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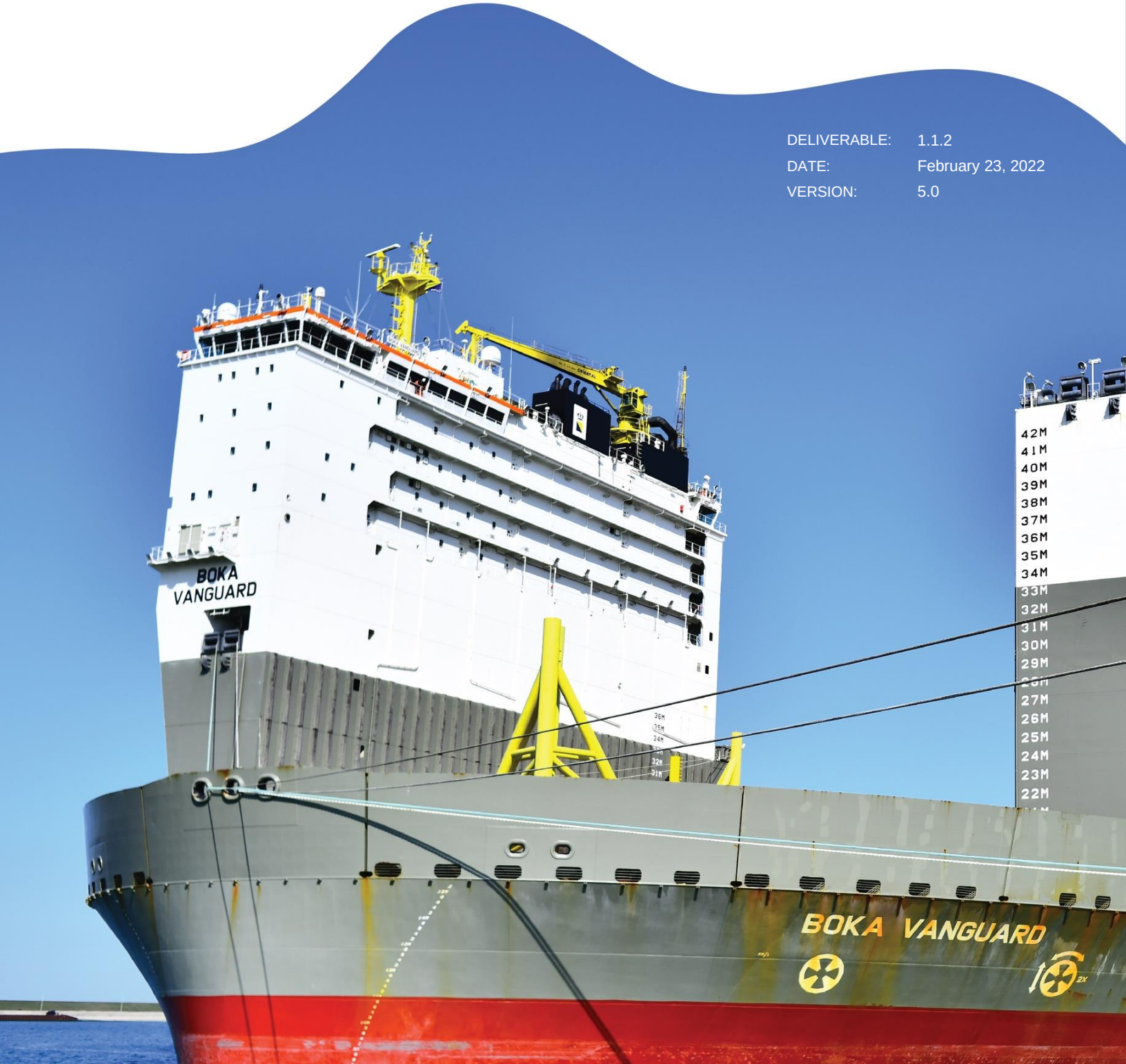

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Summary SkillSea Report

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Future-proof skills for the maritime transport sector

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Technology and digitalisation are transforming the shipping industry. ‘Smart’ ships are coming into service, creating demand for a new generation of competent, highly-skilled maritime professionals. Europe is a traditional global source of maritime expertise and the four-year SKILLSEA project is launched with the aim of ensuring that the region’s maritime professionals possess key digital, green and soft management skills for the rapidly-changing maritime labour market. It seeks to not only produce a sustainable skills strategy for European maritime professionals, but also to increase the number of these professionals - enhancing the safety and efficiency of this vital sector.

Contents

Introduction....5
Setting the scene....6
Maritime education and training....10
Industry perspective....13
Methodology....18
STCW Convention....21
Overview of literature....31
Projects....31
Reports and studies....34
Overview of common MET institutions and programmes....37
Higher education MET institutions....37
Maritime training centres....38
Specialised MET establishments....40
Survey....43
Shipboard personnel....43
Shore-based personnel....60
Results and outcomes....78
Conclusions....85
Annexe 1 Courses attended by masters on LNG ships....88
Annexe 2 – Courses attended by masters on passenger ships....90

Introduction

The shipping sector in Europe is of great importance to the European economy and has been a catalyst for economic development and prosperity throughout its history.[1] Shipping is also an essential source of employment, both onboard and ashore. Shipping-related jobs are often knowledge-intensive and depend on individual and group experience. Therefore, there is a genuine EU interest not only to increase the attractiveness of a seafaring career for EU nationals – both male and female, and young people in particular – but also to provide the industry and the wider maritime cluster with skilled and experienced personnel, whilst at the same time ensuring the competitiveness of the European maritime industry.

Consequently, the main concerns of the European social partners in the field of maritime transport are:

- The current mismatch between the demands of the industry and the supply of graduates from the educational institutions and a deficit of skills developed onboard and/or applied ashore.
- The response to global trends and changes concerning the new skills needed to deal with the changes and challenges faced by world shipping in the near future, with the essential requirements linked to the environment-friendly performance of shipping, new transport technologies, increased digitalisation, etc.
- Seafarer education and training require more comprehensive cooperation between European shipping companies and maritime training institutions to ensure that products of the educational system meet the qualifications and skills required by the industry, thus enhancing and ensuring employability.

This report presents the most essential results and outcomes of Task 1.1.2 Current Skills Needs - Reality and Mapping.

The goal of the Task was to map relevant skill needs and competencies required in the maritime industry and identified in current projects and research on a regional, national and European level. In addition, the needs identified are characterised according to the relevant period: current skill needs; short-term skill needs; and medium-term and long-term skill needs.[2] In addition, skills and competencies not charted in the International Maritime Organisation (IMO) Standards of Training Certification & Watchkeeping (STCW) Code A are considered, such as those delivered by the shipping industry (in the public domain), training centres, equipment providers, or as part of on-the-job training.

In particular, skills and competencies common among shore-based maritime industry employees were investigated to assess their potential inclusion in the skill sets common among active seafarers, thus increasing the mobility of active seafarers towards shore-based jobs and easing the transfer of maritime knowledge and experience.

The results are presented in nine chapters. Each chapter begins with its goal and ends with the most essential conclusions. All the conclusions are summarised in the last chapter. Besides the goals and conclusions, each chapter contains short background information, a brief presentation of the approach used, and the main outcomes.

[1] Summary document of the Blueprint for Sectoral Cooperation on Skills ETF-ECSA, 2017

[2] Task 1.1.3 deals with future skill needs.

Setting the scene

Seas and oceans are essential drivers for the European economy and have great potential for innovation and growth. Within the European Union, the activities related to the exploration of the seas are embraced under one strategic umbrella – Blue Growth. This is a long-term strategy to support sustainable growth in the marine and maritime sectors.[3] It represents the framework used by the maritime industry to contribute to the Europe 2020 strategy for smart, sustainable and inclusive growth.

Approximately 5 million people work in the Blue Economy. They are employed within five broad sectors: shipping;[4] shipbuilding; non-living resources (primarily oil and gas); living resources (fishing, aquaculture, processing); and coastal tourism.[5]

In terms of its importance for overall wellbeing and continuous development, shipping has maintained its pivotal role for decades. There are no indications that such a position will change soon. In 2018, sea and coastal passenger and freight transport had a gross value of €18.7 billion and employed 176,000 workers.[6]

Shipping and maritime industries and services operate in a global market, and the global market significantly influences national transport systems. This mutual interaction will remain or probably become even more essential in the years ahead. Due to the nature of the industry, human capital is probably the single most essential factor making the shipping industry efficient, effective and safe. Therefore, its human capital needs to be strengthened to support shipping competitiveness. By doing so, the jobs of tomorrow are ensured, employability is enhanced, and shipping competitiveness of today and tomorrow is maintained.[7]

The main challenges the maritime shipping sector must face are:

Current and future shortage of maritime professionals. Maritime transport industries create many jobs, directly and indirectly. It is estimated that some 70% of shipping-related shore jobs[8] are knowledge-intensive, high-quality jobs. These jobs largely depend on former seafarers who possess expertise, skills and a unique working attitude. A possible shortage of maritime professionals (both seafarers and on-shore workers) may therefore be considered a significant risk for long-term sustainability and competitiveness of the industry, especially if available human resources needed by the industry fall below a certain level. However, a shortage of maritime professionals, both current and future, is not the result of any single cause;

[3] https://ec.europa.eu/maritimeaffairs/policy/blue_growth_en

[4] Data on European seafarers may be found in STUDY ON EU SEAFARERS EMPLOYMENT - FINAL REPORT, European Commission, Directorate-General for mobility and transport, Directorate C – Maritime transport, MOVE/C1/2010/148/SI2.588190. Also, highly valuable data can be found in the EMSA publication SEAFARERS' STATISTICS IN THE EU – Statistical review (2017 data STCW-IS), 2019.

[5] COMMISSION STAFF WORKING DOCUMENT Report on the Blue Growth Strategy, Towards more sustainable growth and jobs in the blue economy

[6] The EU Blue Economy Report. 2019

[7] Data on EU shipping competitiveness can be found in EU Shipping Competitiveness Study - International benchmark analysis, Delloitte. The Study is commissioned by the European Community Shipowners Associations, February 2017

[8] Data on shipping-related jobs and relevant economic values can be found in Oxford Economics' THE ECONOMIC VALUE OF THE EU SHIPPING INDUSTRY - 2017 update. A report for the European Community Shipowners Associations (ECSA)

it is a consequence of numerous factors, some of which are not likely to be influenced by the industry itself. Moreover, some are more interrelated with the predominant work culture and social drivers than working conditions.

Changes. Recent changes within the maritime industry (such as the concentration and vertical integration of operators, digitalisation, horizontal alliances, further corrective actions due to pressure for the 'greening' of shipping, and automation of operations), and particularly those caused by a large-scale implementation of advanced technological systems, significantly influence the current and future skills required by maritime professionals. Due to these advances, high training standards and professional competence are essential for maritime professionals to ensure safe, secure, and environmentally sound shipping operations, both by sea and land.

Mobility issues. The traditional labour mobility in the maritime sector mainly involves seafarers who move from positions onboard ship to positions on-shore, thus transferring the basic professional knowledge, expertise and work ethics to other non-maritime specialists and throughout the industry. This process ensures the retention of talents/knowledge/skills and human resources to the industry ashore and many safety-critical roles. However, horizontal mobility of seafarers from ship to shore is often hampered by a lack of information about on-shore job availability, recognition of maritime qualifications, training courses covering shore job requirements, and lack of horizontal skills required for shore jobs. In addition, vertical labour mobility requires specific upskilling or re-training.

Communication issues. Lack of cooperation and communication between knowledge providers, competent authorities, and the industry (usually recognised as a Triple Helix) has occurred for decades in maritime activities, particularly in those related to shipping. The main reasons for unsatisfactory communication are usually attributed to different cultural and organisational schemes, caused mainly through very different drivers affecting various partners. The current knowledge providers are, as a rule, limited by legislation in force, which does not provide for flexible adaption of curricula to match emerging needs. Therefore, cooperation between knowledge providers and the industry, with heavily involved authorities, is crucial to ensure the smooth development and continuous delivery of an adequately trained workforce.[9] Strengthening the cooperation between the educational and employment sides is crucial to filling and preventing skills gaps.[10]

Core skill sets. Another vital issue caused by the rapidly accelerating technological changes is the set of professional skills (core skills) that a person or group must master. In the past, a narrow, well-defined set of skills was successfully used for decades. Today, a set of necessary skills for a particular job might be of partial use when applying for a similar job, even within the same industry or a sector (in the last two decades, the maritime industry has already witnessed the disappearance of numerous professions and their associated skill sets). Consequently, employees need a broad set of skills or the ability to update or upgrade their set of skills, as may be appropriate, to achieve their full potential, both at work and in society.[11] For this reason, besides the skills needed as a maritime professional, a person looking for a job ashore needs

[9] Effective communication is the necessary precondition for developing corporate social responsibility. At the same time, developed corporate responsibility promotes effective communication among different social groups.

[10] EU Commission staff working document on the implementation of the EU Maritime Transport Strategy 2009 – 2018.

[11] COMMUNICATION FROM THE COMMISSION TO THE EUROPEAN PARLIAMENT, THE COUNCIL, THE EUROPEAN ECONOMIC AND SOCIAL COMMITTEE AND THE COMMITTEE OF THE REGIONS: A NEW SKILLS AGENDA FOR EUROPE Working together to strengthen human capital, employability, and competitiveness

a set of transitional skills and sector-specific and cross-sectoral skills.[12]

Digital skills. Digital skills include those skills enabling a person to use or interact, either professionally or as a citizen, with different digital services. The number of digital services is constantly increasing, and the ability to use these services is becoming essential. Recent technological developments show the same process throughout the maritime industry, thus requiring maritime professionals to be able to use these services and specific maritime services in particular. Therefore, attention must be paid to the skills required to maintain cyber security, either onboard or ashore.

In recent years, digital competence as a value chain component has also gained increasing importance in the shipping industry. This includes IT systems, engineering for integrated logistics, and blockchain technology for value chain integration.

Green skills. Another necessary extension of the set of core skills for maritime professionals is the green skill set. This set broadly consists of the skills required to limit pollution and environmentally-damaging emissions caused by the routine operations of ships or in the event of an emergency. They also cover the proper use of different tools and equipment to achieve these objectives and maintain energy efficiency.[13] Although not essential for the economic viability of business activity, these skills have become critical, primarily because of their impact on climate change, increasingly strict regulatory requirements, and the overall image of companies and industry.

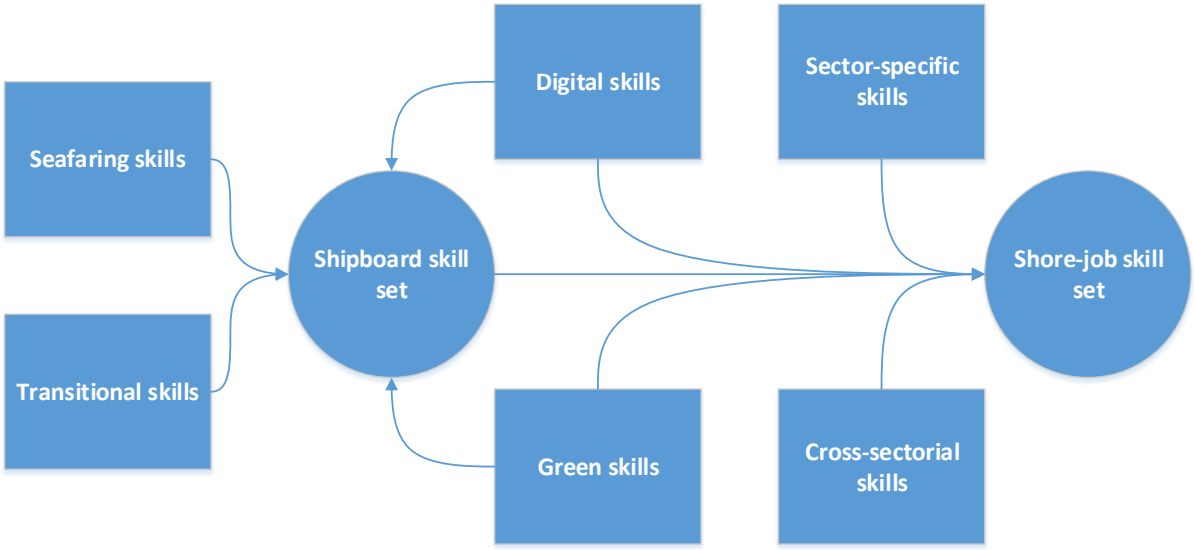

Figure 1 The process of acquiring skills for shore-based jobs where the seafaring background is considered essential

It may be concluded that:

1. Present and future challenges facing the maritime industry will create significant pressure on the present model of manning the maritime industry, both on ships and ashore. There are strong

[12] Valuable insights in that respect are given in the Vinh V. Thai, Stephen Cahoon and Hai T. Tran, Skill requirements for logistics professionals: findings and implications, 2011, available at www.emeraldinsight.com/1355-5855.htm.

[13] https://to2025.dnvgl.com/shipping/energy-efficiency-and-fuels/

indications that new technologies and the resulting social interactions will significantly affect the required core skill sets, the modes of acquiring skills, and the relationships among key stakeholders, those being active in the labour market(s) and others.

2. Designing a future-proof skill set for management positions in the maritime industry is a complicated task. It must be developed as an additional set of skills for those who already possess a basic shipboard skill set, accompanied by a balanced set of transitional skills and digital and green skills. Probably the most challenging task would be to find a proper balance of sector-specific skills and cross-sectoral skills because they very much depend on job requirements.

Maritime education and training

Maritime Education and Training (MET) is traditionally defined as an educational process providing students with the knowledge, understanding and proficiency required to assume different duties onboard ships. Consequently, maritime education is carried out at MET institutions delivering structured educational programmes, which are, in most countries, required for the certification of seafarers at the management level. Maritime training is usually defined by a strong focus on the practical skills required for specific tasks onboard. While maritime education is mainly offered by maritime academies and universities and most commonly lasts several terms (semesters) or whole academic years, training centres offer maritime training. The courses are shorter and relatively independent, with a strong focus on hands-on experience.

This is expressly pointed out in the METNET report (2003):

MT became MET with an increased science part in the programme; it introduced higher admission requirements and eventually reached academic degree status. Existing MET on the non-degree level was normally maintained. All MET, the non-degree and the degree ones, came in EU countries under the supervision of (Higher) Education Ministries and the already existing supervision by Transport or Shipping Ministries. The emergence and participation of a fourth main stakeholder, after MET institutions, maritime industry and maritime administration, came at a price about which stakeholders partly differ.

All European countries (except the land-locked ones) have one or several maritime institutions offering MET to students. In almost all EU countries, the education part of the process is organised in accordance with the Bologna declaration,[14] 1999, and the graduates receive a BSc-level degree. In many countries, MET institutions are part of the local universities and offer post-BSc education, leading to MSc level or even to PhD level. There are several countries where vocational education leading to STCW management-level Certificates of Competency is offered.

Some MET institutions also offer required practical training as a part of their programmes. In contrast, others rely on maritime training centres (or, in some cases, rely on private shipping/maritime industry training establishments). In addition, in several countries, onboard training is a part of regular education as required by the STCW Convention. In contrast, in others, it is the students' responsibility to find a placement onboard.

Regarding the skill set offered to students, all EU MET institutions offer education and/or training to at least the level prescribed in the STCW 1978 Convention, as amended. However, some institutions offer programmes that contain courses with syllabuses beyond the STCW requirements. The number and scope of courses extending beyond STCW requirements varies from country to country. As a rule, institutions formally linked to universities offer more programmes and subjects, and their syllabuses are more demanding. It is essential to note that programmes dealing with on-shore jobs are highly diversified, and in some cases, require onboard experience. In contrast, in others, onboard experience is considered irrelevant.

It is essential to note that in all EU countries, the higher education programmes offered by MET institutions are subject to the supervision of the ministries responsible for education and those responsible for maritime affairs. Such an approach guarantees that the education delivered is in accordance with the required

[14] The Joint Declaration of the European Ministers of Education (Bologna declaration) was adopted in Bologna in 1999 by ministers of education of 29 European countries. It established a European Higher Education Area in which students and graduates move between countries, based on a system of easily readable and comparable degrees. The system is based on three main cycles, undergraduate, graduate and postgraduate. Access to the next cycle requires successful completion of the previous one. The degree awarded after the first cycle shall also be relevant to the European labour market as an appropriate level of qualification. The second cycle should lead to the master and the third one to the doctorate degree.

standards, and the degrees are comparable with the degrees offered by other higher education institutions.

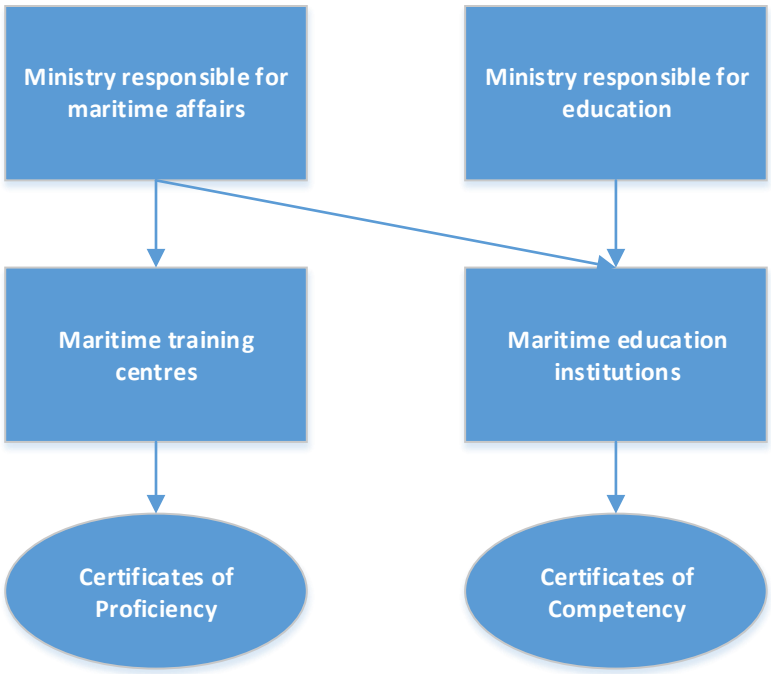

Figure 2 MET processes leading to CoC and CoP

As a rule, MET institutions offering higher education are financed by the ministry responsible for education. In general, this means that any amendments to the curricula must follow the standard administrative procedure, and their implementation is a formal, usually long-lasting, process. Consequently, the response to change is relatively slow.[15]

On the other side, maritime training centres invariably offer short courses leading to Certificates of Proficiency, offered directly to the industry. Consequently, they are mainly private establishments[16] developing and delivering courses as the target industry requires and financed by direct beneficiaries (either companies or individuals). As a rule, the response to the industry needs is prompt.

Finally, it must be emphasised that "… competence is not forever. Changes in policy, procedures, regulations, technology and equipment, business goals, and objectives mean that workplace performance standards need to be modified and updated. The new standards must be developed for new job functions that may arise from the changes."[17] Thus, besides study programmes offered to regular students ("newcomers") MET institutions increasingly develop and offer different refresher/upskilling study programmes to seafarers as well as to employees already working within the maritime industry. These activities create a new market for institutions and provide significant support to the industry (if courses are offered on time and up to the expected level).

[15] In most EU countries, higher MET institutions as well as programmes have to be approved by responsible accreditation bodies.

[16] In most cases, maritime training centres that are part of MET institutions are profit-oriented and are not financed by the government.

[17] Robert Rayner, IDESS Interactive Technologies, see https://splash247.com/competence-assurance-for-ships-crew/

It can be concluded that:

1. MET institutions offering education and training at all levels are generally able to respond to the industry's needs and fill the skill gaps. However, the ability to provide different skills – particularly high-level skills – may vary significantly between institutions and countries.

2. Due to the different positions and levels of development of MET institutions in different countries, their uniform response to changes and challenges is not easy to ensure. It will depend on the scope of education required, capacities and expertise available at an institution, and financial incentives provided in each case.

3. There exists no EU-wide alliance or similar form of association of institutions offering MET programmes. However, many institutions offering MET programmes at least at the MSc level are members of the International Association of Maritime Universities (IAMU).

Industry perspective

In this report, the term maritime industry denotes two broad classes of business ventures: shipping companies and supporting industries. Shipping companies include companies owning and/or operating ships in national and international trade. In this report, the term *supporting industries* includes all other companies providing different services to shipping companies but not operating cargo or passenger ships. The term includes pilots, tug operators, maintenance services, equipment producers, ship repairing services, agents, crew management companies, etc.

It is estimated that the EU shipping industry employs 640,000 people, controls approximately 40% of the world gross tonnage and contributes approximately €57 billion to EU GDP.[18] It is essential to note that the number of people employed by the EU shipping industry includes actual and former seafarers and other employees with no maritime background. However, for the shore-based industry, masters and officers – both deck and engine – are of significance because they bring high-level expertise, maritime insight and experience to the industry.

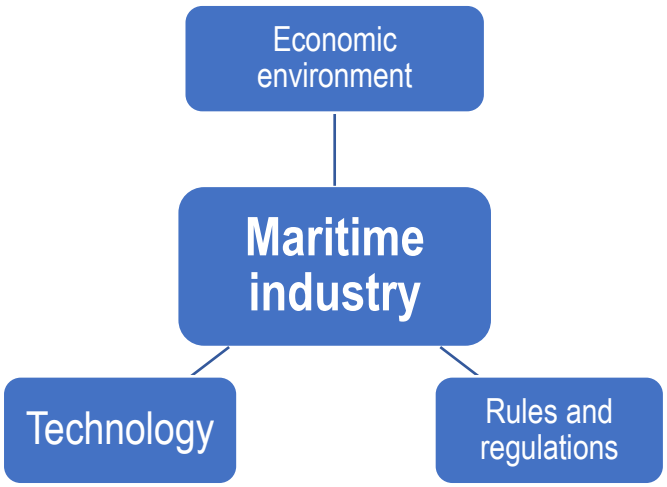

Figure 3 The most essential drivers

Three main characteristics mark the maritime industry:

1. Being profit-oriented, this industry heavily depends on economic forces and drivers, such as market changes, monetary and fiscal policies, interest rates, employment, inflation rates, demographic changes, political changes, energy, security, and natural disasters. All of these have a direct effect on the ways in which the industry produces and distributes its services. All of these are, in significant part, beyond the reach of the main actors, forcing even the most influential actors to adapt constantly to these forces.

2. The industry significantly depends on modern technologies. Being highly competitive, all the actors in the arena are forced to use any available means to ensure business advantage over the competition. In that respect, the use of new technologies in many cases means a better service for the clients and, consequently, a better market position.

[18] ECSA Strategic priorities for EU shipping policy 2019–2024, 2019

3. Finally, the maritime industry – and shipping in particular – is intensely regulated. Today, international, regional or national rules and regulations set numerous restrictions on almost any activity at sea and in ports. This holds even for contractual relations, especially in companies operating in the international market.

Analysing such a vast system, with so many actors, interests and influences, is a highly demanding task and considerably beyond the scope of this report. However, to detect the skills required by various actors, the most essential subjects and associated actions must be identified. It is reasonable to assume that the most essential subjects and associated actions will be the most frequently mentioned in the relevant lexical corpus, i.e., the importance of the terms and expressions used is roughly equivalent to their frequency in the relevant text corpus. The language used is English, and the software used for the analysis is Wordsmith 7.0, produced and delivered by Lexical Analysis Software and Oxford University Press.

Figure 4 Keywords used to describe the economic environment

The available sources have been selected and subjected to linguistic analysis to identify the essential terms and expressions used in each of the areas influencing the maritime industry. The source corpus has been selected in a way to reflect the importance of the subject within the area under investigation. It was assumed that each area's essential subjects and actions would be recognised among the most used terms and expressions.[19]

The corpus used to describe the economic environment is based on selected texts covering all maritime economy and business areas. The corpus consists of 731,398 running words (tokens) and 18,030

[19] When selecting the texts to be included in the corpus, texts providing extended coverage are preferred to those providing more words. Considering the highly specialised subject under investigation, it is estimated that corpuses with more than 200,000 will return the most essential keywords with satisfactory reliability. In addition, no text printed or published before 2000 is used in the corpus.

distinctive words (types). The analysis results are presented in the form of a word cloud with font size reflecting the frequency of the word.[20]

The words most frequently used ("ship", "cargo", "regulation", "code", "port", "certificate", "vessel", "master") reflect the factors mainly influencing the economic efficiency of the maritime industry. It is worth noting that the term "regulation" is one of the most frequently used words in the corpus. It emphasises the significant influence of the external regulations on the economic efficiency of the industry. The second term to be emphasised is "master". This suggests that ship masters still play an essential role in the shipping operations, although opposite statements are pretty frequently heard among active masters.

The corpus used to describe maritime law consists of 264,186 running words and 11,754 uncommon words. The keywords are present in the form of the word cloud with a font size reflecting the frequency of the word.

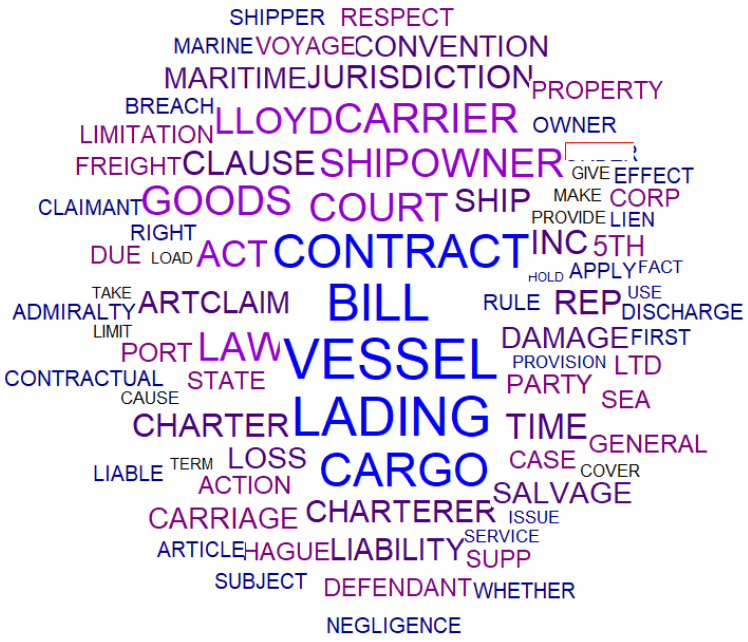

Figure 5 Keywords used to describe maritime law

The words with the highest frequencies are those describing contractual relationships ("contract", "bill") among different stakeholders. Next to them are words referring to the main stakeholders in the process ("ship-owner", "carrier", "court"; "charterer", etc.).

