

Master in Maritime Logistics: An Industry-Driven Design

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Abstract—The existence of mismatches between the qualification requirements of professionals in the maritime industry and existing higher education offers was verified within the scope of the European project MarLEM (Maritime Logistics Engineering and Management). Professionals in the maritime industry today and in the future face additional obstacles as a result of the sector's global nature as well as the sector's rapid technological and social evolution. As a result, they feel the need to update their skills and knowledge. A professional-oriented master's program was developed to fill this gap. The NOVA School of Science and Technology and the Portuguese Naval School co-developed this Master's program with the active participation of MarLEM project partners from academia and industry. In this work, the principles and approach used to design the master's program are presented. Its design and a concise synopsis of the courses' content are shown. In addition, other international courses covering the same topic are compared. As a result of this work, the teaching materials related to maritime logistics are improved and the assumptions and methodology that guided the creation of an international master's program in maritime logistics are disseminated.

Keywords—Education, maritime logistics, shipping, industrial engineering, management, soft skills.

I. INTRODUCTION

THE exponential growth of society and technology results in an evolutionary dynamic and an increase in uncertainty. Professionals of the future will face significantly different demands and challenges, some of which will remain unpredictable.

During the last centuries, the expository method has been the primary method of knowledge transmission in education and training. Teaching cannot confine its action to the transmission of accumulated knowledge, but must encourage the development of critical thinking and the ability to learn throughout life. Case studies, role-playing, the interrogative or experimental methods, and the use of immersive technologies like virtual reality and augmented reality are among other teaching methods and tools that require a more active participation of students. To prepare them to deal with a dynamic and disruptive process, it is necessary to use critical thinking to anticipate problems and new situations.

Academics, professionals, and authorities must actively interact in order for knowledge to be formed. As educational institutions with a strong emphasis on research and innovation, universities must actively participate in environmental protection, economic development and social enhancement. Considering the speed of evolution of most sectors, the

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process of creating and transmitting knowledge must permanently adapt to the needs of tomorrow's society, rather than focusing on today's problems. Therefore, the question for educators is: What to teach today so that the upcoming professionals are prepared for the challenges they will face?

The main goal of this work is to discuss the needs and challenges of maritime logistics education and to present the principles and method used to design a master's program in maritime logistics.

Besides this introduction where the context is made, Section II analyses the maritime logistics education needs and challenges, and a comparison between European-wide master's programs in maritime logistics is made. In Section III, the objectives and structure of the proposed master program are presented. Section IV offers some conclusions.

II. MARITIME LOGISTICS EDUCATION NEEDS AND CHALLENGES

All companies that are part of the maritime logistics universe face ever-growing changes that affect the way business and processes are carried out, related mainly to digitalization, sustainability, generational gap and the need of reskilling. Moreover, maritime training has an interdisciplinary perspective due to the globalized business environment. Many existing degrees, in fact, are too generic or outdated and, there is an asymmetry between the maritime industry real needs and the knowledge taught in those programs [1]. Globalization, technological and social development and awareness of environmental preservation make a permanent need for innovation in all sectors of activity. One of the industries most affected by this desire for innovation is the maritime sector because of its global nature and relevance to the global economy. Professionals and institutions responsible for their education and training must constantly update their knowledge, skills and competences to keep up with this innovation dynamic. Today's new technologies are both a challenge and an essential teaching tool [2], [3]. This implies that higher education organizations cannot easily complete the design and planning of new curricula just by themselves, but they urge the support of the maritime cluster during all stages to clearly identify the latest and most important employability skills.

Several studies have been published regarding the topic. One of them is the report Matchtech and IMarEST [4] which states that the industry is looking to recruit professionals with experience and the maritime industry is facing a disproportionate number of retirees, while at the same time facing a lack of engineers in the 35 to 45 age group. Moreover, it is understood that without timely transfer of

knowledge, and development of the pool of mid-career talents, a significant quantity of experience will be lost from the industry in the coming future (estimated as five years at the time of the report). From another perspective, Skills Ireland found that demand for blue skills will experience strong increases (10.138 full time equivalent jobs with reference to 2020 under the optimistic scenario), with the largest expansion expected to be in maritime transport, shipbuilding and services [5]. These findings reflect the European Union Atlantic Action Plan 2.0 [6], emphasizing the potential ability of the Blue Economy to deliver growth and promote jobs in the coming years. However, an adequate supply of blue related skills is essential. In its Annual Growth Survey [7], the EU recognizes a growing skills shortage in the labor market, which particularly affects sectors that base their activity on knowledge. The growing technological evolution and processes changes in the blue economy main activities require updating the skills of its professionals. The evolutionary pace of education and training is lower than the growth seen in the industry, being evident the mismatch of skills between the needs of the labor market and the production of educational institutions. Education-provided knowledge and skills must be aligned with actual industry requirements. This alignment between supply and demand is only possible if there is an effective cooperation between education and industry.

