LEADERSHIP
Skills of tomorrow in the European maritime sector

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Report on emerging skills and occupational profiles

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1. Introduction

The shipbuilding industry, a cornerstone of global trade and naval defence, is undergoing a transformative evolution. With advancements in technology, environmental regulations, and a shifting economic landscape, the sector faces new and dynamic workforce requirements. Modern shipyards are no longer just sites of manual labour and craftsmanship; they have become hubs of innovation, requiring a blend of traditional skills and cutting-edge expertise. Technological advancements, particularly in automation and digitalization, are reshaping the industry. The integration of robotics, artificial intelligence (AI), and advanced software systems necessitates a workforce proficient in these areas. Workers now need to be adept not only in traditional shipbuilding techniques but also in operating and maintaining sophisticated machinery and software. This shift demands a new breed of shipbuilders—those who can bridge the gap between hands-on craftsmanship and technological proficiency. Environmental sustainability has also become a critical focus. Stricter regulations and the global push for greener practices compel shipyards to adopt eco-friendly materials and energy-efficient processes. Consequently, there is a growing demand for professionals knowledgeable in green technologies, environmental science, and sustainable engineering. The ability to innovate and implement sustainable practices is increasingly valuable, as the industry strives to reduce its carbon footprint and meet international environmental standards.

Furthermore, globalization and the corresponding increase in maritime trade have intensified competition, requiring shipbuilders to enhance productivity and efficiency. This necessitates a workforce that is not only skilled but also versatile and adaptable. Employees must be capable of performing a range of tasks and willing to continuously update their skills in response to evolving industry needs.

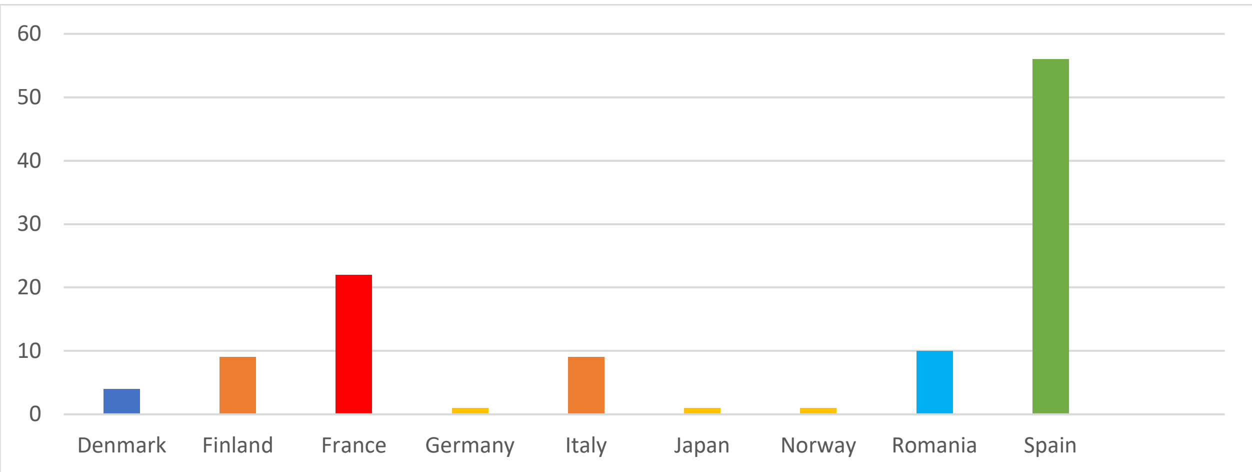
In summary, the shipbuilding industry's evolving landscape presents both challenges and opportunities. By embracing technological advancements, prioritizing environmental sustainability, and fostering a versatile workforce, shipyards can navigate these changes effectively. The future of shipbuilding will depend on the industry's ability to adapt and innovate, ensuring that its workforce meets the demands of a rapidly changing world.

1.1 External validation

In an effort to align with the evolving requirements of the European shipbuilding industry, a comprehensive questionnaire was circulated among various stakeholders within the shipbuilding supply chain, facilitated by the project partners. This initiative was integral to Task 2.4 of Work Package 2 (WP2). The meticulous process of preparing and drafting the questionnaire involved extensive collaboration and input from key industry participants, ensuring its relevance and comprehensiveness. A significant portion of the questionnaire has been analysed to pinpoint both emerging and urgent skills essential for the industry's future. This analysis aims to capture the skill gaps and areas requiring immediate attention, providing a foundation for developing targeted training programs. The insights gained from this process will be instrumental in shaping the curriculum for future courses, which will be designed in the subsequent tasks of WP3.

By systematically identifying these critical skills, the project aims to enhance the competency of the shipbuilding workforce, ensuring it meets the modern demands of the industry. This proactive approach will help in fostering a skilled and adaptable workforce, capable of navigating the technological advancements and sustainability requirements that are increasingly defining the European shipbuilding industry. Through this initiative, the project not only addresses current skill deficiencies but also anticipates future needs, thereby contributing to the overall competitiveness and innovation of the European shipbuilding sector. The findings from this questionnaire will serve as a cornerstone for educational and training initiatives, ultimately driving the industry towards a more skilled and future-ready workforce.

The analysis of the questionnaire yielded a total of 163 valid responses before filtering out incomplete submissions and those lacking pertinent information for skill gap identification. Considering only the responses over 60% of completeness, questionnaire yielded a total of 112. This curated data set forms the basis for a detailed examination of the current and future skill requirements in the European shipbuilding industry. The geographical distribution of the repliers to the questionnaire, as illustrated in Figure 1, reflects a wide range of participation from various regions. This diverse representation ensures a comprehensive understanding of the industry's needs across different areas. By mapping the responses geographically, we can identify regional trends and variations in skill requirements, which is crucial for tailoring training programs to specific local needs. This geographical analysis also highlights the collaborative nature of the project, showcasing the involvement of multiple stakeholders from different parts of Europe. Such inclusivity enriches the data quality and ensures that the findings and subsequent training programs are relevant and applicable across the entire European shipbuilding sector. However, while mail shipbuilding countries are represented in the replies, due to the lack of partnerships in the project of German partners, this country is under-represented. On the other hand, northern Europe is well represented by surrounding countries like Finland, Denmark and Norway.



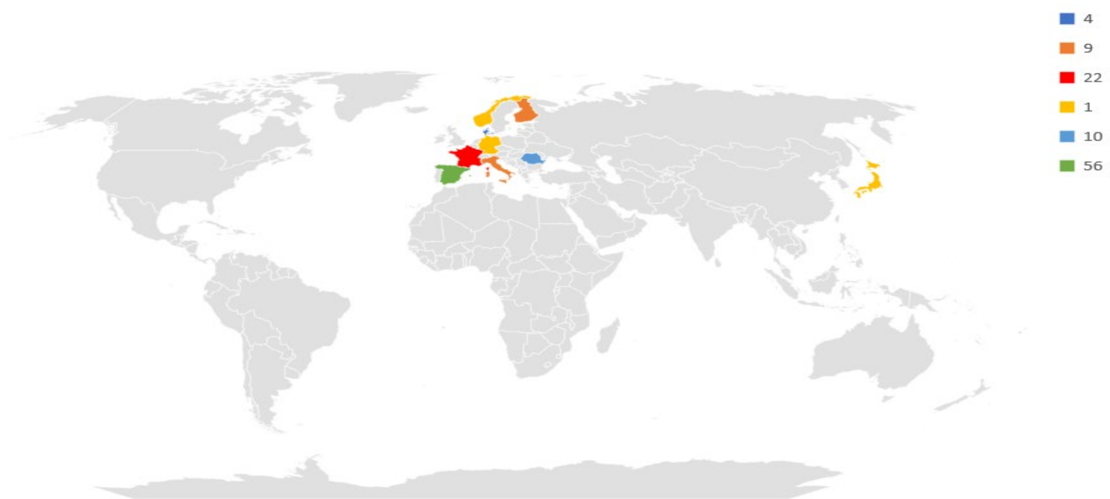


Figure 1. Geographical distribution of responses

In addition to the initial analysis, a more detailed examination was carried out by segmenting the stakeholders' responses (Figure 2 and 3). This segmentation was performed on two primary dimensions: national basis and company type. By analysing the data on a national basis, we aimed to uncover any significant regional discrepancies in the responses. This approach allows us to identify region-specific skill gaps and training needs, which are crucial for developing tailored educational programs that address the unique challenges and opportunities within different countries. Furthermore, the responses were also categorized according to the type of company, enabling a deep understanding of how different segments of the shipbuilding industry perceive and experience skill gaps. This categorization helps in pinpointing specific needs and priorities of various types of companies, such as shipbuilders, suppliers, and service providers. Understanding these distinctions is essential for creating targeted interventions that effectively address the diverse needs of the industry.