It is essential to note that the most frequently used words are much more equally distributed than those used to describe the economic environment. There are no clear reasons to explain this fact. As in the case of the economic environment, the most frequently used word categories are nouns and just a few verbs.[21]

[20] Beside frequencies of the words used, numerous other statistical measures and qualities of the corpus have been analysed, including keywords and collocations of the most significant terms. In this report, only the most essential outcomes are present.

[21] Most other types of words are excluded from the analysis using standard stop-list for English language and developed by the Oxford University Press.

The corpus used to describe technology consists of 288,987 running words and 17,734 distinctive words. The keywords are present in the form of the word cloud with increasing font size reflecting the frequency of the word.

As expected, the words with the highest frequencies refer to different shipboard systems. Besides the terms “ship”, “vessel”, and “cargo”, the term with the highest frequency is “system”, obviously reflecting significant interdependence and connectivity of various types of onboard equipment.

The second term worth emphasising is “gas”, obviously being recognised as a fuel that will be much more essential in the future than in the past. In this case, more action verbs must be recognised than in the previous two subject areas. It may be concluded that ships’ technology is somehow much more “dynamic” than maritime law or economic environment.

Figure 6 Keywords used to describe ship technology

Finally, there is a constituent of the EU maritime industry that must be particularly highlighted – the workforce, both ashore and aboard. Regarding shipboard personnel, and reflecting its truly internationalised nature, the maritime industry employs a large number of European seafarers and a significant number of non-EU seafarers. According to a recent EMSA report,[22] the total number of masters and officers holding valid Certificates of Competency (CoC) on 31 December 2017 at the EU level (i.e. issued by one of the EU member states) was 202,190. Of these, 3.60% held CoCs entitling them to serve in the deck and engine departments. Another 87,810 masters and officers held original CoCs issued by non-EU countries with endorsements issued by the EU member states attesting their recognition.

The proportion of EU seafarers employed by EU-based companies significantly depends on each company's management and crewing policy. Furthermore, different companies may implement very different policies, thus making any estimates of employment levels unreliable. These practices also mean

[22] Seafarers Statistics in the EU - Statistical review (2017 data STCW-IS), 2019

that it is possible to change crewing policy at the company level in a short period of time.

It is essential to note that the same pool of seafarers serves on ships flying EU flags and on ships flying non-EU flags and that there is a constant flow of seafarers between these two fleets. In addition, there is a constant inflow of new seafarers joining EU fleets and a constant outflow of seafarers taking up jobs ashore or retiring. The data describing these changes are not identified.

In general, it is recognised that shipping companies' safe and efficient operations (and the industry as a whole) significantly depend on a steady flow of knowledge and expertise from ships to shore-based offices. However, due to recent developments and the ever-increasing dependency on new technologies, this flow is not as smooth today as it was in the past. Therefore, it is reasonable to assume that the effective transfer of knowledge and expertise from ships will be even more challenging in the future, primarily due to the expected extensive use of sophisticated technological tools.

To sum up, it may be concluded that:

1. The maritime industry is a highly dynamic industry, exposed to numerous external influences. At the same time, it is a highly regulated industry at international, regional and national levels.
2. The maritime industry is highly competitive, thus heavily dependent on the effective implementation of modern technologies.
3. Keywords used to describe critical subjects and actions are identified for all three subject areas – maritime law, ships’ technology, and maritime economy.

Methodology

The skill gap is commonly understood as the difference between the skills required on the job and the actual skills possessed by the employees. Skill gaps may occur at an individual, departmental or organisational level. Skill gaps are more visible if there is a lack of critical skills (usually defined as skills preventing task completion). Non-critical skill gaps are gaps that prevent a task from being completed efficiently (sub-optimal execution). Measures to remove skill gaps may vary significantly, from minor adjustments within the working process or minor training programmes to overall restructuring of the process and resources used.

A skills gap analysis may be defined as a set of tools used to determine the skill requirements. It is most often implemented by medium to large companies to reveal the variances between the existing and the required skill levels and identify the best strategies to close the gap or reduce the variations.

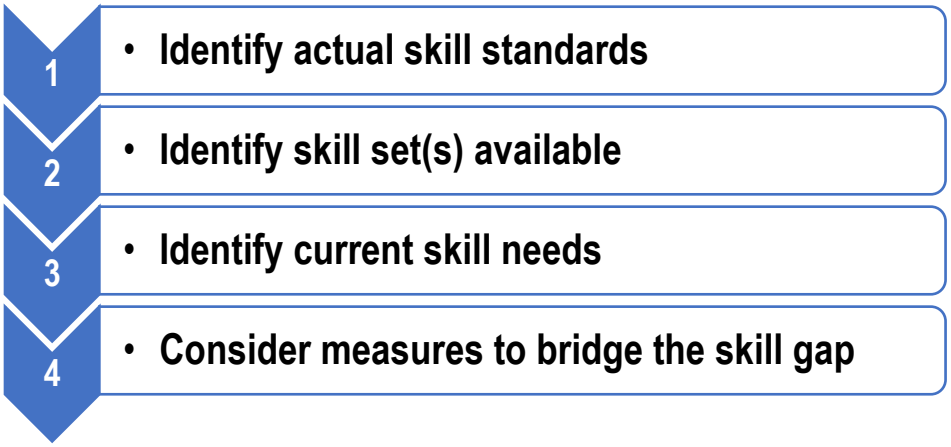

Figure 7 Skill gap analysis

The primary tools used to assess the current (actual) skill levels include questionnaires, performance assessments, group discussions, and interviews. The same set of tools is commonly used to estimate the desired skills. The main difference lies in target subjects: in the case of current skills, the target subjects are actual or potential employees, while in the case of desired future skills, the target subjects are company managers, their goals and projections, and their long-term development plans.

Essential maritime skills (skill standards) are outlined in the STCW Convention in the relevant competencies tables, notably in STCW Code A, Chapters II to VI. STCW Code A is a mandatory part and must be implemented by each signatory of the Convention. Part B of the Code contains recommended guidance intended to help member states implement the Convention and the STCW Code. The measures suggested are not mandatory, and the examples given are only illustrative. However, in general, the recommendations represent an approach that has been harmonised through discussions within IMO and consultation with other international organisations. Part B is structured similarly to Part A, and, for ease of use, the numbering corresponds to the numbering in Part A.

In the STCW Convention, competencies (required skills)[23] are assigned to various ship operations (functions) at the support, operational and management levels. The set of skills described in the tables is appropriate for ships sailing at the time when the Convention was developed. At that time, differences

[23] In this report the terms *skill* is understood as equivalent to the term *competency* as defined in the STCW Convention.

between main ship types and trades were relatively insignificant, working procedures were less demanding, and communication with shore-based companies, management and authorities were simple. Maintaining and upgrading required competencies was also relatively simple, if ever required. Once acquired, the skill set was considered consistent and adequate; working environments did not change for years.

Nowadays, technological differences between various ship types and trades are significantly larger. Because of that, skills are not easily transferrable, and short updates of knowledge and/or proficiency are not sufficient, especially for technologically advanced ships, such as LNG carriers.

Finally, it must be emphasised that skills, as defined in the STCW Convention, refer only to a single person's knowledge, understanding, and proficiency. Professional competencies of work teams are not considered, although teamwork as a mode of carrying out complex tasks is included in the text of the STCW Convention. Even more so, the concept of working environment is not considered in the Convention (although it is addressed in numerous documents presented at IMO meetings).

Due to the aforementioned developments, the STCW Convention has been amended several times, sometimes pretty extensively (in 1995 and 2010). However, more essentially, to ensure uniform implementation, the IMO has developed numerous Model Courses in cooperation and member governments' assistance. Each Model Course offers a more detailed explanation of the subjects, requirements and delivery methods required for each position onboard, and includes:

- a course framework (detailing the scope, objective, entry standards, and other information about the course)
- a course outline (timetable)
- a detailed teaching syllabus (including the learning objectives that should have been achieved when students have completed the course)
- guidance notes for the instructor, and
- a summary of how students should be evaluated

Several Model Courses are supported with teaching materials (compendium).[24]

In addition to essential skills described in the STCW Convention 1978, in the last few decades, ship-owners and various other organisations have developed dozens of different, mainly short, courses to extend the skill sets of their seafarers. Some of these courses have become a constituent part of the STCW Convention (such as Bridge Resource Management). In contrast, some others are still required for seafarers on a particular class of ships by different organisations but are not formally included in the text of the Convention. Unfortunately, data on these courses, although available on course providers' websites, are not easily quantified. The main reason is that the number and structure of seafarers attending these courses and the courses' structure significantly depend on the companies' policies and may be amended according to the requirements in each and every case.

At the same time, during the last two decades, numerous higher maritime education and training (MET) institutions in various EU countries have developed new programmes that not only target students wishing to join the maritime industry but which are also available to maritime professionals with onboard experience

[24] In October 2019 a total of 79 Model Courses were available, covering various aspects of maritime safety, security and pollution prevention. Other aspects of the maritime industry (such as maritime economy, law, or various ship technologies are not considered.

looking for a job ashore. These programmes – particularly those offered to professionals with onboard experience – try to bridge the skill gap between onboard jobs and jobs in the maritime industry and can be used as indicators of potential skill gaps. As with additional short courses, the skill gaps tackled by these programmes are even more challenging to quantify.

Bearing in mind all these circumstances, implementing the standard skill gap analysis as a tool to assess the whole industry is particularly demanding, if not impossible. The main areas of concern are as follows:

- quantification of data is generally tricky, not warranting reliable outcomes
- the inherent problems in determining whether a specific skill set are appropriate or not when a wide range of jobs is under consideration
- determining the goal(s) of a system consisting of numerous stakeholders is difficult, mainly because different stakeholders may have conflicting goals

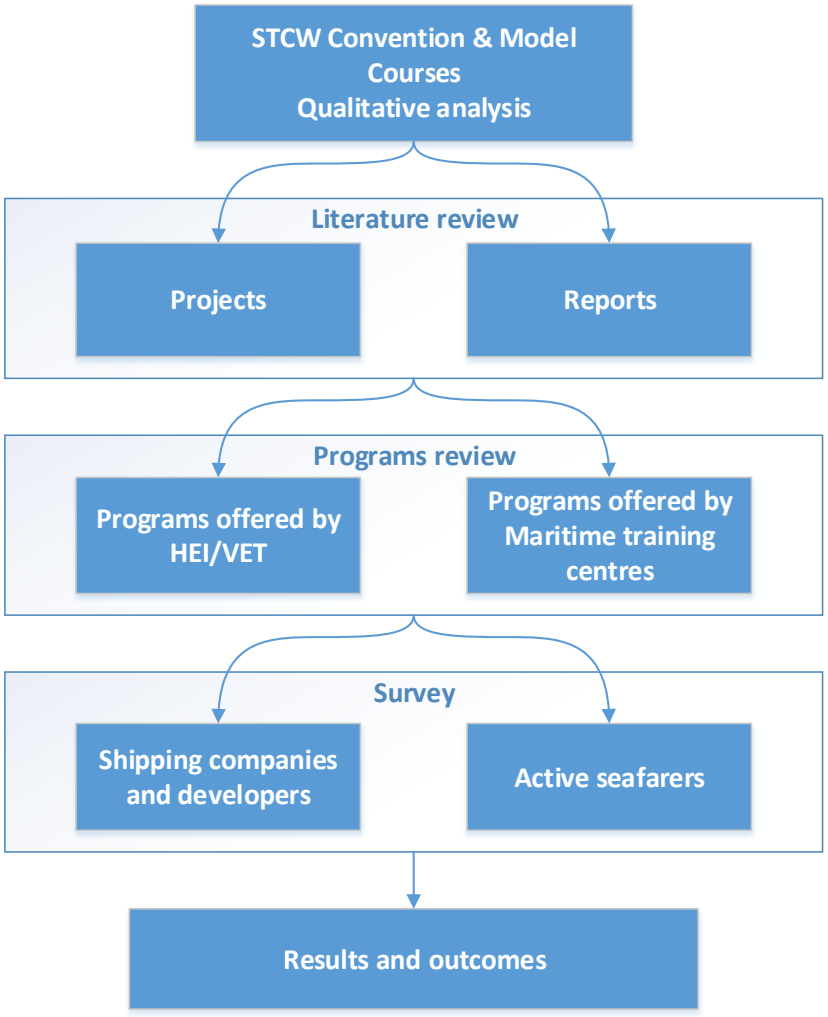

Figure 8 Skill gap analysis - steps

Consequently, it was decided to implement skill gap analysis consisting of the following steps:

- quantitative analysis of the STCW Convention, its supporting documents, and its development
- literature review, with particular attention drawn to projects and reports considering present or future skills required in the maritime industry, and those considering technological developments that may impact the required skill sets
- quantitative analysis of programmes offered by the representative MET providers
- development and distribution of a survey, using an electronic questionnaire, aiming to reveal the position of shipping companies, developers of new technologies for the maritime industry and active seafarers on the present skill gaps

The target subjects for the survey were members of shore-based management or those responsible for the development and use of new technologies, while for shipboard personnel, the survey targeted mainly officer positions with operational and management functions onboard larger ships and those who might consider new jobs ashore within the maritime industry. Positions below the operational level are not considered in detail because the skills assumed with these positions are only rarely transferable to other occupations ashore.

STCW Convention

The International Convention on Standards of Training, Certification and Watchkeeping for Seafarers (STCW), 1978, was adopted on 7 July 1978 and entered into force on 28 April 1984. The primary purpose of the Convention was to promote the safety of life and property at sea and the protection of the marine environment by establishing internationally-agreed global standards of training, certification and watchkeeping for seafarers. Since its introduction, the Convention has twice been significantly improved: in 1995 and 2010.

The version initially developed in 1978 focused almost entirely on knowledge. The amendments in 1995 shifted emphasis to practical skills and competencies underpinned by theoretical knowledge. It has been frequently emphasised that the competency-based approach is the most crucial aspect of the amendments adopted in 1995 and in 2010.

Therefore, the Convention in its present form describes the sets of skills that seafarers are assumed to master according to the position onboard. The skills required are described in the Annex to the Convention in the STCW Code A in the form of tables. Tables of competencies are related to different functions on board, and each contains four columns:

1) Competence

2) Associated knowledge, understanding and proficiency

3) Methods for demonstrating competence

4) Criteria for evaluating competence

Associated knowledge, understanding and proficiency in column 2 may be understood as a skill the seafarer has to master up to the practical level. Following that line of reasoning, it may be concluded that the skill set required for Masters and Chief Officers consists of 129 different operational and 142 skills at the management level. For the Chief and Second Engineer CoCs, the skill set consists of 100 different skills at

the operational level and another 78 skills at the management level. In addition, the STCW Code A in Chapter III also contains an additional 82 skills required for Electro-Technical Officer (ETO).[25]

Skills described in STCW Code A are further elaborated in STCW Code B and more detailed in the associated Model Courses. The associated Model Courses include:

- Master and Chief Mate (Model course 7.01) (2014 Edition),
- Chief Engineer Officer and Second Engineer Officer (Model course 7.02) (2014 Edition),
- Officer in Charge of a Navigational Watch (Model course 7.03) (2014 Edition), and
- Officer in Charge of an Engineering Watch (Model course 7.04) (2014 Edition).

Each Model Course consists of several sections, the essential being:

- Part A: Course Framework for all functions
- Part B: Course Outline
- Part C: Detailed Teaching Syllabus
- Part D: Instructor Guide
- Part E: Evaluation

The essential part of each Model Course is a detailed teaching syllabus, presented as a series of learning objectives. Therefore, the objectives describe what the student must be able to do to demonstrate that the specified knowledge or skill has been transferred. Thus, each learning outcome is supported by several performance elements related to the required proficiency.

Learning outcomes are an essential part of any study programme because they indicate the level of complexity and intended scope of the associated learning programme. Learning outcomes, as a rule, follow Bloom's taxonomy[26]. This covers three different domains of learning: cognitive, affective, and psychomotor.[27] Each domain consists of a hierarchy of increasingly complex processes that students are supposed to acquire.

Within the cognitive domain, which is commonly considered to be the most essential, there are six different levels of "knowing":

[25] Although the Convention in other chapters contains numerous additional skills, those skills are not considered as relevant for the project goals because most of them are at the support level, and in scope strictly restricted to shipboard duties, and as such have minimal relevance for the maritime industry as a whole.

[26] Benjamin Samuel Bloom (1913 - 1999) was an American educational psychologist who made significant contributions to the classification of educational objectives and to the theory of learning. He is particularly noted for leading educational psychologists to develop the comprehensive system of describing and assessing learning outcomes in the mid-1950s.

[27] It is interesting to note that affective and psychomotor domains are much less considered than the cognitive ones. At the same time subjects that are associated with affective domain (attitudes, motivation, communication styles, management styles, learning styles, use of technology and nonverbal communication) are frequently discussed within the industry as being a part of the core values of any efficient management.

- knowledge
- comprehension (understanding)
- application (proficiency)
- analysis
- synthesis
- evaluation[28]

It is assumed that each level is based on the previous one. Analysis, synthesis, and evaluation are considered higher-order thinking skills. In addition to the cognitive domain, Bloom's taxonomy has two other domains: the affective domain and the psychomotor domain. The affective domain ("Feeling") concerns value issues; it involves attitudes. The psychomotor domain ("Doing") involves the coordination of the brain and muscular activity.

For each domain and level, Bloom suggested certain action verbs that characterise the ability to demonstrate achievements.[29] These verbs are a key to identifying associated (or intended) learning outcomes.

Action verbs associated with the "knowledge" level are:

arrange, collect, define, describe, duplicate, enumerate, examine, find, identify, label, list, memorise, name, order, outline, present, quote, recall, recognise, recollect, record, recount, relate, repeat, reproduce, show, state, tabulate, tell.

Action verbs associated with the "comprehension" level are:

associate, change, clarify, classify, construct, contrast, convert, decode, defend, describe, differentiate, discriminate, discuss, distinguish, estimate, explain, express, extend, generalise, identify, illustrate, indicate, infer, interpret, locate, predict, recognise, report, restate, review, select, solve, translate.

Action verbs associated with the "application" level are:

apply, assess, calculate, change, choose, complete, compute, construct, demonstrate, develop, discover, dramatize, employ, examine, experiment, find, illustrate, interpret, manipulate, modify, operate, organise, practice, predict, prepare, produce, relate, schedule, select, show, sketch, solve, transfer, use.

Action verbs associated with the "analysis" level are:

analyse, appraise, arrange, break down, calculate, categorise, classify, compare, connect, contrast, criticise, debate, deduce, determine, differentiate, discriminate, distinguish, divide, examine, experiment, identify, illustrate, infer, inspect, investigate, order, outline, point out, question, relate, separate, sub-divide, test.

[28] According to Anderson and Krathwohl (2001), the levels may be understood as: 1) To remember, 2) To understand, 3) To apply, 4) To analyse, 5) To evaluate, and 6) To create.

[29] Eventually these verbs have been amended and reordered. Here the recent version proposed by Kennedy, Declan & Hyland, Áine & Ryan, Norma. (2007). Writing and Using Learning Outcomes: A Practical Guide is used.

Action verbs associated with the “synthesis” level are:

argue, arrange, assemble, categorise, collect, combine, compile, compose, construct, create, design, develop, devise, establish, explain, formulate, generalise, generate, integrate, invent, make, manage, modify, organise, originate, plan, prepare, propose, rearrange, reconstruct, relate, reorganise, revise, rewrite, set up, summarise.

Finally, action verbs associated with the “evaluation” level are:

appraise, ascertain, argue, assess, attach, choose, compare, conclude, contrast, convince, criticise, decide, defend, discriminate, explain, evaluate, interpret, judge, justify, measure, predict, rate, recommend, relate, resolve, revise, score, summarise, support, validate, value.

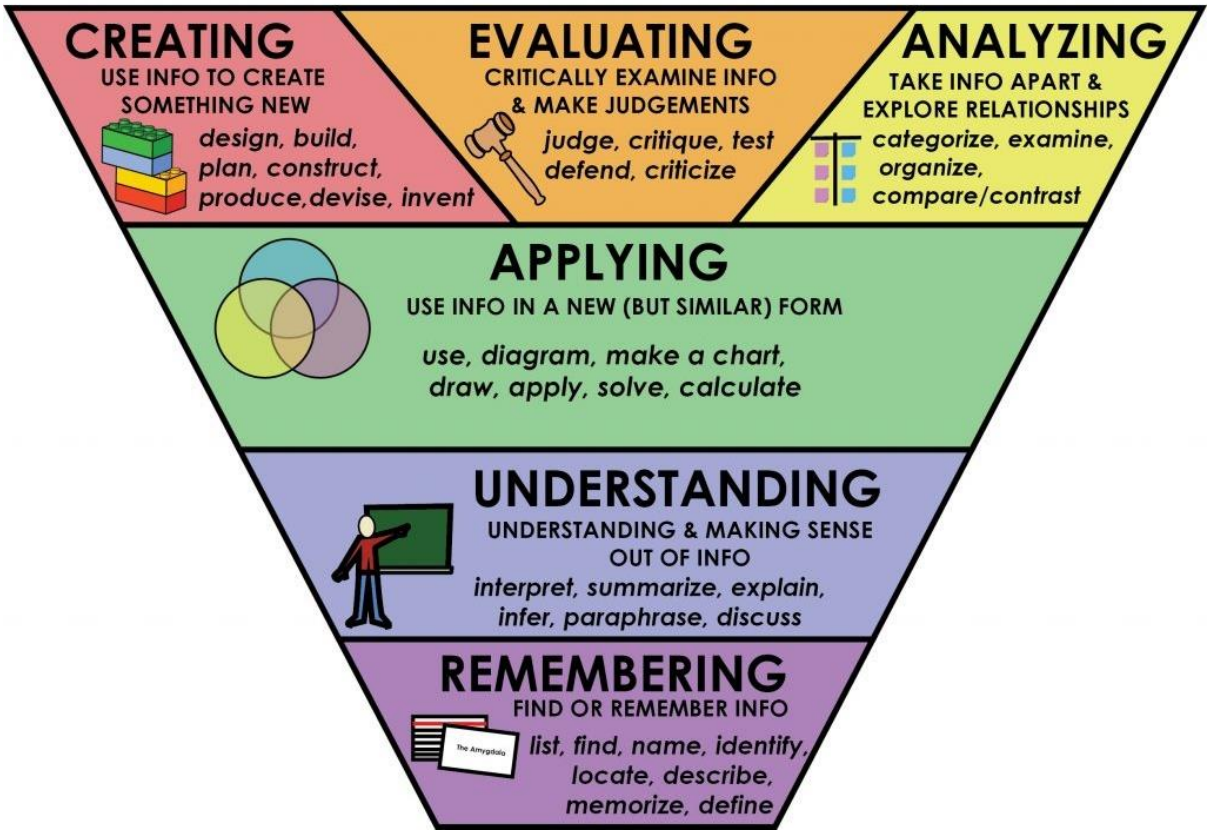

Figure 9 Bloom's taxonomy in the cognitive domain[30]

To identify the current skill requirements, it was necessary to analyse the specific part of the STCW Convention where learning outcomes are defined or indicated, including the associated Model Courses. The lexical analysis has been carried out for two main onboard positions:

1. Master and Chief Mates on ships of 500 gross tonnage or more
2. Chief Engineer Officers and Second Engineer Officers on ships powered by main propulsion

[30] https://www.toppr.com/bytes/blooms-taxonomy/

machinery of 3,000 kW propulsion power or more

For Group 1, the following sources have been accepted as relevant:

- Specification of minimum standard of competence for officers in charge of a navigational watch on ships of 500 gross tonnage or more (A-II/1, Column 2)
- Specification of minimum standard of competence for masters and chief mates on ships of 500 gross tonnage or more (A-II/2, Column 2)
- Master and Chief Mate (Model Course 7.01 – Part C)
- Officer in Charge of a Navigational Watch (Model Course 7.03 – Part C)

For Group 2, the following sources have been accepted as relevant:

- Specification of minimum standard of competence for officers in charge of an engineering watch in a manned engine-room or designated duty engineers in a periodically unmanned engine-room (A-III/1 – Column 2)
- Specification of minimum standard of competence for chief engineer officers and second engineer officers on ships powered by main propulsion machinery of 3,000 kW propulsion power or more (A-III/2 – Column 2)
- Chief Engineer Officer and Second Engineer Officer (Model Course 7.02 – Part C)
- Officer in Charge of an Engineering Watch (Model Course 7.04 – Part C)

The analysis of Group 1 sources has been carried out using Wordsmith 7.0. The corpus included a total of 94,718 words (tokens), among them 6.540 distinct words (types)

1	*states*	1269	1.34%	15	*port*	185	0.20%
2	*describes*	973	1.03%	16	*damage*	184	0.19%
3	*explains*	906	0.96%	17	*requirements*	184	0.19%
4	*ship*	786	0.83%	18	*safety*	176	0.19%
5	*cargo*	545	0.58%	19	*convention*	173	0.18%
6	*ships*	301	0.32%	20	*required*	170	0.18%
7	*use*	260	0.27%	21	*bulk*	169	0.18%
8	*water*	235	0.25%	22	*equipment*	167	0.18%
9	*international*	230	0.24%	23	*defines*	167	0.18%
10	*information*	217	0.23%	24	*stability*	158	0.17%
11	*control*	206	0.22%	25	*system*	158	0.17%
12	*loading*	202	0.21%	26	*cargoes*	152	0.16%
13	*sea*	199	0.21%	27	*vessel*	150	0.16%
14	*given*	193	0.20%	28	*master*	143	0.15%

Figure 10 List of most frequent words used to describe skills required by the STCW Convention and associated Model Courses for deck functions

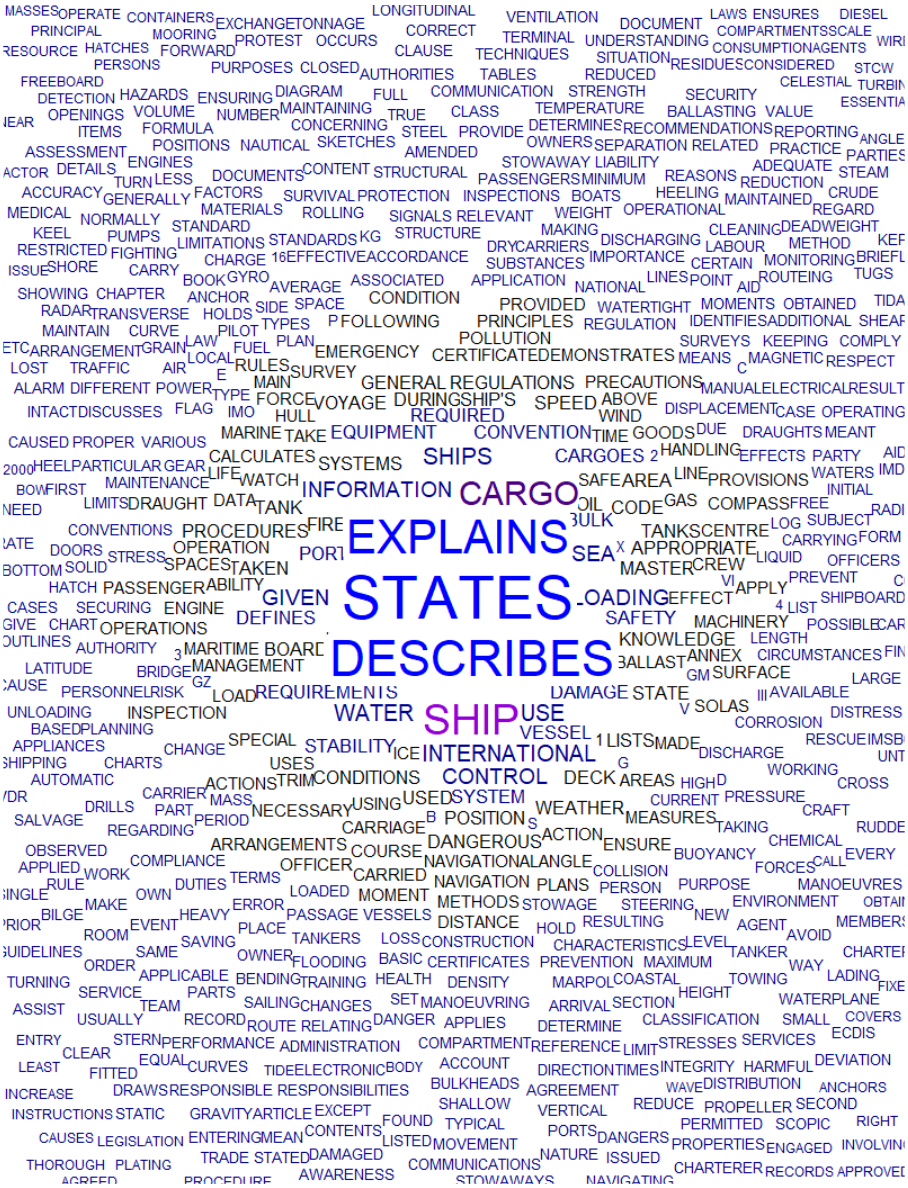

Figure 11 Word cloud - Deck department

The most essential action verbs (with the number of occurrences) are:

states	1.269
describes	973
explains	906
defines	167
lists	124
calculates	98

demonstrates 72

identifies 44

determines 33

All action verbs belong to the lowest level of Bloom's taxonomy. Only two words belong to the "application" level – *calculates* and *demonstrates,* while only one belongs to the "analysis" level ("*determines*").

It is interesting to note that the verb form *causes*, used as a term, is located far from the essential terms (mentioned 51 times). In the STCW Convention, analysing causal relations does not bear significant importance, especially if compared with factual knowledge.

The total corpus for Group 2 included 60,928 tokens (running words) in text, among them 5.548 distinct words (types).

1	*states*	640	1.05	15	*operation*	154	0.25
2	*explains*	632	1.04	16	*engine*	151	0.25
3	*describes*	510	0.84	17	*defines*	146	0.24
4	*ship*	317	0.52	18	*knowledge*	144	0.24
5	*control*	310	0.51	19	*use*	143	0.23
6	*system*	245	0.40	20	*air*	139	0.23
7	*water*	238	0.39	21	*steam*	136	0.22
8	*systems*	224	0.37	22	*pressure*	136	0.22
9	*oil*	221	0.36	23	*marine*	136	0.22
10	*safety*	184	0.30	24	*procedures*	131	0.22
11	*equipment*	181	0.30	25	*fuel*	119	0.20
12	*ships*	176	0.29	26	*convention*	116	0.19
13	*used*	168	0.28	27	*using*	114	0.19
14	*international*	156	0.26	28	*sea*	114	0.19

Figure 12 List of most frequent words used to describe the skills required by the STCW Convention and the associated Model Courses for engine room functions

The essential action verbs (with the number of occurrences) are:

states 640

explains 632

describes	510
defines	147
sketches	109
lists	69
uses	65
measures	65
demonstrates	59

Even in this case, most of the action verbs belong to the “knowledge” and “comprehension” levels, while one (*measures*) belongs to the highest level (“evaluation”). It must be emphasized that this verb is used primarily in a technical (“*to measure*”) or procedural sense (“*explain measures*”).

