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WORKSHOP THEME: Green technologies in the shipbuilding and ship-repair industry

DATE: 19th of December 2018, 13:30 – 18:30

VENUE: Premises of the Thessaloniki Chamber of Small & Medium Industries - Thessaloniki, Greece

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GENERAL DESCRIPTION OF THE WORKSHOP:

Objectives

- To inform relevant stakeholders about the scope, objectives and planned activities of the MATES project
- To present and further discuss the characteristics and current situation of the shipbuilding and ship repair industry in Greece, addressing also latest developments and emphasizing more on emission reduction technologies and zero emission solutions (e.g. alternative fuels, electrification, etc.)
- To present and further discuss / validate the project's interim results with regard to current and future skills gaps in the targeted sectors
- To discuss targeted actions that may be deployed for improving the attractiveness of the targeted sectors (e.g. to young people by promoting ocean literacy).
- To identify and prioritize, through a questionnaire survey, new trends in the targeted sectors likely to be imposing a significant impact in the near or more distant future

Target Audience

Directors and managers of companies actively involved in the shipbuilding and ship-repairing industry and the broader maritime sector were the main target audience of the workshop along with managers and researchers of maritime clusters and technology centers, academics, trainers and educators.

Programme

Agenda	
13:30 – 14:30	Reception and registration, Buffet lunch Welcome words <ul style="list-style-type: none"> ▪ CERTH - HIT ▪ Thessaloniki Chamber of small & medium industries ▪ EXANTAS Institute of port training
14:30 – 15:00	Overview of the MATES project and purpose of the Workshop - Prof. Maria Boile
15:00 – 16:30	Session I - Shipbuilding, new trends and the role of green technologies Short Presentations by partners of the project MATES and invited Experts <ul style="list-style-type: none"> ▪ New technologies in the European shipbuilding industry - Cosmas Cosmidis, COSNAV Engineering ▪ Green technologies in the shipbuilding industry - Apostolos Dasios, Spanopoulos group shipyards ▪ The Role of Merchant Shipping and the marine equipment industry in the World Economy - Babis Marmagelos, Olympia Electronics ▪ The possibility of creating a high-tech ship repair zone at the port of Thessaloniki - Vassilis Kechagias, SuperAlloys Engineering

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Roundtable discussion I - Hierarchy of new trends in shipbuilding industry and Delphi questionnaire

16:30 – 16:45 Coffee Break

16:45 – 18:15 Session II - Education and training requirements

- Briefing of the baseline analysis and findings - George Tsafonias, CERTH-HIT

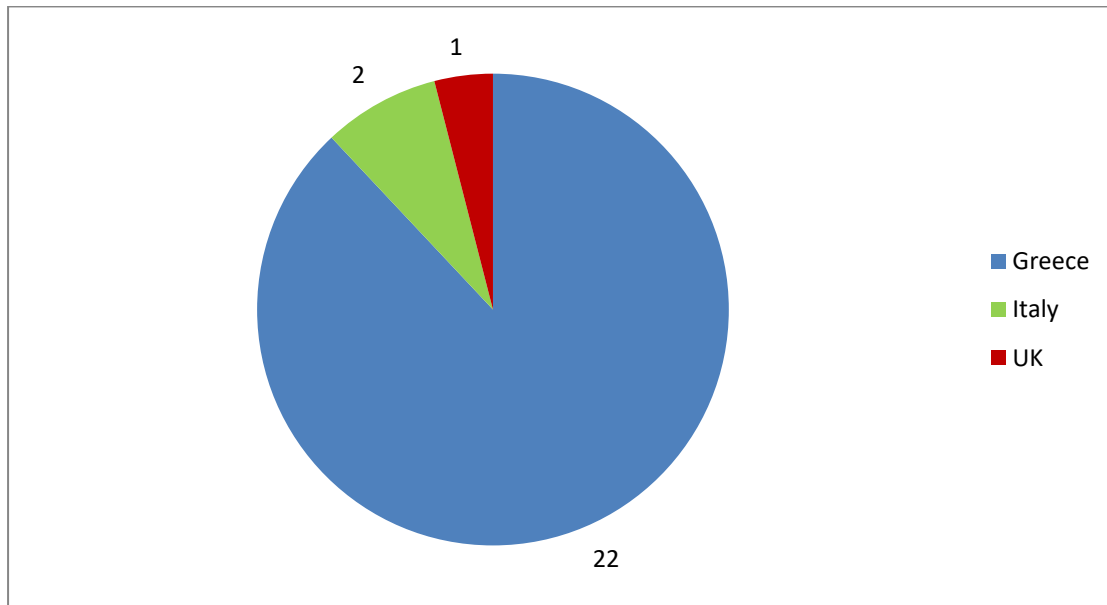
Roundtable Discussion II - Required skills, shortages, the role of vocational training and industry

18:15 – 18:30 Conclusions – End of meeting

Attendance

In total, 25 stakeholders attended the workshop including 3 hosts of CERTH/HIT (84% were males and 16% were females). Expert partners from Italy and UK were also invited to support the relevant discussions.