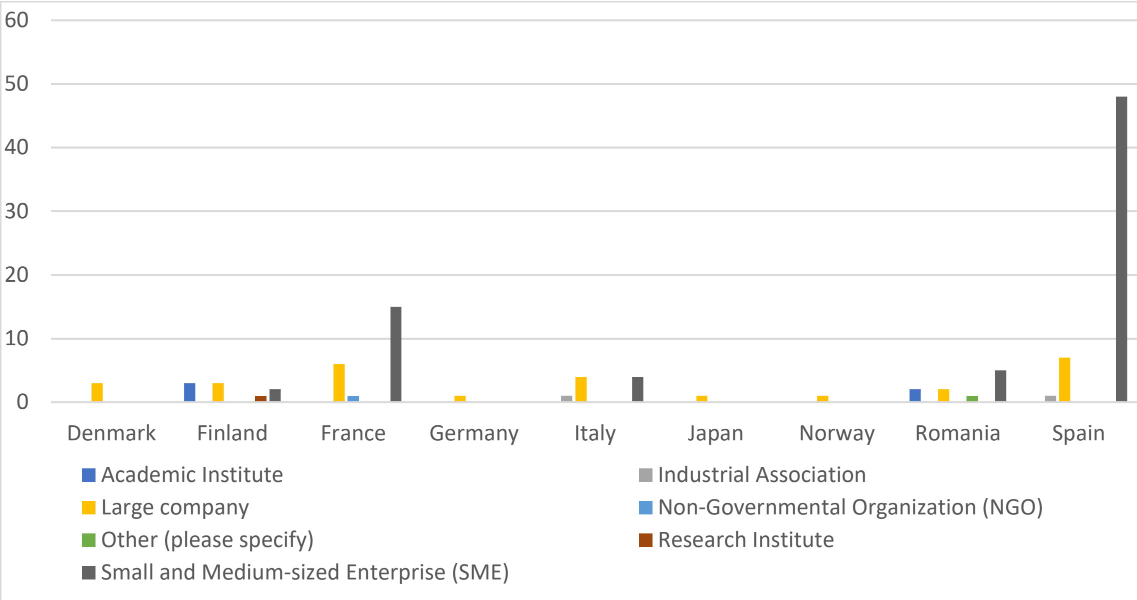


Figure 2. Responses to the survey on company and national base

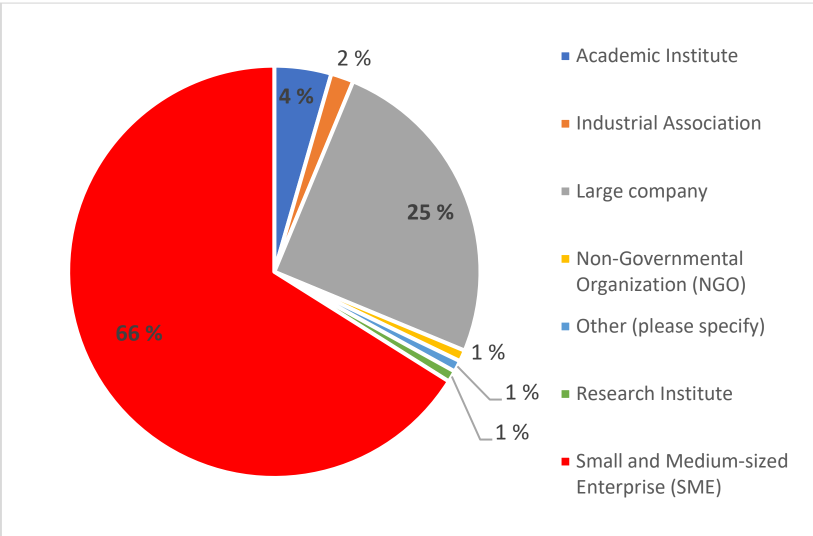


Figure 3. Company base distribution

The data reveals that a significant portion of the responses, around 66%, originates from small and medium-sized enterprises (SMEs). This substantial representation underscores the critical role that SMEs play in the shipbuilding industry and highlights their perspectives on skill gaps and training needs. The focus on SMEs is essential, as they often face unique challenges and opportunities that differ from those of larger corporations.

When the contributions from large companies are included, the combined sample represents approximately 90% of all responses. This comprehensive coverage ensures that the analysis is reflective of the broader industry landscape, encompassing a wide range of company sizes and types. The inclusion of large companies in the survey provides a balanced view, integrating insights from both ends of the business spectrum.

This diverse representation is crucial for developing a holistic understanding of the industry's skill requirements. By considering the input from SMEs and large enterprises alike, the findings can inform more effective and inclusive training programs. These programs can then be tailored to meet the specific needs of different company sizes, ensuring that both SMEs and large enterprises are adequately supported in addressing their skill gaps.

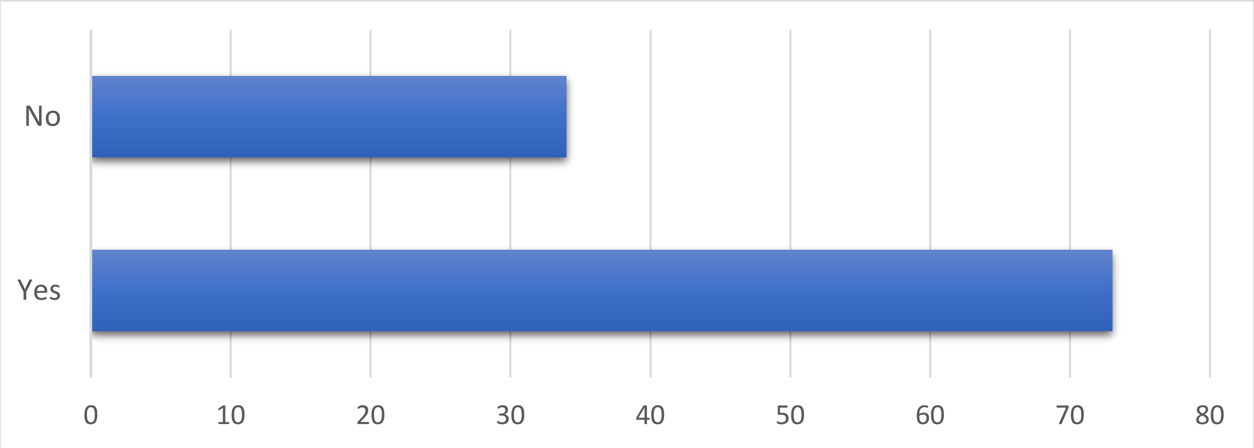
1.2 New skills and occupation detected

To effectively identify the urgent and emerging skills needed in the shipbuilding industry, a targeted analysis was conducted using selected portions of the comprehensive stakeholder questionnaire. The specific focus was on the numerical responses from questions Q32 to Q40, and the qualitative insights provided in the open-ended questions Q29 and Q61. This strategic selection was made to streamline the data analysis and to extract the most relevant information regarding skill gaps and training needs.

Given that all responses to the questionnaire were optional, the analysis prioritized percentages over absolute numbers. This approach ensures that the findings are representative of the overall repliers' pool, providing a more accurate depiction of the industry's skill requirements. By focusing on the relative distribution of responses, the analysis can highlight prevalent trends and common needs among the stakeholders.

For the open-ended questions, Q29 and Q61, a methodological approach was taken to group similar professional profiles. This grouping was essential to reduce the dispersion of results, which often occurs with qualitative data. By consolidating similar profiles, the analysis could derive clearer and more actionable insights into the specific skill sets that are in demand. This method also allowed for a more precise numerical representation of the labour market needs, facilitating the identification of key areas for training and development. Figure 4 illustrates the findings from question Q32 of the questionnaire, revealing a significant insight into the professional training landscape within the shipbuilding industry. The data shows that nearly one-third of the participating companies do not engage in developing professional training courses. This notable proportion highlights a potential gap in the industry's approach to continuous professional development and skills enhancement. However, the analysis of the responses does not provide a clear reason for this trend. It remains uncertain whether the absence of training initiatives is due to a shortage of specific training courses that meet the industry's needs or a general lack of interest or perceived value in such training programs. An alternative reason could be in the fact that several SMEs are included in the repliers pool, resulting into a substantially lower possibility to engage in training initiatives unless they are supported by dedicated supporting funds like European and/or national funding programs.

Tough, this ambiguity points to an area that requires further investigation to understand the underlying causes and to develop strategies that encourage more comprehensive training efforts.



#	Answer	%	Recount
1	Yes	68.22%	73
2	No	31.78%	34
	Total	100%	107

Figure 4. Response to: Q32: Do your company provide any internal course?

Figure 5 highlights the responses to question Q33 from the questionnaire, shedding light on the training practices within the shipbuilding industry. The data reveals that nearly 80% of the surveyed companies focus their training efforts exclusively on personnel who are already employed. This prevalent approach indicates that most companies prioritize the development and enhancement of skills for their existing workforce rather than offering training programs to potential new hires or the broader labour market.

This focus on in-house training can be seen as a strategic decision to maximize the investment in current employees, ensuring that they are continuously updated with the latest skills and knowledge required for their roles. It reflects an understanding that retaining and developing current staff can be more cost-effective and beneficial in maintaining operational efficiency and competitive advantage. However, at the same time, this imply a more traditional and somehow old perspective of the labour market given that nowadays the labour market is evolving more and more towards short term positions.

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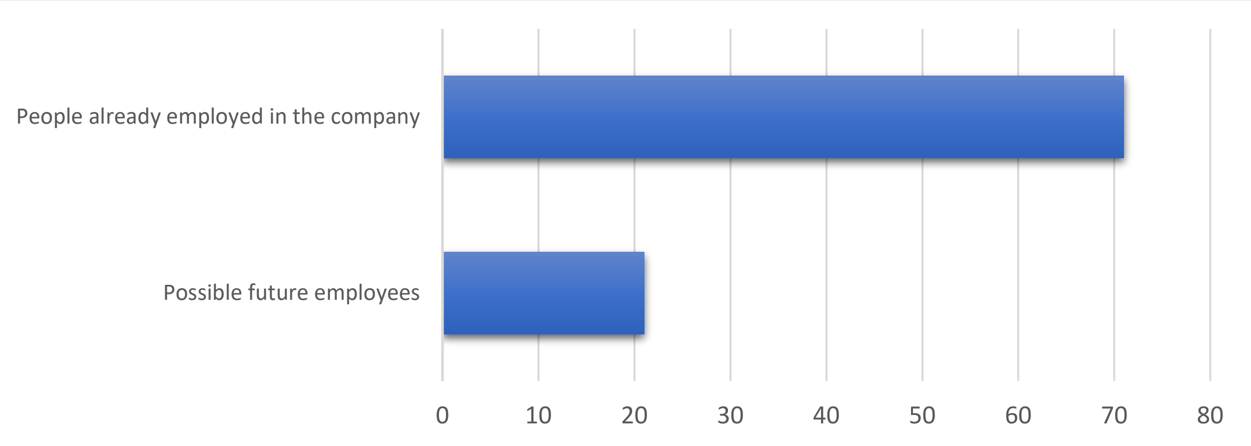
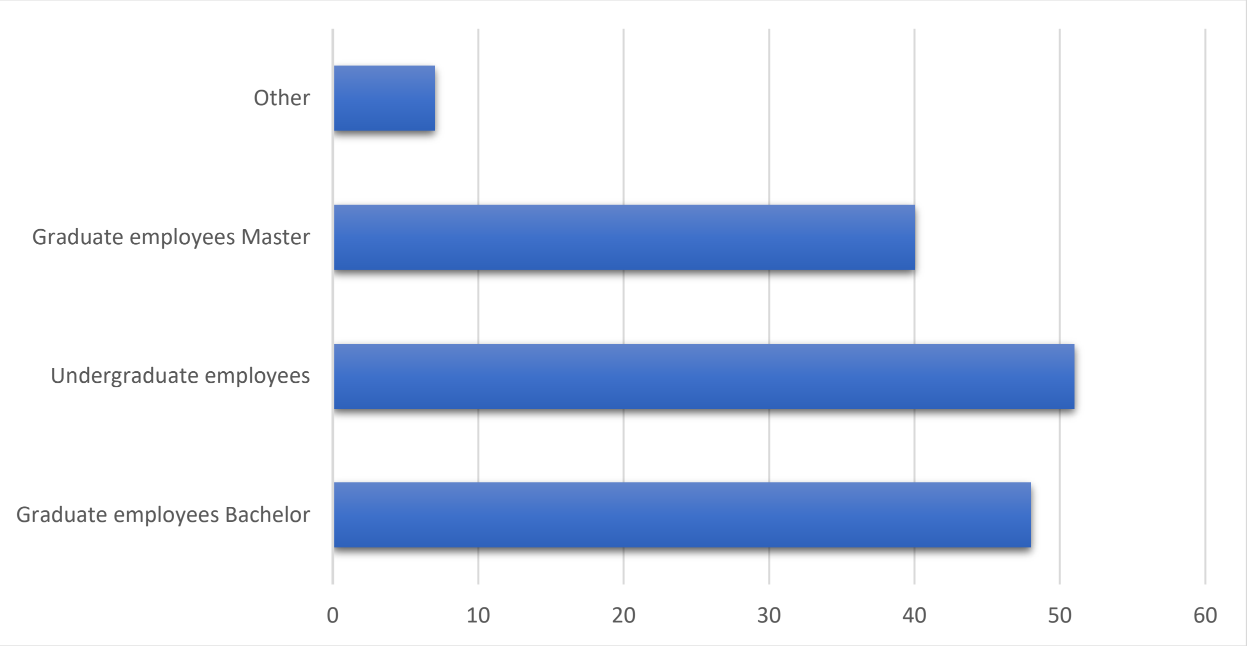


#	Answer	%	Recount
1	People already employed in the company	77.17%	71
2	Possible future employees	22.83%	21
	Total	100%	92

Figure 5: Response to: Q33: Who are the courses addressed to?