Figure 13 Word cloud - Engine department

Suppose word clouds for the deck and engine departments are compared with clouds generated for maritime law, ships' technology and economic environment. In that case, it is pretty clear that there are no significant similarities. There is a certain similarity between the deck and engine word cloud and the one calculated for ship's technology. Contrary to this, the similarity between the word clouds calculated for deck and engine positions is relatively modest (except for the most basic terms like "ship" and "vessel"), indicating a sparse representation of these subjects in the STCW competencies.

Finally, the skills in the STCW Convention were classified according to their applicability. The classes were:

- Skills usable only for onboard positions, such as "1. Ability to use celestial bodies to determine the ship's position."

- Skills equally usable for onboard positions as well as for shore-based positions in the maritime or related industries, such as “21. Troubleshooting of electrical and electronic control equipment.”
- Skills useful for any position aboard or ashore (translational skills), such as “51. Development, implementation, and oversight of standard operating procedures.”

A pervasive interpretation was applied in deciding whether a specific skill is applicable for shore-based jobs and positions. This means that even the skills predominantly associated with shipboard jobs were equally assigned as applicable for jobs and positions aboard and ashore, provided that there are shore jobs where these could be extensively used. For example, skill “57 Preparation of contingency plans for response to emergencies.” was classified as equally applicable for onboard and shore-based jobs because experience in shipboard implementation appears to be highly relevant when developing contingency plans for shore emergencies.

According to the opinion of the four invited experts, Certificates of Competence at the management level provide:

- 90 skills appropriate for onboard use, 32 skills equally usable aboard and ashore, and ten skills for deck certificates, and
- 42 skills appropriate for onboard use, 55 skills equally usable aboard and ashore, and ten skills for engine certificates.

The exercise results are not surprising: it is well known that engineer officers relatively easily find shore-based jobs.

In addition, a relatively high number of skills are considered transitional skills. This number must be taken with caution since it covers a relatively narrow scope of transitional skills (mainly management-related).

The last point to be emphasised is that the STCW Convention does not contain defined learning outcomes in the psychomotor domain and even less so in the affective domain. However, there is clear evidence that skills in these two domains directly impact ship safety, security, and environmental protection.[31]

It may be concluded that:

(1) Minimal requirements of the STCW Convention for the management level functions onboard contain only the basic levels of “knowing”, i.e. knowledge (recognising or remembering facts, terms, and concepts), understanding of these facts and ideas (by comparing and interpreting the main ideas), and application, i.e. solving problems in new situations by applying previously acquired knowledge and understanding.

(2) For management-level positions, the STCW Convention does not assume higher-level capabilities, such as analysis, synthesis and evaluation.

(3) The STCW Convention does not refer to digital skills. Computer literacy is considered an optional tool (in the Model Courses) to support acquiring core professional skills.

[31] Michael Ekow Manuel: Beyond rules, skills and knowledge – Maritime education and training for optimized behaviour, dissertation submitted to WMU, 2005

(4) The STCW Convention contains only general references to pollution prevention. References mainly deal with proper handling of onboard equipment; there is no supporting information on the causes and effects of pollution, consequences and environmental protection principles.

(5) The STCW Convention refers to a limited set of transversal skills applicable in managing ships' crews (resource management, communications onboard, situational awareness and decision-making). These skills are designed solely for shipboard use.

(6) The STCW Convention does not require competencies needed for shore jobs at the management level in the maritime industry or competencies needed to manage sophisticated ships. Education for these jobs must necessarily include subjects significantly beyond STCW requirements, either as a part of regular education or in the form of upgrading courses.

Overview of literature

A literature search was carried out to identify the most critical projects and studies dealing with various aspects of horizontal transfer of workforce from ships to shore. Articles dealing with the subject are cited in the text or referred to in the bibliographic notes.

Projects

The most important projects dealing with the skills required or outlined in the maritime industry, carried out since 2000, are briefly explained in the following paragraphs.

METHAR. The project Harmonization of European Maritime Education and Training Schemes (WMU) consisted of a research study and concerted action. The METHAR research was carried out by a consortium of five partners, with one of the universities acting as a coordinator from 1997 until 2000. In the Concerted Action on Maritime Education and Training (CAMET), MET institutions and, in a smaller number, governmental MET administrations of the 15 participating "METHAR countries" were represented. The nationally appointed members in CAMET served as information providers to the METHAR partners. The 11 meetings of CAMET served as a discussion for METHAR findings and draft reports on METHAR work packages.

In cooperation with CAMET, the research project identified problems in the education and training of ships' officers in the 15 participating countries. METHAR/CAMET also identified the main reasons for these problems and made general proposals for solutions. Common European objectives at which an improved, more harmonised, and more widely applicable MET for ships' officers may be built are based on enhanced employability because of increased competitiveness through improved quality and innovation and extended mobility. The second set of Common European objectives aims to increase safety, environment protection and efficiency of sea transport through an overall improved MET.

The project identified the "reasons", explaining the main issues existing at that time. The reasons are divided into three groups: individual, industrial, and MET.

METNET. The project was a thematic network on Maritime Education and Training and the mobility of seafarers. This programme was carried out under the Fifth Framework Programme of the European Community for research, technological development and demonstration. It was carried out in the field of "Competitive and Sustainable Growth". The project was initiated in 2000 and concluded in 2003.

The main objectives of METNET were to improve the quality, harmonise the contents and extend the applicability of Maritime Education and Training (MET) for ships' officers in the EU. Improved MET quality is perceived to increase the competitiveness of ships' officers, create more jobs for EU citizens, and make EU shipping safer, more environmentally acceptable, and efficient. Harmonised MET contents should help

develop the basis for future European ships' officers, improve mobility, mutual recognition of their certificates and facilitate cooperation between MET institutions. Extended MET applicability should make the ships' officer career more attractive. It should help to meet the existing demand for national ship officers in most EU countries through an increased supply that will also ensure the provision of skilled and experienced ships' officers for positions in the maritime cluster ashore.

The project proposed the so-called 4E concept. The first E, *Essentials,* covers the STCW subjects according to the requirements for issuing the relevant certificate of competency. *The extension* includes MET, comprising more detailed and more comprehensive STCW subjects. In other words, STCW does not specify in detail the requirements for all subjects, such as marine environmental protection. Other subjects that are not mentioned in STCW but are considered relevant for shipboard operations also belong to *Extension*, including ship-shore information technology, freight contracts, charter parties, marine insurance, general and particular average, salvage, the safety of labour etc. *Enrichment* denotes MET, including subjects more relevant to occupations ashore. This considers the fact that increasingly more young MET graduates understand the shipboard career to be a part of a longer career within the wider maritime industry where shipboard experience is desired. MET institutions can develop their enrichment profile, such as maritime economy, maritime law, or maritime technology. Finally, *Elevation* brings about upgrading of the MET system (postgraduate studies). This is necessary to foster the maritime knowledge base in Europe. Certain occupations in the industry, administration and education require specialist skills and expertise that can only be obtained in postgraduate studies. Therefore, it should be possible for a limited number of candidates to attend postgraduate courses once they have spent enough time onboard.[32]

KNOWME. The KNOWME[33] project (Transport Research Institute at Edinburgh Napier University, United Kingdom) aims to create a maritime industry knowledge network for raising the knowledge level of the sector's human resources. In addition, it aims to improve the image and marketability of the industry among key decision-makers, the labour market, and the public. The KNOWME project focused on the importance of the human factor within the shipping industry, covered by the European Commission's Maritime Transport Strategy 2009-2018. The project lasted three years, from 2011 to 2014, and involved researchers from six countries across Europe.

Outputs of the project included:

- Best practices of maritime stakeholders related to social responsibility and sustainable development
- Strategy for using media as a means for improving the image of the industry
- Future demand of maritime professionals in the maritime and port industry
- Report on cross-cultural training needs of seafarers, shore-based personnel, and industry stakeholders
- The status of integration of maritime education and training in Europe and its future potential
- Training Needs Assessment Report
- State of policies and strategies for training, education, and knowledge development

[32] See more details in the proceedings of the 4th IAMU General Assembly, Jens-Uwe Schröder, Malek Pourzanjani, Günther Zade, The Thematic Network on Maritime Education, Training and Mobility of Seafarers (METNET): The Final Outcomes

[33] https://www.edumaritime.net/archived-pages/the-knowme-project-e-courses

- Development of a portal for career management and development[34]
- Development of three free e-courses (Cross-Cultural Training, Maritime Logistics and Supply Chain Management, Environmental Management)[35]

The Mapping of Career Paths in the Maritime Industries. The European Community Shipowners' Associations (ECSA) and the European Transport Workers' Federation (ETF) engaged in a joint project with the support of the European Commission called The Mapping of Career Paths in the Maritime Industries.[36] The objective of the study was to provide, through the construction of a series of career maps across a range of the Member States, an overview and/or global estimates of the following: possible and actual career paths of seafarers; demand for seafarers at sea and in relevant shore-based maritime sectors, where information is available; and barriers to the mobility of qualified seafarers between the sectors.

During the project development, considerable similarities between maritime industries in the various member states and a number of differences became apparent. It was hoped that this study would contribute to the understanding of these parameters. The individual member states would be able to learn from each other if appropriate and resolve the issues within their own distinctive maritime and national culture.

One of the interesting comments in the study refers to education for shore positions:

"An officer's education may be too preoccupied with narrow operational, technical questions for some management positions ashore. There is a view among some prospective shore-based employers that maritime education should focus more on general management issues, including commercial and business management."

The project was extensively updated in 2013.[37] The Maritime Career Path Mapping, 2013 Update, as developed on request by ECSA and ETF, provides an overview of the structures in place in Denmark, Germany, Greece, Italy, Latvia, the Netherlands, Poland, Spain, Sweden, and the United Kingdom.

KIKLOP. Development of qualifications and innovative methods of competence acquisition in logistics and maritime transport (the University of Rijeka, Faculty of Maritime Studies).[38] This project aimed to explore the real needs of the labour market in the field of maritime transport and logistics, to identify new knowledge and new interests, to develop proposals, occupational standards and qualifications standards in accordance with the principles of the Croatian Qualifications Framework, and in accordance with the industry needs. In addition, it sought to adjust the educational programmes and to offer high quality, efficient and innovative higher education based on the SMART learning outcomes, enabling the mobility of educational programmes, studies, students and teachers, retaining the flexibility to adapt to constant and rapid changes in the broader social context.[39]

EU-PORTRAItS. The project European PORTWorkers TRAIning Scheme (Centre for Research and

[34] www.go-maritime.net

[35] www.go-maritime.net/e-courses

[36] http://www.ecsa.eu/sites/default/files/publications/054.pdf

[37] https://www.ecsa.eu/images/files/Rapport_Maritime_Career.pdf

[38] http://www.kiklop.eu/

[39] The outcomes of the KIKLOP project have been used as a basis for selection of the key players in the Croatian maritime industry.

Technology, Greece)[40] facilitates the implementation of a broad and open dialogue with the social stakeholders to establish a mutually recognisable framework on the training of port workers in different fields of port activity. It aims to bring EU maritime industries to the forefront of competition by investing in developing well-trained, competent and strong human capital, thus securing the employees' rights at work.

EU-PORTRAItS examines the 'map' of the EU 'human capital' concerning the sector's current and future needs and requirements for well educated, trained and qualified staff, who can ensure safe and efficient operations in EU ports, securing the competitiveness of the industry.

Reports and studies

Finally, the essential reports and studies recently published and dealing with foreseeable changes in the shipping industry are described in the following section.

Seafarers and digital disruption - The effect of autonomous ships on the work at sea, the role of seafarers and the shipping industry was prepared by the SBA Hamburg School of Business Administration for the International Chamber of Shipping (ICS) in 2018. The study aims to identify and highlight issues that may have consequences for seafarers because of possible digital disruption onboard ships. It also serves as a basis for further discussions, research and strategy building. The goal is to define essential developments in line with other bodies of ICS that derive from:

- digitisation and digitalisation of ships and their systems
- digital transformation of ship operations
- increased autonomy of ships and their systems
- the newly emerging trend of cooperation between shore-based operating centres (Remote Operating Centres, ROCS) and ship-centred input

The study enables a discussion in a structured manner about the effects on the regulatory environment, training of new skills, re-skilling, manning, awareness of security considerations, the social environment and all aspects of labour relations, including seafarer well-being welfare (mental and physical). The conclusions are highly relevant for anyone aiming to design study programmes for shore jobs in the maritime industry, particularly the one under consideration in this report.

The study titled **Autonomous vehicles' impact on port infrastructure requirements** was prepared by the Fraunhofer-Center für maritime Logistik und Dienstleistungen CML for Hamburg Port Authority and IAPH Port Planning and Development Committee.

This study aims to provide an overview of the current state of autonomous driving in ports and its consequences for planning and developing ports' infrastructure regarding future requirements. Furthermore, the study aims to formulate recommendations for action supporting port authorities in preparing themselves for technological progress. The study covers four transport modes road, rail, waterway and aerial transportation.

In **An exhaustive analysis of employment trends in all sectors related to sea or using sea resources**, Summary report for the European Commission, DG Fisheries and Maritime Affairs, prepared in 2006, the authors anticipated significant developments and significant employment opportunities. Interestingly,

[40] https://www.imet.gr/index.php/en/projects-en-2/indicative-sector-c-projects-en/212-eu-portraits-en

positive prospects involving shore-based jobs are expected much more than in respect of shipboard jobs.

The study titled **Analysis of the trends and prospects of jobs and working conditions in transport,** prepared in 2015 by Panteia deals with overall EU prospects for jobs and working conditions in transport. Annex 12 to this Study, entitled **Labour Market Maritime Transport,** has a significant bearing on this Report. The Annex covers the PESTLE-analysis,[41] labour market trends, discrepancies in the labour market, options to reduce the discrepancies, and the main findings. In the main report, one can also find a detailed assessment of the relative job quality, a review of the human capital perspective, a consideration of a human capital map of the EU transport sectors for 2010 and 2020, and other supporting materials.

Maritime Training Insights Database (MarTID) is a non-commercial initiative collaboratively founded by the World Maritime University, New Wave Media and Marine Learning Systems. The database was initiated in 2018, and since then, has provided annual reports. The database provides a global picture of maritime training not currently available elsewhere. It provides data on current and emerging training trends and techniques, staffing models, focus areas, training tools, resource allocation, and assessment practices. It allows each organisation to benchmark their practices and enables governments and other regulatory agencies to be more informed and effective in their oversight and industry support. It helps to highlight training issues and training successes and disseminates that information quickly and broadly through a free and widely circulated annual report. The overarching goal is to make the industry safer and more efficient, benefiting everyone. It is based on questionnaires sent to ship operators, seafarers and MET institutions. The last issue (2019) deals explicitly with autonomous vessels, as seen by those questioned.

Finally, probably the most important study published recently and directly dealing with present and future education of seafarers and workers in maritime transport industries is that prepared by the World Maritime University and the International Transport Workers' Federation, entitled: **Transport 2040: Automation, Technology, Employment - The Future of Work** (2019).

The goals of the study were:

- Which new and emerging technologies will be introduced in global transport?
- How will global transport develop until 2040?
- What are the effects on the transport labour force?
- What is the impact of local factors on implementing technology and automation?

Key findings of the study are:

- Economic benefits, demographic trends and safety factors are catalysts for automation, but in many areas of global transport, the pace of the introduction of automation will be gradual.
- The increasing trade volume leads to more demand for transportation in the future, while regional changes in transportation patterns are expected.
- With the gradual pace of the introduction of technology and the increased volume of trade, their effects on employment are predictable. Low- and medium-skilled workers will be exposed to a high risk of automation. However, the pace of introduction and diffusion of technologies will

[41] In PESTLE analyses P stand for Political, E for Economic, S for Social, T for Technological, L for Legal and E for Environmental. The method gives a bird's eye view of the whole environment from many different angles that one wants to check and keep a track of while contemplating on a certain idea/plan.

depend on differences in the development stage of countries and their comparative advantages.

- The local context influences automation and technology. The assessment of individual country profiles shows that countries and regions are not at the same level of readiness to adopt new technologies and automation. An analysis of relevant vital factors highlights the gap between developed and developing countries.
- The study describes in detail the expected new technologies. It summarises expectations in the main areas, the essential one referring to the expected trends in respect of employment and professional developments.

Therefore, it may be concluded that:

(7) The importance of the availability of a skilled workforce, onboard and ashore, for efficient development of the maritime industry has been identified in the past.

(8) The accelerating transformation of the industry can be recognised in the study of all the sources investigated. Therefore, it is beyond any doubt that the maritime industry is facing significant technological challenges.

(9) These changes will inevitably alter the required skill sets required for onboard and shore-based jobs and positions. Consequently, an effective transfer of knowledge of shipboard operations and expertise needs to be assured if the present position of the EU maritime industry is to be maintained

Overview of common MET institutions and programmes

The training of seafarers was traditionally based on empirical knowledge acquired during shipboard work. During the 19th century, new challenges - the most essential being the introduction of steam engines - necessarily led to the development of a different approach to the education of seafarers. Being historically related to the navy, many maritime schools at the time maintained a military-style and did not follow the development paths of higher education institutions. During the first half of the 20th century, many maritime schools established close relations with shipping companies and mainly focused on providing specialist maritime education and training for these companies.

A significant development took place in the 1970s and 80s when numerous maritime schools, mainly those offering post-secondary education, became members of the local universities or agreed on some form of formal relations with universities. Some of these higher-education MET institutions continue to provide MET as VET institutions and some as university institutions - the foremost difference is institutional participation in research programmes. In the 1980s, though highly diversified in their status and formal goals, these MET establishments instigated international cooperation, firstly through the International Maritime Lecturers' Association (IMLA[42]) and later through the International Association of Maritime Universities (IAMU[43]). While IMLA continues to be an association of individuals (i.e. lecturers at higher education MET institutions), IAMU represents an association of institutions and requires that each institution provides one or more study programmes leading to Certificates of Competence at the management level and at least one study programme at Master of Science degree level[44].

Higher education MET institutions

Programmes offered by MET HEI institutions deliver coherent STCW-related study programmes, mainly those leading to Certificates of Competency at management level and non-STCW study programmes. The non-STCW programmes commonly focus on maritime trade and business, international shipping and logistics, maritime law, and similar.

Duration of these programmes is as, a rule, two to three years and may include onboard training. Sometimes onboard training, as a prerequisite for the respective Certificate of Competency, is left to be arranged by the students themselves. In several countries, programmes are offered as "sandwich" education, i.e. periods of academic activities interchanged with periods of onboard training.

The programmes required for the management level and offered by higher MET institutions may be grouped into two broad categories:

- programmes offering STCW subjects only, with no or with only additional minor subjects
- programmes offering STCW subjects but extended in scope and depth

VET institutions usually provide the first group of programmes. The education process is most often adjusted to the needs of serving seafarers. The duration of the programme depends on whether onboard

[42] http://www.imla.co/

[43] https://iamu-edu.org/

[44] As of April 2019, IAMU has 66 members from 35 countries,

training is a part of the process or not.

According to the European Qualifications Framework, the second group of programmes are commonly offered by university-level institutions and are usually identified as Level 6 programmes. In addition to core STCW skills, these programmes commonly assume more in-depth knowledge in core professional skills such as mathematics, mechanics, and stability. They are extended with the maritime economy, technology, and/or maritime law subjects.[45] Most institutions at this level are members of their respective universities (usually, universities of applied sciences[46] or polytechnics[47]). Some are fully-fledged technical universities offering a range of programmes for the maritime industry.[48]

In many cases, particularly in EU member states, institutions offer top-up programmes for those who are willing to continue their careers onshore after serving as officers in shipboard management-level positions.

It should be emphasised that the courses offered by EU VET and university-level institutions are characterised by high diversity in terms of their duration and modes of delivery, even in the case of subjects outlined in the STCW Convention. The most fundamental reason for such diversity is development based on the predominant education model in a respective country, different national interests, and traditions. Consequently, the wide diversity of programmes and modes of delivery means that identifying skill gaps based on the analysis of these programmes does not guarantee sufficiently reliable results.

Maritime training centres

With the adoption of the amendments to the STCW Convention in 1995, seafarers at all levels and positions were required to attend one or several short, usually very practical, courses. These courses initially dealt mainly with safety subjects, while subsequently the range of required courses included security issues and pollution prevention.

Although in many cases being a part of regular education, the short courses instigated the development of maritime training centres – institutions offering these short courses primarily to shipping companies or seafarers who did not acquire such competencies during regular education. Most maritime training centres are privately owned and profit-oriented. Some are owned, entirely or partially, by one or several shipping companies, and they provide training primarily to seafarers employed by these companies.[49] On the other side, many MET institutions run their maritime training centres as separate profit-oriented units, offering short courses to their students as part of the study programme and shipping companies and seafarers.

The number of maritime training centres varies, and there are probably hundreds of such centres at the global level.[50]

[45] For example, the Solent University - Warsash Maritime Academy offers eight undergraduate programmes, of which only two comprises STCW skills leading to the management level CoC. In addition to these, the University offers another four postgraduate programmes, all offering maritime subjects. https://www.solent.ac.uk/courses/

[46] Bremen University of Applied Sciences, https://www.hs-bremen.de/internet/en/studium/stg/nautik/

[47] Universitat Politècnica de Catalunya Barcelona, Facultat de Nàutica de Barcelona, https://www.upc.edu/en/the-upc/schools/fnb

[48] Gdynia Maritime University, https://www.umg.edu.pl/en/

[49] See for example Helen Sampson & Lijun Tang (2016) Strange things happen at sea: training and new technology in a multi-billion global industry, Journal of Education and Work, 29:8, 980-994,

50 For example, in Croatia there are 26 authorised maritime training centres, while in the Philippines 63 approved maritime training centres operate only in the Metro Manila area (https://www.seamanmemories.com/list-

In the early 2000s, the largest number of maritime training centres mainly offered STCW-required training. More recently, many developed training programmes dealing with the subjects proposed by the industry, going way beyond the requirements of the STCW Convention. The most prominent non-STCW subject areas are:

- the offshore industry, including exploration of oil[51] and gas and wind farms
- operation of large yachts/superyachts
- handling (manoeuvring) ships with unusual characteristics
- handling sophisticated shipboard equipment
- ship and cargo surveying
- hotel management
- operation of fishing vessels, etc

In the early 2000s, many companies started inviting their crews – mainly those at the management level – to shore-based seminars to keep them up-to-date on numerous subjects. In the beginning, the primary goal was to increase the safety culture onboard ships. However, the range of subjects was rapidly increased to include commercial subjects and new technological advances. An indicative, though not exhaustive, list of topics is provided below:[52]

- changes in legislation applicable to ships and industry
- management reviews
- safety, quality, environment, health, energy, operational matters
- accident/incident/near-miss and their root causes/lessons learnt,
- customers' complaints
- security, cyber security
- company philosophy, etc

Therefore, seafarers onboard sophisticated ships may be required to attend numerous courses (besides those required by the STCW Convention) during their seagoing career. Very relevant evidence is provided in the analysis of the list of various certificates acquired by masters on LNG carriers[53] , and large passenger

of-marina-accredited-maritime-training-centers-in-manila-2018/)

[51] Offshore Petroleum Industry Training Organization – OPITO (UK) has designed numerous courses for offshore industry, which became *de facto* industry standards. The courses are provided by numerous training providers all over the world.

[52] E. Bal Besikci, J.U. Schröder-Hinrichs, A. Sıhmantepe, D. Dalaklis, J. Larsson, Evaluating maritime education and training needs for tanker shipping companies, 13th International Technology, Education and Development Conference, Valencia-Spain, 2019

[53] The courses presented here are required for masters on LNG ships operated by companies operating 188 LNG ships at the time. See Gundić, Ana; Ivanišević, Dalibor; Zec, Damir, ADDITIONAL MET PROGRAMS FOR THE MASTERS ON BOARD LNG CARRIERS // Proceedings of the 7th International Conference on Maritime Transport, Barcelona: Oficina de Publicacions Academiques Digitals de la UPC, 2016

ships carried out in 2015 and refreshed for this report.[54]

From the data analysed above, the following may be concluded:

- Several courses are focused on dedicated equipment standards for specific ship types. The main goal seems to be to ensure in-depth knowledge and hands-on experience for key personnel (for example, Ship Handling & Manoeuvring - Azipod).
- A large group of courses is dedicated to ensuring safe and uniform implementation of complex procedures, mainly those involving teamwork (for example, Maritime Resource Management - Attitude and Management Styles).
- Several courses aim to improve human interactions (such as Bridge Resource Management and similar).

A significant overlapping in subjects and goals can be noted from the lists presented. In addition, most courses are designed to last between three and five days.

A significant number of courses are simulator-based, with a great deal of hands-on training. Moreover, in several advanced maritime training centres, handling of large, sophisticated ships is carried out using manned models to increase the reality of the training.

Another essential observation is a specific difference in requirements across different companies. There is a strong belief that additional competencies are needed, but there is no consensus on which competencies are essentially needed.

As pointed out by Manuel[55], "traditional seafarer training has always focused on the acquisition and use of practical skills. This approach recognises that a degree of cognitive skills is needed, but it focuses on and emphasises the acquisition of hands-on practical skills. On the other hand, academic education has been much more focused on developing in-depth analytical and critical thinking skills; cognitive skills that are less reliant on hands-on task-oriented training, but stress critical reading and discussion."

These two opposing views are even more polarised in the case of highly sophisticated ships. On the one side, all activities onboard are considered "vocational", i.e., jobs requiring only job-specific technical training and not requiring higher knowledge skills. On the other hand, it is pretty clear that the complexity of the environment and systems to be controlled and managed demands abilities and skills way beyond traditional vocational training.

Specialised MET establishments

Specialised MET establishments may be defined as institutions or establishments providing specialised and/or high-level education, mainly for people already working in the maritime or shipping industry ashore or for seafarers looking for a job ashore. They may be understood as educational units offering more in-depth knowledge and competencies than maritime training centres but less consistent and overarching than education programmes offered by universities or similar institutions.

The courses offered may be of different duration, from a few days up to 18 months. Stand-alone courses

[54] Courses for which data on duration and content were available are listed in Annex 1 and 2.

[55] Manuel M.E, Vocational and academic approaches to maritime education and training (MET): Trends, challenges and opportunities WMU Journal of Maritime Affairs, September 2017, Volume 16, Issue 3

may be a part of one or more longer courses, thus providing flexibility for participants in terms of content, duration, and degree. Specialised MET establishments, as a rule, offer programmes tailored to full-time and part-time students, executives (abridged coursework typically occurring on nights or weekends) and distance and online learning students, many with specialised topics.

Course subjects mainly include maritime law and finance; contracts and insurance; management; offshore (oil and gas mainly); port operations; logistics; safety; ship manning and operations; and shipbuilding.

After graduation, the participant may be awarded a certificate, diploma or degree, depending on the national accreditation system requirements. Programmes leading to an MBA or MSc degree are as a rule carried out in cooperation with one or more established educational institutions, usually universities.

These institutions may use traditional modes of teaching (i.e. front-end lecturing), although more modern modes of delivering are predominant, such as distance or blended learning.

Examples of recognised MET establishments include the Lloyd's Maritime Academy (UK)[56] and STC Maritime & Logistics University of applied sciences (Netherlands).[57]

Different entities with accumulated knowledge in a specific maritime field view this as an opportunity to enter the education market and offer courses in their fields of expertise. This approach can be recognised among classification societies[58] . It can also be noted among equipment producers (for example, Kongsberg[59]), associations (for example, IALA[60]), and maritime training solution providers (for example, Videotel, Seagull, Marlins, etc[61]). However, the programmes offered by those ventures usually remain close to their field of expertise and rarely offer courses from other fields.

MET establishments' courses mainly target shipping companies' employees and supporting industries. The course subjects are flexible in terms of duration, scope and delivery. The most attractive courses cover maritime law, maritime economy and ships' technologies.

It may be therefore concluded that:

(10) There is very high variation in institutional forms offering maritime training and education, ranging from privately owned institutions offering only short courses to seafarers and shipping companies up to independent maritime universities.

(11) In almost all EU member states, the university-level study programmes delivering courses in the field of international shipping and logistics, maritime law and business, port management (i.e. programmes for the shore-based maritime industry) are identified.

[56] http://www.lloydsmaritimeacademy.com/

[57] https://stc-mlu.com/en/

[58] See DNV-GL (https://www.maritime-executive-diploma.com/) and ABS (https://ww2.eagle.org/en/Products-and-Services/maritime-training.html)

[59] https://training.km.kongsberg.com/course-category

[60] The objective of the IALA Academy is not to conduct training itself, but to develop and promote the use of its model training courses. The Academy will facilitate such courses as required. https://academy.iala-aism.org/wwa/training/

[61] https://videotel.com/maritime-training-solutions

(12) Maritime education and training institutions offering education leading to management-level Certificates of Competency are in most cases supervised by the ministries responsible for education and by the ministries responsible for maritime affairs.

(13) The cooperation among EU MET institutions is irregular and of questionable usefulness. The cooperation among MET institutions in different countries occurs mainly as a part of EU-funded projects. And even in this case, the institutions cooperating are mainly those with specific research capabilities while others participate only sporadically.

(14) No recognised EU-wide initiatives aim to harmonise maritime education programmes offered by different institutions or in different countries. This is not the case even regarding the subjects defined in the STCW Convention. The only formal contact identified among MET institutions regarding study programmes is a partial comparison of courses delivered by two institutions at the university level within the Erasmus student exchange programmes.

(15) Thanks to ever-accelerating technological development and the increasing number of high-tech companies who accumulate expertise, the number of education and training providers for dedicated applications is expected to increase significantly, thus changing the institutional position of the traditional MET providers.

(16) New modes of delivery (blended learning, distance learning and similar) are expected to increase their share.

(17) The number of specialised courses aiming to upgrade or re-skill adult workers associated with the maritime industry and who have already earned degrees is expected to increase, both in numbers and scope.

Survey

The main objective of this survey was to define the essential areas of knowledge and expertise required by seafarers and shore-based personnel employed with modern shipping companies and companies operating in related industries.

Two surveys were developed, one for seafarers and one for shore-based personnel. Both questionnaires share the same core set of questions. At the same time, the one for shore-based staff also includes an additional set of questions, mainly related to expected developments in the maritime industry.