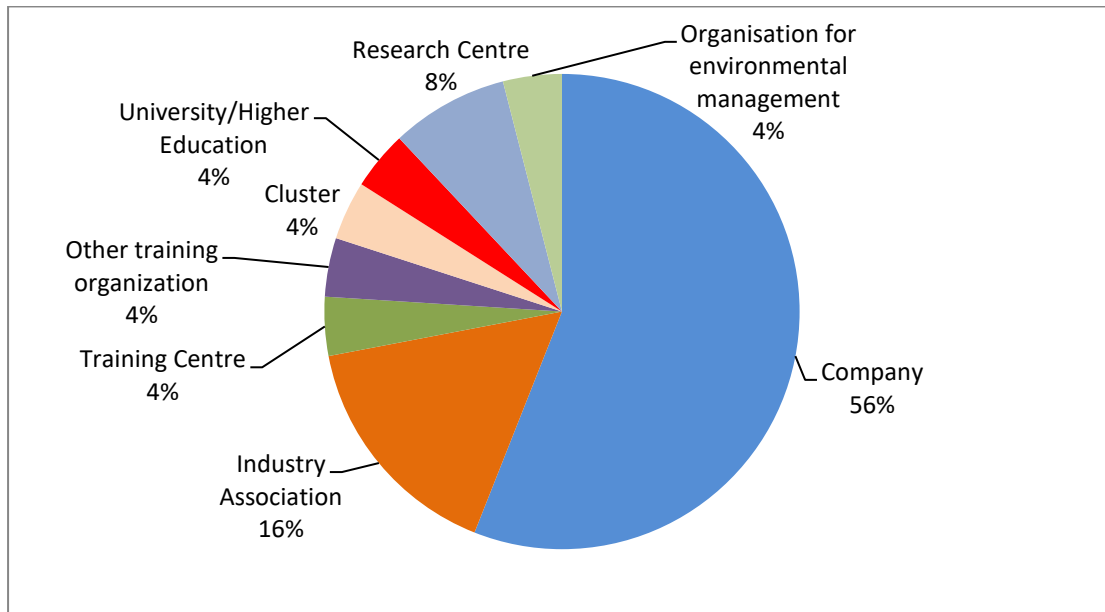
Figure 1: Country of professional activity of workshop participants



Industry representatives accounted for the majority of workshop participants but all other relevant sectors (i.e. academia, training providers, research centers) were also represented ensuring in that way that all different perspectives are expressed and discussed in a multidisciplinary manner (Figure 2).

Figure 2: Type of organizations represented in the workshop

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SUMMARY OF THE WORKSHOP:

The meeting started with Prof. Maria Boile (CERTH-HIT) welcoming the attendees and briefly describing the main scope of the meeting and the anticipated outcomes. She set the relevant framework, indicated the issues that would be discussed and stressed out the need to thoroughly understand the real needs of the industry in the Mediterranean region but also across Europe. A round of introductions followed, with the representatives of the Thessaloniki Chamber of Small and Medium Sized Industries (VETH) and the EXANTAS Training Institute highlighting the importance of the workshop, pointing out the unexploited potential that exists for the development of high-tech ship repair activities in the region and the importance of setting appropriate strategies / actions for increasing the sector's attractiveness. Furthermore, the need to establish efficient communication channels between education and training institutions and the business community of the region was also pointed out, enabling as a result to develop proper training programs that can supply the market with well trained and specialized workers.

The introductory part of the workshop was concluded with Prof. Maria Boile briefly presenting the MATES research project:

Presentation 1 – Overview of the MATES project - Prof. Maria Boile, CERTH-HIT

The presentation began with an overview of the MATES project and the ERASMUS+ programme and the 'Sector Skills Alliances' call that MATES addressed. The participants were introduced to the overall aim and specific objectives of the project, the consortium, the structure of the technical activities (Work Packages), thus got an overview of the expected outcomes, the progress achieved so far and the upcoming activities.

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The two technical sessions then followed:

Session I - Shipbuilding, new trends and the role of green technologies

The session presentations were of high scientific and technical interest. They outlined the current situation in the shipbuilding and ship repair industry and analyzed the current skills gaps of the relevant workforce.

Presentation 2 - New technologies in the European shipbuilding industry – Mr. Cosmas Cosmidis, COSNAV Engineering

Mr. Cosmidis referred in his presentation to two important issues that are currently in the agenda of regulatory bodies regarding international shipping, and will be impacting the shipbuilding sector as well. These are pollution and safety. Pollutant emissions from shipping are important. Research has shown that CO₂ emissions from shipping represent 2-3% of global emissions while NO_x and SO_x account for 17% and 13% respectively. If nothing changes, CO₂ emissions are expected to increase by 50% in the next decades. Therefore, the contribution of the maritime industry towards reversing this trend and supporting the sustainable development of the blue economy is important. The latter is constantly enriched with new activities such as offshore renewables, but there is a direct and important connection with traditional sectors such as shipbuilding.