Figure 6 illustrates the findings from question Q34, providing valuable insights into the allocation of training courses among different levels of personnel within the shipbuilding industry. The data shows that the distribution of training efforts is relatively equitable, suggesting that companies are investing in the professional development of employees across various roles and responsibilities. To simplify the data collection process and make it more accessible for repliers, the questionnaire inquired about the educational levels of the candidates rather than using the European Qualifications Framework (EQF) levels.

This approach was intended to ensure clarity and ease of response, recognizing that not all stakeholders might be familiar with the EQF system. The results underscore a critical insight: there is a clear necessity to develop training programs that cater to all levels of post-secondary education. This broad-spectrum approach acknowledges the diverse educational backgrounds of the workforce and emphasizes the importance of inclusive training strategies that accommodate varying levels of expertise and knowledge.



#	Answer	%	Recount
1	Graduate employees Bachelor	27.40%	48
2	Undergraduate employees	34.93%	51
3	Graduate employees Master	4.79%	40
4	Other	32.88%	7
	Total	100%	146

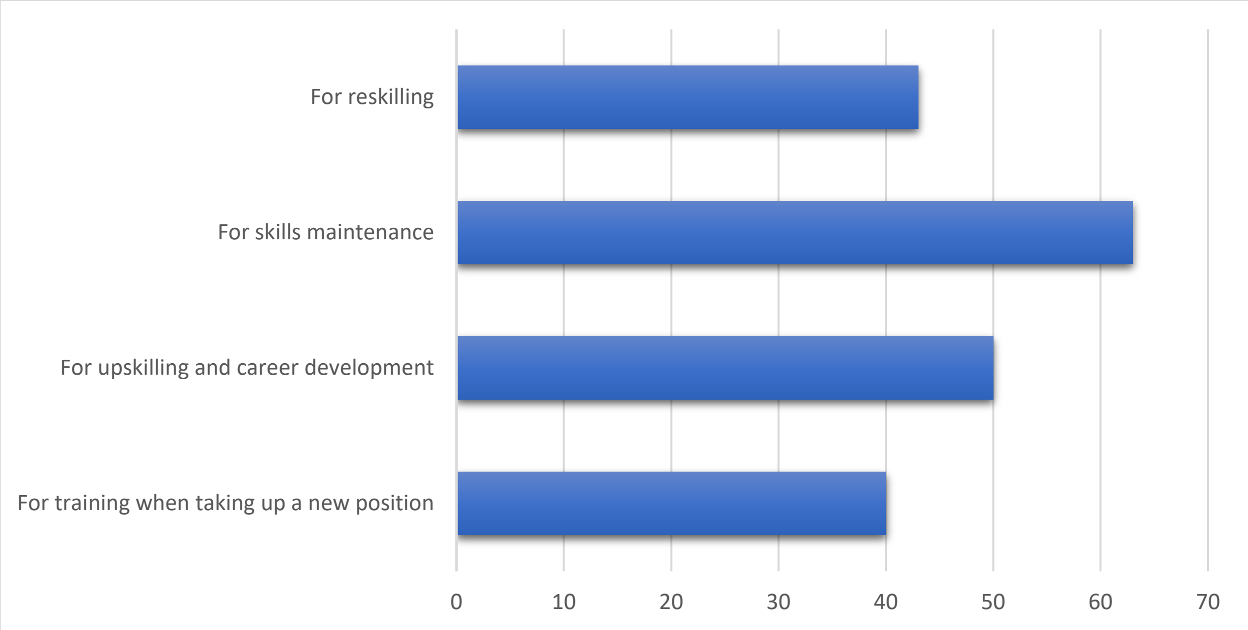
Figure 6 to: Q34: Who are the courses held for?

Figure 7 showcases the responses to question Q35, which delves into the primary objectives of the training courses offered by companies in the shipbuilding industry. The data indicates a diverse range of responses, reflecting the varied training priorities among the surveyed companies. Despite this variety, a significant trend emerges: the predominant focus is on maintaining already acquired and consolidated skills.

This emphasis on skill maintenance over upskilling and reskilling suggests that many companies are prioritizing the reinforcement of existing competencies to ensure that their workforce remains proficient in current practices. While this approach is important for sustaining operational efficiency and quality, it reveals a potential gap in addressing the evolving needs of the industry.

The relatively lower focus on upskilling and reskilling can be attributed to a shortage of specialized training programs designed to equip employees with new skills. Possibly, the need of upskilling and reskilling is not adequately perceived as the European shipbuilding industry is generally

considered a rather advanced one. Notwithstanding it is in comparison with Far-East countries as far as high added value ships is concerned, this should not be given for granted in the near future being the competition more and more challenging.
As the shipbuilding industry undergoes significant transformations driven by technological advancements, environmental regulations, and shifting market demands, the ability to acquire new competencies becomes increasingly crucial.



#	Answer	%	Recount
1	For training when taking up a new position	20.41%	40
2	For upskilling and career development	25.51%	50
3	For skills maintenance	32.14%	63
4	For reskilling	21.94%	43
	Total	100%	196

Figure 7. Response to: Q35: Who are the courses held for?

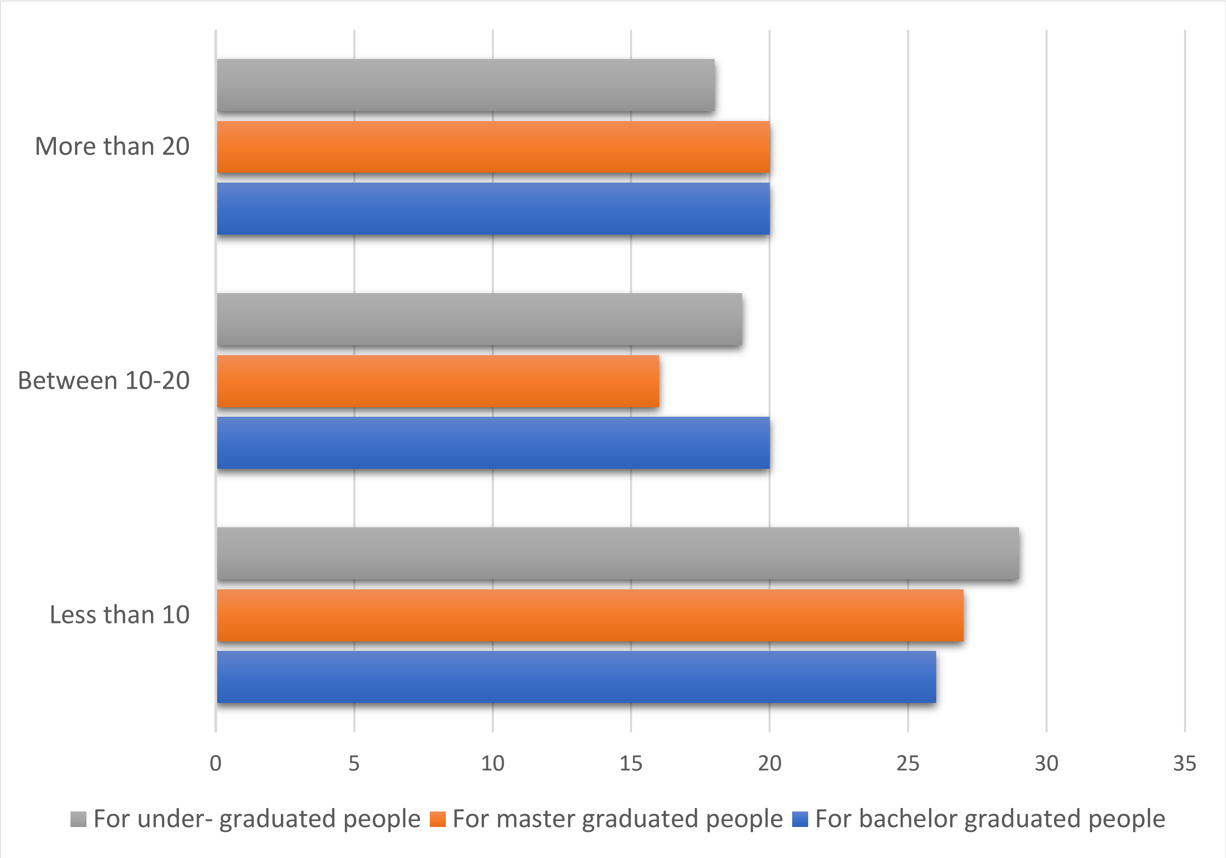
Upon examining the outcomes of question Q35 and 36 (Figure 9 and 10), a clear trend emerges: companies in the shipbuilding industry tend to favour training their personnel in smaller groups, typically comprising fewer than 10 individuals. This preference underscores a practical approach to training delivery, aiming for more personalized and focused learning experiences.

The inclination towards smaller group sizes may stem from several factors. Firstly, smaller groups often facilitate more interactive and tailored training sessions, allowing for deeper engagement and individualized attention from instructors. This setup can enhance the effectiveness of training programs by addressing specific learning needs and promoting peer-to-peer collaboration among participants.

Furthermore, the preference for smaller groups suggests a strategic consideration of resource allocation and logistical feasibility. It may reflect the practical limitations associated with organizing and conducting training sessions, such as available facilities, qualified trainers, and scheduling constraints. Companies may find it more manageable and cost-effective to deliver training in smaller batches, ensuring quality and consistency in learning outcomes.

However, this approach also highlights a potential constraint in offering more extensive courses that cover a broader range of skills, including cross-functional competencies. Larger-scale training initiatives that encompass both technical and interdisciplinary skills are essential for fostering a versatile and adaptable workforce in the evolving shipbuilding industry landscape.

The limited availability of comprehensive training programs could pose challenges in addressing the diverse and evolving skill requirements of the industry. As technological advancements and market demands continue to shape the shipbuilding sector, there is a growing need for training initiatives that span multiple disciplines and incorporate both technical expertise and broader competencies such as project management, leadership, and innovation, besides technical matters.