Both questionnaires were developed and distributed using the SurveyMonkey platform.[62] Participation was voluntary, and participants were allowed not to answer a question or questions or terminate their participation at any time.

Shipboard personnel

The questionnaire for seafarers was developed with a strong focus on active seafarers. The target group was seafarers with at least 20 years of working experience and serving at management level positions (masters, chief mates, chief and second engineers).

The questionnaire consists of the following parts:

- information on the person questioned: age, ship department, education, onboard experience and rank
- general information about the company: country of residence, size, predominant area of activity
- views on onboard skills and competencies, such as professional education and basic competencies, professional competencies (STCW functions), appropriateness of professional knowledge and skills, recognised skill deficiencies, the essential subjects in maritime law, maritime business and technology, and transitional skills
- views on the transition from onboard jobs to shore jobs, such as target jobs, required onboard experience, missing skills, and successfulness of the transition

Initially, the survey questionnaire was distributed through the European Transport Workers' Federation (ETF). After that, it was distributed directly from partners and through selected publications.

In total, 1,149 responses were collected from seagoing personnel. Altogether, seafarers employed with companies residing in 51 countries participated in the research. Countries of residence of the companies with the highest percentage of respondents are the UK (36%), Netherlands (16%), Sweden (9%), Denmark (6%), the US (6%), Norway (5%), Singapore (4%), Germany (4%), Poland (2%), Turkey (2%) and Cyprus (1%).[63]

[62] https://www.surveymonkey.com/

[63] Seafarers employed with companies registered in Antigua and Barbuda, Australia, Bahamas, Bahrain, Belgium, Brazil, Canada, China, Croatia, Finland, France, Greece, Iceland, Indonesia, Ireland, Italy, Japan, Kuwait, Latvia, Liechtenstein, Lithuania, Malta, Marshall islands, Monaco, New Zealand, Nigeria, Oman, Philippines, Portugal, Qatar, Romania, Russian Federation, Saudi Arabia, Solomon Islands, South Africa, Spain, Swaziland, Switzerland, Thailand and UAE also participated in the survey.

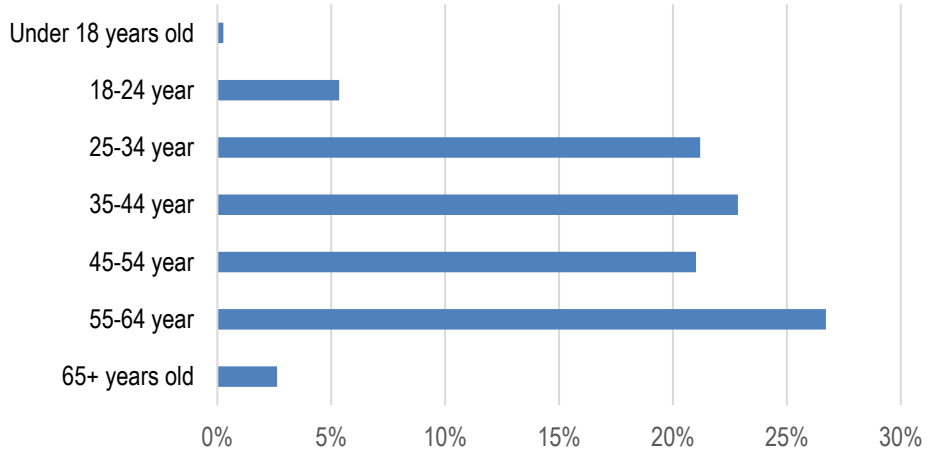

Figure 14 Age of the participants

The majority (27%) were in the age group from 55 to 63 years. Almost a quarter of respondents were in the age group from 35 to 44 years (23%), while 21% of respondents were in the age group from 25 to 34 years and those from 45 to 54 years. Less than 5% were respondents in other age groups (younger than 24 years or older than 65 years). In this respect, the survey confirmed expectations and collected opinions from experienced seafarers.

Most respondents have a deck (61%) and engine (33%) background. Only 6% of the respondents are with other departments. These proportions were not surprising and are considered as not biasing the overall results.

Almost half of the respondents graduated from high schools (40%), 27% hold BSc degrees, and 12% hold MSc degrees. In total, 20% of respondents stated that they hold other degrees. Eleven respondents selected a PhD as a level of education, representing almost 1% of the total population, while 131 respondents identified themselves as holding MSc level. This data (12% of the total population hold MSc and PhD!) indicates a significant inclination to higher levels of education among seafarers, particularly among masters and deck officers who represent 71% of seafarers with MSc and PhD degrees, and participating in the survey.[64]

[64] In respect to total population It may be reasonable assumed that seafarers holding MSc and PhD degrees are much more inclined to participate in surveys like this one.

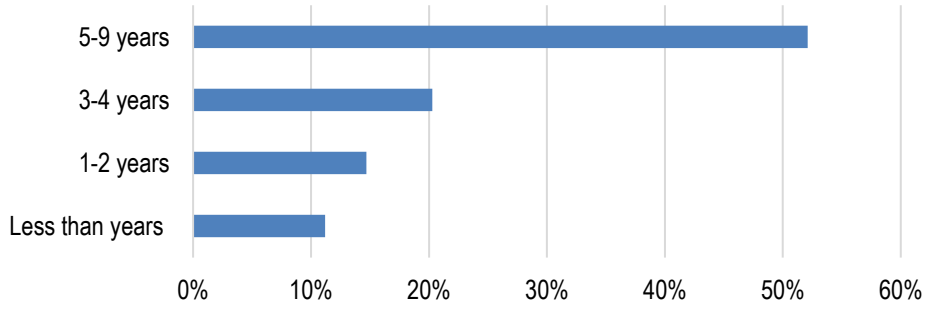

Figure 15 Respondents' onboard experience

Most respondents (75%) spent 10 or more years at sea. This indicates that senior seafarers, who have chosen a seagoing career as a lifelong job, are keen to participate in surveys like this one and share their views and experience. Accordingly, the second largest group consists of those who have served at sea for between 5 and 9 years.

In line with these conclusions, the majority of those who participated were Masters, followed by Chief Engineers and Chief Mates. These data indicate that the target group has been successfully approached, as intended in the survey plan.

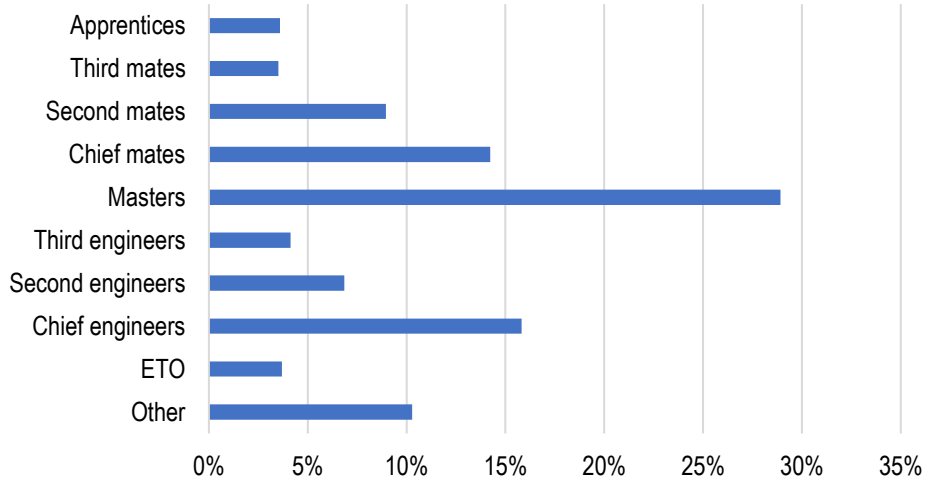

Figure 16 Respondents' onboard positions

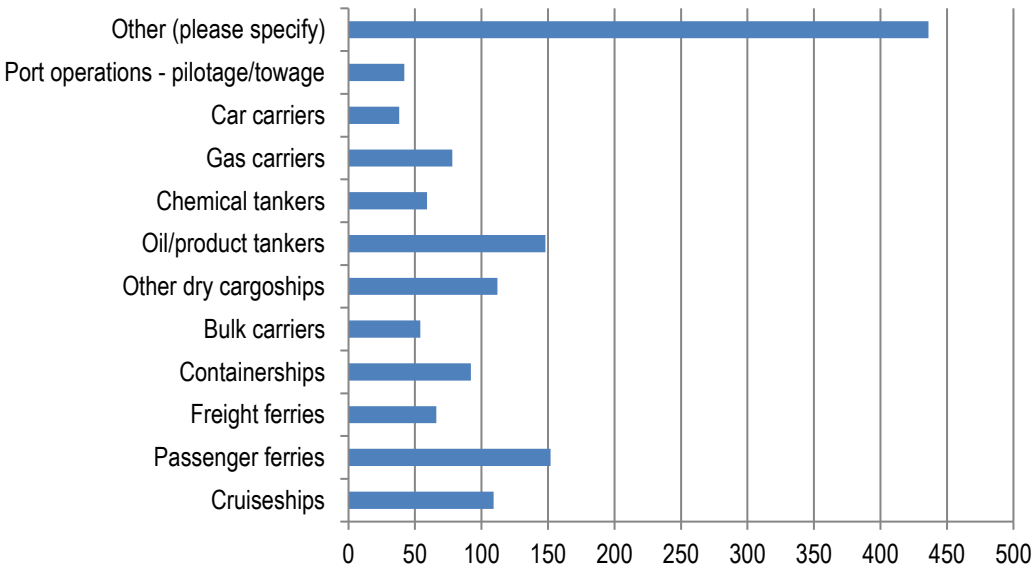

Figure 17: The field of trade the respondents' present companies predominantly operate

Regarding the field of trade, the respondents served in all the proposed trading areas. Most respondents serve on oil and product tankers and passenger ferries (11% each), followed by other dry cargo ships and cruise ships (8%). The largest group consists of respondents (32%) who selected the "other" option, i.e. a field of trade not listed in the questionnaire. The most frequent field of trade in this group was different types of vessels engaged in the offshore industry.

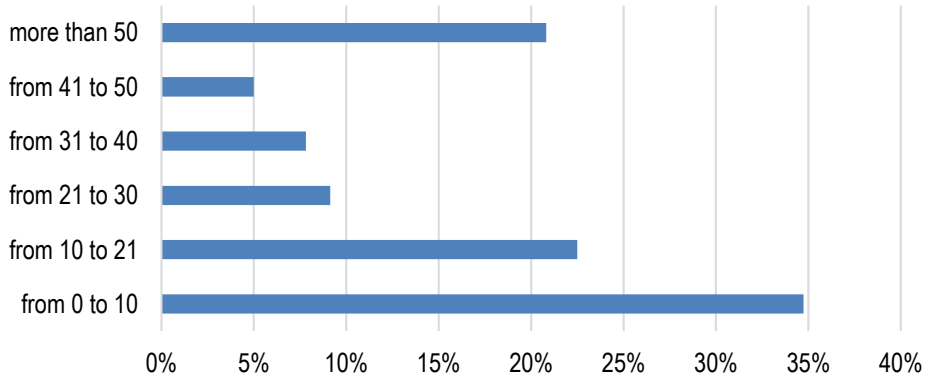

Figure 18 The size of the company's fleet

Most of the respondents (35%) are employed by rather small companies, operating up to 10 ships. However, 21% of all respondents are employed by companies operating more than 50 ships.

More than half of the respondents (57%) stated that the companies they are employed by are trading globally, and only 7% of the respondents indicated trading within national borders. The same 7% of respondents indicated a regional trade as predominant. Almost 29% of all respondents are trading within European waters, thus indicating a well-balanced distribution of respondents in respect of their predominant trade area.

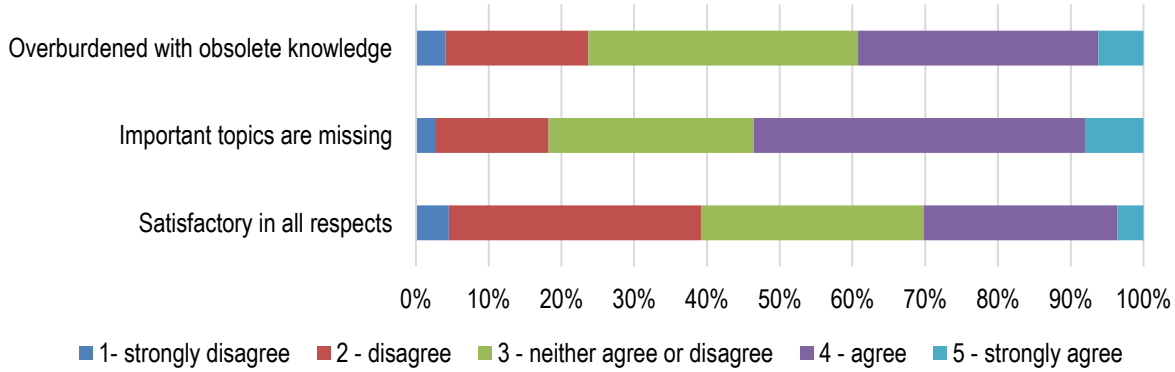

Figure 19 Respondents' position on professional education and competencies as outlined in the STCW Convention

Respondents strongly questioned the validity of professional education and competencies as outlined in the STCW Convention. In that respect, many respondents (35%) indicated that professional education and competencies (as outlined in the STCW Convention) are unsatisfactory. In comparison, 22% of all respondents emphasised that essential topics are not dealt with in the STCW Convention. Finally, 33% of respondents agreed that professional education and basic competencies are overburdened with obsolete knowledge. It is essential to note that presented "disagreements" are equally distributed among respondents.

Bearing in mind that many respondents are experienced seafarers, such statements reveal considerable dissatisfaction with the present model of education based on the STCW Convention.

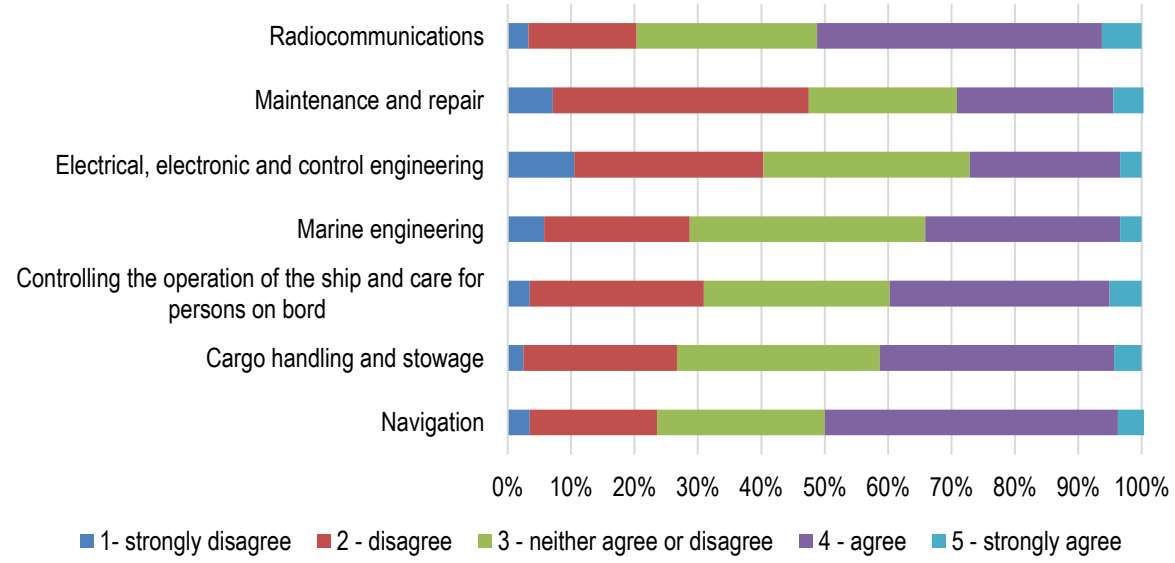

Figure 20 Respondents' position on compliance of professional competencies (STCW functions) with actual onboard needs

In this question, respondents were asked to refer only to certified functions.

Accordingly, respondents expressed significant concerns on compliance of professional competencies with actual onboard needs. Functions identified as being the least compliant with actual needs are *Maintenance and repair* (47%) and *Electrical, electronic and control engineering* (40% of respondents).

Marine engineering and *Controlling the operation of the ship…* are functions considered more compliant. However, 28% and 31% of seafarers considered these competencies inadequate for onboard duties even for these functions.

Functions considered as mainly in accordance with onboard needs are *Radiocommunications* and *Navigation*. But even for these two functions, 20% and 24% of respondents, respectively, consider these competencies as not in line with onboard needs.

In principle, competencies acquired in accordance with the STCW Convention, although being the minimum standard, should be adequate for all safety, security and pollution prevention related tasks. Therefore, the seafarers' views on the shortcomings of STCW professional competencies are considerably beyond expectations and serve as a cause of serious concern.

In principle, professional knowledge and skills depend on numerous factors. Therefore, respondents were asked to express their opinion on several distinctive groups' professional knowledge and skills. It should be noted that the presented qualifications are not verified facts, although they are based on a pretty large sample. Therefore, the answers presented here should be considered predominant beliefs among those questioned.

Accordingly, more than 40% of all respondents identified younger seafarers and non-European officers as not being qualified in accordance with their expectations. The highest level of appropriate professional knowledge and skills (65%) are identified among officers older than 50 years.

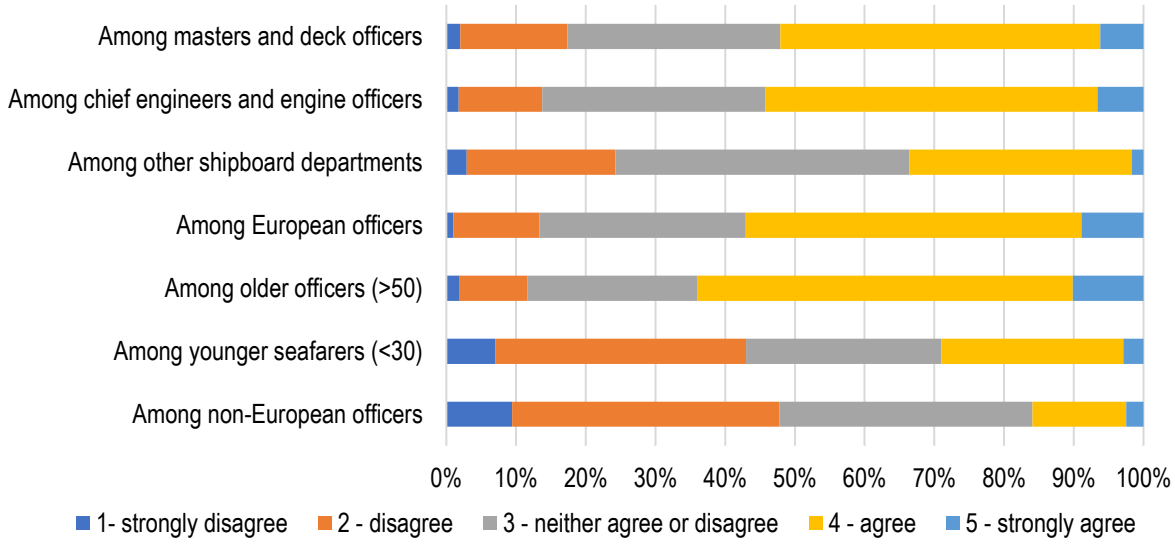

Figure 21 Respondents' position on the appropriateness of professional knowledge and skills among different groups

Considering that most respondents are senior European masters and officers, it is perhaps not surprising that these groups are identified as the most skilful. Several factors may lie behind this attitude, such as cultural differences, communication issues, inappropriate expectations from newcomers and apprentices,

misunderstanding of the role of onboard training, and effectiveness of MET processes.

Much more exhaustive research on professional qualifications is recommended based on the evident differences. It may be accompanied by more comprehensive research into different beliefs and attitudes among seafarers.

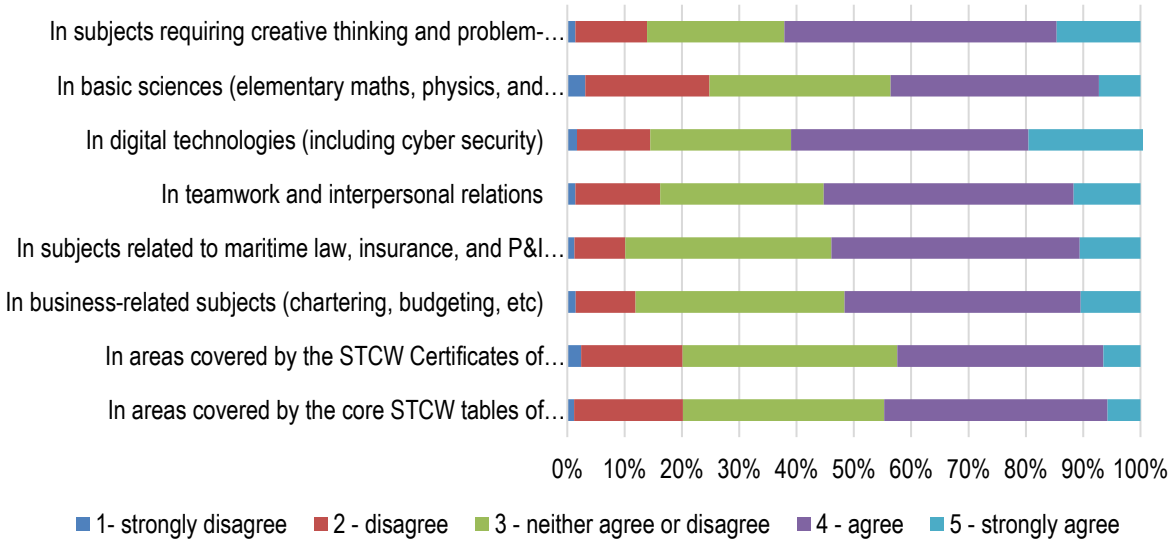

Figure 22 Subject areas with serious skill deficiencies

The next question sought to identify more precisely the subject areas where respondents noted serious skill deficiencies. In that respect, almost half of the participants agree that serious skill deficiencies can be recognised in:

- subjects requiring creative thinking and problem-solving (62%)
- familiarity with digital technologies, including cyber security (61%)
- teamwork and interpersonal relations (55%)
- subjects related to maritime law, insurance, and P&I coverage (54%)

In this question, respondents evidently pinpointed transitional skills (i.e. non-professional skills; skills only modestly identified in the STCW Convention) as a group of skills where the most severe skill deficiencies are recognised.

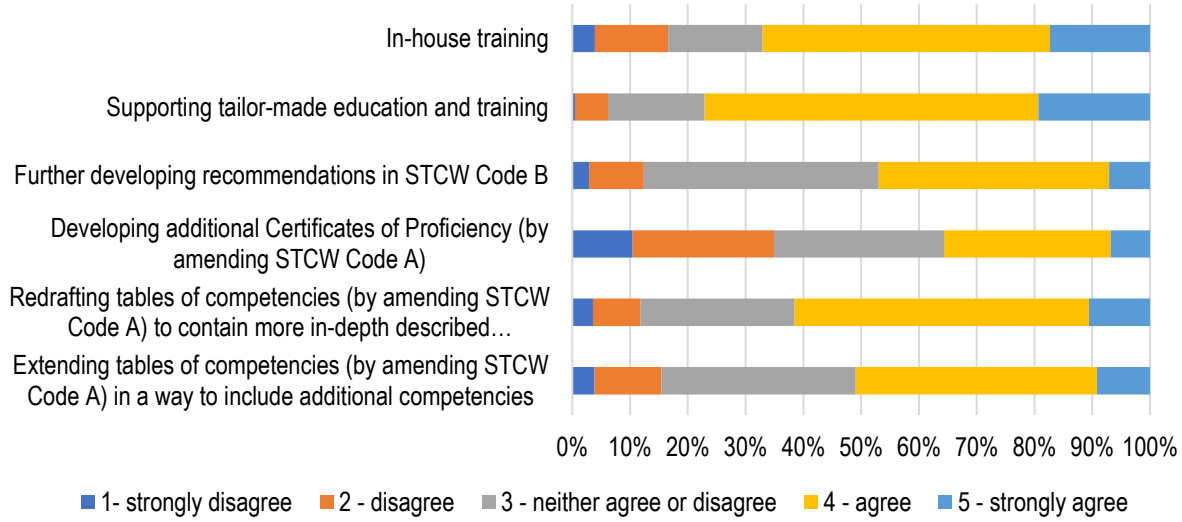

Figure 23 The most effective ways to improve STCW competencies

According to respondents, the most effective ways to improve STCW competencies are further personalised education and/or training modes. Consequently, *Tailor-made education and training* is supported by 68% of all respondents (58% of respondents agree and 10% strongly agree). Almost the same percentage, 67%, supported *In-house training* (50% of respondents agree and 17% strongly agree). This indicates that seafarers expect much active participation from shipping companies in their professional development.

It is essential to note strong support for redrafting the STCW Code A and to include more in-depth described professional competencies (51% of respondents agree with this proposal). Respondents also opposed further development of Certificates of Proficiency by amending the STCW Code A (29% agree, while 25% disagree and 10% strongly disagree with this idea).

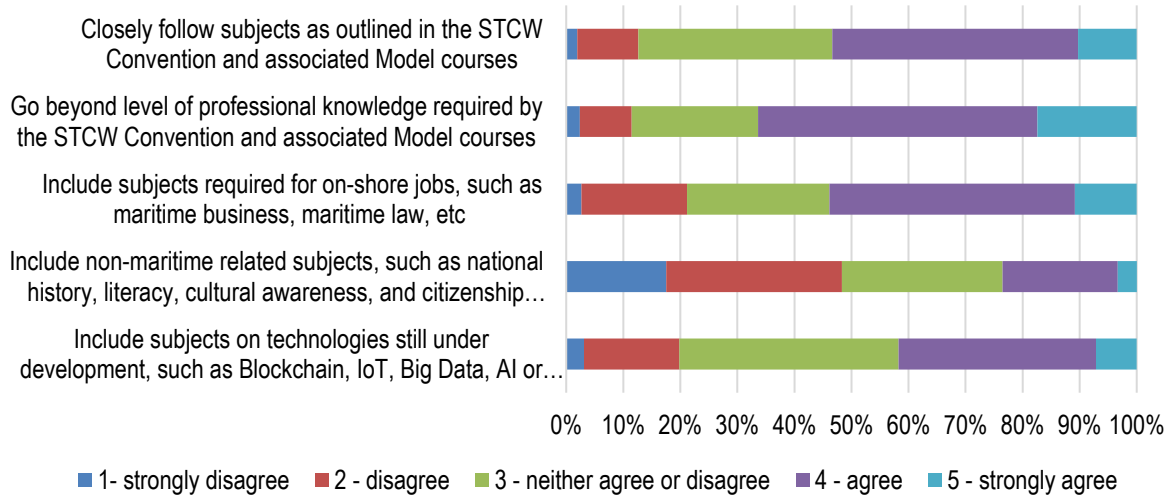

Figure 24 Preferred further development of MET institutions

In line with previous statements, most respondents suggest that maritime institutions should offer education and training beyond that assumed in the STCW Convention and associated Model Courses (49% agree and 19% strongly agree). Only 2% of respondents strongly disagree with this statement!

However, the opinions on the following two questions are almost equally divided between those who suggest close adherence to the STCW Convention requirements and those who propose to include subjects most appropriate for those planning to continue their career ashore. It seems that these answers depend mainly on personal preferences.

It should be noted that non-maritime related subjects are not welcomed. Only 23% of respondents favour these subjects, while 48% disagree or strongly disagree. This obviously indicates a desire among respondents for a strong focus on professional development.

Finally, there are mixed feelings about technologies still under development. Almost 39% of respondents have no opinion on the subject, while 42% would like to see subjects on new technologies.

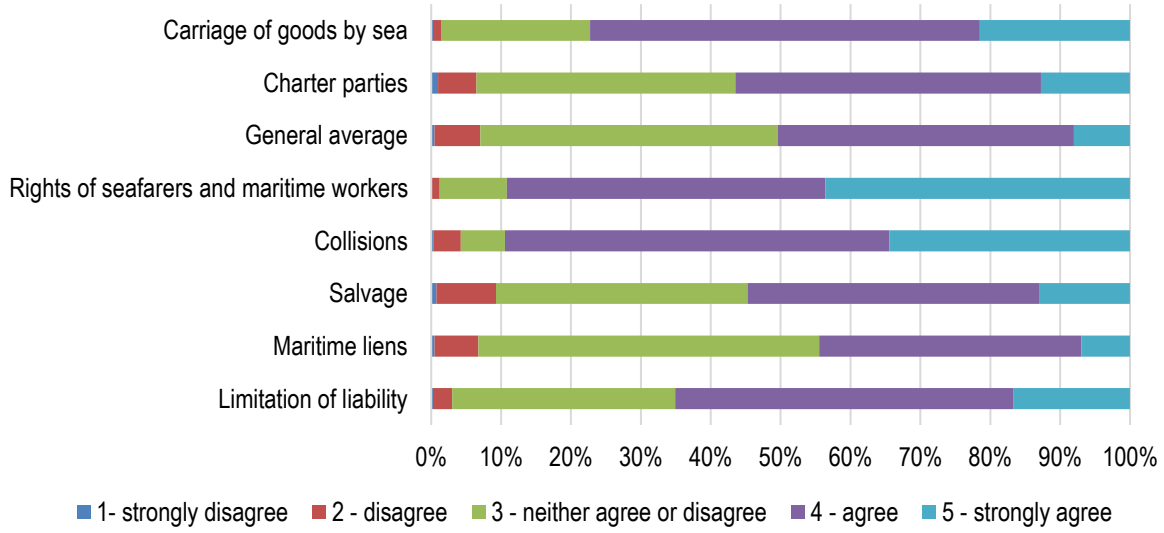

Figure 25 The most valuable topics in the maritime law for shipboard management

According to respondents, the most valuable maritime law topics are those related to the *Rights of seafarers and maritime workers*, supported by 89% of all respondents. Only 1% of all respondents consider the topic as not essential. The next one is *Collisions*, supported by almost the same percentage of respondents.

The second group of topics are the "mainstream" maritime law topics: *Carriage of goods by sea* and *Limitation of liability*. It is essential to note that these topics are not covered by the STCW Convention and are usually considered not essential for seafarers. This also applies to the following two topics: *Charter parties* and *Salvage,* supported by 56% and 55% of all respondents.

It is worth noting that "*strongly disagree"* is a minimal or non-existent response in this group of topics. These numbers indicate noteworthy skill gaps in the subject area and considerable interest among seafarers, obviously keen to know more about such topics.