The foreseeable long-term development of the cruise industry and the production of energy from offshore renewable sources will also affect the shipbuilding sector. The projection in 2013 showed an increase of \$130 billion in gross value added, mainly due to the construction of a large number of high value added vessels (e.g. cruise vessels). Shipbuilding is known for using heavy chemicals and generating a high environmental impact. Therefore, a model of green sustainable shipbuilding industry should be adopted to minimize air and water pollution, impact on humans while saving resources and maximizing economic and social benefits. Such a model will aim to minimize the environmental impact during the design, construction and dismantling phases of a ship in order to reduce pollution. Some key technologies supporting the development of 'green' ships include:

- Improving the propellers' flow, resulting in 2-8% improved efficiency
- Better design using various mathematical models
- Use of new and lighter materials for constructing the hull and equipment (e.g. aluminum)
- Lubrication of the hull with a system that produces a layer of air bubbles resulting in a 5-10% reduction in fuel consumption
- New paints that reduce vessels' friction, results in a 3-10% reduction in fuel consumption
- Optimum ship trim reduces fuel consumption by 5%

The main technologies that are being currently implemented or investigated for reducing air emissions from shipping include:

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- Use of alternative fuels for propulsion (mainly LNG). This requires the development of cryogenic technology and the installation of the appropriate equipment on board the vessels as well as the development of supply networks
- Installation of exhaust gas cleaning systems (scrubbers)
- Use of renewable energy sources systems on board
- Use of on-shore power systems (cold ironing) during vessel berthing
- Installation of dual fuel engines
- Use of underwater robots for cleaning the hull in shorter time periods, thus improving the consumption of the ship

Other technologies that can contribute towards minimizing current environmental impacts and maximizing efficiency include:

- Ecological methods for dismantling. The global trend is towards green scrap yards
- Management system for the sewage discharges produced by ships
- Reduction of shipborne noise emissions
- Ballast water treatment
- Some north European countries also promote the development of autonomous vessels

A *green shipyard* must ensure the high performance of the materials used and cater for a reasonable use of resources during construction and maintenance, while also reducing at the same time all harmful emissions.

Generally, the benefits of sustainable development of the blue economy will be multiple considering that:

- The gross added value of sea transport will reach \$118 billion by 2030 and employment is expected to increase from 1.2 to 1.5 million workers
- The added value of port activities will reach \$373 billion and port workers will increase to 4.2 million from today's 1.7.
- The cruise industry will reach a gross added value of \$777 billion by 2030 from \$390 billion, and the employees will approximate 8.5 million. This is good news for the European shipbuilding sector although the Chinese are trying to expand in the cruise market as well
- The shipbuilding industry will have a gross added value of \$103 billion with 2.3 million workers
- Offshore R.E. will have \$230 billion added value with 435.000 employees.

Presentation 3 – Green technologies in the shipbuilding and ship-repair industry - Mr. Apostolos Datsios, Spanopoulos Group Shipyards

The SPANOPOULOS Group of Companies was founded 50 years ago with the aim of becoming a leader in the shipping industry. Since its inception, the Group has developed significant capabilities in the docking, shipbuilding, repair and retrofitting services. According to Mr. Datsios, the main green technologies and procedures that are currently being used in shipbuilding include the following:

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- Management of all produced waste in the production areas (shipbuilding, machine shop, carpentry and maintenance department etc.) as well as waste generated by office activities.
- Management of all lubricants and oils produced during plant operation.
- Concentration and management of all waste metal generated by the operation of the installation in a designated area.
- Management all scrapped electronic equipment in suitable bins.
- Water consumption monitoring
- Use of desalination machines
- Monitoring of electricity consumption
- Use of low-power consumption machines (e.g. led lighting, etc.)
- Use of cold-ironing systems and forcing the docked vessels (of both the Group and the customers) to have their engines switched off.
- Controlling the operation of heating and cooling systems by minimizing emissions to the environment
- Use of heat-insulating and sound-insulating materials
- Use of certified ecological colors
- Avoiding solvent during dyeing
- Minimize controlled closed sandblasting using Vacuum
- Exclusive use of power-driven instead of diesel water blasting and welding machines
- Monitoring and noise measurements at installation boundaries
- Monitoring and environmental measurements of particulate matter