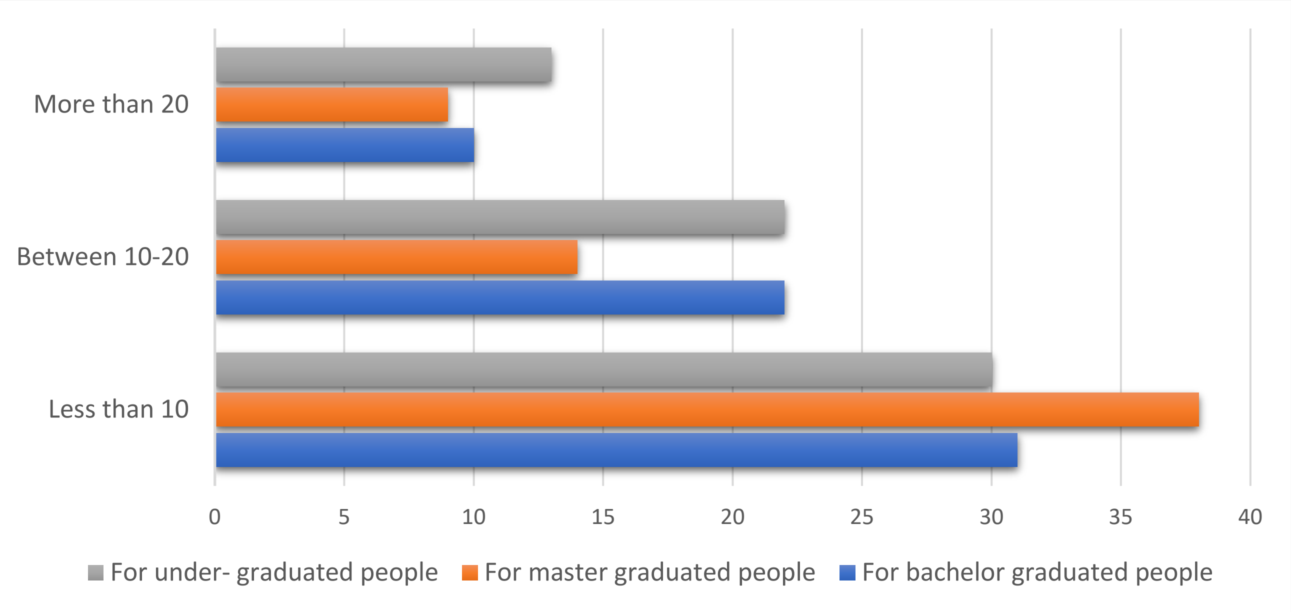


#	Question	Less than 10		Between 10-20		More than 20		Total
1	For bachelor graduated people	39.39%	26	30.30%	20	30.30%	20	66
2	For master graduated people	42.86%	27	25.40%	16	31.75%	20	63
3	For under- graduated people	43.94%	29	28.79%	19	27.27%	18	66

Figure 8. Response to: Q36: How many hours does a course last on average?

Examining the results from the response to questions regarding the duration of training courses, it becomes apparent that there is a slight preference for shorter-duration courses among companies in the shipbuilding industry. This preference contrasts with the need for comprehensive and extensive training that covers a wide range of skills and competencies.

The inclination towards shorter-duration courses can be attributed to several factors. Firstly, companies may prioritize efficiency and flexibility in training delivery, opting for shorter sessions that minimize disruption to daily operations and allow employees to return to work quickly with newly acquired skills. This approach helps maintain productivity while addressing immediate training needs. Moreover, the preference for shorter courses may reflect a strategic decision to leverage specialized educational institutions, such as universities or vocational institutes, for more in-depth and extensive training programs. These institutions are often equipped with the resources, expertise, and infrastructure necessary to offer comprehensive training that spans multiple disciplines and addresses complex skill requirements.



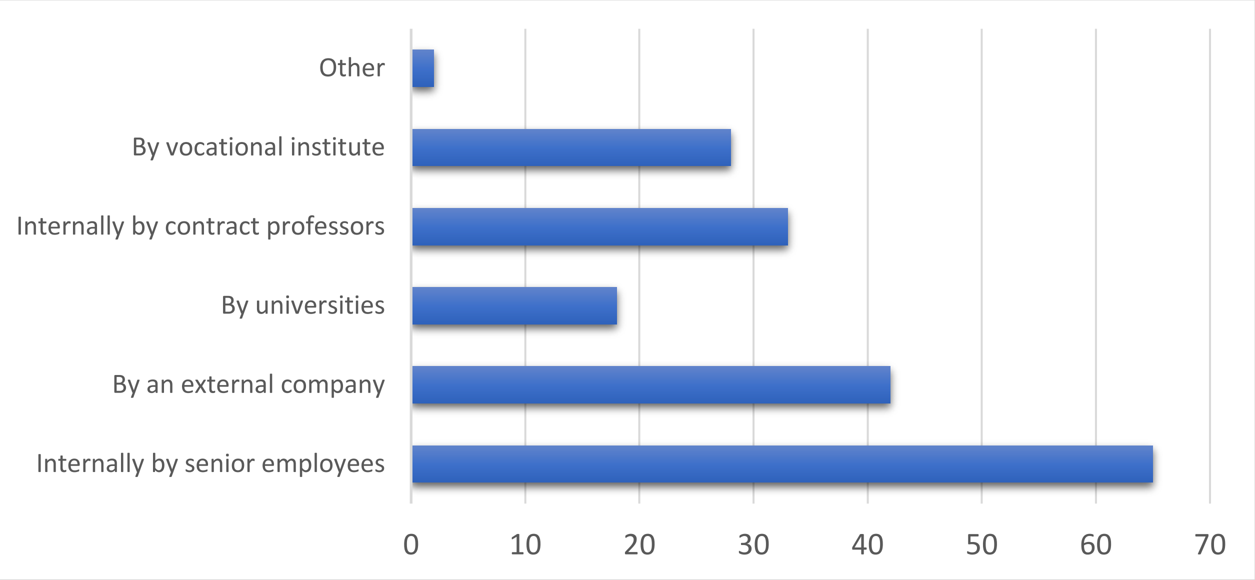
#	Question	Less than 10		Between 10-20		More than 20		Total
1	For bachelor graduated people	49.21%	31	30.30%	22	15.87%	10	63
2	For master graduated people	62.30%	38	25.40%	14	14.75%	9	61
3	For under- graduated people	46.15%	30	28.79%	22	20.00%	13	65

Figure 9. Response to: Q37: How many people are involved in a course on average?

Analysing the responses to question Q38 in Figure 10 provides valuable insights into the preferences of companies within the shipbuilding industry regarding the delivery of training programs. The data reveals that a significant portion, accounting for 50% of the repliers, favours internal training methods. This internal training can be conducted by experienced senior staff members within the company who possess in-depth knowledge of specific processes and practices. Alternatively, companies may opt to engage external professionals who bring specialized expertise and insights to the training sessions.

The preference for internal training reflects a strategic approach to leveraging existing talent and resources within the organization. By utilizing internal expertise, companies can tailor training programs to meet specific operational needs and ensure alignment with organizational goals. This approach not only enhances the relevance and applicability of the training but also fosters a culture of continuous learning and development among employees.

Furthermore, the data indicates that 25% of repliers opt to collaborate with specialized institutions such as universities or vocational institutes for training initiatives. These institutions are valued for their comprehensive educational frameworks and specialized knowledge, which can enrich training programs with advanced theoretical concepts and practical applications. Partnering with external entities allows companies to access cutting-edge research and industry best practices, contributing to the professional growth and proficiency of their workforce.



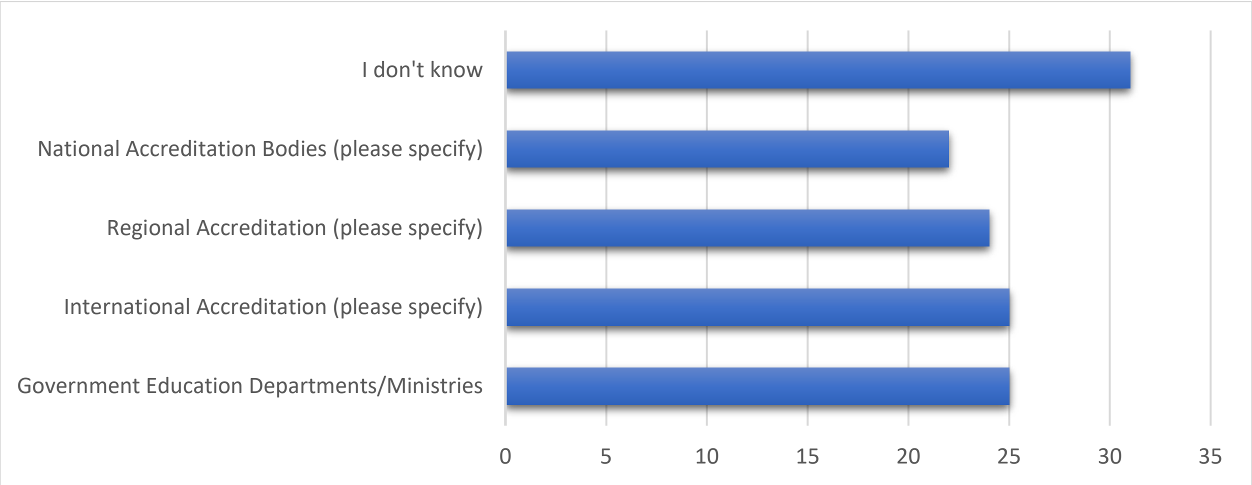
Answer	%	Recount
Internally by senior employees	34.57%	65
By an external company	17.55%	42
By universities	9.57%	18
Internally by contract professors	14.89%	33
By vocational institute	22.34%	28
Other	1.06%	2
Total	100%	188

Figure 10. Response to: Q38: The courses are held?

Questions Q39 and Q40 provided valuable insights into the technical aspects of training courses within the shipbuilding industry, as depicted in Figures 11 and 12. These questions specifically addressed the potential official accreditation of courses and the language in which they are delivered.

In Figure 11, which analyses responses to Q39 concerning accreditation, it was found that approximately 25% of repliers indicated uncertainty regarding whether the courses they offer are officially recognized by external entities. This uncertainty likely stems from a lack of formal recognition of the courses by external accrediting bodies. Excluding this percentage, the remaining responses were varied and evenly distributed among regional, national, international, and governmental accrediting entities. This diversity suggests that companies within the shipbuilding industry recognize the importance of seeking accreditation from various levels of authority to validate the quality and relevance of their training programs.

Accreditation plays a crucial role in ensuring that training courses meet established standards and benchmarks, thereby enhancing the credibility and effectiveness of the educational offerings. Companies that seek accreditation demonstrate a commitment to maintaining high standards of training and aligning with industry best practices, which is essential for fostering trust and credibility among stakeholders.