In reply to the Blue Economy Call from the European Commission's Blue Careers program, which aims to accelerate the implementation of the EU Maritime Policy to attain a sustainable development of the blue economy across Europe, MarLEM (*Maritime Logistics Engineering and Management*) [8] arises as a project to design a Joint Master program in Maritime Logistics Engineering and Management. This program, in order to fill the identified gaps and needs of higher education, intends to contribute to the improvement of the Maritime Education and Training. The idea behind the creation of a whole new training program in maritime logistics is to provide an answer to the increasing demand of skilled professionals in the maritime industry, one of the most significant and impactful industries of the so-called blue economy. Therefore, this unique *Master in Maritime Logistics* (MML) program is intended for professionals, and was designed to meet the education needs previously identified by the industry. The program delivers essentially an integrated view of maritime logistics and a set of managerial-oriented skills, accompanied by a three-month internship or design/implementation of a final project, supported on a three pillars structure (Fig. 1). Students can also take advantage of the mobility program with NTNU (*Norges Teknisk-Naturvitenskapelige Universitet*) to fulfil the last pillar.

The MarLEM project approach to the design of this master's program takes into account the "XXI Century Skills/Learning" approach and the OECD Conceptual Framework for Education for 2030 [9]. In order to avoid a mismatch between the proposed curriculum and the real industry needs, experienced specialists worked out the best options and gathered their knowledge of the field in this unique program all along the preparation phase. That was achieved also by the

introduction of the so-called Atlantic Knowledge Triangle (Fig. 2), a network of thinking and experience sharing that brings together the Academia, the Authorities and the Industrial world.



Fig. 1 The Master's 3 Pillars Structure

Besides the School of Science and Technology from the NOVA University of Lisbon (NOVA SST), and the Portuguese Naval Academy (Escola Naval), other academic institutions and industrial entities from different European countries took part in the development of this program and will collaborate in the delivery of the curriculum in the coming future. The other partners of the MarLEM project are University of Strathclyde (United Kingdom), *Qualiseg - Engenharia e Gestão Lda.* (an engineering company and the MarLEM project's coordinator), Fórum Oceano (a collective entity of public utility devoted to the development of the Sea Economy, Portugal), WEGEMT (European Association of Universities in Marine Technology and Related Sciences, Netherlands), CERTH (Centre for Research & Technology, Greece), and Marine South East Limited (maritime cluster, United Kingdom).

Furthermore, the Master's degree would be highly enriched by a broader participation of women, which still represent only a third of the shore-based maritime professionals and are hardly employed in non-administrative tasks or at managerial levels [10]. The master's program, beyond gender equality legal rules and best industry practices, will include the view of women in the sector by means of cases and, eventually, testimonials, fostering their participation as professionals in this industry.

The plethora of shipping-oriented undergraduate and graduate programs, most of them covering business and management subjects, is evidence enough of the industry needs and of the permanent effort the higher education institutions put to fulfil such needs. Yet, there is an educational gap, identified in the wholeness of the maritime logistics, which comprises the management and engineering ensemble, acknowledged by several organizations, both independent (e.g., OECD) and from the industry.

Apart from the different approach in the planning of this master's degree, which vastly involves industry partners, the other main difference in relation to other similar duration European-wide Master's programs is the different student target since it is mandatory to have at least five years of relevant work experience (Table I).

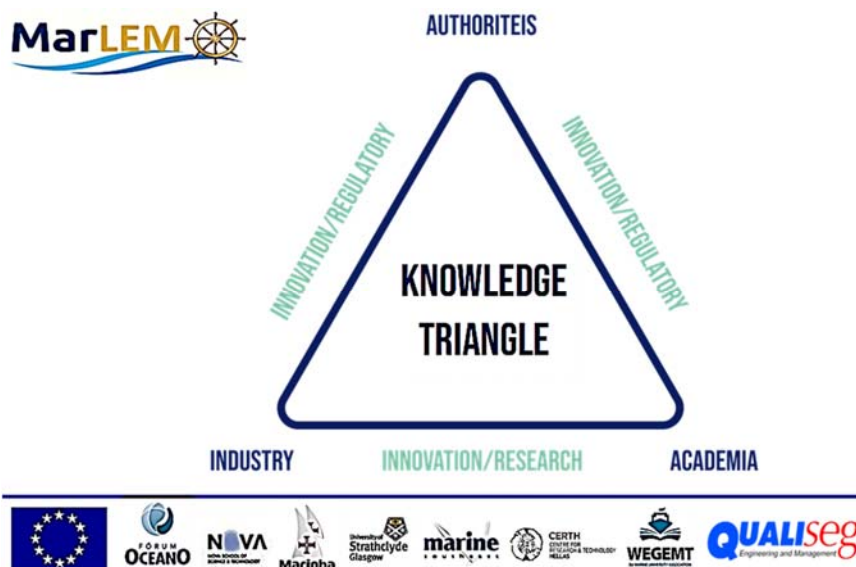


Fig. 2 Atlantic Knowledge Triangle [8]