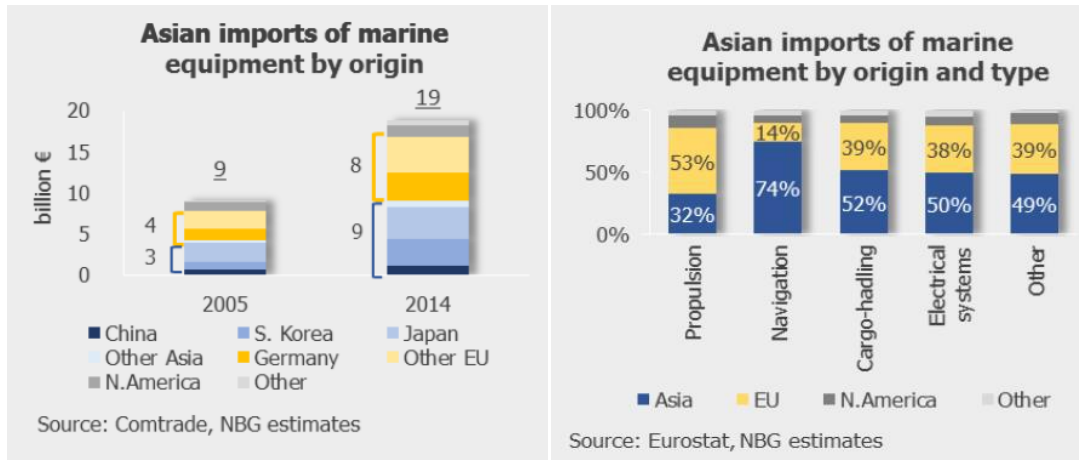
Presentation 4 - The role of merchant shipping and the marine equipment industry in world economy - Mr. Babis Marmagelos, Olympia Electronics

At first, the overview of the world's shipbuilding industry was presented by Mr. Marmagelos. The European shipbuilding industry does not account at the moment for the building of commercial vessels like bulk carriers and tankers, mainly due to the fierce competition it is facing from the Asian market where labor costs and steel prices are significantly lower. For retaining their competitiveness, European shipyards concentrated on the construction of high value vessels such as cruise ships, mega yachts, navy vessels and offshore structures. For illustrating the difference between the two, it is worth noting that the average value of these vessels is \$2.000 per ton whereas for cargo carrying vessels such as bulk carriers, tankers and containerships it is approximately \$500 per ton. Currently, the number of vessels produced per year is lower but at the same time capacity has significantly increased.

The second part of Mr. Marmagelos' presentation focused on the industry of marine equipment. As indicated in Figure 3 below, Asia spent around €19 billion in 2014 for importing marine equipment, of which approximately 50% was provided by the European market.

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Figure 3: Asian imports of marine equipment



The Greek market is being supported by HEMEXPO, a marine equipment cluster which consists of 25 of the largest companies in Greece, promoting the cooperation between shipowners and shipyards. The member-companies design and produce innovative high-quality products related to environmental protection, electrical and electronic equipment, shipboard systems, water treatment and furniture for interior and public spaces. These products together with technical services are intended for the building, conversion and maintenance of ships and maritime structures.

Presentation 5 - The possibility of creating a high-tech ship repair zone at the port of Thessaloniki – Mr. Vassilis Kechagias, Superalloys Engineering

The presentation of Mr. Kechagias concerned a study that was undertaken for supporting the development of a high tech ship repair zone in the port of Thessaloniki as a means to attract larger vessels and increase operations at the container terminal. For meeting this goal, vessels should be served directly and appropriate technological competences should exist for addressing the need of a maintenance emergency or for repairs and retrofits. According to the results of the study, the existence of a ship repair zone in the area will also serve as a pole of attraction for investment firms, thus will support organizations involved in research and development projects related to shipbuilding as well as in the development and promotion of new and innovative technologies.

Roundtable discussion I - Hierarchy of new trends in shipbuilding industry and Delphi questionnaire

The first part of the questionnaire survey aimed at identifying the new emerging technological trends in the shipbuilding sector and their influence on the industry's development. The second part examined the level of difficulty in employing the appropriate workforce with the required skills and qualifications and the educational and skills gaps that constraint the sector's further development. The data sample includes 20 participants, while the included parameters are mainly rated with ordinal scales and occasionally with written statements of the workshop participants.

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New and emerging technological trends in the shipbuilding sector

According to experts, the identified technological trends (Table 1) are expected to impose a significant impact on the development of the shipbuilding sector, with their rating ranging from 3.5 to 4.47 (1= low impact, 5=high impact). The trends with the greatest impact on the sector (average score \geq 4.0) are expected to be *Alternative fuels*, *Automation & Robotics* and *Ballast Water Treatment* following a descending order. Figure 4 provides a more detailed overview of the experts' responses.

Table 1: Level of importance and influence of the identified new and emerging technological trends in shipbuilding industry.

