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An Overview of the Shipbuilding Labour Market: The LeaderSHIP EU Project

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Abstract. In recent years, the maritime technology and shipbuilding industry, including yachts and pleasure crafts as well as marine structures, have faced significant challenges, such as technological advancements, environmental sustainability, and global competitiveness. This article presents a comprehensive investigation conducted within the European project LeaderSHIP, focusing on the current state of training programs for workers in the sector and specifically identifying emerging and urgent skills necessary for future success. Using a mixed-methods approach, data were collected through surveys distributed to industry professionals, educational institution representatives, and companies. The results highlight a disparity between the skills demanded by employers and those provided by training programs. Notably, the investigation reveals critical gaps in essential areas such as sustainable design, technological innovation, and resource management, underscoring the need for immediate action. The analysis emphasizes the importance of continuous updating and a closer alignment between academia and industry. It suggests that collaboration between educational institutions and businesses could significantly enhance training quality. Implementing practical learning programs and internships, along with creating flexible curricula that can adapt to the sector's dynamic needs, is proposed as a vital strategy to address these gaps. Finally, the article discusses future perspectives for training in maritime technology, stressing the necessity to invest in advanced skills and foster a culture of innovation. This study provides valuable insights for policymakers, educators, and entrepreneurs, highlighting the critical need for an integrated approach to effectively tackle the challenges posed by emerging and urgent skills in the shipbuilding industry.

Keywords. Shipbuilding Labour Market, Technological Innovation, Skills Gap Analysis.

1. Introduction

The shipbuilding industry is undergoing a profound transformation [1], [2], [3], driven by technological advancements [4], [5], [6], [7], [8], [9], stricter environmental regulations, and the pressures of an evolving economic landscape. Once centered around manual labor and traditional craftsmanship, modern shipyards have become hubs of innovation, where technological expertise is as crucial as hands-on skills. The integration of automation, artificial intelligence (AI), and advanced digital systems has revolutionized the industry, demanding a workforce capable of operating and maintaining sophisticated machinery while also mastering traditional shipbuilding techniques. This evolution requires a new generation of shipbuilders who can bridge the gap between craftsmanship and cutting-edge technology.

Environmental sustainability is another critical driver of change in the sector. As global regulations tighten and the demand for eco-friendly practices grows, shipyards are adopting greener materials and energy-efficient processes to reduce their carbon footprint. Professionals with expertise in green technologies, environmental science, and sustainable engineering are increasingly sought after to help the industry meet international standards and create innovative, eco-conscious solutions. The ability to integrate sustainability into shipbuilding processes has become essential for remaining competitive.

To meet the evolving demands of the marine industry, the LeaderSHIP project is dedicated to developing tailored training programs that align with the sector's push for sustainable solutions through digitalization. The primary aim is to support the green transition by reducing the industry's carbon footprint and accelerating the adoption of renewable energy sources and alternative fuels. The project also highlights the integration of advanced digital tools in training, such as the use of digital twins in shipbuilding and the optimization of processes within shipyards. These training pilots are designed to address the specific needs of individual shipyards while also establishing standardized, European-level education accessible to all.

As an initial step, the LeaderSHIP project conducted a comprehensive survey among stakeholders across the European shipbuilding supply chain to gather insights and identify key priorities.

This initiative aimed to identify current and emerging skill gaps within the workforce. After filtering incomplete responses, 112 valid submissions were analyzed, offering insights into the industry's needs across different regions and company types. The geographical distribution of participants ensured a diverse representation, highlighting regional trends and discrepancies in skill requirements. While some countries, like Finland, Denmark, and Norway, were well-represented, others, such as Germany, had limited participation due to the lack of project partnerships in those regions. Despite non uniform geographical distribution, this wide-ranging input is invaluable for tailoring training programs to specific local needs. See Fig 1 for an overview of the geographical distribution of participants.