TABLE I
COMPARISON BETWEEN OTHER SIMILAR EUROPEAN-WIDE MASTER'S PROGRAMS

Institution	Designation	Students' prerequisites	Duration (years)	ECTS
NOVA SST & Escola Naval	Master in Maritime Logistics	Professionals \geq 5 years' experience	1	60
Solent University (Southampton)	MSc International Shipping and Logistics	Students and Maritime professionals	1	n. a.
University of Plymouth	Master of Science International Logistics and Supply Chain Management	Students with Bachelor degree	1	n. a.
Kedge Business School (Marseille)	MSc International Trade & Logistics	Students with Bachelor degree	1	n. a.
Ecole de Management de Normandie (Le Havre)	MSc International Logistics and Port Management	Students with Bachelor degree	1	n. a.
University of applied sciences (MLU-OAS Netherlands)	MSc Shipping and Transport	Students with Bachelor degree	1	60
Rotterdam School of Management	MSc Supply Chain Management	n. a.	1	60
University of Antwerp	Master of Science in Maritime and Air Transport Management	n. a.	1	60

Notes: n. a. – not available; ECTS - European Credit Transfer and Accumulation System

III. MASTER OBJECTIVES AND STRUCTURE

A central body of information from Logistics, Industrial Engineering, and Management is brought together in this master's program. It makes it possible for professionals who are currently employed in the maritime and port industry or who intend to work there in the future to acquire the necessary technical and soft skills to deal with the dynamism and the requirements of the sector. This includes topics like critical thinking, proactive attitude and the ability to learn and investigate throughout life, that enable professionals to respond to the industry's constant innovation, complexity, and demanding regulations.

The master's program is designed to achieve its comprehensive goal of training the next generations of professionals in maritime logistics, enhanced by encouraging the development of both hard and soft skills by all participants.

In the field of Port and Maritime Operations, the more relevant Technical Skills that need to be exhaustively covered, include:

- An integrated view of the maritime logistics chain
- Port and shipping operations (operations, transport and

distribution)

- Integrated logistics (integrated lifecycle view of systems)
 - Value chain management (designing, planning, assessing, analyzing and performance evaluation).
 - Maritime logistics business sustainability
- The sought Digital Skills include:

- Data analysis expertise
- Information and Communications Technology (ICT)
- Cybersecurity
- Systems integration

Moreover, Green Skills will also be addressed, such as:

- Sustainability awareness
- Economy of resources
- Increased efficiency
- Reduce time and waste
- Circular economy

Finally, the main soft skills highlighted by sector interlocutors are:

- Clear-cut values and educated character
- Interpersonal Communication
- Leadership and teamwork
- Proactivity and accountability

- Cultural awareness
- Creativity and Innovation.

A particular emphasis on creativity and innovation has been requested by different port and maritime actors, pointing out that workers need the ability to develop new and imaginative solutions to complex problems rather than just relying on traditional thinking and usual ways of working. Other important skills pointed out were: concentration, reflection, contemplation, visualization, emotional intelligence, complex problem solving (CPS) and simple solution approach (SSA).

The program has a duration of one full year with a workload that corresponds to 60 ECTS and encompasses two semesters. The first semester encompasses the curricular part and is delivered as weekly-based modules that enable intensive

learning approaches and the development of a proactive and critical attitude in the analysis and identification of problems. The search for innovative solutions and the ability to take decision are also developed (Table II). The second part allows students to have the option to either elaborate or implement a real-world maritime and port logistics project or to engage in a professional internship. Moreover, the M4ML (Mobility for Maritime Logistics) project promotes and supports the bilateral exchange, between Norway and Portugal, of students and trainees within the domain of the Master in Maritime Logistics program. This project gives students the opportunity to engage in internships in Norwegian companies, under the joint supervision of NOVA SST, the Naval Academy and NTNU professors.