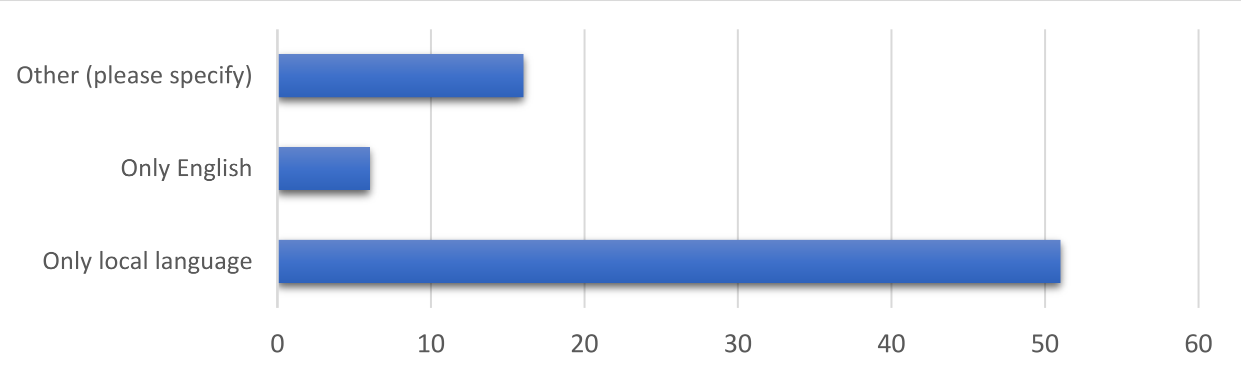
Answer	%	Recount
Government Education Departments/Ministries	19.69%	25
International Accreditation (please specify)	19.69%	25
Regional Accreditation (please specify)	18.90%	24
National Accreditation Bodies (please specify)	17.32%	22
I don't know	24.41%	31
Total	100%	127

Figure 11. Response to: Q39: Are these courses certified? By whom?

Moving to Figure 12, which examines responses to Q40 regarding the language of course delivery, the data highlights significant preferences among respondents. Approximately 70% of respondents indicated that courses are conducted exclusively in the local language. Over 20% reported that courses are delivered in both English and the local language, while less than 10% stated that courses are exclusively delivered in English.

The preference for conducting courses in the local language underscores the importance of linguistic accessibility and cultural relevance in training initiatives. Local language delivery ensures that training materials and instructions are comprehensible and relatable to participants, facilitating better understanding and retention of knowledge. It also promotes inclusivity by accommodating participants who may have varying levels of proficiency in English. However, the notable percentage of courses offered in both English and the local language reflects a recognition of the global nature of the shipbuilding industry, where proficiency in English is often necessary for international communication and collaboration. Offering courses in both languages allows companies to cater to diverse audiences and enhance the international competitiveness of their workforce.

The findings underscore the clear need to develop training courses in the local languages of partners and stakeholders. By expanding linguistic accessibility, companies can enhance engagement, improve learning outcomes, and foster a more inclusive training environment that supports the diverse linguistic and cultural backgrounds of participants.



Answer	%	Recount
Only English	8.22%	51
Only local language	69.86%	6
Other (please specify)	21.92%	16
Total	100%	73

Figure 12. Response to: Q40: Are they held in English or in your own local language

In conclusion, the analysis of Q39 and Q40 provides valuable insights into accreditation preferences and language considerations within the shipbuilding industry. Addressing these aspects—seeking accreditation from recognized bodies and developing multilingual training programs—will be essential for ensuring the relevance, effectiveness, and global competitiveness of training initiatives in the evolving shipbuilding sector.

In the context of analysing the two open-ended questions about deficient professional profiles, it becomes evident that the shipbuilding industry faces a significant challenge in meeting its workforce needs. The responses to these questions provide a wide understanding of the specific skill gaps and job vacancies that companies are currently experiencing.

The first open-ended question, Q61, seeks to identify the skills that are currently lacking in the shipbuilding labour market. The aggregated results, as shown in Table 1, highlight a range of missing competencies. These skill gaps are reflective of the evolving technological and operational demands within the industry. As the shipbuilding sector continues to advance, the need for specialized skills becomes increasingly critical. Training programs must adapt to these changes by incorporating relevant skill sets that address both current and future industry requirements.

To address the immediate skill gaps identified in question Q61, the industry could benefit from targeted training programs that focus on upskilling and reskilling the current workforce. These programs can be designed to quickly impart the necessary skills and competencies, thereby improving the employability of workers and meeting the urgent needs of companies.

In parallel, partnerships between industry and educational institutions can play a pivotal role in developing comprehensive curricula that align with industry standards and future trends. By fostering collaboration between these stakeholders, the shipbuilding industry can ensure a steady pipeline of well-trained professionals who are equipped to handle the complex demands of the sector.

Table 1. Response to: Q61: If there are any skills that you consider important, you may include here.

Mechanics	5
Maintenance	5
Ship technology	4
Welding	3
OT digital design	3
Maritime cybersecurity	3
IT/programming	3
Data science	3
Connectivity/IoT	3
Structural calculation	2
Logistic	2
Languages	2
Virtual twins	1
Survey skills	1

RF signal processing	1
Pedagogical skills	1
MBSE	1
Fishing	1
Drawing interpretation and production	1
Collaboration	1

The second open-ended question, Q29, delves deeper into specific job positions that companies find challenging to fill. Table 2 aggregates these results, revealing a high demand for Naval Architects. This particular role is crucial within the industry, requiring advanced knowledge and technical expertise that can only be obtained through extensive university-level education. The fact that Naval Architects are in high demand underscores the strategic importance of this profession in designing and overseeing the construction of ships and marine structures.

However, the lengthy and intensive training required to become a Naval Architect, typically involving the completion of 180 to 300 university credits, poses a significant challenge. Given the time and resources needed to train these professionals, the role cannot be considered the primary focus of short-term training projects. Instead, there is a need for a multifaceted approach that includes both immediate skill development initiatives and long-term educational strategies. A similar finding can be done for the position of Electric Marine Engineer, while it could be more interesting, for the aim of this Project, to realize a sort of “navalization” of a classical Electrical engineer or an “electrification” of a classical Naval Architect.

Table 2. Response to: Q29: What figures profiles or skills are not available on the labour market?

Naval architects	34
Mechanics-Mechatronics	22
Electric/electronics marine engineers	20
Welders	16
Pipeliners	15
Maintenance mechanics	13
OT engineers	12
Project Managers	11
IT/Cybersecurity	10
Draftsman	8
Big data/data analysis	6
IoT technicians	5

Boilermakers	4
Interior design	4
Shipyard painters	4
Toolmakers	3
Planner	2
Logistic expert	2
Additive manufacturing	2
Training	2
Offshore	1
Lab technicians	1
Business experts	1
Theoreticians	1
Blockchain experts	1
System integration	1
Cathodic protection experts	1
AR/VR	1
Commercial admin	1
Operators	1
Insulation fitters	1
Bridge/engine graduate	1
Scuba workers	1

The analysis of the survey responses highlights an intriguing trend: the increasing demand for cross-functional roles like project managers, maintenance mechanics, and IT/cybersecurity specialists. This demand is particularly significant in light of the ongoing transformations within the shipbuilding industry and the broader shift towards ecological transition and Industry 5.0
As the shipbuilding industry evolves, driven by technological advancements and sustainability imperatives, the need for a diverse skill set becomes more apparent. The role of a project manager, for instance, has gained prominence due to the complexity and scale of modern ship projects. Project managers are essential for coordinating various aspects of shipbuilding and maintenance, ensuring that projects are completed on time, within budget, and to the required quality standards. Their ability to manage resources, risks, and stakeholders effectively is crucial for the successful execution of complex shipbuilding projects.

Maintenance mechanics, on the other hand, play a vital role in ensuring the operational efficiency and longevity of vessels. As ships become more technologically advanced, the need for skilled maintenance personnel who can handle sophisticated equipment and systems increases. The emphasis on preventive maintenance and the adoption of new technologies for condition monitoring and diagnostics highlight the importance of this role in the modern shipbuilding industry.

The inclusion of IT and cybersecurity specialists in the list of in-demand positions reflects the growing digitalization and connectivity within the shipbuilding sector. With the increasing reliance on digital systems for navigation, digital twins, communication, and operational management, the importance of cybersecurity cannot be overstated. Protecting critical infrastructure from cyber threats and ensuring the integrity of digital systems are paramount for maintaining the safety and security of ship operations.

These cross-functional roles are not only relevant to the current needs of the naval industry but also align with the broader industrial trends towards ecological transition and Industry 5.0. The ecological transition emphasizes sustainable practices, energy efficiency, and reduced environmental impact, all of which require a workforce equipped with diverse skills and knowledge. Industry 5.0, characterized by the integration of advanced technologies and human-centric approaches, further underscores the need for professionals who can bridge the gap between technology and human expertise.

The analysis of the survey data indicates that the demand for positions at lower EQF levels is just as significant as that for higher-level roles, especially considering the impending changes ships will undergo due to the ecological transition and the advancements in Industry 5.0. This highlights the need to redesign training programs for key technical roles such as welders, pipeliners, draftsmen, boilermakers, and logistics experts to align with the new technologies and practices emerging in the shipbuilding and nautical sectors.

Welders, for example, are crucial in shipbuilding and repair, and their skills must evolve to accommodate new materials and welding techniques that enhance the sustainability and efficiency of ships. Training programs for welders should incorporate advanced welding technologies, such as laser welding and robotic welding systems, which improve precision and reduce environmental impact.

Pipeliners, responsible for the installation and maintenance of piping systems on ships, must also adapt to the changing landscape. With the shift towards greener fuels and advanced propulsion systems, pipeliners need to be proficient in working with new types of materials and technologies. Training should include a focus on the latest piping materials, such as composite materials, and modern installation techniques that ensure system integrity and efficiency.

Draftsmen, who play a pivotal role in creating detailed technical drawings and plans for ship construction and modification, must be adept at using advanced computer-aided design (CAD) software and 3D modelling tools. As ships become more complex and technologically sophisticated, draftsmen need to be trained in the latest design software and techniques to produce accurate and detailed plans that facilitate efficient construction and maintenance processes.

Boilermakers, who construct and repair boilers and other large pressure vessels on ships, must also stay current with new technologies and methods. The transition to more sustainable energy systems, such as those utilizing alternative fuels or advanced thermal management systems, requires boilermakers to be knowledgeable about new materials and fabrication techniques. Training programs should emphasize the latest advancements in boiler design and maintenance to ensure efficiency and compliance with environmental regulations.

Logistics experts, essential for the efficient management of supply chains and materials in shipbuilding and operations, need to be well-versed in modern logistics technologies and practices. The integration of digital tools, such as inventory management systems, predictive analytics, and blockchain technology, is transforming logistics in the shipbuilding industry. Training programs should focus on these new technologies, equipping logistics experts with the skills to optimize supply chains, reduce waste, and enhance overall operational efficiency.

2 State of art at the regional level

Identifying the needs for improvement based on the new demands of shipyards, the implementation of new technologies, and the necessity to include transversal, digital, and green skills into sectoral profiles is crucial. The maritime industry is undergoing rapid changes driven by technological advancements and environmental considerations. As shipyards adopt new technologies and processes, there is an increasing demand for a workforce equipped with the latest skills and knowledge. This includes not only technical expertise but also a strong foundation in digital competencies and sustainability practices.

After analysing the responses to the questionnaire and identifying the existing gaps, the next step is to verify the state of the art of the existing courses for each partner country. This process involves a thorough evaluation of the currently available training programs, aiming to identify areas for improvement or opportunities to develop new courses that can address the identified gaps. The evaluation should consider various factors such as course content, delivery methods, industry relevance, and the integration of new skills that are becoming increasingly important.