Technological Trend	Missing values	Mean	Std. Deviation
Alternative Fuels	1	4,47	0,697
Autonomous Vessels	1	3,68	1,003
Ballast Water Treatment	1	4,00	0,882
Automation & Robotics	0	4,45	0,686
Drones for Inspections	2	3,83	1,043
Augmented Reality	2	3,56	0,616
Virtual Reality	2	3,50	1,043
3D Printing	0	3,95	0,999

Source: CERTH/HIT elaboration on data retrieved from questionnaire survey.

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Figure 4: Heat map of new and emerging technological trends in shipbuilding sector (% of responses)



Source: CERTH/HIT elaboration on data retrieved from questionnaire survey

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During the survey, the experts also recommended additional technological trends that they believe will have an impact on the sector's development, in both the medium- and long-term, responding to the relevant question included in the survey. Their recommendations, which mainly fall under the categories of digitalization and green technologies, were the following:

- *Digitalization apps*
- *Energy storage systems*
- *Green ship dismantling / Green technologies in ship recycling*
- *New materials for shipbuilding systems.*

Session II - Education and training requirements

Presentation 6 - Briefing of the baseline analysis and findings - Mr. George Tsafonias, CERTH-HIT

Mr. Tsafonias presented the progress and interim results of the baseline analysis that has been conducted within the framework of the MATES project thus outlined the next actions to be undertaken and the specific objectives to be achieved. The workshop participants had the opportunity to review and comment on the extensive work that has been undertaken for mapping relevant education and training programmes currently offered at different institutions across Europe, as well as on the present and future skills needs that have been identified which will provide the basis for providing targeted suggestions for properly reforming the existing educational and training programmes so that the relevant market can be supplied with highly qualified and well-trained personnel meeting the challenges of the new business environment. More specifically:

- 60 occupational profiles have been identified in the shipbuilding sector, 35 of which correspond to core occupations and 25 to occupations providing supporting services.
- 69 occupational profiles have been identified in the offshore renewable energy sector, 23 of which correspond to core occupations and 46 to occupations providing supporting services.
- The process of mapping existing educational and training offers in Europe is still ongoing for both sectors. Data have already been collected for 10 countries (i.e. United Kingdom, Greece, Portugal, Germany, Spain, Cyprus, Belgium, Bulgaria, Denmark and France).
- Educational gaps identified in both sectors confirm mismatches between the industry needs and the educational curricula. Vocational education graduates prove not to be ready to work and often require on-the-job training. Soft skills are found to be provided only by on-demand short term programs.

Roundtable Discussion II - Required skills, shortages, the role of vocational training and industry

During the second session of discussion, the participants were asked to respond to the second part of the survey, which addressed the level of difficulty in employing the appropriate workforce with the required skills and qualifications and the educational and skills gaps that

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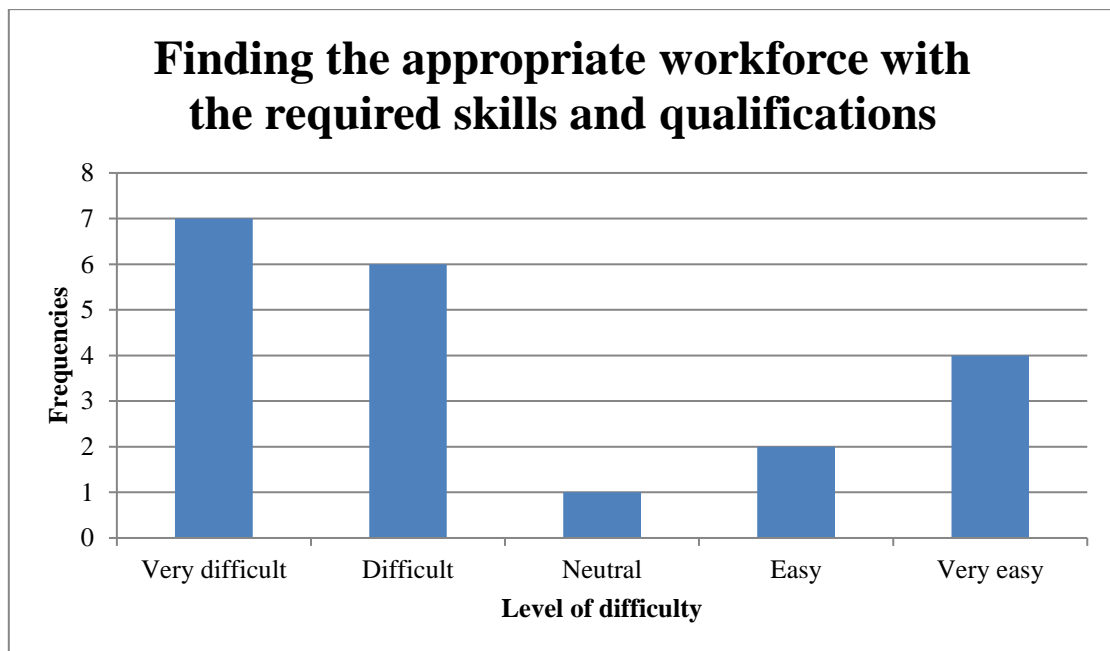
currently constraint the sector’s further development. The relevant results are being reported below.