The analysis also segmented responses by company size and type, uncovering unique challenges faced by different stakeholders. Notably, 66% of responses came from small and medium-sized enterprises (SMEs), underscoring their critical role in the shipbuilding

industry (see Fig. 2). SMEs often encounter distinct challenges compared to larger corporations, making it essential to develop targeted training initiatives that address their specific needs. When responses from large companies were included, the dataset represented nearly 90% of the industry, offering a comprehensive view of skill gaps across the sector. By integrating the perspectives of both SMEs and larger enterprises, the findings provide a balanced and holistic understanding of the industry's requirements.

In summary, the shipbuilding industry stands at a crossroads, with technological innovation and sustainability shaping its future. By embracing these changes and fostering a versatile, well-trained workforce, the industry can navigate the challenges and seize the opportunities ahead. The insights gained from the questionnaire will form the foundation for educational and training programs designed to address skill deficiencies and anticipate future needs. These efforts will ensure that the workforce remains competitive, adaptable, and prepared to meet the demands of a rapidly changing world. Through this proactive approach, the European shipbuilding sector can strengthen its position as a global leader in innovation and sustainability.

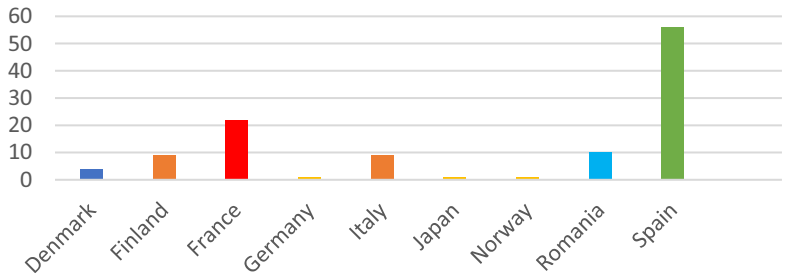

Fig. 1: Geographical distribution of responses

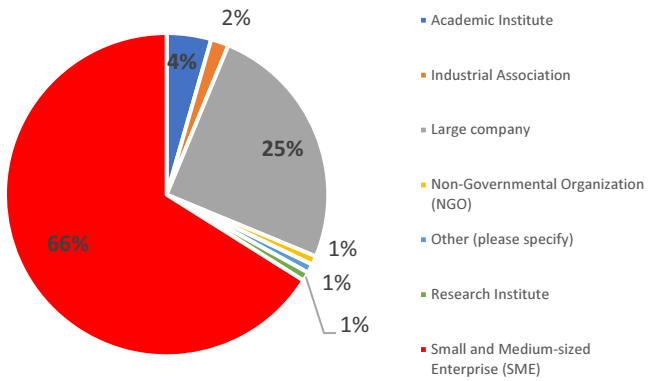

Fig.2: Company base distribution

2. Analysis of replies to questionnaire

To The LeaderSHIP project [10] (Learning European Alliance for Digital, Environmental, and Resilient Shipbuilding) is an initiative aimed at advancing

digitalization, environmental sustainability, and resilience within the European shipbuilding industry. A central component of the project is the development of a sectoral skills intelligence framework, supported by a robust methodology and a digital tool designed for the continuous collection and analysis of industry skill needs.
The survey instrument, consisting of 69 questions (both open-ended and closed), was carefully crafted to capture input from both academia and industry, ensuring its relevance to each sector. A unique survey link was distributed to a broad range of stakeholders using a voluntary response method, with outreach facilitated through project partner networks across European shipbuilding regions, resulting in 160 responses that provided crucial insights into urgent and emerging professional skills gaps. The participant pool was not stratified, but efforts were made to ensure sectoral diversity across company sizes and geographical areas. Of the 160 responses collected, 112 were deemed complete and valid for analysis. To enhance the reliability of the survey instrument, it was reviewed by subject matter experts in maritime training and piloted among a small sample of stakeholders before full deployment. This preliminary feedback was used to refine question clarity and improve the logical flow.
The ultimate aim is to utilize these findings to design pilot courses that address the identified needs, fostering a dynamic and comprehensive approach to skills intelligence that integrates both historical and ongoing project insights.
The project employs a cutting-edge digital model, developed using Deusto's Qualtrics platform, which optimizes data collection, filtering, and visualization processes. This tool significantly enhances stakeholder engagement by simplifying the navigation and interpretation of industry trends. In turn, it facilitates informed decision-making and promotes the development of a skilled, competitive workforce in the European shipbuilding sector.
The analysis placed particular emphasis on the qualitative insights derived from the open-ended questions. This focused approach enabled the efficient extraction of the most pertinent information regarding skill gaps and training needs. Below, we provide an analysis of two particularly significant questions, highlighting key findings and implications for future training initiatives.