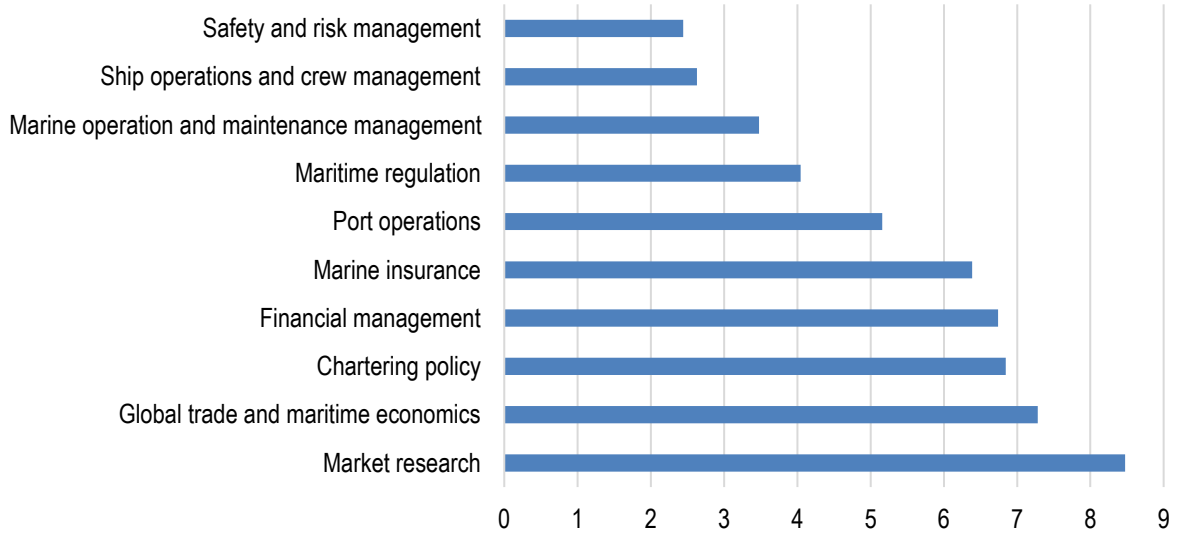

Figure 26 Subjects from the maritime business domain considered as the most valuable for shipboard management (ranked according to average values)

Regarding the maritime business domain, respondents were asked to rank the subject areas they consider essential for ship operations (1 being the most essential and ten being least essential). The priorities were averaged and presented on the graph.[65]

Accordingly, the most valuable topic from the maritime business domain is *Safety and risk management*. More than 48% of respondents rated this topic as the most essential (ranked with 1). *Ship operations and crew management* was selected by 30% of respondents who rated it as the most essential. Approximately 14% of all respondents rated *Marine operation and maintenance management* as the most essential. Contrary to this, "pure" economic subjects (such as *Market research*) are relatively low interest among respondents.

It is also worth noting that very similar rankings are created if topics are sorted according to the average priorities. *Maritime regulations* and *Port operations* are next regarding their importance for shipboard management. In addition, these answers are in line with answers given to previous questions. Again, most subjects are not covered by the STCW Convention or at most at the introductory level.

[65] The same approach applies for all following similar graphs.

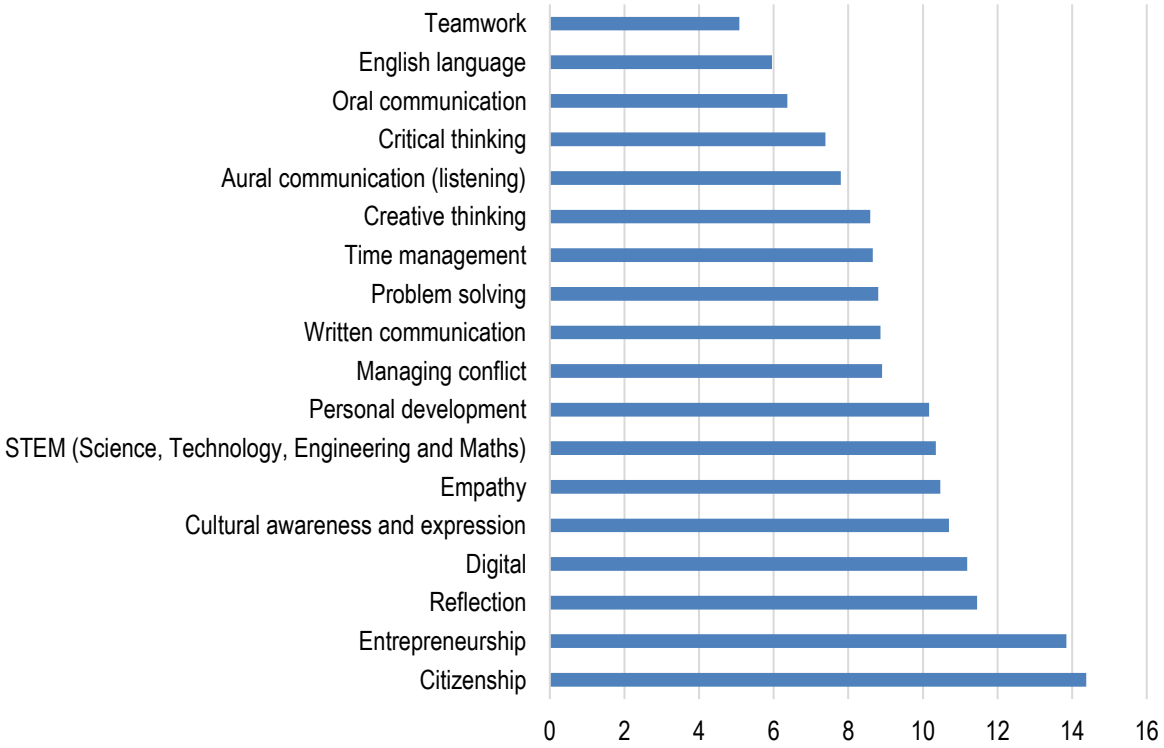

Figure 27 The most relevant (transitional) skills for modern ship officers (ranked according to average values)

Regarding the transitional skills that seafarers consider the most essential, the respondents were requested to rank those skills according to their importance on a scale of 1 (most valuable) to 10 (not valuable at all). The average priorities are sorted and presented on the graph.

Accordingly, the most valuable transitional skill is *Teamwork,* selected as the most essential by 18% of respondents. The second one is the *English language,* selected as the most essential by more than 21% of all respondents. However, the *English language* was also given a low priority by a fairly large group of respondents, causing the average priority to be lower than the one assigned to *Teamwork*. Communication issues (*English language, Oral communication, Aural communications)* are valued as essential transitional skills. The only exception is *Written communications*, being assigned a relatively low priority

A prominent group of skills are problem-oriented skills, such as *Critical thinking, Creative thinking, Time management* and *Problem-solving. Problem-solving* was selected as the essential skill by 11% of respondents and *Critical* thinking by 8% of all respondents. It is essential to note that these skills are not even mentioned in the STCW Convention and associated Model Courses. In fact, the STCW Convention is intentionally designed not to require these skills (i.e. it does not require skills assigned to higher levels of Bloom's taxonomy).

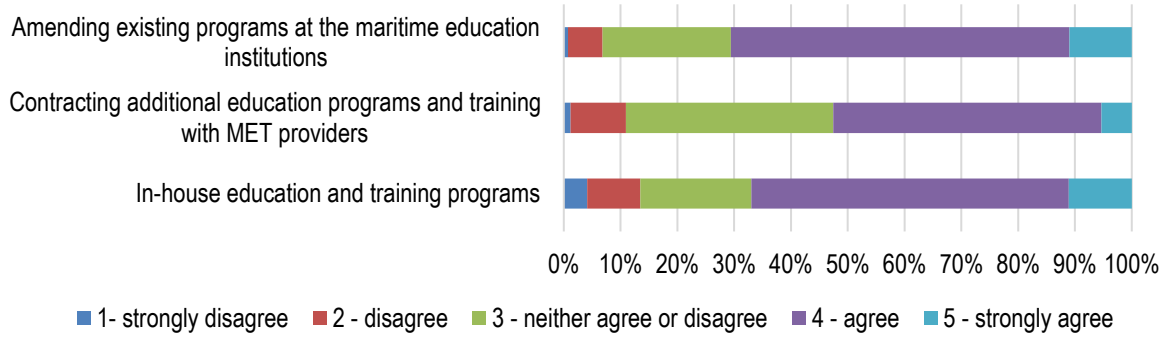

Figure 28 Modes of acquiring transitional (generic) skills

According to the respondents, the most valuable transitional skills should be acquired through amending existing programmes at maritime education institutions (60% agree and 11% strongly agree with this statement). Less than 1% of respondents strongly disagree with this statement.

In line with the previous statement, seafarers prefer as a second option in-house education and training (56% of respondents agree and 11% strongly agree, while only 4% of respondents strongly disagree with this statement). Contracting additional programmes (independently) with MET providers is an option for 47% of respondents.

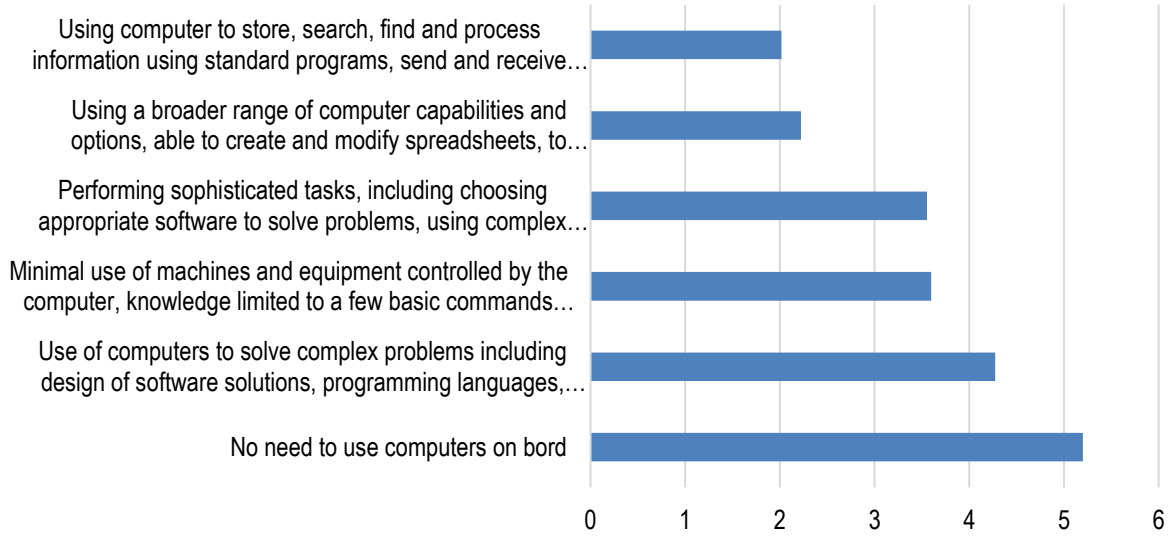

Figure 29 The level of digital abilities and computer literacy expected from shipboard management (ranked according to average values)

In respect of digital skills, respondents were asked to rank these skills according to the actual onboard needs on a scale ranging from 1 (most valuable) to 6 (not valuable at all). Most respondents selected the following as the most essential:

- Using the computer to store, search, find and process information using standard programs, send and receive electronic mail, use word processing, and manage files (40%), and

- Using a broader range of computer capabilities and options, creating and modifying spreadsheets, creating documents using formatting options, and creating original drawings or illustrations (34%).

All other options were given much lower priority. It is interesting that two extreme options - *No need to use computers onboard and Use of computers to solve complex problems including design of software solutions, programming languages, development,* and *adaptation of computer software in accordance with specific purposes, setting up and modelling a computer network* - were selected as the least essential.

It is essential to note that 8% of all respondents still believe that there is no need to use computers onboard (who selected this option as the most appropriate). Although a relatively small percentage, this is an essential finding against the increasing importance of digital services for modern seaborne trade. It may be related to the respondents' age distribution (29% of all participants are senior seafarers older than 55 years).

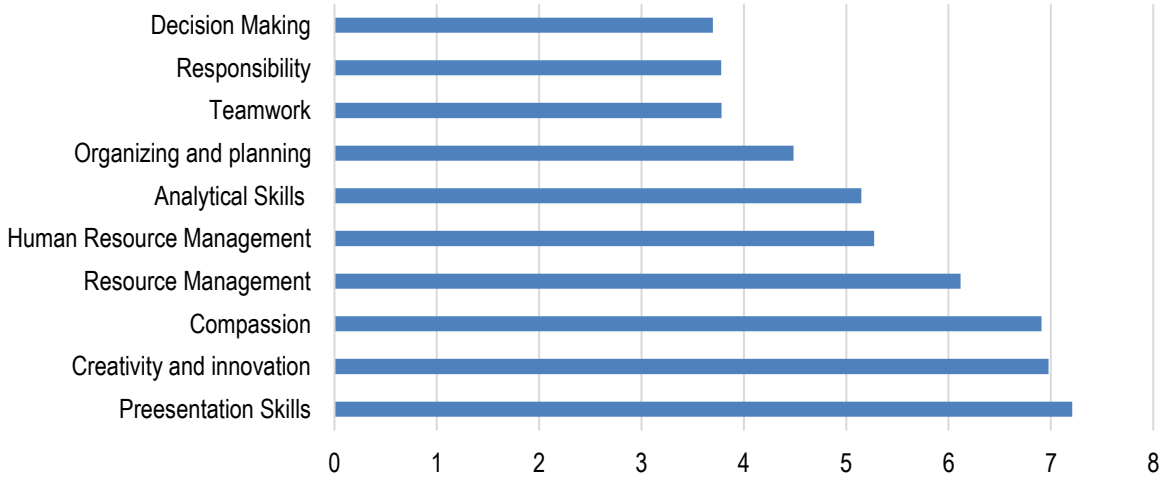

Figure 30 The most essential abilities and skills according to their importance for shipboard duties (ranked according to average values)

Regarding the importance of abilities and skills for shipboard duties, seafarers were asked to assign the rank to each ability/skill on a scale of 1 (most important) to 10 (not important at all). According to the respondents, the essential abilities are *Decision making*, *Responsibility* and *Teamwork*. Below are short explanations of every ability/skill considered and the percentage of respondents who assigned top priority to that ability/skill:

Responsibility - conscientiously, properly performing work tasks, considering personal rights and obligations as well as rights and obligations of others and the environment (25%)

Teamwork - participation in working with others that involves understanding, respecting differences, listening, and consulting (21%)

Decision-making - ability to choose among options that will lead to the desired goal (20%)

Organising and planning - ability to set goals, planning performance, running time, and monitoring work (10%)

Human resource management - directing, coordinating, and monitoring the work of others, and motivating

and providing development opportunities (9%)

Presentation skills - ability to make a clear, fluid, and arguable transfer of ideas in oral or written form (5%)

Analytical skills - ability to collect and view various information and perspectives, to verify assumptions and to make conclusions/solutions (5%)

Resource management - financial planning, material and equipment use, maintenance (4%)

Compassion - ability to understand the feelings of other people and respond adequately to them (3%)

Creativity and innovation - creating new ideas, services, products, ways of working and their application (1%)

Again, it seems that seafarers place the highest value on the abilities that most effectively fulfil the target goals.

Accordingly, the seafarers were asked to select the essential personal qualities in respect to their importance for shipboard duties.

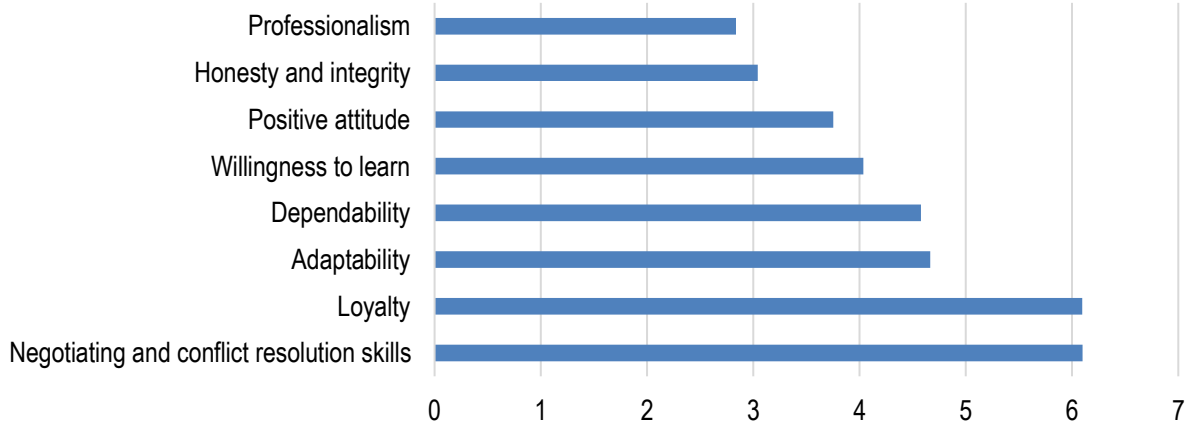

Figure 31 The most essential personal traits in accordance with their importance for shipboard duties (ranked according to average values)

More than one-third of respondents ranked *Professionalism* with 1, on a scale of 1 (most important) to 6 (not important at all). The second one, *Honesty and integrity,* is selected by 28% of respondents. Also, it is indicative that 15% of all respondents selected a *Positive attitude* as the essential personal trait.

In respect to the most attractive shore-based jobs, respondents expressed the most significant interest in *Training of seafarers and Fleet management*, followed closely by *Shipbuilding, Classification societies, Technical superintendence, Project management, Port Operations, and Research and development (including new buildings)*. These jobs, except *Project management*, are beyond doubt jobs most heavily dependent on previous shipboard experience. Even *Project management* bears certain similarities with shipboard management duties, i.e. duties of the Master and Chief Engineer. The least attractive shore-based jobs are those related to *Finance and accounting, Sales and Chartering, and Market Research*, which are most the jobs where shipboard experience has little or no value.

Interestingly, most respondents (16%) selected *Company management* as the top priority job. In second

place is *Forwarding agents*, with 13%, while 12% of respondents selected *Crew management* as the most attractive job. Interestingly, no one seafarer selected *Technical superintendent* as the most attractive job, but it has by far the most significant number of high positions. It is pretty clear that understanding the attractiveness of shore-based jobs is a highly individual matter.

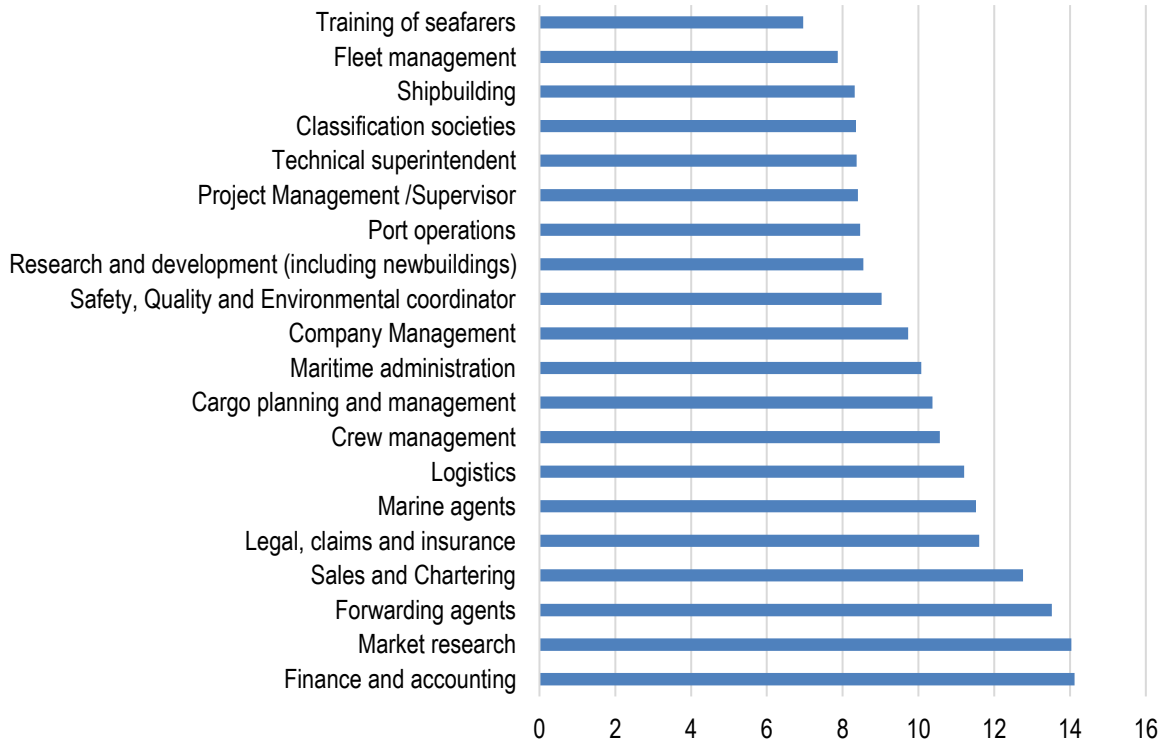

Figure 32 The most attractive shore-based jobs (ranked according to average values)

It is worth noting that these jobs heavily depend on competencies already identified as the most essential for modern ship officers (*Teamwork, English language, Oral communications* and *Critical thinking*).

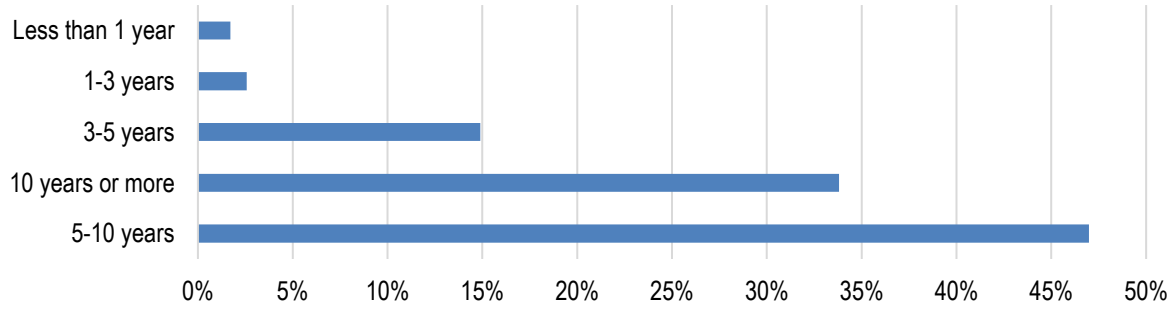

Figure 33 Onboard experience considered the most appropriate for moving ashore

Almost half (47%) of respondents think that shore-based jobs should be considered after 5 to 10 years spent onboard, while 34% prefer more than 10 years of onboard experience as an appropriate shipboard

experience.

Of all respondents, 57% are ready to accept a shore-based job if one was offered to them. Although the sample size is pretty extensive, this information should not be understood as valid for the whole population because the majority of those who responded are in senior positions and should not be considered representative of the whole population of seafarers.

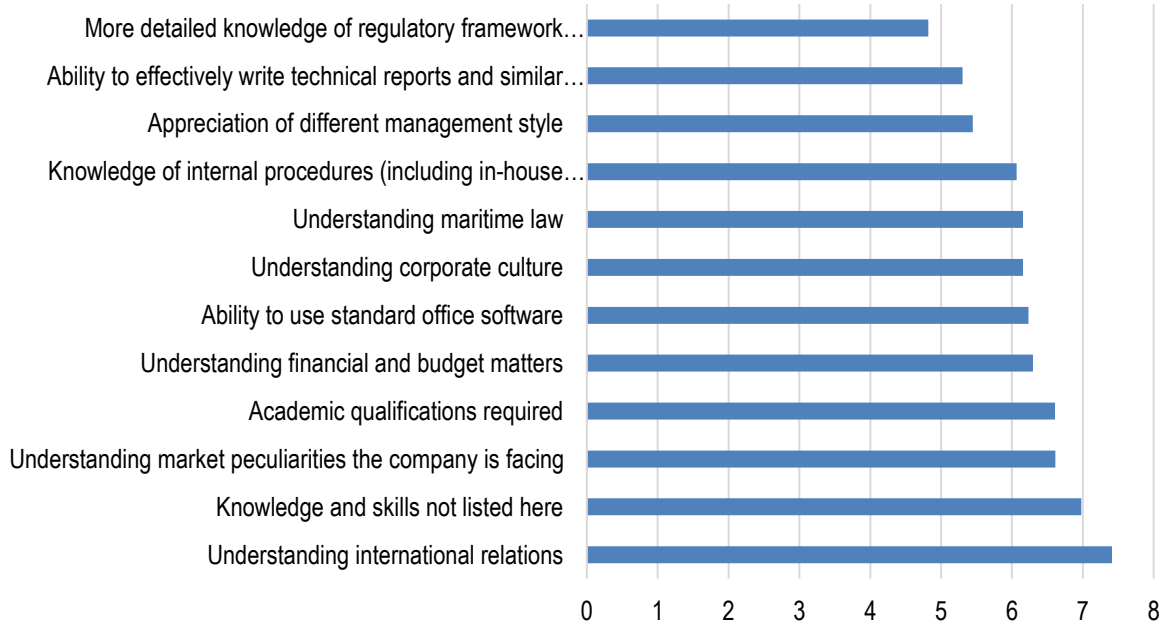

Figure 34 The most essential skills serving seafarers should work on before moving to work ashore (ranked according to average values)

According to respondents, the essential skills seafarers should work on before moving to work ashore are:

More detailed knowledge of regulatory framework (relations with class societies, port state control, etc.), selected by 21% of all respondents as the most important,[66]

Appreciation of different management styles – 12% of respondents ranked this as the most important ability,

Ability to write technical reports and similar documents effectively - 12% of respondents ranked this as the most important ability.

[66] Ranked with 1 on a scale from 1 (most important) to 10 (not important at all).

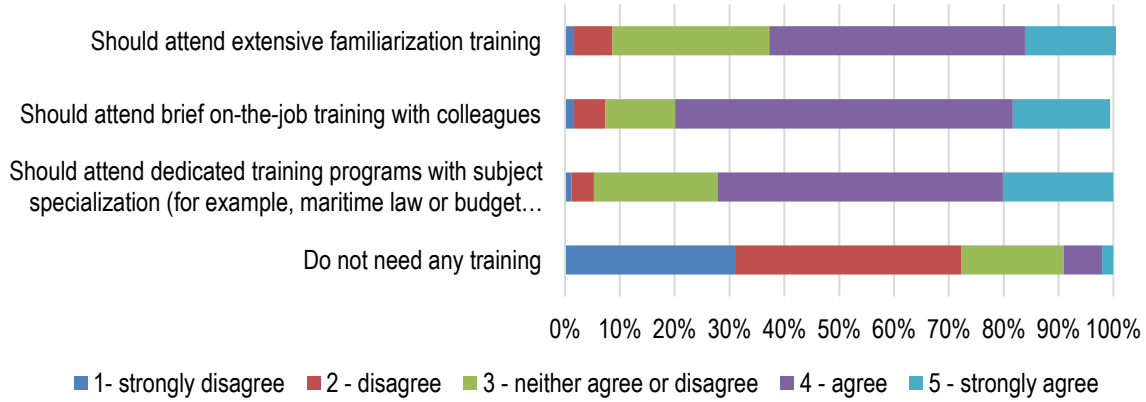

Figure 35 Actions preferred before assuming shore-based duties (if circumstances allow)

Most respondents (62%) agree that active seafarers should attend brief on-the-job training with colleagues before assuming shore-based duties, while another 18% of respondents strongly agree with this idea. Accordingly, 77% of respondents agree or strongly agree that more seafarers will successfully assume shore duties if provided with appropriate familiarisation and/or training.

In line with previous statements, most respondents do not support the proposition that active seafarers, before assuming shore-based duties, do not need any training (41% of respondents disagree with this statement, and 31% strongly disagree with it).

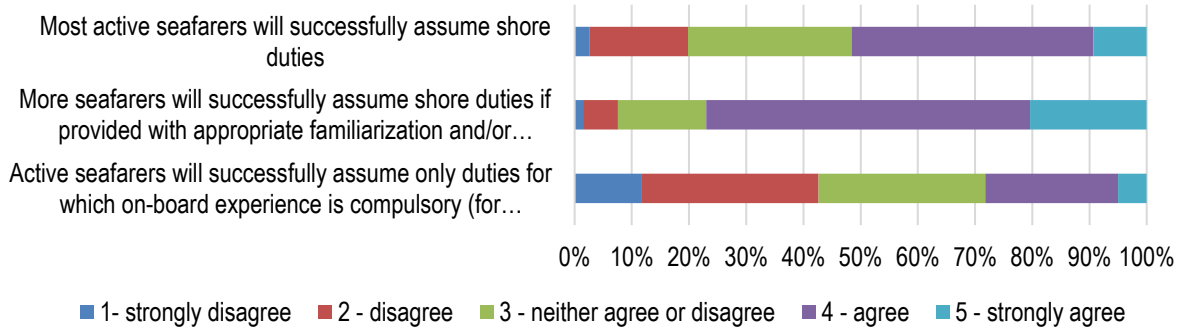

Figure 36 Expected outcomes after assuming shore-based duties

From the answers, it is evident that most seafarers show high levels of confidence about the transition to shore jobs if provided with familiarisation training. Contrary to this, the majority expressed reluctance to accept a job for which additional training and education are not provided.

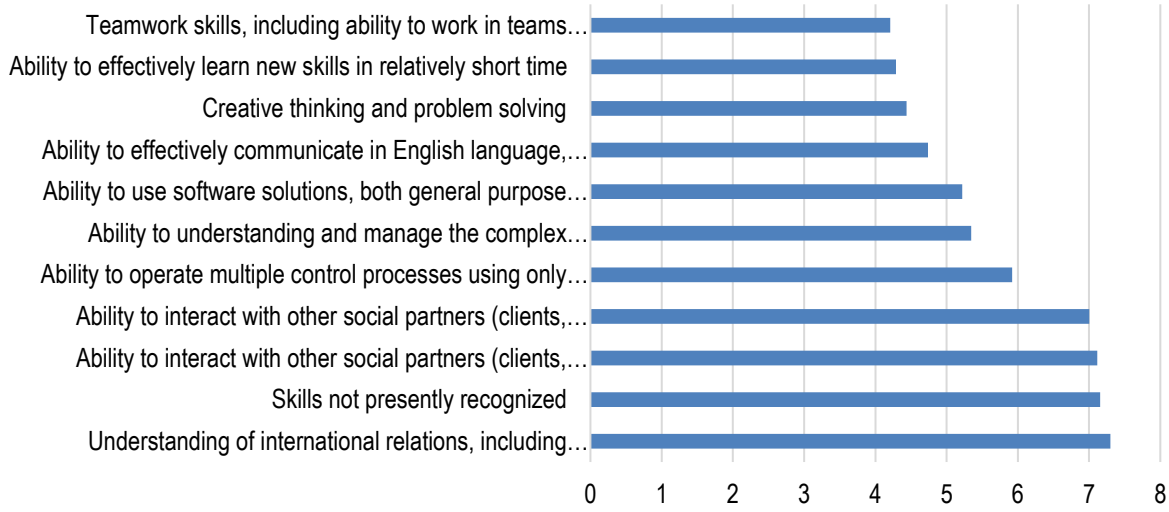

Figure 37 The most needed skills in the years ahead (ranked according to average values)

According to respondents, the most needed skills in the years ahead, ranked with 1, on a scale of 1 (most important) to 10 (not important at all), are:

Ability to effectively communicate in the English language - 21% of all respondents,

Teamwork skills, including the ability to work in teams involving team members located ashore - 19% of all respondents,

Ability to understand and manage the complex control systems - 16% of all respondents,

Creative thinking and problem solving – 13% of all respondents,

Ability to use software solutions, both general-purpose office software and dedicated software – 9% of all respondents.