Current and future occupational profiles

With regard to current and future occupational profiles, besides the above, the survey also focused on identifying new occupational profiles or specializations that the experts expect to emerge in the near future as a result of technological advances and the overall growth of the shipbuilding sector.

On the first point, the vast majority of the experts (7 out of 20 participants) stated that this is still very difficult although the average score of all responses (2.50) indicates a tendency to be considered as just difficult (Figure 5).

Figure 5: Experts’ responses with regard to the difficulty in finding the appropriate workforce with the required skills and qualifications



Source: CERTH/HIT elaboration on data retrieved from questionnaire survey.

On the second point, the participants indicated that due to the expected further development of the shipbuilding sector in the near future, new occupational profiles are likely to emerge such as *Material Engineers*, while they also highlighted current shortages and future demand for *Designers*, *Design drafters with specialization in electronic design*, *Welders* and *Marine upholsterers*.

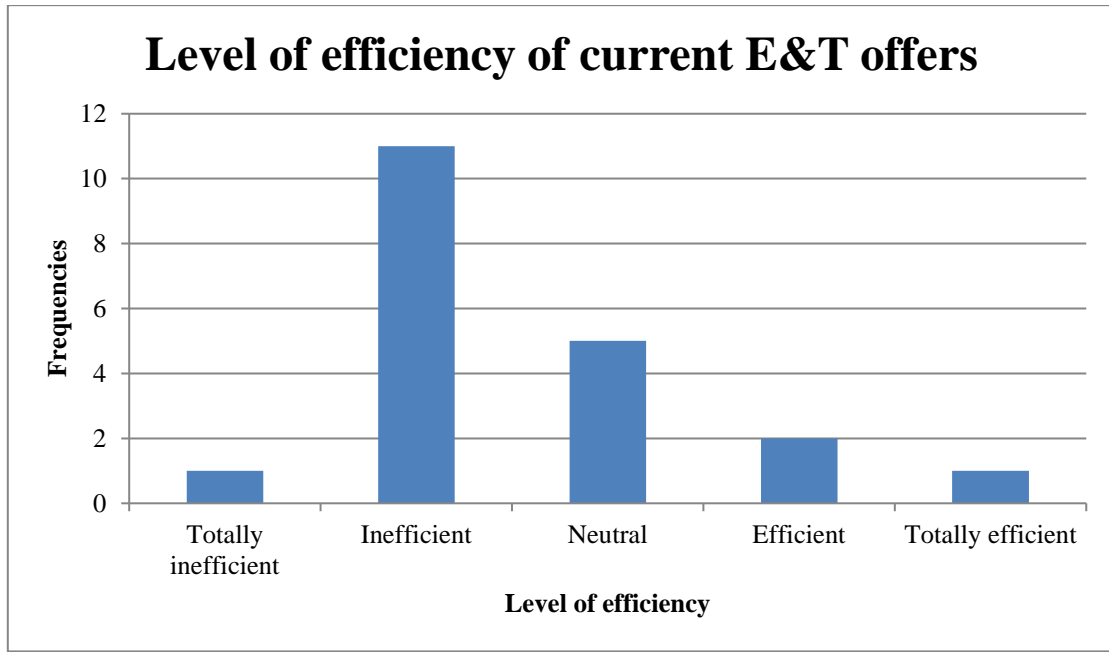
Educational Gaps

With regard to educational gaps, the level of efficacy of relevant current educational and training offers as well as of alternative E&T methods was investigated, enabling to provide at a later stage restructuring recommendations for addressing industry needs. The vast majority

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of survey responders (11 out of 20) characterized current educational and training offers as inefficient for providing the required skills and qualifications (Figure 6).

Figure 6: Experts’ responses with regard to the efficiency of current education and training offers