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

Question Q61 identifies key skill gaps in the shipbuilding labour market, reflecting the sector's evolving technological and operational demands. The findings emphasize the critical need for specialized skills to meet current and future industry requirements. To address these gaps, targeted training programs focused on upskilling and reskilling the workforce can quickly equip employees with essential competencies, enhancing their employability and supporting industry needs.

Additionally, collaboration between industry and educational institutions is crucial. By developing comprehensive curricula aligned with industry standards and emerging trends, these partnerships can ensure a continuous supply of well-trained professionals capable of meeting the complex challenges of the shipbuilding sector. Table 1 show the replies distribution.

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
Fishing	1
Drawing interpretation and production	1
Collaboration	1

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

Question Q29 highlights specific job positions that are difficult to fill, with Naval Architects emerging as a critical role in high demand. These professionals are essential for designing and supervising ship construction, requiring advanced technical expertise obtained through extensive university education (180–300 credits). The long training period presents a challenge, making this role less suited for short-term training initiatives. Instead, addressing this need requires a combination of immediate skill-building efforts and long-term educational strategies.

A similar challenge exists for Electric Marine Engineers, another vital role in the industry emerged more recently. For this project, a more feasible approach could involve adapting ("navalizing") traditional Electrical Engineers or integrating ("electrifying") Naval Architects. These strategies could bridge skill gaps more effectively within shorter timeframes, aligning with the project's goals. Table 2 shows the response.

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
Operation Technology 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

3. Conclusion

The survey analysis reveals a growing demand for cross-functional roles in the shipbuilding industry, including project managers, maintenance mechanics, and IT/cybersecurity specialists. These positions are becoming more crucial as industry evolves with technological advancements and the push for ecological transition and Industry 5.0. Project managers are increasingly needed to coordinate complex ship projects, ensuring timely and efficient delivery. Maintenance mechanics, vital for the operational longevity of vessels, must adapt to handle sophisticated technologies in modern ships. Additionally, IT and cybersecurity specialists are essential due to the rise in digital systems used for navigation and operations, making the protection of these systems critical.

The need for diverse skills also extends to lower-level roles. The ecological transition and Industry 5.0 advancements demand that training programs for technical roles, such as welders, pipeliners, draftsmen, boilermakers, and logistics experts, be redesigned to incorporate new technologies and practices. Welders need to master advanced techniques like laser and robotic welding, while pipeliners must be trained on new materials and greener technologies. Draftsmen must become proficient in advanced CAD and 3D modeling software, and boilermakers must update their skills in sustainable energy

systems and advanced thermal management. Logistics experts must also adapt to modern digital tools like inventory management systems, predictive analytics, and blockchain to optimize supply chains and operational efficiency.

In summary, the evolving demands of the shipbuilding industry call for a versatile workforce skilled in both traditional shipbuilding techniques and emerging technologies. Training programs must be updated to meet these needs, ensuring that professionals at all levels are equipped to handle the complexities of the modern industry.

To translate these findings into actionable outcomes, training institutions should prioritize the development of modular, flexible learning pathways that integrate digital skills, green technologies, and interdisciplinary approaches. Governments and EU bodies can support this effort by aligning funding programs, such as Erasmus+ or the European Social Fund, with targeted upskilling strategies that reflect sectoral needs. Furthermore, the insights from the LeaderSHIP project can feed into the European Skills Agenda and inform policies under the Pact for Skills, guiding coordinated efforts across industry and education to build resilience and innovation capacity in the maritime workforce.

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