These results indicate that seafarers do not expect changes in the essential skills. They are almost the same as those they now consider the most essential.

Shore-based personnel

The survey questionnaire for shore personnel was developed having in mind the technical and operational staff or executives positioned next to the top management of the shipping companies and other maritime-related companies, i.e. heads of operations or technical department or senior superintendents. It was expected that people responding to the questions have at least 10-20 years of working experience and preferably at least a few years of onboard experience.

The questionnaire consists of 31 questions, split into several sections. It is an extended version of the questionnaire targeting seagoing personnel and consists of the following parts:

- information on the person questioned: age, experience in the industry, department working with, education, onboard experience and rank

- general information about the company/institution: country of residence, size, ownership, predominant activity, predominant area of activity
- comments on onboard skills and competencies, such as professional education and basic competencies, professional competencies (STCW functions), appropriateness of professional knowledge and skills, recognised skill deficiencies, the essential subjects in maritime law, maritime business and technology, transitional skills
- comments on transition from onboard jobs to shore jobs, such as target jobs, required onboard experience, missing skills, the successfulness of the transition
- comments on expectations and opportunities, such as labour-market trends, technology trends, environmental protection trends, future skills

The survey questionnaire was initially distributed through ECSA and ETF. After that, it was distributed directly from partners. In this survey, 474 respondents from 20 different countries participated.

The highest percentage of respondents are from Italy (68%), the UK (7%), Sweden (5%), Denmark (5%), Netherlands (3%), Germany (4%), and Cyprus (3%). Fewer than 10 respondents were from each of the following countries: Algeria, Belgium, Brunei Darussalam, Croatia, France, Malta, Nigeria, Norway, Poland, Portugal, Qatar, Singapore and Spain.

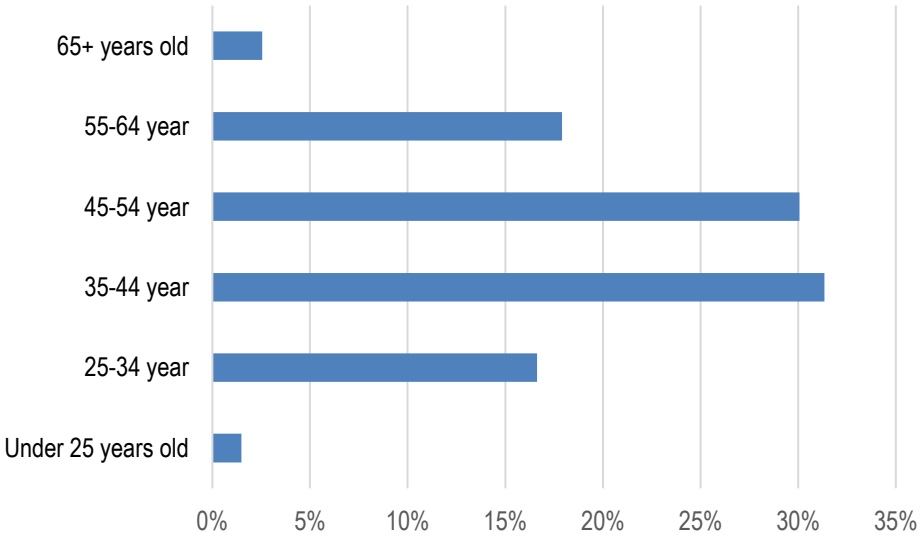

Figure 38 Age of respondents

Most of the respondents are 35 to 44 years old (31%), closely followed by those aged from 45 to 54 (30%). On average, respondents in this survey are more than 10 years younger than those participating in the seafarers' survey.

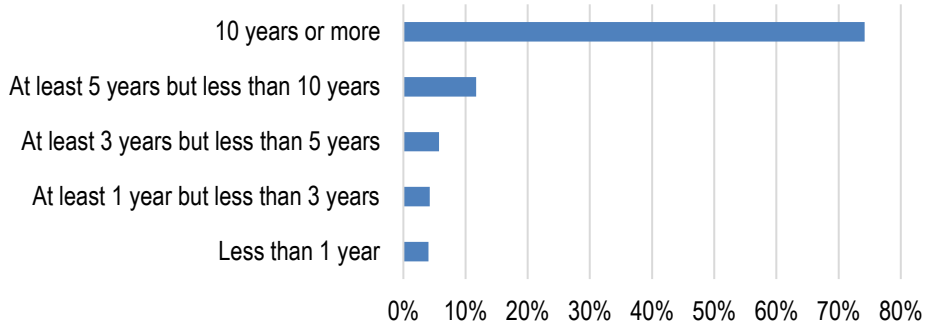

Figure 39 Respondents' experience in shipping and related industries

Most respondents (74%) have 10 or more years of experience in shipping and related industries. Only 4% of respondents have less than one year of experience.

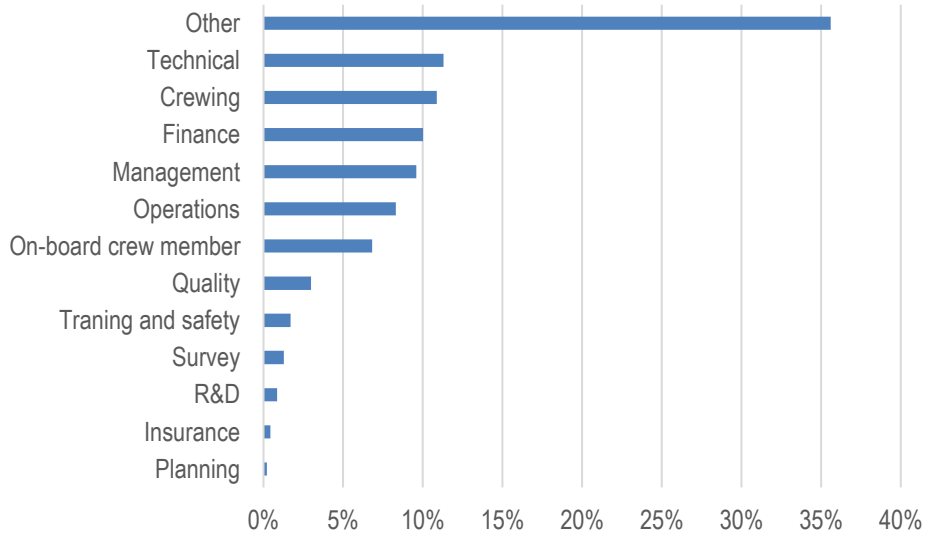

Figure 40 Respondents' departments

Many respondents (35.61%) work in departments not listed as target departments in the questionnaire. As the most frequent answer, respondents selected *Administration* and *Accounting*. The most frequent answers among those specified in the questionnaire are *Finance* (10.02%), *Technical* (11.30%) and *Crewing* (10.87%).

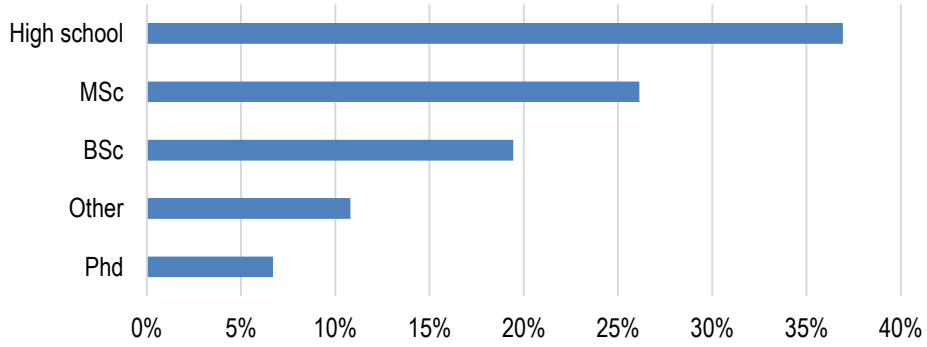

Figure 41 Respondents' education

More than a quarter of the respondents hold high school degrees (37%) and MSc degrees (26%). BSc degree was selected by 19% of respondents, while 7% selected a PhD degree. In total, 11% of respondents selected other degrees.

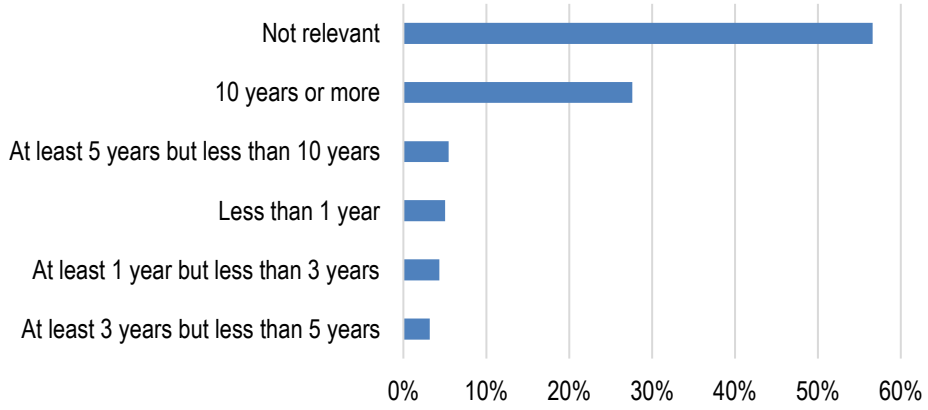

Figure 42 Respondents' onboard experience (total)

Most respondents (57%) have stated that onboard experience is not relevant, followed by 28% of respondents with more than 10 years of experience.

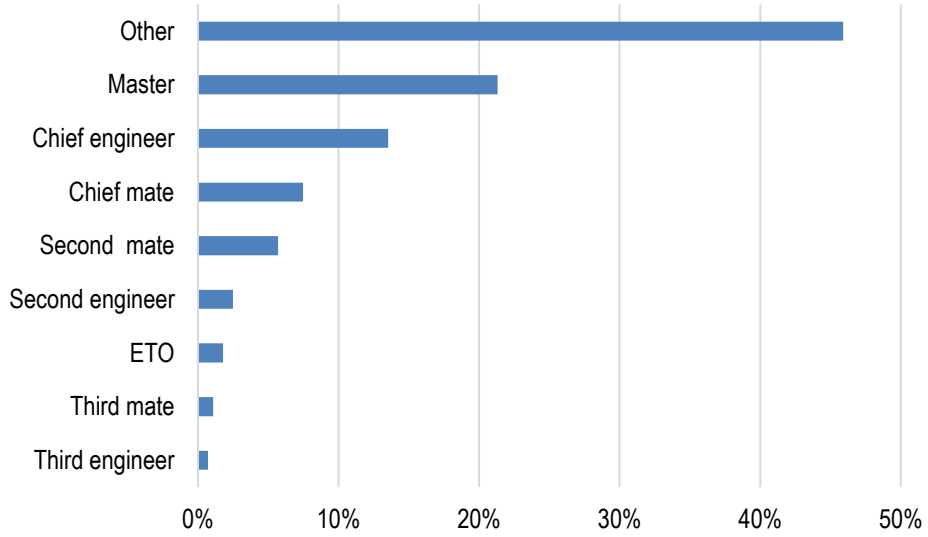

Figure 43 Respondents' onboard position (highest position served)

Approximately 46% of respondents had not served onboard or served in positions not listed in the questionnaire. Approximately 21% of respondents had served as Masters (21%) or Chief Engineers (14%), followed by Chief mates (8%) and Second mates (6%).

Respondents are mainly employed with large companies (74%), i.e. companies with more than 500 employees. Only 7% of all respondents are employed with companies employing fewer than 50 employees.

Consequently, most respondents are employed with private companies (88%) while others are employed with public companies or institutions, trusts, associations, etc. Among those employed with private companies, the largest group consists of those employed with ship-owning companies (53%), followed by those employed in logistics.

Most of the respondents (75%) stated that their companies' predominant geographical area of operation is global. Less than 5% of the respondents selected regional (2%) and national (3%) areas of operations as predominant.

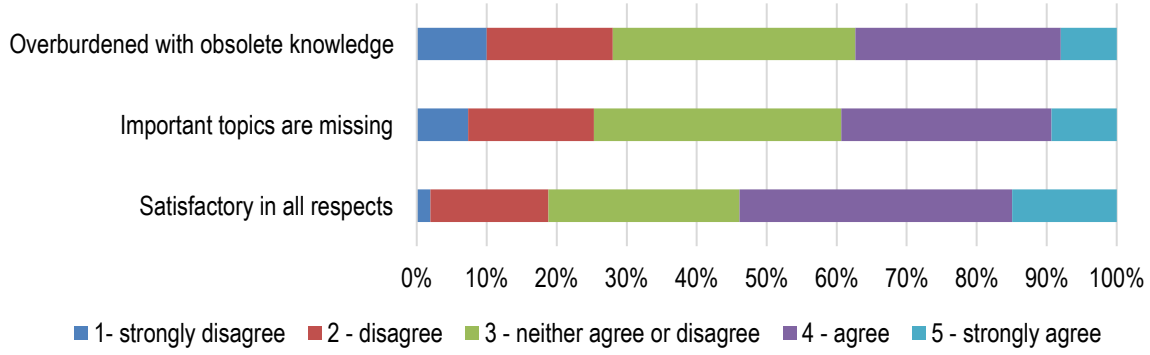

Figure 44 Respondents' opinions on present professional education and basic competencies (as outlined in the STCW Convention)

Regarding the applicability of the competencies outlined in the STCW Convention, 54% of all respondents consider it satisfactory. However, 37% of respondents believe that essential topics are missing, and 39% of respondents believe (agree or strongly agree) that professional education and basic competencies (as outlined in the STCW Convention) are overburdened with obsolete knowledge.

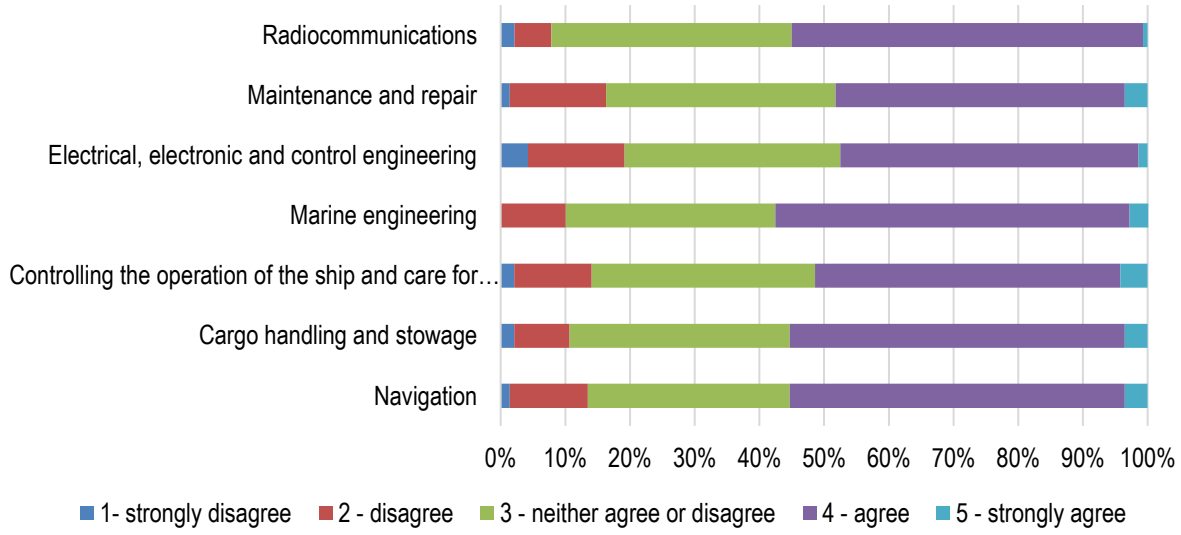

Figure 45 Respondents' position on compliance of professional competencies (STCW functions) with actual onboard needs

Regarding compliance of professional competencies with actual onboard needs, respondents emphasised *Maintenance and repair* and *Electrical, electronic and control engineering* as two functions with insufficient competencies. However, the levels of dissatisfaction are much lower than those expressed by seafarers, indicating that issues related to the functions are not anticipated correspondingly.

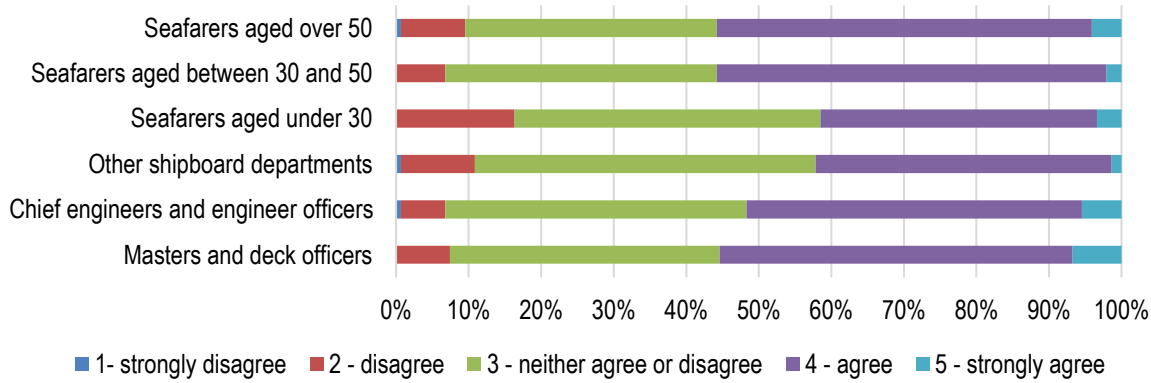

Figure 46 Respondents' position on the appropriateness of professional knowledge and skills among different groups of European seafarers

Respondents identified (among European seafarers) only those under the age of 30 as those whose professional knowledge and skills are not up to the standard. Nevertheless, even for this group, the proportion of respondents sharing such an opinion is minor (17%).

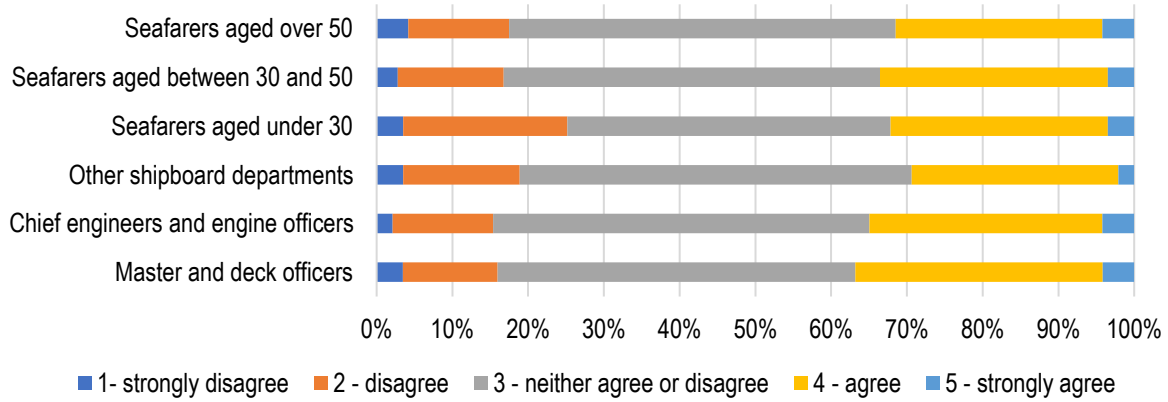

Figure 47 Respondents' position on the appropriateness of professional knowledge and skills among different groups of non-European seafarers

For non-European seafarers, respondents also identified seafarers under the age of 30 as those with professional knowledge and skills below expectations. Such an opinion may refer to either inappropriate prior education or to the more extended onboard experience needed to reach the expected professional knowledge and skills level.

It is worth noting that European seafarers' professional knowledge and skills were rated with higher marks in all groups. The difference is particularly noted among European and non-European seafarers aged over 50 years (56% vs 32% of those who agree or strongly agree with the appropriateness of professional knowledge and skills).

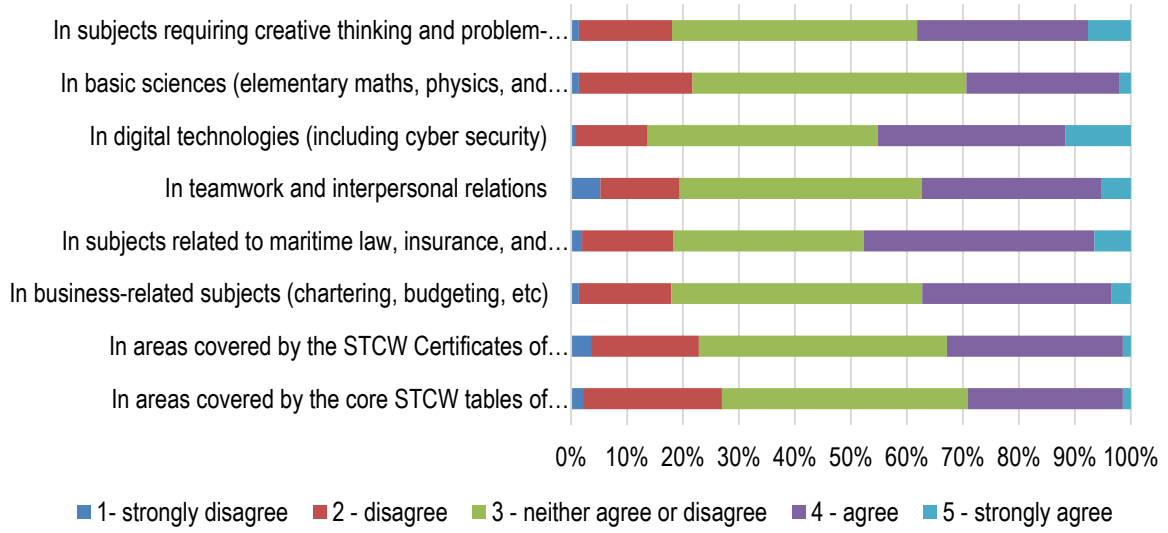

Figure 48 Areas where serious skill deficiencies can be recognised

More than one-third of respondents agreed that serious skill deficiencies could be recognised in subjects related to *Maritime law, insurance, and P&I coverage* (47%), *Digital technologies (including cyber security)* (35%), closely followed by *Subjects requiring creative thinking and problem-solving* (38%), *Business-related subjects* (37%) and *Teamwork and personal relations* (37%).

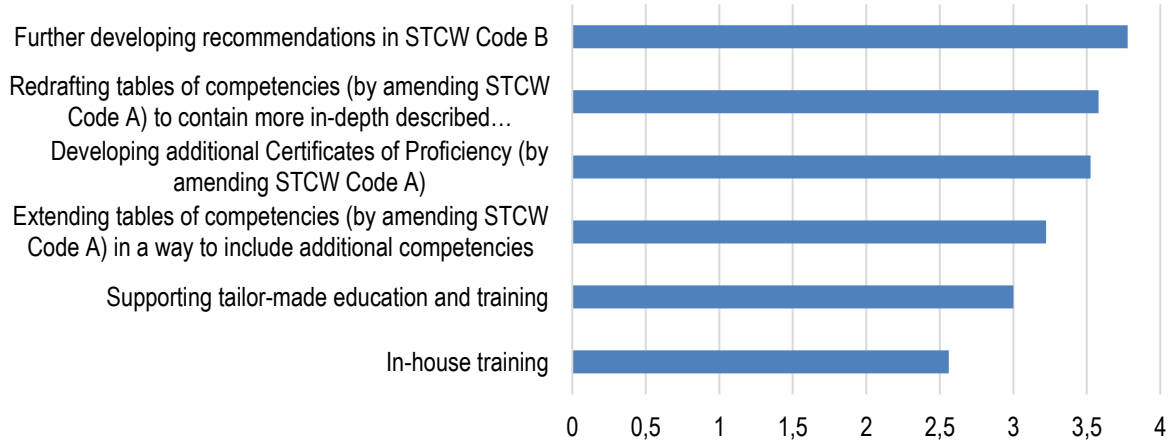

Figure 49 The most effective ways to improve STCW competencies[67] (ranked according to average values)

According to respondents, the best ways to improve STCW competencies are *In-house training* (46% of respondents rated it as the most effective way), *Supporting tailor-made education and training* (19% of respondents rated it with 1), and *Developing additional Certificates of Proficiency (by amending STCW Code A)* (17% of respondents rated it with 1). Further development of the STCW Convention is not supported.

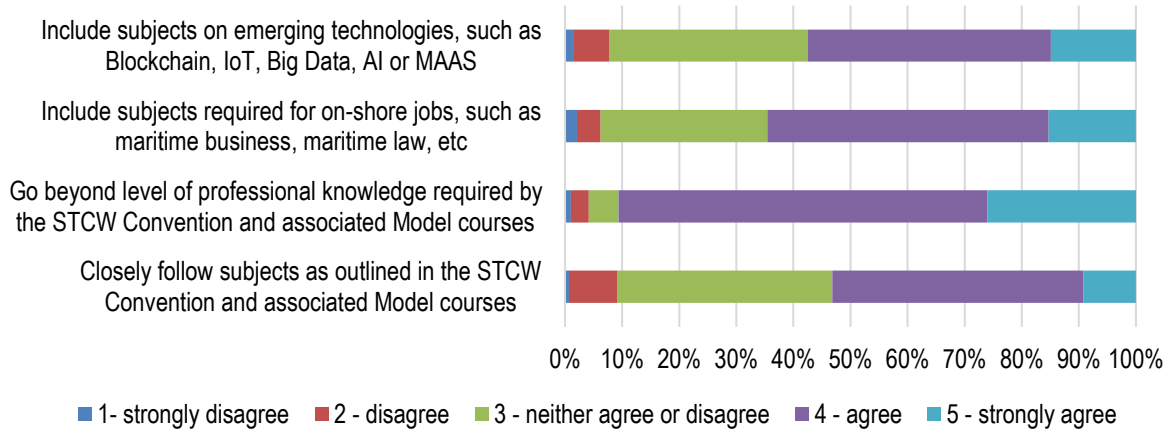

Figure 50 Preferred further development of MET institutions

According to respondents, maritime education and training institutions are expected to go beyond the levels of professional knowledge assumed in the STCW Convention and associated Model Courses. More than 90% of all respondents support this approach, thus recognising that professional knowledge and skills defined in the STCW Convention are not enough.[68]

[67] Rated on the scale 1 (most important) to 6 (not important at all), and then averaged.

[68] One responded stated: "Dumbing down to the lowest common denominator was a disaster for STCW. We will see an increase in potential pollution issues and life critical scenarios. Ultimate removal of sailing crews on some ships may remove some risk but is likely to create others. The survey does not appear to consider offshore construction related industry sectors where further cost cutting efforts will undoubtedly be relevant. European officers are prevalent in this sector where complex commercial and operational systems

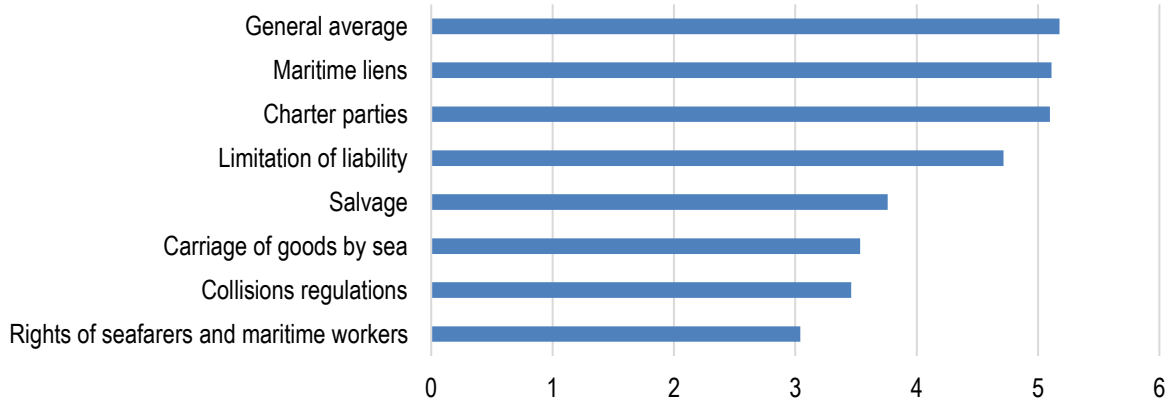

Figure 51 Topics in maritime law considered to be the most valuable for shipboard management (ranked according to average values)

It is worth noting that shore-based respondents selected the same three topics in maritime law as the most essential as seafarers - *Rights of seafarers and maritime workers*, *Collisions*, and *Carriage of goods by sea*.