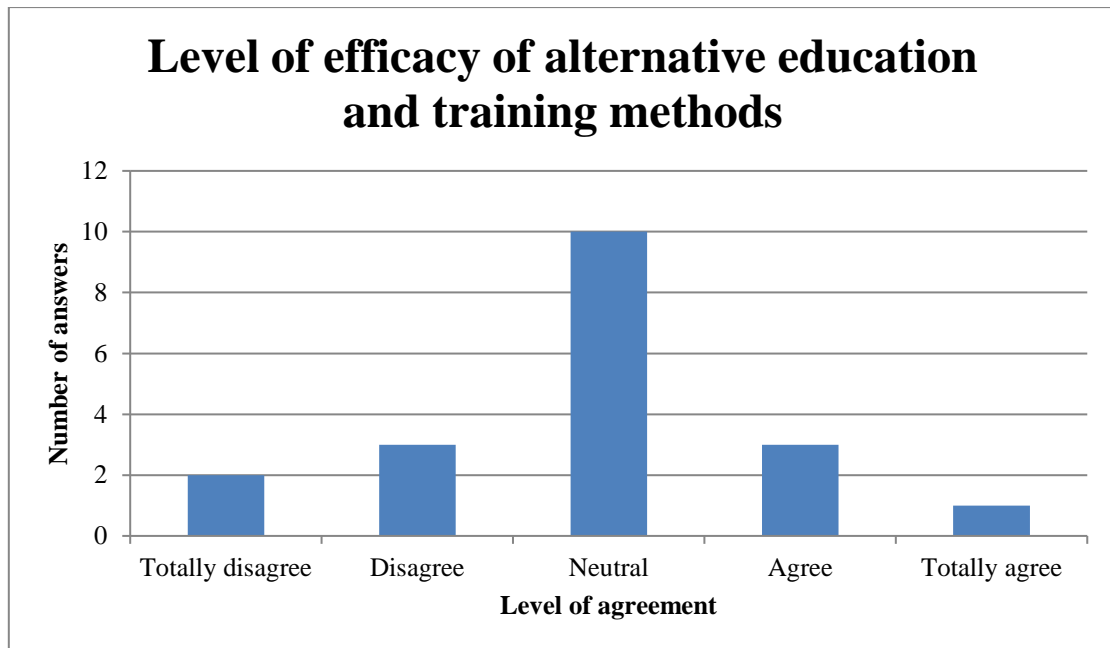


Source: CERTH/HIT elaboration on data retrieved from questionnaire survey.

In addition, the experts were asked to state whether there are alternative education and training methods (e.g. e-learning) that provide the required skills and qualifications more efficiently. The majority of them (10 out of 20 participants) expressed a neutral opinion while if the average is taken into consideration there seems to be a tendency into disagreeing (Figure 7).

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Figure 7: Experts' responses with regard to the level of efficacy of alternative E&T methods in providing the required skills and qualifications.



Source: CERTH/HIT elaboration on data retrieved from questionnaire survey.

Furthermore, during this section of the survey, the experts recommended the E&T methods that they consider to be the most efficient in providing skills and qualifications required in the shipbuilding sector. They recommended mainly E&T methods that support blue collar occupational profiles and are driven by the industry needs. More specifically, their recommendations included the following:

- Programs with emphasis on technical skills
- Technical schools
- On-the-job training
- Training by the industry, supported by government funding
- Training on current facilities
- Training programs, structured in collaboration with industries
- Training Simulation Delivery
- Traineeships, Internships
- Virtual E&T programs
- Vocational Training Certifications

Skills gaps

Last but not least, the survey attempted to investigate the current gaps on different skills in the shipbuilding sector (1=no gap, 5=very big gap). Overall, small gaps were found to exist. As indicated in Table 2, the most important ones address *specific technical skills (welding, assembly, etc.)* highlighting shortages in qualified blue collar workforce. The experts also mentioned additional skills gaps not included in the current survey related mainly to *Material*

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engineering, Reliability management, Mechanical technical skills and Ocean Literacy. Figure 8 provides a more detailed overview of the experts' responses.

Table 2: Current skills gaps in the shipbuilding sector

Disciplinary	Missing values	Mean	Std. Deviation
Specific technical skills (welding, assembly, etc.)	1	3,63	1,116
Engineering Skills	2	3,00	1,138
Mechatronics Skills	2	3,28	1,179
Health & Safety Skills	1	3,37	1,116
Machine Handling and Operating Skills	3	3,06	0,966
Foreign Languages Skills	2	3,06	0,802
Interdisciplinarity Skills	3	3,29	1,047
ICT Skills	3	3,35	0,996
Soft Skills (leadership, teamwork, etc.)	2	3,22	1,353

Source: CERTH/HIT elaboration on data retrieved from questionnaire survey.

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Figure 8: Heat map of the current skills gaps in the shipbuilding sector in (% of responses)



Source: CERTH/HIT elaboration on data retrieved from questionnaire survey

CONCLUSIONS

The good representation and mixture of relevant stakeholders as well as the presentations that were conducted during the workshop ensured the perfect alignment of the discussion with the workshop objectives, facilitating the expression of all different views and perspectives as well as the extraction of some valuable insights and outcomes. The questionnaire survey proved also to be very helpful for the latter since it provided participants with a structured approach where more targeted feedback was requested.