TABLE II
SHORT DESCRIPTION OF COURSES

Courses	ECTS	Subject
Introduction to maritime logistics	6	Understand maritime logistics, identify its business, operational, technological and regulatory Introduction to components in an integrated view of the chain, and Maritime its sustainability and relationships with its Logistics environment, in order to structure and find appropriate approaches to maritime logistics supply chain problems.
Maritime Business Analysis	3	The nature of the diverse types of businesses within the maritime logistics chain (ship and fleet, port and terminal, inland modes and logistics), and operational and investment finance and risks.
Operations Management	3	Operations design, planning, management and control, decision-making support tools, and standards (quality; risk, HSE – Health, Safety & Environment, and physical assets management).
Maritime Logistics Technology	3	Technological multiplicity of maritime logistics: the different technologies, their functional relationships with the logistic operations and the opportunities brought by the new technological tendencies as well as the risks of ignoring them.
Integrated Maritime Logistics	3	Value creation in supply chains and the integrated logistics systems approach and its lifecycle management, under the risk and uncertainty associated with maritime logistics, sustainability requirements and the push of future trends.
Maritime and Port Administration	3	Maritime Administration and its functions as a global organization towards the shipping industry and the sea port and its entities and services.
Maritime Law	3	The concepts and sources of Maritime Law, International Trade and shipping documents, INCOTERMS, and Brokering and Chartering Practice.
Leadership and Team Management	3	Organizations as political entities, organizational behavior and team leadership, collaboration and communication, creativity and innovation frameworks, global awareness and civic literacy.
Intercultural Negotiation	3	A systematic view of negotiation and conflict resolution, both simple and complex, involving two parties or multiple parties, the role of power and influence, tactics, how different cultures negotiate, main fallacies and mind bias in decision making.
Project Work/Professional Internship	30	The Project is carried out in a research Centre in association with an industry partner; the Internship takes place at an industry partner.

Notes: Was considered 1 ECTS = 28 study hours, all included (classes, homework, examination, preparation).
Each course will be delivered in a weekly based module.

Each course comprises face to face classes, in addition to the support of faculty from foreign universities and industry experts' interventions in seminars, including MarLEM project members, to be carried out in person or remotely. A blended format may also be available. Finally, the proximity of the Naval Academy to the *Arsenal do Alfeite*, a State Portuguese shipyard, provides a "living lab" environment for the maintenance activity on the ships, which, together with the planned technical visits to facilities of entities covered by the MarLEM Project, such as port terminals, ensures a component of practical experience.

The modular format of the courses, by being immersive and intensive, is crucial to install adequate analysis abilities and enhance students' problem-solving capabilities through:

- Case analysis supported by the presentation of concepts and tools, developing critical thinking while reinforcing learning
- Presentation and discussion of relevant examples, previously prepared by the teachers, invited specialists, or the students themselves, facilitating the integrated view of

the maritime logistics chain, making explicit its daily problems, and the practice of soft skills

- Interactive techniques and tools, such as simulators, help understanding the structure of problems
- Evaluation instruments, which privilege the analysis of cases and presentations for the class in an appropriate way to support the dynamics of the program.

Água et al. [11] suggest that a blend of methods shall be used in order to develop the critical thinking, among other managerial and soft skills.

A comparison of the contents of similar master programs is presented. According to the used scale, it is clearly visible how the comprehensiveness of the program compares to other programs; there is the possibility of an internship to better assimilate the theoretical information with on the field practice, and how port administration, industrial engineering and digital skills are reinforced instead of finance and taxation matters and maritime economy deep knowledge (Table III).

TABLE III
COMPARISON WITH THE CONTENTS OF THE OTHER SIMILAR PROGRAMS

Institution	Maritime Logistics	Business Analysis	Industrial Engineering	Managerial Skills*	Trade Law	Port Admin.	Internship	Finance & Taxation	Maritime Economy	Digital Skills	Other Soft Skills
NOVA SST & EN	X	X	X	X	X	X	X			X	X
Solent University (Southampton)	X	X		X	X				X		
University of Plymouth	X	X							X		
Kedge Business School (Marseille)	X	X			X		X	X			X
Ecole de Management de Normandie (Le Havre)	X	X		X			X	X		X	
University of applied sciences (MLU-OAS Netherlands)	X			X	X			X	X		
Rotterdam School of Management		X		X			X	X		X	
University of Antwerp	X	X							X		

IV. CONCLUSIONS

Once the master's program is finished, students will possess the knowledge, skills and competences to:

- Understand the maritime logistics and analyze and diagnose its businesses from the operational, technological and regulatory components
- Have an integrated view of the maritime logistics supply chain, its sustainability and relationships with its environment, from a sea literacy perspective
- Identify and structure maritime logistics problems and be proactive in the search for solutions
- Organize information and communicate orally and in writing
- Work individually and as part of teams, defining priorities and managing the time to meet deadlines
- Be motivated to increase the acquired knowledge and skills.

This master's program is a fundamental result of the MarLEM project, whose context is rooted in the gaps found in higher education offerings in the areas related to the sea, in this case in maritime logistics, within the framework of the Blue Economy concept, whose potential for growth and job creation requires a permanent inflow of skills. According to the European Commission's Annual Growth Survey [7], there is a widening gap between the needed and available skills, intensified by the lack of communication and cooperation between education institutions and the industry actors in order to align supply with demand.

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