making and originality retained by the lead author. However, the AI brought considerable capabilities to bear in consulting wider information, and if used correctly, can present alternate viewpoints and challenge siloed thinking.
3) Bias, and the influence it has on the final outputs can come from both Human and AI sources. Simple actions can be taken during a co-development process can identify and highlight such biases in development, enabling the process to adapt to and mitigate against them to a degree. Transparency is critical here, not only in clear reporting of the technology used, but also the manner in which it has been used and the actions taken by the Human author to ensure rigorous quality control and bias mitigation.
4) The technology is very powerful, but has the potential to be deeply flawed and provide questionable conclusions if the Human element is not careful and considerate of all information it is adding to the construct. For example, draft texts, or queries, or simple musings over the course of the process can unwittingly shape the approach taken by the AI in analysing later data. It is imperative that the Human element remain cautious, structured in their enquiries, and healthily skeptical about the outputs.
5) This process was done using a single Human working as part of the construct. Independent verification is highly useful, perhaps using a colleague to discuss and verify outputs of the process are logical and viable. For this example, the wealth of academic experience across the DOORS consortium provides that verification, however other users would benefit from planning their activity with this quality control mechanism in mind.

Overall, the creation and use of a Human-AI chat construct to support the development of an initial course outline for the DOORS Masters proposition proved to be beneficial. It enabling the author to consolidate wide ranging perspectives, influences and information to produce a usable set of content for feedback. The process also proved to be enlightening, emphasizing the need for caution and rigor when engaging with the AI, and skepticism when quality controlling and reviewing (often revising) the construct-generated outputs. It is strongly advisable to factor in the assessment of bias, and verification by independent parties to the development process, when conducting analyses such as this using a Human-AI chat construct. This is already recommended best practice, with this investigation contributing to the demonstration of why it is important.

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