Verifying the state of the art is essential to ensure that the proposed training programs are up-to-date, relevant, and aligned with the needs identified through the preliminary analysis. This step will help in understanding how well current programs meet industry standards and expectations. Additionally, it will highlight any deficiencies or outdated practices that need to be addressed. The goal is to create a robust training framework that not only fills existing gaps but also anticipates future needs, ensuring a continuous supply of qualified professionals who can thrive in an evolving industry landscape.

Understanding the state of the art in each state is fundamental, as it allows us to determine whether the demand for new professional figures is due to the absence of a specific course in that state, while in another state, there already exists a course that meets this need. This knowledge helps identify disparities in the availability and quality of training programs among different partner states. Additionally, it allows for the analysis of whether skill gaps in the workforce are caused by a lack of local training offerings or if there are other reasons, such as low student enrolment or interest. This way, targeted measures can be taken to develop new courses where needed, improve existing ones, and promote greater uniformity in training offerings across states. Understanding these dynamics is essential for devising effective strategies that can adequately respond to labour market needs and emerging sector challenges.

In the following chapters, an analysis of the state of the art at the regional level for each partner state of the project will be presented, as each partner has in-depth knowledge of the situation at the regional level.

2.1 Helsinki and Turku (Finland)

At TUAS the Maritime Industry modules consist of six modules and ship project. These cover the maritime industry environment and ship types, the implementation of a ship project in a shipyard from sale to warranty, and ship weight calculation, buoyancy and stability. The final course "Ship Project" covers the systematics of ship engineering, the different aspects of ship concept development, the ship design process and cost accounting, general ship arrangements, criteria for the selection of transport machinery and material related to the ship contract. The outcome of the design task will be the production of a ship concept and documentation for the chosen ship type. After completing the modules, the student will understand the international and networked nature of the maritime industry. He/she will have a basic knowledge of the network actors and the production processes, rules and regulations of the shipbuilding industry. They will also know the principles and uses of the most common types of vessels used in the offshore industry, be able to perform calculations related to ship weight, and stability, and understand the importance of stability and weight calculation for the safety of ships and floating structures. (https://opinto-opas.turkuamk.fi/21632/fi/21680/21683/1389/651)

At Turku Vocational Institute there are several fields of vocational upper secondary qualifications that are tied with maritime industries: Machine and production technology, Electrical engineering and automation technology and Building maintenance technology. This cover professional skills tied to the shipbuilding industry such as welding, mechanization and automation, electrical, heating, ventilation and air conditioning mechanics as well as plumbing. In addition to vocational education, Turku Vocational Institute also offers courses for in-service employees on its topics of expertise. Currently, our understanding is that the shortage of workers stems from disinterest towards the field. There are considerations for how to make the programs more appealing to possible students.
https://www.turkuai.fi/en/turku-vocational-institute/study-tai/vet-programs-tai

The Marine Technology major studies at Aalto university equips students with the expertise to confront the emerging technical and environmental challenges in marine and arctic regions. This major blend mechanical engineering foundations with specialized knowledge in marine systems, sustainable development and responsibility, and the latest technological innovations. Students gain hands-on experience through the utilization of cutting-edge research results in their projects related to marine technology, renewable energy, and resilience in system-level design for climate change. Under the guidance of renowned academic and industry experts, this major deepens technical proficiency and fosters a commitment to sustainable and ethical engineering solutions in marine environments. (Curriculum 2024–2026 | Aalto University)

Table 3 provides a clear and concise overview of the main courses offer in Turku, making it easy to understand who offers each course, the category of the provider, the duration of the course in terms of hours, the number of students and the EQF qualification level associated with each course.

Table 3: main courses offer in Helsinki and Turku (Finland)

Title of course	Provider	Provider Category	Hours	Number of people involved	EQF level
	Complementary Competence Studies 45 ECTS Bachelor's Thesis 15 ECTS				
Maritime transport and ship types	*Turku University of Applied Sciences*	*University*	***162 h*** *6 credit pts/ECTS*	*20*	*6*
Ship production	*Turku University of Applied Sciences*	*University*	*54 h 2 credit pts*	*20*	*6*
Ship buoyancy and stability	*Turku University of Applied Sciences*	*University*	*189 h 7 credit pts*	*20*	*6*
Ship's machinery and systems	*Turku University of Applied Sciences*	*University*	*135 h 5 credit pts*	*20*	*6*
Ship's resistance and power requirements	*Turku University of Applied Sciences*	*University*	*162 h 6 credit pts*	*20*	*6*
Ship's structures	*Turku University of Applied Sciences*	*University*	*108 h 4 credit pts*	*20*	*6*
Ship project	*Turku University of Applied Sciences*	*University*	*15 credit pts*	*20*	*6*
	Turku Vocational Studies				
Machine and production technology: sheet metal welder	*Turku Vocational Institute*	*VET*	*180 competence points*	*45*	*4*
Electrical engineering and automation technology: electrician	*Turku Vocational Institute*	*VET*	*180 competence points*	*100*	*4*
Building maintenance technology: plumber	*Turku Vocational Institute*	*VET*	*180 competence points*	60	4
Building maintenance technology: heating, ventilation and air conditioning mechanic	*Turku Vocational Institute*	*VET*	*180 competence points*	60	4
	Aalto University Marine Technology/Naval Architecture Studies:				

	Major studies 60 ETCS + Master's thesis 30 ETCS				
Principles of Naval Architecture	*Aalto University*	*University*	*135 h 5 credit pts*	*25*	*7*
Marine and Ship Systems Engineering	*Aalto University*	*University*	*135 h 5 credit pts*	*25*	*7*
Marine Hydrostatics	*Aalto University*	*University*	*135 h 5 credit pts*	*25*	*7*
Marine Hydrodynamics	*Aalto University*	*University*	*135 h 5 credit pts*	*25*	*7*
Ship Structures and Construction	*Aalto University*	*University*	*135 h 5 credit pts*	*25*	*7*
Ship Design Portfolio	*Aalto University*	*University*	*135 h 5 credit pts*	*25*	*7*
Marine Data Analysis	*Aalto University*	*University*	*135 h 5 credit pts*	*25*	*7*
Marine Risks and Safety	*Aalto University*	*University*	*135 h 5 credit pts*	*25*	*7*

2.2 Région Bretagne, Pays de la Loire et Sud PACA (France)

France has a training network implemented by multiple stakeholders. The maritime sector can rely on training programs of varying levels, lengths, and specializations. Training stakeholders, both private and public, are involved in initial and/or continuous professional training: the National Education system, universities, engineering schools, AFPA centers, UIMM (Union of Metallurgical Trades and Industries) training centers, etc. This sector is constantly evolving (new training programs, eliminations, content and name modifications). Thus, it is difficult to be exhaustive about the training programs and organizations available. This document presents the main ones.

The offer of continuous professional training depends, among other things, on regional or national public funding.

In higher education in France, there are various courses and institutions:

- High schools offering BTS (two-year technical degrees after high school),
- Universities developing Technological University Bachelor’s degrees (BUT) and professional licenses (three-year degrees) in University Institutes of Technology (IUT), as well as specialized Masters (five-year degrees),
- Schools: business schools, engineering schools (five-year degrees), and even doctorates (eight-year degrees).

Furthermore, the creation of training solutions (applications and content) for the continuous training of employees is developing, with companies specializing in this niche to address gaps in the educational system.

The main training programs targeting high-demand jobs in the shipbuilding sector have been identified (LEADERSHIP survey and CINAV survey). These training programs are not all specialized in "shipbuilding" or "maritime" but meet the sector’s need for expertise (electrician, mechanic, etc.). CINAV certifies training programs and provides them with a maritime focus (e-learning modules for learners, trainer seminars, etc.): CINav - Carte des formations. Learners thus benefit from a general knowledge base of the maritime environment: the goal is to attract them to the sector and improve their employability.

Several of the training programs listed below struggle to be implemented due to a lack of candidates; this is the case for professional training programs like welder, boilermaker, pipe fitter, as well as university programs such as BUT (Bachelor). These latter, more general training programs can lead to other sectors than shipbuilding and other professions. There is a lack of attractiveness for certain training programs and a lack of knowledge about the professions. Stakeholders like CINAV are working on this. There is also competition between industrial sectors that recruit (e.g., nuclear, aerospace, etc.).

In the survey of companies, the needs identified are both job-specific skills (welders, pipe fitters, shipbuilding mechanics and mechatronics specialists, ship electricians and electrotechnicians) at all levels (operators, technicians, and engineers).

Additionally, there are growing needs: expertise in digital engineering, cybersecurity, data science, and IT professions in general are highly sought after.

In summary in France:

- A substantial and diversified training offer with many stakeholders,
- A lack of attractiveness for certain training programs (and professions),
- A lack of knowledge about the sector and the diversity of its professions

Table 4 provides a schematic overview of the state of the art of courses (non-exhaustive list) in three regions in France (Brittany, Pays de La Loire, South PACA):

Table 4: The state of the art of courses in France

Title of course	Provider	Provider Category	Duration	EQF level
CQPM Intégrateur projeteur BTS Conception de produits industriels BTS Conception et Réalisation en chaudronnerie industrielle BTS CICN (Conception et industrialisation en construction navale) BUT Génie Mécanique et Productique (GMP) Licence pro CRCI Conception et Réalisation en chaudronnerie industrielle	*Pole formation UIMM Saint-Nazaire, Brest, La Roche sur Yon IUT Brest Lorient*	*Pole Formation UIMM, Education nationale, Universités*	*Long : BTS : 2 years BUT : 3 years Licence pro : 1 year*	*4 5 6*
CQPM Mécanicien naval CQPM Mécanicien réparation navale Titre Pro Technicien en maintenance industrielle		*VET (AFPA Poles formations UIMM)*	*Around 4/5 months*	*3 4*
MC mécatronique BTS Mécatronique navale BTS Fluides Energie Domotique, option froid et conditionnement Licence pro métiers de l'industrie	*Lycée Vauban, Brest Lycée Saint Joseph Lorient Lycée maritime de Nantes*	*Education nationale Université*		*4 5 6*
Formations ingénieurs	*ISEN Brest IMT Atlantique ENSTA Bretagne …*	*Ecoles d'ingénieurs*	*3 to 5 years*	*7*
BTS Electrotechnique BUT GEII Génie électrique et	*IUT Toulon UTLN (univ-tln.fr) IUT Brest*	*Education nationale Universités*	*2 à 3 ans*	*5 6*

informatique industrielle Licence professionnelle Métiers de l'électronique Licence professionnelle Maintenance et technologie Licence Pro EEA : Energie Electrique Automatique	*IUT Nantes*			
Bac Pro Métiers de l'Electricité et de ses Environnement Connectés MELEC BTS Electrotechnique CQPM monteur cableur en équipement électrique	*Lycée La Joliverie, Bouguenais Lycée La Croix-Rouge, Brest Lycée Saint-Joseph, Lorient*	*Education nationale VET*	*2 years*	*4 5*
Ecoles d'Ingénieurs	*ENSTA Brest ENSTA Bretagne | (ensta-bretagne.fr) ENSTA Paris Tech Ecole centrale de Nantes Sea Tech Toulon Ecole d'architecture de la Villette*	*Ecole d'ingénieurs*	*long*	*7*
master spécialisé management et gestion de projet Grandes écoles d'ingénieur		*IAE Ecoles de commerce Ecoles d'ingénieurs*		*6*
BTS CIEL Formations ingénieur Ingénieur diplômé de SeaTech: Systèmes numériques - UTLN (univ-tln.fr) École d'Ingénieurs ISEN Brest - École post bac Généraliste du Numérique (isen-brest.fr)	*Lycées Saint Joseph Lorient, Lycée La Croix Rouge Brest, ISEN SEA TECH ANSSAT Lannion*	*Eduction nationale, Ecoles d'ingénieurs*	*long*	*5 7*

EPITECH Marseille Polytech Nice		*Ecoles d'ingénieurs*	*long*	*7*
BUT GEII Génie électrique et informatique industrielle BUT GMP Genie mécanique et productique Licence pro MICN LP Métiers de l'industrie : industrie navale et maritime - UTLN (univ-tln.fr) Licence pro CRCI	*IUT Brest Morlaix, Lorient IUT Nantes et Saint Nazaire IUT Toulon*	*Iut, Universités*	*Bac +3*	*6*

2.3 Basque Country (Spain)

In the year 2000, the restructuring of the maritime sector at the European level led to the loss of critical mass and sectorial training. In the Basque Country, "La Naval," a former ship design and manufacturing company, operated its own training centre, which trained workers for the entire value chain and served as a driving force uniting the entire sector, facilitating skill acquisition. Additionally, this centre promoted the exchange and flow of workers between companies and increased the sector's visibility.