The workshop results prove to be well aligned with the outcomes of the baseline analysis that has been conducted till now and will support the further update of the latter along with the respective results from the other 5 workshops. The keys points of the discussion are being summarized in the following bullet points:

- According to experts, the technological trends that will be affecting the sector in the coming years are: **Alternative fuels, Automation & Robotics, Ballast Water Treatment.**
- Additional technological trends that they expect to have an impact on the sector's development in the medium- and long-term are: **Digitalization apps, energy storage systems, green ship dismantling/green technologies in ship recycling, new materials for shipbuilding systems.**
- 65% of the experts stated that **it is at least difficult** to find workforce with the required skills and qualifications.
- The occupational profiles that are expected to emerge in the future due to the further development of the shipbuilding sector are: **Material Engineers** and **Marine chemists.**
- Shortages currently exists and demand will increase in the near future for: **Designers, Design drafters with specialization in electronic design, Welders and Marine upholsterers.**
- 60% of experts consider the current educational and training offers to be **inefficient** in providing prospective employees with the required skills and qualifications.
- The E&T methods that they consider to be the most efficient in providing the required skills and qualifications in the shipbuilding sector are: **programs with emphasis on technical skills, technical schools, On-the-job training, Industry training supported by government funding, training programs structured in collaboration with industries and apprentices.**
- Current skill gaps in the sector mainly related to **specific technical skills (welding, assembly, etc.), health & safety skills, and skills on Information and Communication Technologies.**
- There needs to be a common European-wide policy setting out the appropriate frameworks for education and training programmes.
- Adequate certification of knowledge is needed.
- The transfer of knowledge to next generations should be ensured.

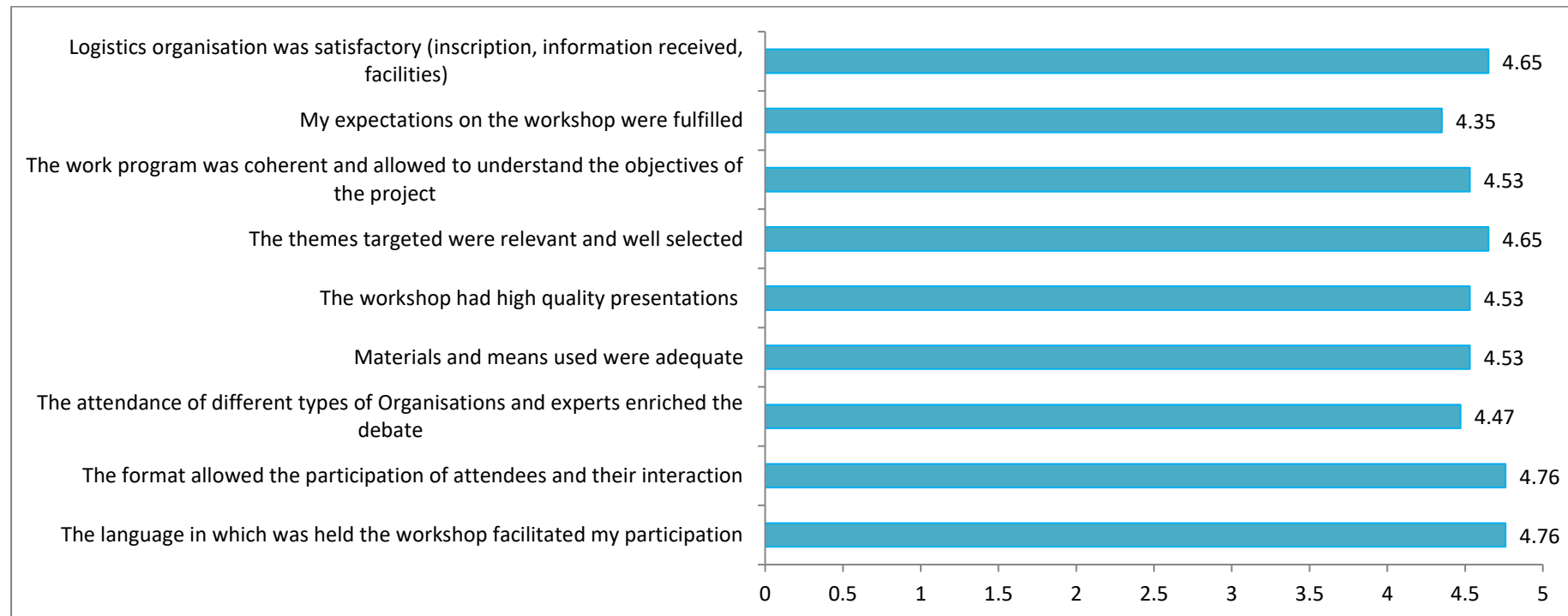
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- More cluster structures are needed for supporting developments in the sector.
- Synergies should be promoted between all parts of the maritime sector.

RESULTS OF SATISFACTION SURVEY:

The results of the satisfactory survey are based on the answers of 18 participants (excl. organizers, 4 participants didn't answer). **The overall score was 4.58.**

Figure 11: Results of satisfactory survey



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PHOTOS



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