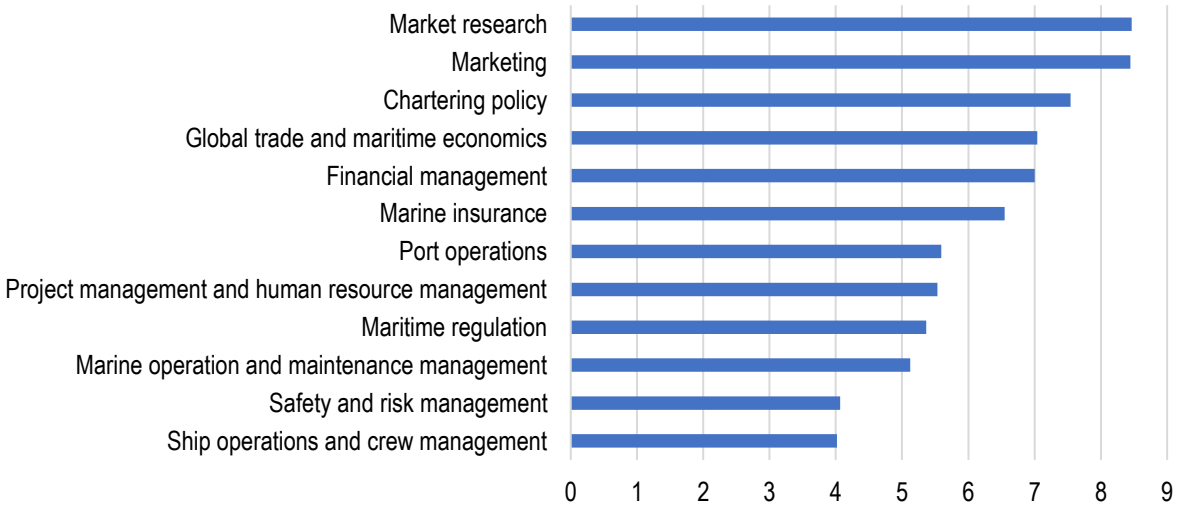

Figure 52 Maritime business subjects considered the most valuable for shipboard management (ranked according to average values)

According to the shore-based survey respondents, the most valuable subjects from the maritime business domain are *Ship operations and crew management* and *Safety and risk management*. The first four subjects to be ranked as most essential were similar for both shore-based employees and seafarers. The only exception is that shore-based personnel gave slightly more preference to *Ship operations and crew management* over *Safety and risk management*.

can lead to opportunities for marine crew at all levels. Commercial and engineering opportunities abound, as much as the managerial, project and expert type roles."

Figure 53 The most relevant (transitional) skills for modern ship officers (ranked according to average values)

According to the shore-based survey respondents, the most relevant transitional skills for modern ship officers are *Problem-solving*, *Teamwork* and the *English language*. If compared with answers given by seafarers, there are similarities and differences. Seafarers prefer *Teamwork* and communication skills, while shore-based personnel respect the same skills but slightly more prefer *Problem-solving* and *Critical thinking*. In respect of other skills, the differences are not significant (the three most minor necessary skills are again the same).

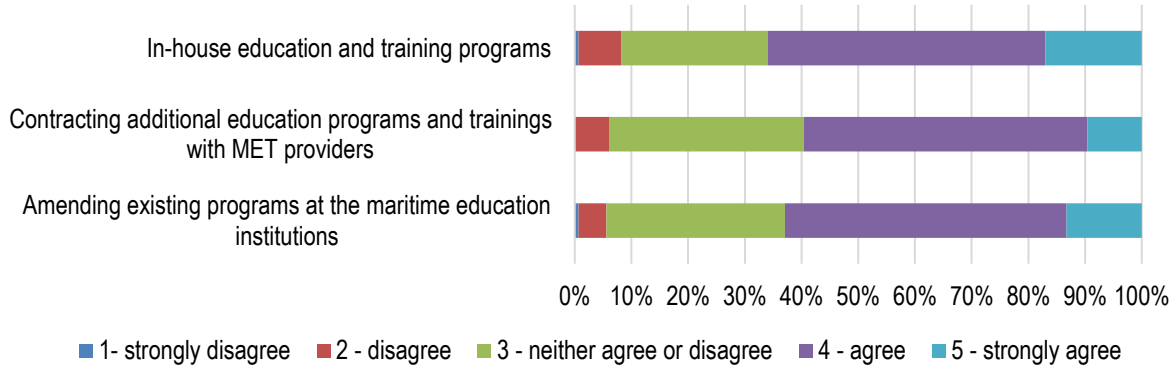

Figure 54 Modes of acquiring transitional (generic) skills

According to the modes that may be used to improve various transitional skills, respondents almost equally support all offered modes. Only 6-8% of respondents disagree with the proposed methods.

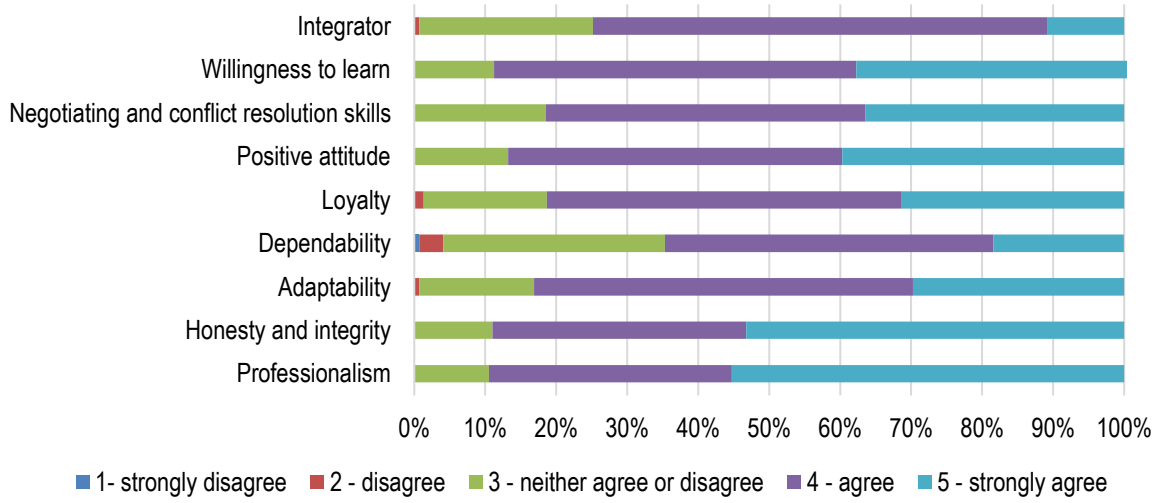

Figure 55 The most important personal traits in accordance with their importance for shipboard duties

Again, respondents employed ashore closely matched the seafarers' rankings of the importance of key personal traits – *Professionalism, Honesty and integrity,* followed by *Positive attitude* and *Willingness to learn.* Therefore, it is evident that these two groups share the same core values.

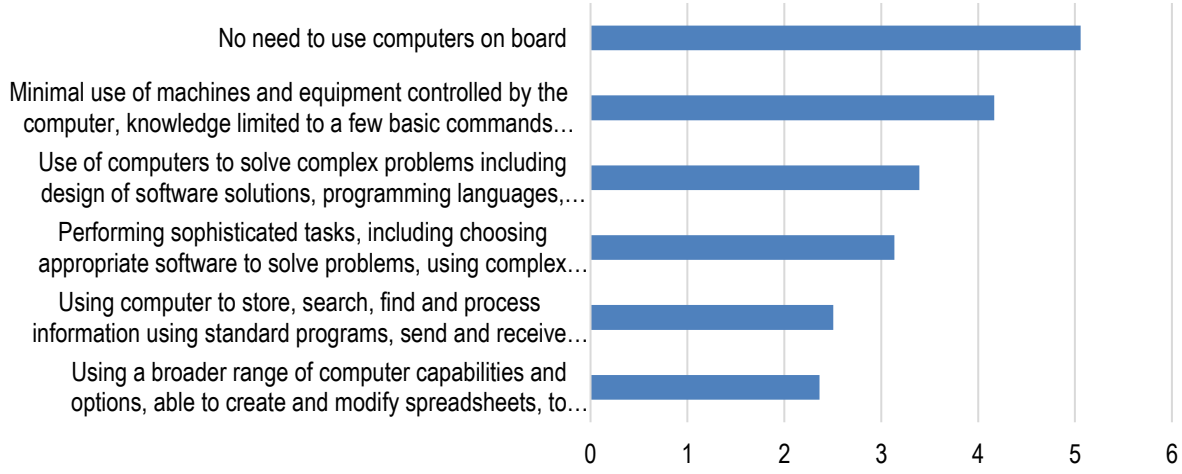

Figure 56 The level of digital abilities and computer literacy expected from shipboard management (ranked according to average values)

In respect of digital skills, respondents were asked to rank these skills according to the level most appropriate for onboard use on a scale ranging from 1 (most valuable) to 6 (not valuable at all). Most respondents selected the following as the most essential:

Using the computer to store, search, find and process information using standard programs, send and receive electronic mail, use word processing, and manage files (29%) and

Using a broader range of computer capabilities and options, creating and modifying spreadsheets, creating documents using formatting options, and creating original drawings or illustrations (22%).

By average value, shore-based personnel expected a higher level of digital abilities (i.e., using a *broader range of computer capabilities and options, …*). Only 13% of respondents saw no need to use computers onboard. Thus, that option was rated as 1.

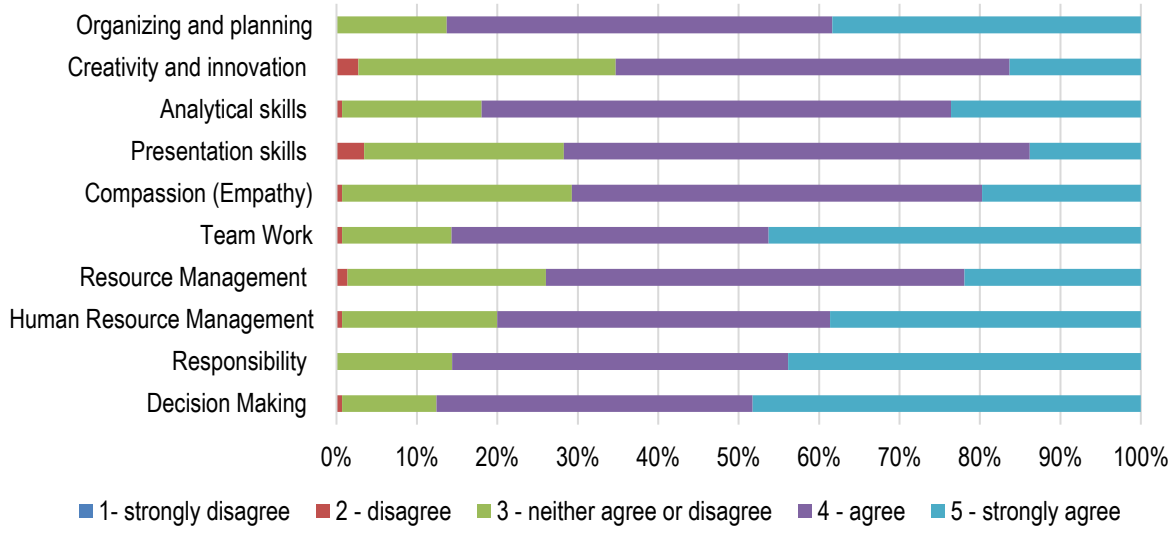

Figure 57 The most essential abilities and skills according to their importance for shipboard duties (ranked according to average values)

According to the respondents, the essential abilities and skills for shipboard duties are *Decision Making* (88%), *Teamwork* (87%), and *Responsibility* (87%).[69] Again, the importance of these abilities is the same as those selected by shipboard personnel, again suggesting that these two communities are very close and share the same professional values.

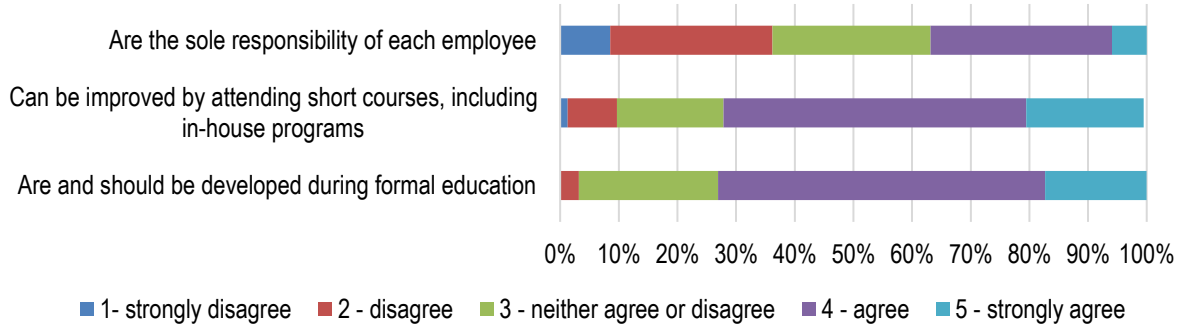

Figure 58 Modes to acquire certain abilities and skills

The survey respondents believe that the previously mentioned abilities and skills should be acquired during formal education or by attending short courses. A significant number of respondents expect employer's participation in the process.

69 Short explanations of abilities/skills are already presented in the section presenting results of survey carried out among seafarers.

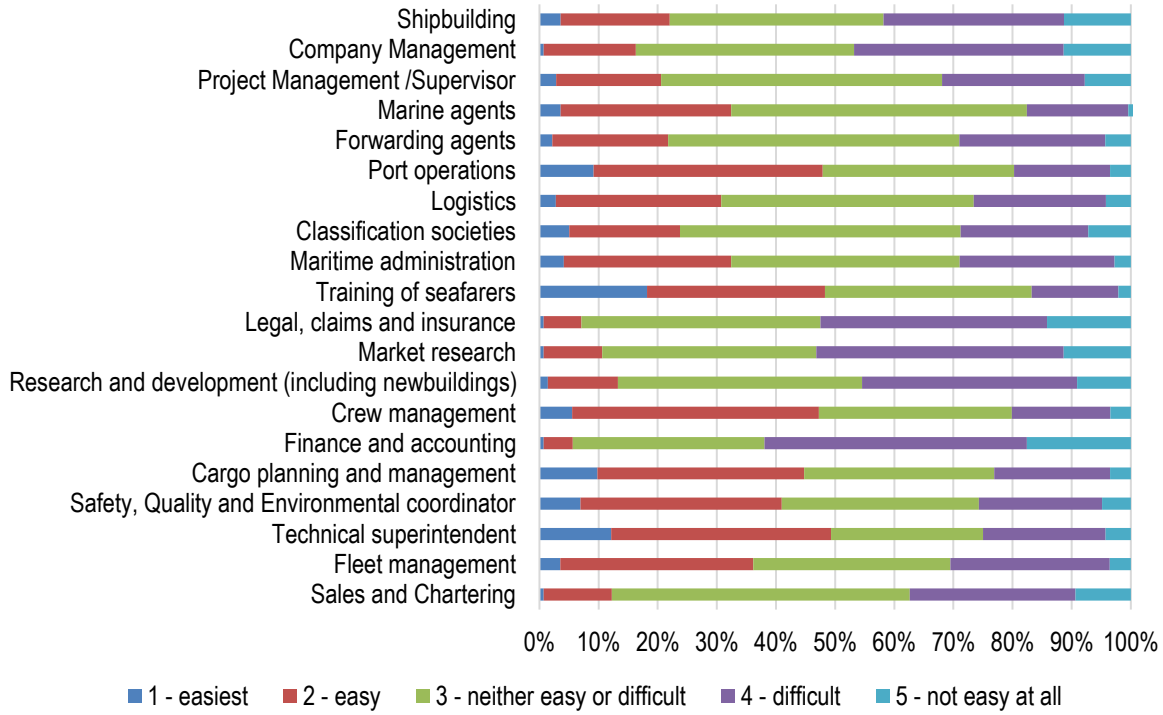

Figure 59 Transition of active seafarers at management level to shore-based jobs

Respondents believe that the most effortless transition for active seafarers at the management level is to the following shore-based jobs: *Training of seafarers* and *Technical superintendent* followed by *Port operations* and *Crew management*. Respondents do not believe there is an easy transition to the following shore-based jobs: *Finance and accounting* and *Legal, claims and insurance* (18% and 14% of respondents respectively ranked it as not easy at all). The results are very similar to opinions expressed by seafarers.

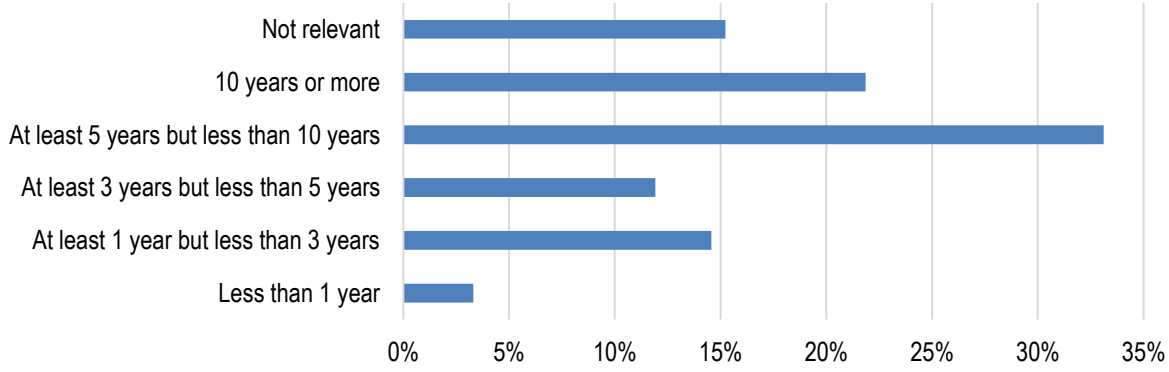

Figure 60 Onboard experience considered as the most appropriate for moving ashore (ranked according to average values)

Once again, shore-based and shipboard personnel fully agree on the most appropriate levels of onboard experience for moving ashore. Approximately one-third of respondents think that the most appropriate time spent onboard before moving ashore is at least five years but less than 10 years. Only 3% of respondents

think that less than one year is an ideal length of onboard experience.

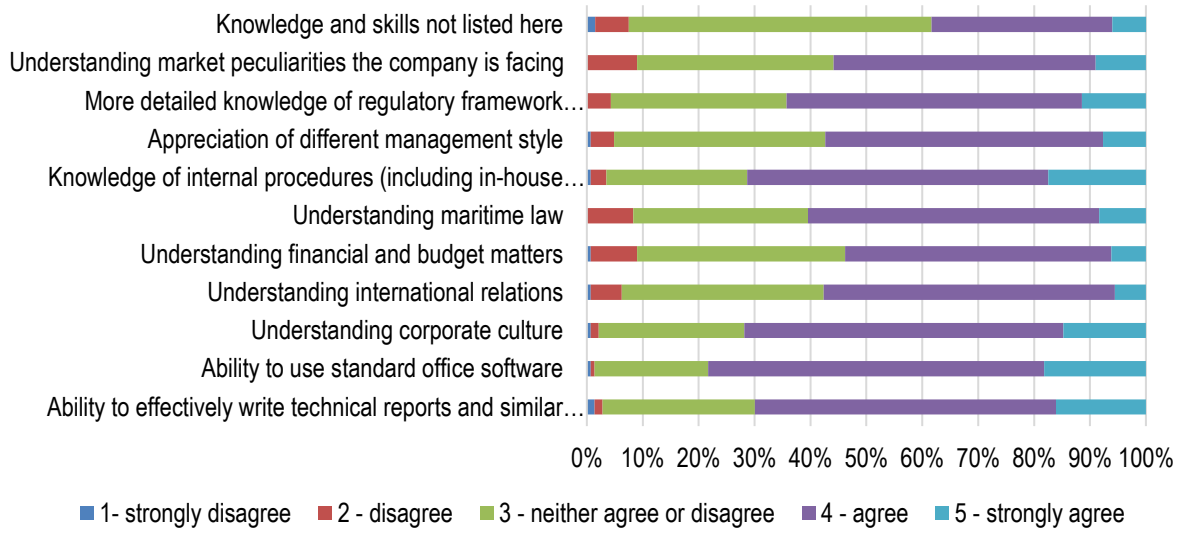

Figure 61 The most essential skills serving seafarers should work on before moving to work ashore

According to respondents, the essential skills seafarers should work on before seeking shore-based jobs are:

- *Ability to use standard office software* – 78% of respondents agree or strongly agree
- *Understanding corporate culture* – supported or strongly supported by 72% of respondents
- *Knowledge of internal procedures* – supported or strongly supported by 72% of respondents
- *Ability to effectively write technical reports and similar documents* – supported by 70% of respondents

It is worth noting that shipboard personnel recognised very different skills as being essential when moving to work ashore.

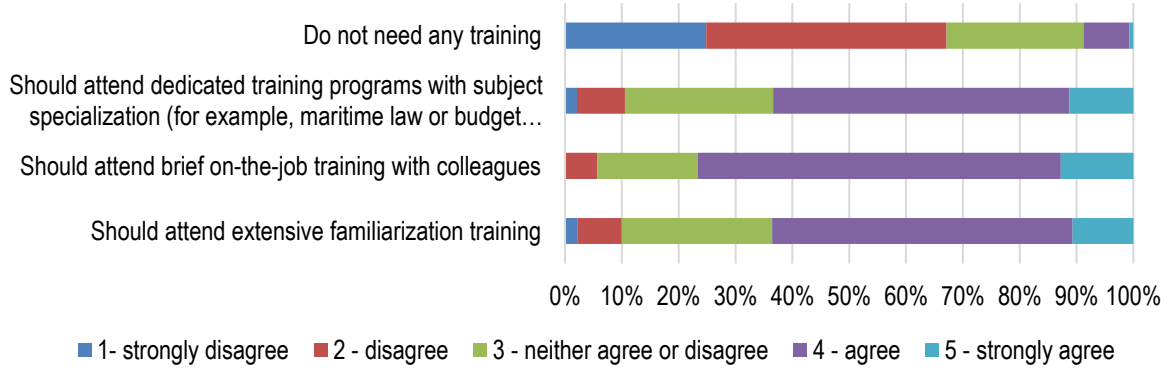

Figure 62 Actions preferred before assuming shore-based duties (if circumstances allow)

Regarding preferred action before assuming shore-based jobs, both groups of respondents (those working aboard and ashore) share the same attitude. In both cases, the preferred method of familiarisation is on-the-job training.

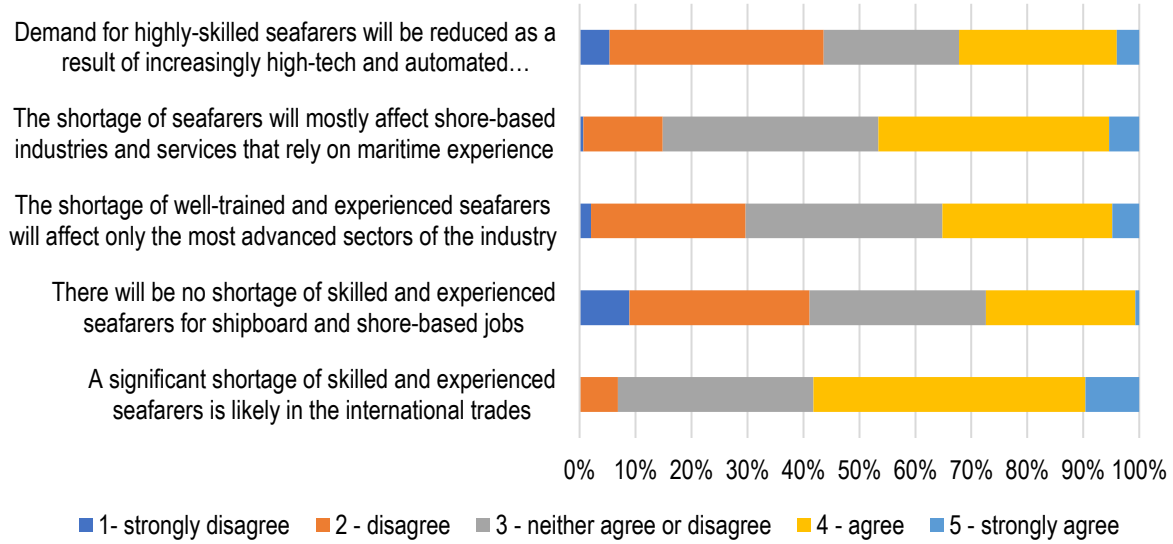

Figure 63 Future developments at the labour market

More than half of the respondents (59%) believe that a significant shortage of skilled and experienced seafarers is likely in the international trades within the next 10 years or so. Different publications have repeatedly expressed this belief in the last few decades (the most cited being the BIMCO/ICS Manpower Report, recently predicting a potential shortage of almost 150,000 officers by 2025). Consequently, it cannot be concluded whether such a belief is induced or can be substantiated through real-life experience.

Almost 47% of respondents agree that the shortage of seafarers will mainly affect the shore-based industries and services that extensively rely on maritime experience. The proportion of respondents who believe that only advanced sectors of the industry will be affected by the shortage of experienced seafarers is approximately the same as those who disagree with the statement.

Finally, 43% of respondents believe that high-tech and automated systems will not reduce the demand for highly-skilled seafarers. Contrary to this, 32% of respondents believe that it would not be the case.

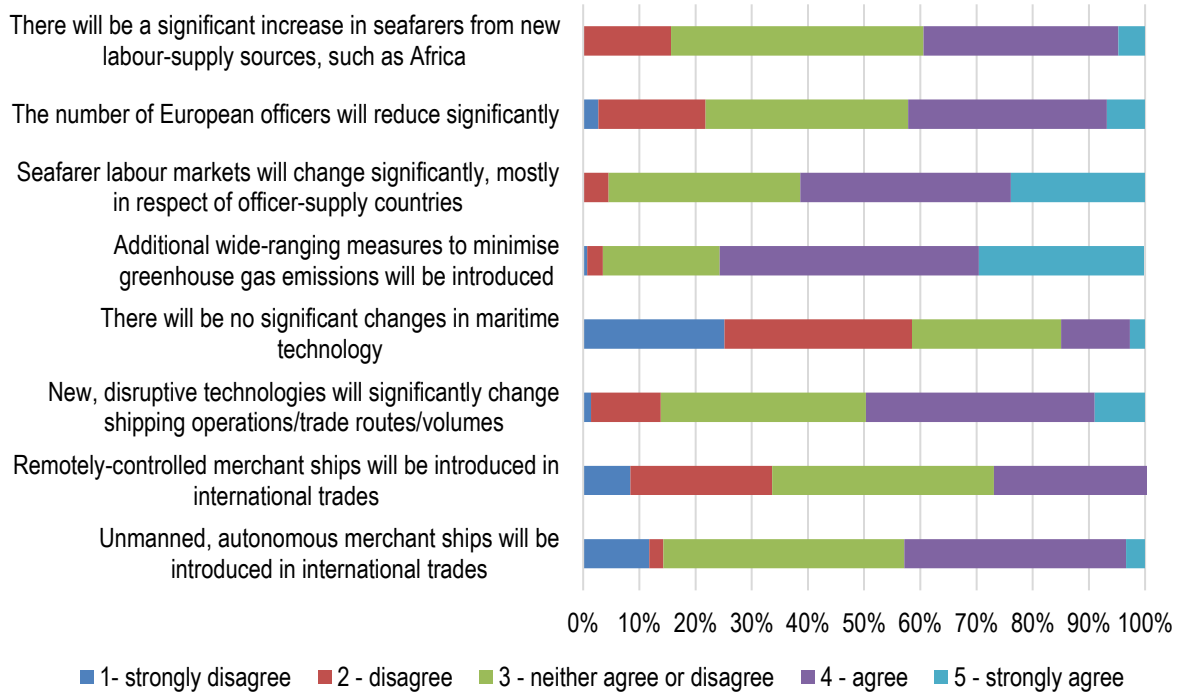

Figure 64 Expected labour market dynamics

In respect of future maritime labour market dynamics, more respondents believe that new labour-supply sources will emerge, probably from developing countries (39% vs 15%). Although with different proportions, the exact expectations were shown in respect of the number of European officers (42% believe that the number of European officers will decrease, while 22% believe it will not). Taken together, these answers support the third statement: that the seafarer labour market will change significantly in the next 10 years or so (an opinion supported by 62% of all respondents).

Respondents show fairly significant agreement regarding future changes: 58% believe there will be significant changes in maritime technologies, while only 15% believe there will be no significant changes. The most crucial area where significant changes are expected is the reduction of greenhouse gas emissions, supported by 76% of all respondents and opposed by only 4% of all respondents.

New, disruptive technologies are expected by almost 50% of all respondents and considered unlikely by only 13%.

Finally, opinions are pretty divided on remotely controlled merchant ships: 27% expect such ships within the next 10 years, but 34% do not. Even more, 43% of respondents expect unmanned, autonomous ships to be introduced in international trade, while only 15% do not agree with the statement.

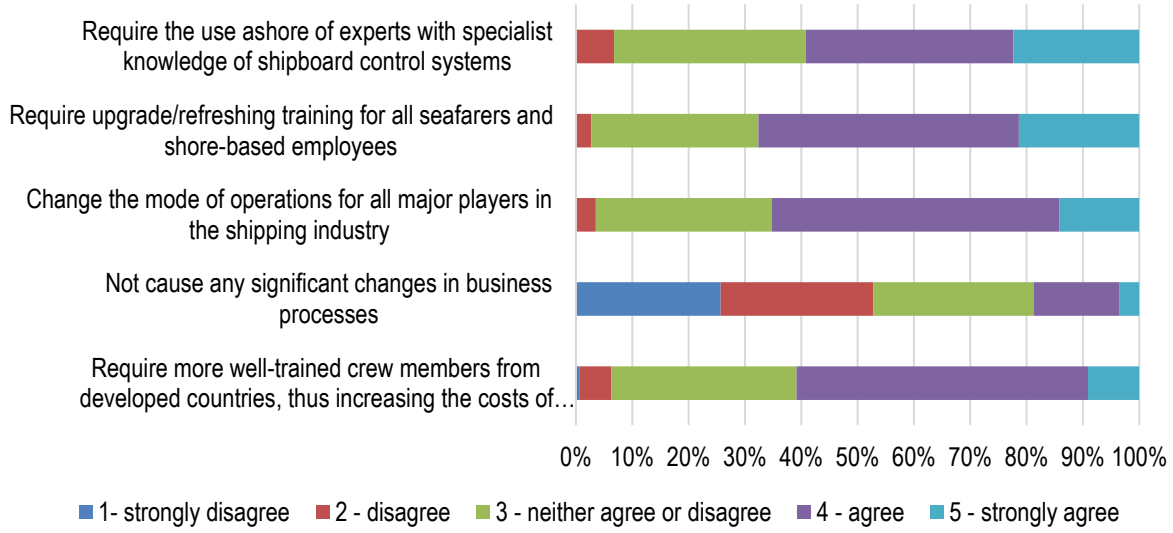

Figure 65 Effects of environmental requirements on shipping

Almost 60% of respondents agree that experts with specialist skills in shipboard control systems will be more extensively required in the future. It is expected that these requirements will demand upgrade/refresher training not only for seafarers but also for shore-based staff (an opinion supported by 67% of respondents). In line with this, there is a broad agreement on the need for more well-trained crew members from developed countries (supported by 61% of respondents and only 6% opposing), thus increasing operations costs.

Finally, a change of the mode of operations for all major players is expected by 65% of respondents (and considered unlikely by only 4%). Accordingly, 53% of all respondents expect significant changes in business processes caused by environmental requirements.