The closure of "La Naval" marked the end of its training centre and all associated activities. The maritime sector has internationally regulated and certified training, and in the Basque Country, there are specific training cycles at both Vocational Training and University levels. However, in the manufacturing industry, there are no sector-specific courses, and workers are trained directly within companies, placing the training burden on these companies.

Given the market's growth towards decarbonization and the emergence of new market niches (offshore wind, new fuels), the demand for workers is increasing annually, making it very challenging to attract and hire qualified labor. Currently, specific and technical knowledge is required, particularly for new skills that have not existed until now. The shortage of workers is attributed to both the lack of specialized new courses and the lack of interested students.

Training Offer of **Vocational Training** in the Basque Country:

- The training offer related to **maritime-fishing activities** can be consulted in this link (page 45):https://www.euskadi.eus/contenidos/informacion/lheskaintza/es_def/adjuntos/PorCiclosOsoa_2024_2025ab.pdf
    - Coastal Navigation and Fishing
    - Maintenance and Control of Machinery on Ships and Vessels
    - Underwater and Hyperbaric Operations

- Maritime Transport and Deep-Sea Fishing
- Aquaculture
- Organization and Maintenance of Machinery for Ships and Vessels

- The training offer related to **mechanical manufacturing activities (all sectors, not only maritime)** can be consulted in this link (pages 20-25): https://www.euskadi.eus/contenidos/informacion/lheskaintza/es_def/adjuntos/PorCiclosOsoa_2024_2025ab.pdf
  - Machining
  - Welding and Boilermaking
  - Planning and control in mechanical manufacturing
  - Welding in natural and protected atmosphere
  - Execution of machining, forming and special procedures in mechanical manufacturing
  - Preparation and programming of machine tools in mechanical manufacturing
  - Manufacture of pipes, constructions and metallic carpentry.
  - Production scheduling in mechanical manufacturing
  - Metallic constructions
  - Mechanical Manufacturing Design
  - Additive Manufacturing
  - Design of metal construction products
  - Programming and design of machining, forming and assembly processes.

Training Offer of **University Education** in the Basque Country:
Regarding university training, the different universities located in Euskadi offer the following training itineraries.

- **University of the Basque Country:**
  - Degree in Nautical: https://www.ehu.eus/es/web/graduak/grado-marina
  - Degree in Nautical and Maritime Transport: https://www.ehu.eus/es/web/graduak/grado-nautica-y-transporte-maritimo
  - Master in Nautical: https://www.ehu.eus/es/web/master/master-marina
  - Master in Nautical and Maritime Transport: https://www.ehu.eus/es/web/master/master-nautica-transporte-maritimo
  - Erasmus Mundus Master in Renewable Energy in the Marine Environment (REM PLUS): https://www.ehu.eus/es/web/master/master-energias-renovables-medio-marino

- **University of Deusto:**
  - Master's degree in Management of Maritime-port Companies and Maritime Law: https://www.deusto.es/es/inicio/estudia/estudios/master-universitario/derecho-maritimo

2.4 Møre and Romsdal County (Norway)

Møre and Romsdal Country in Norway is a highly export-oriented region and hosts a complete maritime cluster. The shipbuilding industry has a long and proud tradition in our region and several world-leading maritime companies are based here.

The regional education offers in Møre and Romsdal county is well-connected to our strong maritime industry. Today, both vocational and higher education providers offer relevant education of future and current workers in the shipbuilding industry – both blue- and white-collar workers. In table 5 reported insight about the regional education system and what kind of education that is available in Møre and Romsdal.

Overall, there is not a lack of relevant education offers in Møre and Romsdal County – especially not in IVET (Initial VET). However, continuing education and training offers could be improved to meet new skills needs. Updating existing curricula to labour market needs, both for initial and continuous education, will be important, especially considering the green and digital transition.
Attracting youth to a career in shipbuilding is ongoing challenge. We are also experiencing demographic changes that over the next few years will see significant decline in young people starting their education. As the current labour market is quite thigh, the fight for skilled workers is strong.

Hence, while the offer of specialized new courses could be improved, the recruitment of skilled workers interested in working in the industry is the main challenge.
It is also worth pointing out that higher education in Norway is run nationally, and many young people in Møre and Romsdal move out of the region to take higher education. An important task is then of course to encourage them to move back when they are finished with their studies.
Vocational education in Møre and Romsdal is part of the Norwegian education system.

- **Upper Secondary Vocational Education (EQF 3-4):** These programs typically last for four years and include a combination of school-based education (2 years) and apprenticeships (2 year). Students can choose specializations such as industrial technology, which covers shipbuilding and other related fields. The curriculum often involves significant hands-on training and practical experience in shipyards and other maritime settings.

  The apprenticeships are a critical component of Norway's vocational training system. These involve on-the-job training in shipyards and maritime companies, allowing students to gain practical experience while also studying theoretical aspects. Apprenticeships typically last two years and culminate in a trade certificate.

  Many of the 20 upper secondary schools in Møre and Romsdal county offers vocational programmes relevant for the ship building industry. Most relevant vocational programmes are:

Technology and Industrial Production	*Welder* *Industrial machinery mechanic* *Industrial plumber* *Industrial fitter* *Industrial painter* *Industrial carpenter* *Automation technician* *CNC operator* *Engine mechanic* *Sheet metal worker*
Electrical engineering and computer technology	*Maritime electrician* *Refrigeration and heat pump fitter* *Ventilation technician*

- **Tertiary Vocational Education** (**EQF 5**): These programs are available at post-secondary vocational colleges (Fagskoler) and provide advanced training beyond the upper secondary level. Courses in this category often focus on specific skills closed linked to labour market needs.

  Møre and Romsdal Higher Vocational College, based in Ålesund and Kristiansund, offers several tertiary vocational education courses. Most relevant programmes for the regional ship building industry are:

Study programme	Level	ECTS	Language
Automation	Higher professional degree - EQF 5	120	Norwegian
Mechanical engineering	Higher professional degree - EQF 5	120	Norwegian

There are three Higher Education Organsations in Møre and Romsdal County:

- Norwegian University of Science and Technology (NTNU) - Ålesund campus
- Molde University College (HiM)
- Volda University College (HVO)

The most relevant programmes are the following:

Study programme	HEI	Level	ECTS	Language	
Ship Design	NTNU	Bachelor (EQF 6)	180	Norwegian	
Maritime and onshore-based energy systems	NTNU	Bachelor (EQF 6)	180	Norwegian	
Mechatronics and Product Design	NTNU	Bachelor (EQF 6)	180	Norwegian	
Mechatronics and Automation	NTNU	Master (EQF 7)	120	English	Specialisation in either • Marine Systems • Robotics and Intelligent Systems

Energy Logistics Logistics	HiM	Master (EQF 7)	120	English	
Logistics	HiM	Master (EQF 7)	120	English	

2.5 Galati (Romania)

Romanian training stakeholders involved in initial and/or continuous professional training in shipbuilding field belong to the public National Educational system (universities, technological high schools for 4, 5, 6, 7, 8 EQF level) or private training centres (ship design companies, shipyards, marine companies- for 4, 5 EQF level).

Dunarea de Jos University of Galati undertakes the mission of generating and transferring knowledge to society through initial training and continuous training at university and post-graduate level, for the purpose of personal development, professional insertion of the individual and satisfying the need for competence of the socio-economic environment. The following courses are addressed to future specialists from naval field:

- Bachelor Naval Architecture/Naval Systems and Equipment: 4 years/2540 hours
- Master in Naval Architecture: 2 years/1432 hours
- Basics of shipbuilding technologies: 28 hours/theory; 28 hours/practice

Damen Shipyards Galati is a very big Company specialized in shipbuilding. For that purpose the Company has its own training center where the production specialist may achieve important knowledge necessary in their day by day production activity. The courses are addressed both to its own worker and to the external worker5s from others company active on the shipbuilding market.

- Foremen School: 1,5 years/1087 hours
- Qualification course: WELDER: 240 hours/theory; 480 hours/practice
- Qualification course: PIPE FITTER: 240 hours/theory; 480 hours/practice
- Qualification course: STEEL FITTER: 240 hours/theory; 480 hours/practice
- Qualification course: MECHANICAL: 240 hours/theory; 480 hours/practice

Radu Negru Technological High School Galati provide naval welder and naval pipeline fitter courses (https://radu-negru.ro/examene/profesionala/15-calendar-profesionala.html).

ICEPRONAV Engineering Romania SRL is a key member of International Contract Engineering (ICE) Group located in Galati, most of its activities being now in the offshore oil, gas and renewable energy fields, including preliminary design and FEED studies, basic design, detailed design. Training is a priority, and the company provide training and development to enhance own people's competencies (https://www.icedesign.info/careers/training/).

The Marine Technology studies (6, 7 and 8 EQF level) are offered by Mircea cel Batran Naval Academy Constanta (military field) and Constanta Maritime University (commercial field).

Mircea cel Batran Naval Academy provide courses for using of naval equipment and armament in combat and safe navigation and for using in combat of military naval electromechanical systems and logistics.
(https://www.anmb.ro/eng/files/pstudy/index.html , https://www.anmb.ro/eng/files/ccdhr/)

The mission of Constanta Maritime University is to:

- train future professionals for transport related activities and develop research activities in related scientific domains, by acknowledging competition as main progress factor and quality management as main means for a continuous development of the educational and research process;
- promote education and research in accordance with the requirements of a knowledge-based society, through education, continuous learning and integration in the circuit of universal values;
- bring a contribution to the local, regional and national development, through the involvement of academics at a social, economic and cultural level.
  https://cmu-edu.eu/en/naval-transport/ https://cmu-edu.eu/en/marine-engineering/

Romanian Maritime Training Center CERONAV Constanta and CERONAV Galati provide training courses for seafarers, river, port and offshore rig personnel.
(https://www.ceronav.ro/cursuri/cursuri-dp/dp.html, https://inscriere.ceronav.ro)

Table 5: The state of the art of courses in Galati (Romania)

Title of course	Provider	Provider Category	Hours	Number of people involved	EQF level
Bachelor Naval Architecture/Naval Systems and Equipment	*Dunarea de Jos University of Galati*	*University*	*2520*	*240*	*6*
Master in Naval Architecture	*Dunarea de Jos University of Galati*	*University*	*1432*	*50*	*7*
Basics of Shipbuilding Technologies	*Dunarea de Jos University of Galati/Department of Continuous Training and Technological Transfer*	University	56	10	5
Foremen School	*Professional Training Centre*	*Damen Academy*	*1087*	*15*	*5*
Qualification course: Welder	*Professional Training Centre*	*Damen Academy*	*720*	*15*	*3*
Qualification course: Pipe fitter	*Professional Training Centre*	*Damen Academy*	720	15	3
Qualification course: Steel fitter	*Professional Training Centre*	*Damen Academy*	720	15	3

Qualification course: Mechanical	*Professional Training Centre*	*Damen Academy*	720	15	3

2.6 Friuli Venezia Giulia and Liguria (Italy)

For decades, Italy has been renowned for its mastery in the timeless art of shipbuilding, a heritage deeply rooted in its rich maritime history and passion for the sea. Shipbuilding in Italy is a complex industry characterized by a high heterogeneity of products and technologies, and a labour organization primarily based on a pyramidal supply chain localized within industrial districts.

The largest and most active shipyards are located in three key areas due to historical reasons: Northeastern Italy (Adriatic Sea), Northwestern Italy (Ligurian Sea), and Southern Italy (Tyrrhenian Sea). This geographic distribution dates back to the unification of Italy in 1861, driven by the shipbuilding capabilities of the three kingdoms.

Italian shipyards are renowned for their craftsmanship and design expertise, excelling in the construction and outfitting of cruise ships, naval vessels, and a variety of elegant and innovative yachts and pleasure crafts, ranging from small boats to mega-yachts resembling large cruise ships. These units are characterized by high technological complexity and high added value.

The shipbuilding industry requires a wide range of knowledge and, crucially, the skills and competencies to integrate various cutting-edge technologies into a cohesive engineering system. These technologies are supplied to shipyards by specialized companies.

Shipbuilding education and training in Italy are geographically distributed and divided into theoretical and practical components, similar to most Southern European countries. At the core of this organization are dedicated public high schools (Istituti Nautici), which cater to young people aged 14-19. These schools primarily train merchant marine officers but also offer shipbuilding training programs (diploma "costruttore navale") and, more recently, programs in ship technical management and specialized areas such as plants and machinery.

Most high school graduates pursue careers in the shipping industry as merchant marine officers, while some continue their studies in vocational institutes or university BSc programs. A high school diploma is necessary to access university education, as is the case in many European countries.

Over the past twenty years, various institutions in Italy have created vocational institutes, many of which are public-private partnerships involving shipowners, the shipbuilding industry, and local public entities (regions, municipalities, etc.). These institutes often have the status of "Istituto Tecnico Superiore" (Higher Technical Institute, ITS Academy) and sometimes operate as consortia among stakeholders. The Ministry of Universities (MUR) implemented a recent reorganization through law no. 99 of July 15, 2022, to expand the professional training of technicians with high technological and professional technical skills. This new system aims to support economic development and competitiveness by addressing the mismatch between labour supply and demand.

ITS Academies offer courses to young people and adults (including those already employed) who hold a diploma of upper secondary education or a four-year education diploma. Their vocational training programs typically last at least 800 hours and culminate in a certificate of superior technical specialization. Courses can be biennial or triennial, divided into semesters like universities, and often include theoretical, practical, and laboratory activities. At least 60% of the training is provided by industry professionals, and business internships are mandatory for at least 35% of the course duration, with opportunities for internships abroad.

These institutions offer practical, career-oriented courses similar to the German Hochschule, focusing on hands-on experience and industry-relevant skills. While universities are research-oriented and offer various technical and scientific fields aimed at producing skilled professionals, vocational institutes provide education tailored to industry and business needs.

At the top of the education system are universities, which traditionally offered comprehensive programs in naval architecture and marine engineering (BSc + MSc) at the University of Genoa, the University of Trieste, and the University of Naples Federico II. These programs, originating before Italy's unification, remain active. In the 1990s, an additional course was created in La Spezia, dedicated to yachts and pleasure crafts, a sector in which Italy is a major manufacturer.

These courses train professionals in Naval Architecture and Marine Engineering, ensuring students have a solid foundation in scientific knowledge (mathematics, physics, chemistry, material technologies, etc.) and specific professional knowledge in naval architecture, shipbuilding, and ship plants. The programs also prepare students for technical and organizational roles, emphasizing the coordination of specialists to handle the complexity of modern high-value ships built in Italy and Europe. Internships in maritime sector companies are included.

Italian universities are connected with industrial stakeholders through consultation committees aimed at continuously updating and improving course offerings. Many former students of Italian universities are employed abroad in shipyards, design offices, research institutions, and classification societies, particularly in EU countries.

Specific teaching units in shipbuilding are available to university students, and professionals can enrol in these units without completing an entire BSc or MSc program. Universities also offer dedicated courses for specific industry needs, further enhancing continuous education opportunities for employed professionals.

The following table provides the main features of a few courses and references to their detailed descriptions. It is important to note that the list is not exhaustive, as vocational institutions continuously update and organize new courses according to industry needs. Additionally, the Italian university system is undergoing significant changes, with traditional courses in shipbuilding and ship design being improved and modernized to address specific industry challenges.

Table 6: The state of the art of courses in Friuli Venezia Giulia and Liguria (Italy)

Title of course	Provider	Provider Category	Hours	Number of people involved	EQF level
Tecnico della Logistica Marittimo-Portuale *https://accademianautica.it/tecnico-della-logistica/*	*Accademia Nautica dell'Adriatico*	*ITS Academy*	*1800 (2 years)*	*25 + 25*	*5*
Progettista Navale *https://accademianautica.it/progettista-navale/*	*Accademia Nautica dell'Adriatico*	*ITS Academy*	*1800 (2 years)*	25+25	*5*
Mastro Velaio - Sail Maker *https://accademianautica.it/mastro-velaio-sail-maker/*	*Accademia Nautica dell'Adriatico*	*ITS Academy*	*1800 (2 years)*	25+25	*5*
Tecnico delle architetture di rete e della cyber security *https://accademianautica.it/tecnico-cyber-security/*	*Accademia Nautica dell'Adriatico*	*ITS Academy*	*1800 (2 years)*	25+25	*5*
Ufficiale di macchina e di coperta *https://accademianautica.it/ufficiali-di-macchina-e-di-coperta/*	*Accademia Nautica dell'Adriatico*	*ITS Academy*	*36 months*	25+25+25	*6*
Tecnico superiore arredo navale, nautico e dell'hospitality *https://www.itsmalignani.it/settore-arredo-213*	*MITS - Nuove Tecnologie per il Made in Italy*	*ITS Academy*	*2000*	25+25	*5*
Bachelor's degree: Naval Architecture and Marine Engineering https://corsi.units.it/in04/descrizione-corso	*UNITS*	*University*	*180 CFU (3 years)*	-	*6*
Master's degree course: Naval Architecture and Marine Engineering https://corsi.units.it/in16/descrizione-corso	*UNITS*	*University*	*120 CFU (2 years)*	-	*7*
Bachelor's degree: Naval Architecture and Marine Engineering https://corsi.unige.it/en/corsi/8722	*UNIGE*	*University*	*180 CFU (3 years)*	-	*6*
Master's degree course: Naval Architecture and Marine Engineering https://corsi.unige.it/en/corsi/8738	*UNIGE*	*University*	*120 CFU (2 years)*	-	*7*
Bachelor's degree course: Pleasure Craft Engineering https://corsi.unige.it/en/corsi/8721	*UNIGE*	*University*	*180 CFU (3 years)*	100	*6*
Master's degree course: Yacht design https://corsi.unige, it/en/corsi/9268	*UNIGE*	*University*	*120 CFU (2 years)*	50	*7*
Bachelor's degree: Naval Architecture and Marine Engineering https://www.corsi.unina.it/D17/home	*UNINA*	*University*	*180 CFU (3 years)*	-	*6*
Master's degree course: Naval Architecture and Marine Engineering https://www.corsi.unina.it/D21/home	*UNINA*	*University*	*120 CFU (2 years)*	-	*7*
Assembler and installer of machines and plants	*Cisita*	*vocational institute*	*800 hours*	8	*5*

On-board electrician https://www.corsiturismo.it/corso-per-elettricisti-di-bordo/	*nell'ambito del Patto Formativo Locale "Un Mare di lavoro - Trasporti marittimi e Turismo", autorizzato e finanziato dal Ministero del Lavoro e dalla Regione Campania*		*500*	15	*5*
Mechanical designer	*Ente Nazionale Formazione Europea*		*600*	10	
Installer of naval and nautical air conditioning systems	*Regione liguria*		*200*	8	*5*
International Etiquette and Intercultural Communication	Cisita	vocational institute	*60 hours*	15	*5*
Project Management	Cisita	vocational institute	*60 hours*	15	*5*
Multipurpose operator for boating	*Sanlorenzo Academy*		*800 hours*	16	*5*
"Vessel chief"	*Fincantieri*		*800 hours*	17	*6*

3 Conclusion

The shipbuilding industry is at a critical juncture, where technological advancements and the push for sustainability are reshaping the landscape. The analysis of the industry's current and emerging skill needs, as revealed through our comprehensive survey, underscores the growing demand for cross-functional roles, particularly those involving project management, maintenance mechanics, and IT/cybersecurity expertise. These roles are essential to meet the challenges of Industry 5.0 and the ecological transition, which are driving significant changes in shipbuilding practices.

The findings indicate that while higher-level roles require specialized knowledge, there is an equally urgent need to address skill gaps at lower EQF levels. This includes technical roles like welders, pipeliners, draftsmen, boilermakers, and logistics experts. For these positions, modernizing training programs to incorporate new technologies and sustainable practices is imperative.

Moreover, the shift towards shorter, more focused training sessions, preferred by many companies, highlights the need for efficient, adaptable training models that can be delivered in smaller group settings. However, this trend also points to a potential gap in comprehensive training programs that address the broader, interdisciplinary skill sets required by the industry.
In conclusion, the shipbuilding industry must prioritize the development of versatile, forward-looking training programs that align with both current demands and future challenges. By fostering a skilled workforce capable of bridging traditional craftsmanship with modern technological and environmental requirements, the industry can secure its competitiveness and resilience in the face of ongoing transformations.