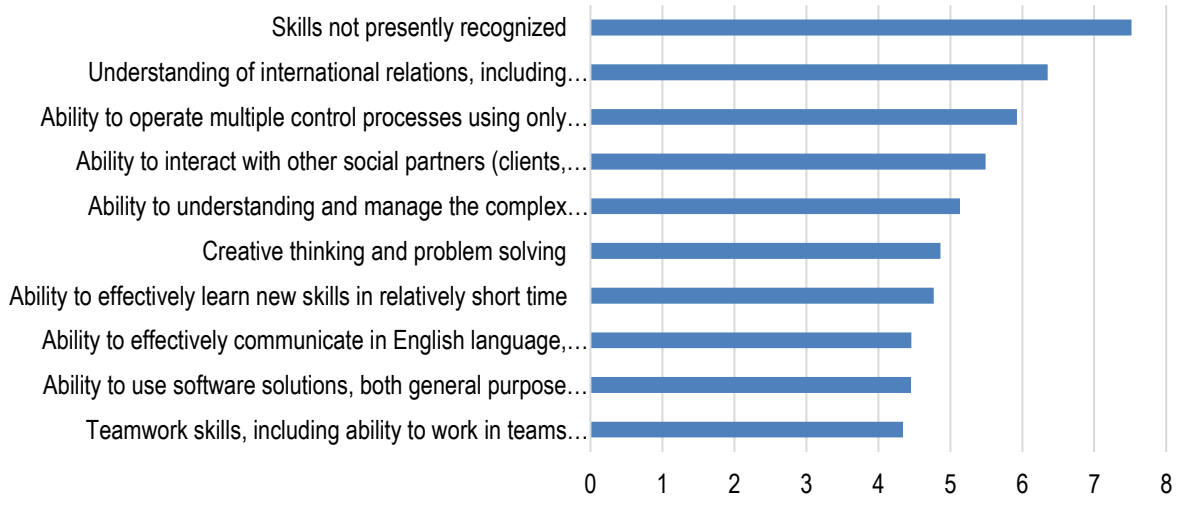

Figure 66 Skills expected to be the most needed in the years ahead (ranked according to average values)

Finally, respondents were asked to rank skills that will be required in the next 10 years or so. Accordingly,

the essential skills remain *Teamwork skills, including the ability to work in teams involving team members located ashore, the ability to use software solutions, both general-purpose office software and dedicated software, and the ability to communicate in English language, oral and writing effectively*. Such results are not surprising.

It may be therefore concluded that:

(18) Considerable skill gaps are identified in the following subject areas: ships operations; maritime economy and law; and transitional and digital skills – all of which are only marginally included in the STCW Convention and associated Model Courses.

(19) The essential missing transitional skills are those related to teamwork, personal communications and problem-solving.

(20) The essential subject areas dealing with the maritime economy and business, and requiring upskilling, are: safety and risk management; ship operations and crew management; and marine operation and maintenance management.

(21) The essential subject areas related to maritime law, requiring up-skilling, are those dealing with seafarers' rights and collision regulations.

(22) Substantial technological changes are expected within the next 10 years, requiring seafarers and shore-based personnel to upgrade existing skills and adopt new digital skills.

(23) Further developments of environmental protection measures are expected within the next 10 years or so, leading to considerable changes in the mode of operations of all major players and requiring considerable upskilling of seafarers and shore-based personnel.

Results and outcomes

Based on the previously described outcomes, the following key competencies have been identified as missing in general or in certain segments of the maritime industries. In addition to the skills identified as skills needed onboard, this chapter deals with required or highly recommended skills when a seafarer, after serving at a management-level position onboard, looks for a job ashore in the maritime cluster. A lack of these skills might be the primary cause of higher mobility between onboard and shore-based jobs within the maritime industry.

Maritime economy. Skills related to various aspects of the maritime economy and business have been dropped from the regular programmes for educating seafarers, mainly because there is no such requirement in the STCW Convention. Consequently, numerous MET institutions and shipping companies are not considering these subjects as sufficiently essential to require inclusion into the programmes. At the same time, dropping these subjects has reduced the costs of delivering, removed the need to recruit personnel with such expertise, and released certain institutional capacities for other purposes.

Although highly welcome for onboard positions, these skills are mandatory for positions ashore, particularly for medium and top management in shipping. They represent core professional skills for shore-based management, although the importance of different aspects may vary significantly across different positions.

Due to the size of the subject area, a possible upgrading programme for former seafarers should cover the subject area in at least several courses and focus on logistic aspects of sea trade and/or maritime transport technologies. The subject area may be partitioned according to other criteria if the resulting courses consider the previous knowledge of former seafarers, their work schedules, and selected modes of delivery.

Maritime law. Although not all the skills related to various aspects of maritime law were left out, as in the case of maritime business skills, the lack of skills in this subject area serves as an obstacle to former seafarers in assuming duties in shore-based maritime industries, particularly at the level of medium- and top-level management. It is worth noting that the subject matter of maritime law mainly left out is that dealing with contractual obligations, while the content dealing with statutory regulations has remained, and even increased in last few years, thanks to numerous new regulations, mainly dealing with safety and pollution prevention.

The skills in this group are welcomed onboard but are not a mandatory requirement. Contrary to this, these skills are frequently compulsory for positions at the management level ashore. Since many shore-based companies employ legal experts, the full scope of such skills is not required for those with shipboard experience.

In that respect, and because of the size of the subject area, a possible upgrading programme for former seafarers needs to cover the subject area in at least several courses, being individually selectable and focused on the main functions of shipping companies or similar ventures (insurance, claims, etc.). The subject area may be partitioned in different ways reflecting the previous knowledge of former seafarers, their work schedules, and selected modes of delivery.

Ship technologies. The skills related to ship technologies (particularly the use of different equipment) are the most frequent skills described in the present STCW Convention. However, these skills mainly refer to technologies standards on ships trading in the mid-1990s, i.e. at the time when the first significant revision of the STCW Convention had been prepared.[70] Amendments adopted in later years focused mainly on the

[70] The same view is shared by the industry. Speaking in Manila, Esben Poulsson, the Chairman of the International Chamber of Shipping (ICS) has called for a comprehensive revision of the STCW Convention which governs global standards for the training and

human element, leadership and management (HELM), and less on new technologies.

Modern ships are being developed, or have already been developed, under the influence of radically different technologies, many of them with extensive built-in AI support. Such advancements significantly reduce the opportunities for on-the-job training (learning by doing), which was extensively used to upgrade skill sets. In addition, a certain number of skills, pretty essential in the past, will probably become obsolete. Consequently, these trends should be considered during the next revision of the STCW Convention.[71,72]

The approach applied in the present STCW Convention requires seafarers wishing to sail aboard sophisticated ships or to perform specific duties aboard, attend additional short courses (lasting three to five days mainly), and upgrade their skill sets. In addition to this, during the last few decades, the industry developed many non-STCW courses aiming to upgrade competencies required to handle complex technologies aboard or improve certain aspects of the work aboard (see Annex 1 and 2 as examples of such an approach on LNG carriers and passenger ships). This approach is appropriate if employees using particular technology remain with a company and on the same class of ships for a long time.

Since many of the courses identified for specific technologies are pretty similar, these courses (or at least most frequently required courses by the companies) may be standardised and even included in the next revision of the STCW Convention in the STCW Code B. In this case, it would be possible to extend the scope of the courses beyond safety, security and pollution prevention.

Since new technologies are being introduced, upskilling of former seafarers looking for a job ashore through numerous short courses might not be feasible, especially if the contents of the courses are to be left to individual companies to decide. A more appropriate approach would be the development of several more extensive courses containing all additional competencies for certain classes of ships or technologies, having in mind the positions frequently found in shore-based industry (for example, an upskilling course for superintendents[73]).

Green skills.[74] According to **the European Centre for the Development of Vocational Training**

certification of around two million merchant seafarers.

"It's now commonplace for employers to routinely provide additional training and assessments prior to the deployment of many officers holding STCW certification which raises questions as to whether the Convention as currently drafted is still fit for purpose in the 21st Century," said Poulsson. "A fully revised STCW regime would allow the industry to adapt much more effectively to technological developments including increased automation. It should provide a structure of sufficient flexibility to hit the moving target of a changing world fleet, and may need to develop a more modular approach to competency accumulation and certification. The arrival of new technology is already changing the functions that seafarers perform on board and the skills and training they require." https://www.maritime-executive.com/article/ics-calls-for-revision-of-stcw

[71] The work on the next revision of the STCW Convention was expected to start in 2020.

[72] See Emad, GR, Improving Maritime Education and Training: The Need for Reform, Proceedings of SEAS 2017 Korea Maritime Week, Busan. Korea (2017)

[73] The approach proposed is already implemented by the Lloyds Maritime Academy.

[74] According to Cedefop 2014, Europe, green skills are "Abilities needed to live in, develop and support a society which aims to reduce the negative impact of human activity on the environment." Terminology of European education and training policy (2014)

According to the EU Commission: "Environmental awareness skills refer to the knowledge, abilities, values and attitudes [in the general population] needed to live in, develop and support a society which reduces the impact of human activity on the environment. These generic 'green' skills include the capacity to include environmental concerns alongside others (such performance and safety) in taking decisions, including in the choice of processes and technologies." EU Commission (Skills panorama) 2015, Europe,

(Cedefop), “Developing a low-carbon economy depends [more] on improving existing skills rather than specialised green skills.”[75]

Figure 67 Importance of "true" green skills relative to other transversal skills[76]

As in other industries, green skills in shipping are much more based on attitudes than on knowledge. However, attitudes, especially in the case of adult professionals, can be more easily imparted if argumentation is based on facts and through the understanding of the causes and effects.

In that respect, the current approach used in the STCW Convention is of limited use because only lower-level knowledge skills are required for most subject areas. Even for the professional subjects, the required knowledge, understanding and proficiency is limited to what is required for safe operations of the ship.

Therefore, the leading causes and effects of processes in sea transport and influencing the environment should be explained both to shipboard and shore-based personnel. This can be done through several different activities, ranging from printed materials, videos, and social media to short courses to be introduced in the next revision of the STCW Convention, either in STCW Code A or B.

It is assumed that such a campaign should equally influence shipboard and shore-based personnel.

[75] Cedefop – Briefing note: Skills for green jobs, July 2010

[76] ibid.

Digital skills. Digital skills required onboard may be divided into two broad groups: skills required to use dedicated software and skills connected with general information management. The skills belonging to the first category will be required only for seafarers specialising in the maintenance of complex systems and similar high-tech jobs. The skills required for information management will be required by a much larger group of seafarers, practically for all those executing functions at operational and management levels and those working ashore.

Presently, digital skills are not part of the STCW Convention. However, the majority of active seafarers today already acquire a minimal set of digital skills (mailing, basic spreadsheet and word processing). The level of acquired digital skills is left to each person, and it significantly depends on personal inclinations. To improve digital skills among seafarers and recognise skills already acquired by seafarers, a formally recognised set of digital skills and assessment methods (standard of proficiency) should be developed. It may prescribe several levels of proficiency. The standard of digital proficiency could be included in the STCW Convention (STCW Code B) to ensure effective implementation. Alternatively, the standard may be set up as an EU standard, voluntarily implemented by the industry.

In any case, the standard should be designed in accordance with the needs of the maritime industry. This does not prevent the use of the standard by shore-based personnel. Its extensive implementation will significantly facilitate the mobility of active seafarers towards shore-based positions. It will also affect mobility in the opposite direction. In addition, it may be used by would-be personnel.

Transversal skills. Transversal skills[77] are the skills that may be used in almost any job. Minimal requirements for transversal skills, i.e. skills mainly used onboard, are listed in the STCW Convention[78]. However, these skills are highly related to the jobs carried out aboard. Therefore, it is highly questionable whether these skills are applicable in other situations, apart from those they are designed for.

Compared with lists of commonly accepted transversal skills, it is easy to identify that the programme seafarers are required to attend deals only with a limited set of skills; the majority of transversal skills are not covered. Finally, the subjects required (as represented in the respective Model Courses) assume relatively high levels of cognitive skills beyond the level assumed in the present revision of the STCW Convention. If compared with the key competencies recommended by the European Parliament, almost all transversal skills are missing in the STCW Convention. Therefore, it seems that transversal skills of the presently active European seafarers are much more the outcome of primary and secondary education,

[77] There are numerous categorisations of transversal skill. According to UNESCO "'transversal competencies' has six domains: 1) critical and innovative thinking, 2) interpersonal skills, 3) intrapersonal skills, 4) global citizenship, 5) media and Information literacy, and 6) others. The domain 'others' was created as a way for researchers to include competencies, such as physical health or religious values that may not fall into one of the other." Source: UNESCO Bangkok 2016, Asia-pacific, https://unesdoc.unesco.org/ark:/48223/pf0000244022

The European Parliament and Council set out a recommendation on the key competences for lifelong learning. The recommendation defined eight key competences that are considered essential for every European to develop and update throughout their lives to be able to adapt to change. They are based on the need for personal fulfilment and development, active citizenship, social inclusion and employment: 1) Communication in mother tongue, 2) Communication in foreign languages, 3) Mathematical competence and basic competences in science and technology, 4) Digital competence, 5) Learning to learn, 6) Social and civic competences, 7) Sense of initiative and entrepreneurship, and 8) Cultural awareness and expression.

[78] The Convention lists the following transversal skills: 1) Ability to apply task and workload management, including planning and co-ordination, personnel assignment, time and resource constraints and prioritisation. 2) Knowledge and ability to apply effective resource management: allocation, assignment, and prioritisation of resources; effective communication onboard and ashore; decisions reflect consideration of team experiences; assertiveness and leadership, including motivation; obtaining and maintaining situational awareness. 3) Knowledge and ability to apply decision-making techniques: situation and risk assessment; identify and consider generated options; selecting course of action; evaluation of outcome effectiveness.

culture, tradition and personal inclination than they are intentionally designed and developed.

The deficient level of transversal skills as required by the STCW Convention and associated Model Courses only represent a minimal requirement. Consequently, it could be likely that these subjects will be significantly extended in scope and depth in the following revision of the Convention.

Regarding the transversal skills required for shore jobs in the maritime industry, the standard outlined in the STCW Convention is beyond any doubt below the industry's requirements.[79] Consequently, opportunities to acquire these skills should be provided. Since such skills are helpful in all situations and in all jobs, developing an appropriate set of training programmes and tools (most probably using distance learning as a method of delivery) is recommended. The programmes and tools should be developed with the industry's needs in mind.

Based on the identified skill deficiencies, the following measures to respond to the identified challenges are proposed for further consideration:

Challenges	Gaps	Measures
Current and future shortage of maritime professionals	**Restricted shore-to-ship mobility** **Educational restrictions** **The public image of the profession**	• The study programme offered by MET institutions should include topics/courses covering subjects beyond and above STCW requirements. • An EU alliance of MET institutions should be proposed, aiming to promote harmonised workforce education for the EU maritime industry, both aboard and ashore. • Coordinated action (at the EU level) should be initiated, aiming to change public perception of the maritime industry, particularly in respect of seafarers. • MET institutions should be encouraged to increase the number and scope of study programmes aiming to up-skill the maritime industry workforce.
Mobility issues	**Resistance to relocate** **Labour competition** **Inadequate communication**	• The courses aiming to upgrade or re-skill shore workers associated with the maritime industry should be promoted. • Student exchange between MET institutions across the EU should be further promoted to ensure an appropriate understanding of different cultures. • Academic staff exchange should be further promoted to accelerate the update and harmonisation of study programmes among different institutions.

[79] According to one research report, "…the industry employers surveyed seemed to consider transferrable skills such as communication, problem solving, adaptability, self-management, and team work more essential than disciplinary technical skills". Peggy Shu-Ling Chen, at al., Employability skills of maritime business graduates: industry perspectives, WMU Journal of Maritime Affairs (2018) 17:267–292.

Communication issues	Inadequate communication Cultural differences	Courses aiming to upgrade seafarers' communication and language skills should be promoted. EU-wide proficiency standards in language skills for people working in the maritime industry should be considered. EU-wide programmes of measures aiming to increase cultural awareness among seafarers and shore-based staff should be considered.
Core skill sets	Deficiency in core competencies and competencies concerning maritime economy, law and ships technology	The maritime industry should cooperate more closely with maritime administrations and MET institutions to provide trainees with more opportunities for practical training. Courses aiming to upgrade the knowledge and skills of the maritime industry workforce should be promoted. Courses should be modular and flexible in terms of duration, scope and delivery. Degrees awarded should be comparable and based on the ECTS system. Courses aiming to upgrade the management skills of former seafarers and shore-based staff should be developed and promoted.
Digital skills	Deficiency in use of analytical tools Deficiency in dedicated software	Courses aiming to upskill seafarers in the use of standard software tools should be developed and promoted. They should be in accordance with the standard EU set of skills (DigComp 2.0).[80] Courses aiming to up-skill shore-based personnel using analytical software tools should be developed and promoted. Courses aiming to upskill seafarers in remote monitoring, surveillance and control technologies should be

[80] https://ec.europa.eu/jrc/en/digcomp/digital-competence-framework

		developed and promoted Courses aiming to upgrade shore-based employees' skills in maritime information and control systems should be developed and promoted.
Transversal skill	Inappropriate attitude regarding constant upskilling Inability to communicate constructively in different environments	Courses aiming to upskill seafarers in the human element, leadership and management skills beyond those already outlined in the STCW Convention should be developed and promoted. EU-wide programmes of measures aiming to promote "learning to learn" attitudes should be promoted.
Green skills	Inadequate understanding of needs to protect the environment Insufficient knowledge of competencies needed to use tools and follow procedures ensuring appropriate environment protection properly	EU-wide programmes of measures aiming to increase environmental awareness among seafarers and shore-based staff employed with the maritime industry should be considered. Courses aiming to upskill seafarers in procedures and proper use of tools to ensure appropriate environmental protection should be developed and promoted.

The courses proposed in the previous table, aiming to upskill seafarers and shore-based staff, should be developed coherently and be consistent with skills already required by the STCW Convention.

The list of measures presented here is not exhaustive. Any other measure aiming to remove identified gaps should be supported as much as practically possible.

It may be therefore concluded that:

(24) Removing identified skill gaps requires the development and implementation of numerous measures, ranging from amending existing education and training programmes, introducing new educational and training programmes, methods of delivery and tools, and actions aiming to disseminate and promote new professional standards.

(25) Harmonised implementation of the measures, including setting up new standards (internationally or at the EU level), can significantly accelerate their successful application.

Conclusions

The most important conclusions of this study are as follows:

(1) Present and future challenges facing the maritime industry will create significant pressure on the existing model of manning the maritime industry, both on ships and ashore. There are strong indications that new technologies and the resulting social interactions will significantly affect the required core skill sets, the modes of acquiring skills, and the relationships among key stakeholders, those being active in the labour market(s) and others.

(2) Designing a future-proof skill set for management positions in the maritime industry is an extremely difficult task. It must be developed as an additional set of skills for those who already possess a basic shipboard skill set, accompanied by a balanced set of transitional skills and digital and green skills. Probably the most challenging task would be to find a proper balance of sector-specific skills and cross-sectoral skills because they very much depend on job requirements.

(3) MET institutions offering education and training at all levels are generally able to respond to the industry's needs and fill the skill gaps. However, the ability to provide different skills – particularly high-level skills – may vary significantly between institutions and countries.

(4) Due to the different positions and levels of development of MET institutions in different countries, their uniform response to changes and challenges is not easy to ensure. It will depend on the scope of education required, capacities and expertise available at an institution, and financial incentives provided in each case.

(5) There exists no EU-wide alliance or similar form of association of institutions offering MET programmes. However, many institutions offering MET programmes at least at the MSc level are members of the International Association of Maritime Universities (IAMU).

(6) The maritime industry is a highly dynamic industry, exposed to numerous external influences. At the same time, it is a highly regulated industry at international, regional and national levels.

(7) The maritime industry is highly competitive, thus heavily dependent on the effective implementation of modern technologies.

(8) Keywords used to describe key subjects and actions are identified for all three subject areas – maritime law, ships' technology, and maritime economy.

(9) Minimal requirements of the STCW Convention for the management level functions onboard contain only the basic levels of "knowing", i.e. knowledge (recognising or remembering facts, terms, and concepts), understanding of these facts and ideas (by comparing and interpreting the main ideas), and application, i.e. solving problems in new situations by applying previously acquired knowledge and understanding.

(10) For management-level positions, the STCW Convention does not assume higher-level capabilities, such as analysis, synthesis and evaluation.

(11) The STCW Convention does not refer to digital skills. Computer literacy is considered an optional tool (in the Model Courses) to support acquiring core professional skills.

(12) The STCW Convention contains only general references to pollution prevention. References mainly deal with proper handling of onboard equipment; there is no supporting information on the causes and effects of pollution, consequences and environmental protection principles.

(13) The STCW Convention refers to a limited set of transversal skills applicable in managing ships' crews (resource management, communications onboard, situational awareness and decision-making). These skills are designed solely for shipboard use.

(14) The STCW Convention does not require competencies needed for shore jobs at the management level in the maritime industry or competencies needed to manage sophisticated ships. Education for these jobs must necessarily include subjects significantly beyond STCW requirements, either as a part of regular education or in the form of upgrading courses.

(15) The importance of the availability of a skilled workforce, onboard and ashore, for efficient development of the maritime industry has been identified in the past.

(16) The accelerating transformation of the industry can be recognised in the study of all the sources investigated. Therefore, it is beyond any doubt that the maritime industry is facing significant technological challenges.

(17) These changes will inevitably alter the required skill sets required for onboard and shore-based jobs and positions. Consequently, an effective transfer of knowledge of shipboard operations and expertise needs to be assured if the present position of the EU maritime industry is to be maintained.

(18) There is very high variation in institutional forms offering maritime training and education, ranging from privately owned institutions offering only short courses to seafarers and shipping companies up to independent maritime universities.

(19) In almost all EU member states, university-level study programmes delivering courses in the field of international shipping and logistics, maritime law and business, port management (i.e. programmes for the shore-based maritime industry) are identified.

(20) Maritime education and training institutions offering education leading to management-level Certificates of Competency are in most cases supervised by the ministries responsible for education and by the ministries responsible for maritime affairs.

(21) The cooperation among EU MET institutions is irregular and of questionable usefulness. The cooperation among MET institutions in different countries occurs mainly as a part of EU-funded projects. And even in this case, the institutions cooperating are mainly those with specific research capabilities while others participate only sporadically.

(22) No recognised EU-wide initiatives aim to harmonise maritime education programmes offered by different institutions or in different countries. This is not the case even regarding the subjects defined in the STCW Convention. The only formal contact identified among MET institutions regarding study programmes is a partial comparison of courses delivered by two institutions at the university level within the Erasmus student exchange programmes.

(23) Thanks to ever-accelerating technological development and the increasing number of high-tech companies who accumulate expertise, the number of education and training providers for dedicated applications is expected to increase significantly, thus changing the institutional position of the traditional MET providers.

(24) New modes of delivery (blended learning, distance learning and similar) are expected to increase their share.

(25) The number of specialised courses aiming to upgrade or re-skill adult workers associated with the maritime industry and who have already earned degrees is expected to increase, both in numbers and scope.

(26) Considerable skill gaps are identified in the following subject areas: ships operations; maritime economy and law; and transitional and digital skills – all of which are only marginally included in the STCW Convention and associated Model Courses.

(27) The essential missing transitional skills are those related to teamwork, personal communications and problem-solving.

(28) The essential subject areas dealing with maritime economy and business, and requiring upskilling, are safety and risk management, ship operations and crew management, and marine operation and maintenance management.

(29) The essential subject areas related to maritime law, requiring up-skilling, are those dealing with seafarers' rights and collision regulations.

(30) Substantial technological changes are expected within the next 10 years, requiring seafarers and shore-based personnel to upgrade existing skills and adopt new digital skills.

(31) Further developments of environmental protection measures are expected within the next 10 years or so, leading to considerable changes in the mode of operations of all major players and requiring considerable upskilling of seafarers and shore-based personnel.

(32) Removing identified skill gaps requires the development and implementation of numerous measures, ranging from amending existing education and training programmes, introducing new educational and training programmes, methods of delivery and tools, and actions aiming to disseminate and promote new professional standards.

(33) Harmonised implementation of the measures, including setting up new standards (internationally or at the EU level), can significantly accelerate their successful application.

Annexe 1 Courses attended by masters on LNG ships[81]

Course subject	Days	Hours[82]	Core[83]	Generic[84]	Other[85]
Voyage planning					
Dynamic Positioning – Induction course	5	40	100%	0%	0%
Octopus – onboard Wavex light structures Operator Course	3	24	100%	0%	0%
ECDIS Type specific course	3	24	100%	0%	0%
Ice Navigation Simulator Training	5	40	82%	0%	18,18 %
Advanced Ice Navigation Simulation Course	5	40	75%	8,33%	16,67 %
Ship Handling and Manoeuvring Phase One	5	40	100%	0%	0%
Ship handling Phase Two	5	40	100%	0%	0%
Ship Handling & Manoeuvring (Azipod)	3	24	100%	0%	0%
Safe Mooring	3	24	100%	0%	0%
The Manned Model Course in Handling of Large Ships and Ships with unusual manoeuvring characteristics	5	40	100%	0%	0%
Port of Bonny simulator familiarisation course	2	16	100%	0%	0%
Integrated Bridge System	5	40	75%	25%	0%
Safety and pollution prevention					
Proficiency in Survival Craft and Rescue Boat operation	5	40	80%	0%	20%
Marine Environmental Protection	1	8	25%	0%	75%
OPA 90	4	32	100%	0%	0%
Shipboard Safety Officers course	2	16	80%	10%	10%
Onboard Safety Officer	2	16	75%	12,50 %	12,50 %
Safety Officer	2	16	85,71 %	0%	14,29 %
Security training for seafarers with designated security duties	2	16	100%	0%	0%
Incident investigation training course	2	16	33,33 %	0%	66,67 %
Risk Assessment Incident Response & ISO 14001 Awareness	1	8	16,67 %	0%	83,33 %
AMOS M&P course – Spec Tec Ltd.	3	24	83,33 %	16,67 %	0%
Inventory and consumable store control	4	32	100%	0%	0%

[81] The list contains short courses collected by interviewing experienced masters on board LNG ships and serving on companies controlling 188 LNG ships at the time of interviews. The interviews have been carried out as a part of the PhD research of Ana Gundić, a PhD student at the University of Rijeka. The list contains only courses for which program content and duration was available.

[82] Duration of the course in working hours.

[83] Estimated percentage of the course content characterised as a part of the core skill set.

[84] Estimated percentage of the course content characterised as a part of the generic (transversal) skill set.

[85] Estimated percentage of the course content characterised as a part of the sectoral and cross-sectoral skill set.

Loading and unloading of cargo					
Tanker Familiarization	2	16	50%	0%	50%
Liquid Cargo Handling Simulator (LICOS)	5	40	100%	0%	0%
LNG Cargo Handling Course (SIGTTO)	5	40	100%	0%	0%
Dangerous Cargo Handling	3,5	28	100%	0%	0%
Dangerous and Hazardous Substances in solid form in bulk and in packaged form	4	32	50%	0%	50%
LNG carrier Operator Course	3	24	91,67 %	0%	8,33%
K-bridge Operator Course	4	32	100%	0%	0%
Hamworthy LNG Regasification System	3	24	100%	0%	0%
Off-Shore Loading, LNG STL Operation, Ph SP	5	40	100%	0%	0%
GT & T Training on Membrane LNG Carrier Techniques	4	32	100%	0%	0%
SIGTTO-LNG Training Course	5	40	100%	0%	0%
Kongsberg K-Chief Automation Systems Basic course	5	40	100%	0%	0%
Communications and human resources					
Ship Handling and Bridge Teamwork	5	40	0%	100%	0%
Assessor Training course	2	16	25%	0%	75%
Maritime Resource Management (Attitude and Management/Management Styles)	3	24	0%	100%	0%
Bridge Resource Management	4	32	11,77 %	88,24 %	0%
SAS Bridge Resource Management	4	32	9,09%	90,91 %	0%
Safety Management Course	2	16	91,67 %	0%	8,33%
Ice Crew	3	24	77,78 %	0%	22,22 %
MTI Network Seafarers Media Awareness	1	8	36,36 %	63,64 %	0%
Other					
Familiarisation Course in Norwegian Maritime Rules & Regulations	0,125	1	100%	0%	0%
Food Safety	2	16	0%	0%	100%
Apollo - Root Cause Analysis Training	2	16	0%	100%	0%
Regulations for NIS flagged vessels	3	24	100%	0%	0%

Annexe 2 – Courses attended by masters on passenger ships

Course subject	Days	Hours	Core	Generic	Other
Voyage planning					
ECDIS Phase 1	5	40	100%	0%	0%
ECDIS Phase 2	3	24	100%	0%	0%
ECDIS type specific training	1	8	100%	0%	0%
Radar & ARPA, Bridge teamwork & search and rescue	5	40	100%	0%	0%
AIS Operator	2	16	100%	0%	0%
NACOS – ECDIS Course Phase 2	4	32	95%	0%	5%
Operational Use of Automatic Identification Systems (AIS)	1	8	100%	0%	0%
International Regulations for Preventing Collisions at Sea	2	16	100%	0%	0%
Ships Handling	5	40	100%	0%	0%
Ships Stability Course	2	16	100%	0%	0%
Manned Model Ship Handling	5	40	100%	0%	0%
Ship Handling/Manoeuvring Simulator	5	40	100%	0%	0%
DP Advanced Simulator	4	32	100%	0%	0%
DP Basic Operator	4	32	100%	0%	0%
DP & Advanced Ship Handling Azipod	5	40	70%	30%	0%
Advanced Ship Handling	5	40	100%	0%	0%
DP and BRM Ship Handling	4	32	50%	50%	0%
Safety and pollution prevention					
ISM Code	3	24	88,89 %	0%	11,11 %
SA Ships Safety Officer	1	8	66,67 %	0%	33,33 %
Hazmat	2	16	85,71 %	0%	14,29 %
Tender Operator	2,5	20	100%	0%	0%
Amos Training Certificate	4	32	85,71 %	0%	14,29 %
Pest Management Certificate	3	24	16,67 %	0%	83,33 %
Communications and human resources					
Application of Leadership and Teamworking Skills	1	8	40%	60%	0%
Bridge Resource Management – Phase 1	3	24	0%	100%	0%
Bridge Resource Management – Phase 2	5	40	0%	100%	0%
Use of Leadership and Managerial Skills	2	16	0%	100%	0%
Train the Trainer	3	24	0%	100%	0%
Other					
Ship Captains Medical Care	5	40	12,50 %	0%	87,50 %
Certificate Cruise Professional (CCP)	5	40	57,14 %	0%	42,86 %
Maritime Tune Up Training	1	8	0%	0%	100%

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