CURRENT SKILL NEEDS

Reality and Mapping

PROJECT: SkillSea

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SKILLSEA

CONTENT

1. 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 important 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 in not only increasing the attractiveness of a seafaring career for EU nationals – both male and female, and especially youngsters – but also in providing the industry and the wider maritime sector 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, as well as a deficit of skills developed onboard and applied ashore.

The response to global trends and changes with respect to the new skills needed to deal with the changes and challenges faced by world shipping in the near future; with the most important requirements linked to the environment-friendly performance of shipping, new transport technologies, and increased digitalisation, etc.

Seafarer education and training, requiring more thorough 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 important 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 sector 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 time span, i.e. 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, and 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 11 chapters and five annexes. Each chapter begins with its goal, followed by short background information, a brief presentation of the approach used and the main outcomes.[3] Each chapter is closed with the most important conclusions. All the conclusions are summarised in the last chapter. This report is assumed to be the basis for the following work packages and tasks, predominantly for Task 1.1.3. FUTURE SKILL NEEDS.

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

2 Task 1.1.3 deals with future skill needs.

3 In this report, well-known facts or trends and their sources are omitted or minimised to restrict the number of pages to the reasonable level.

2. SETTING THE SCENE

Seas and oceans are important 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 – the Blue Growth. It is a long-term strategy to support sustainable growth in the marine and maritime sectors.[4] 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 EU Blue Economy. They are employed within five broad sectors: shipping;[5] shipbuilding; non-living resources (primarily oil and gas); living resources (fishing, aquaculture, processing); and coastal tourism.[6]

In terms of its importance for overall well-being and continuous development, shipping has maintained its pivotal role for decades, and 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 EUR 18.7 billion and employed 176,000 workers.[7]

Shipping and maritime industries and services operate globally, and the global market significantly influences national transport systems. This mutual interaction will remain or become even more important in the years ahead. Due to the nature of the industry, human capital is probably the single most important 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 the competitiveness of today and tomorrow is maintained.[8]

The main challenges facing the maritime sector 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[9] are knowledge-intensive, high-quality jobs. These jobs largely depend on former seafarers with 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 the 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; 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 rather 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'

4 https://ec.europa.eu/maritimeaffairs/policy/blue_growth_en

5 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 – Statistics on Seafarers in EU – Statistical review (2020 data from the STCW-IS as provided by 31 December 2021)

6 COMMISSION STAFF WORKING DOCUMENT Report on the Blue Growth Strategy, Towards more sustainable growth and jobs in the blue economy, 2017

7 European Commission, Directorate-General for Maritime Affairs and Fisheries, Joint Research Centre, Addamo, A., Calvo Santos, A., Guillén, J., et al., The EU blue economy report 2022, Publications Office of the European Union, 2022, https://data.europa.eu/doi/10.2771/793264

8 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

9 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)

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, maintaining high training standards and professional competence of maritime professionals is essential 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 ships to on-shore roles, 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, particularly for safety-critical positions. 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 a lack of horizontal skills required for shore jobs. In addition, vertical labour mobility often requires specific upskilling or re-training.

Communication issues. Lack of cooperation and communication between knowledge providers, competent authorities (regulators), and the industry (usually recognised as a Triple Helix) has occurred for decades in maritime activities, particularly those related to shipping. The main reasons for unsatisfactory communication are usually attributed to different cultural and organisational schemes, caused mostly by different drivers affecting stakeholders. The current knowledge providers are, as a rule, limited by legislation in force, which does not enable the flexible adaption of curricula to match emerging needs. Therefore, cooperation between knowledge providers and the industry, with authorities being heavily involved, is crucial to ensure the smooth development and continuous delivery of a properly trained workforce.[10] Strengthening the cooperation between the educational and employment sides is crucial to fill and preventing skills gaps.[11]

Core skill sets. Another important issue caused by the rapidly accelerating technological changes is the set of professional skills (core skills) that a person or a group of persons has to master. Previously, 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 only partial use when applying for a similar job, even within the same industry or sector (in the last two decades, the maritime industry has witnessed the disappearance of numerous professions and associated skill sets, for example, radio officers). Consequently, employees need a broad set of skills or the ability to update or upgrade their skills, as may be appropriate, to achieve their full potential at work and in society.[12] For this reason, besides the skills needed as a maritime professional, a person looking for a job ashore needs a set of transitional skills, including sector-specific and cross-sectoral skills.[13]

10 It is assumed that 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.

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

12 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

13 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.

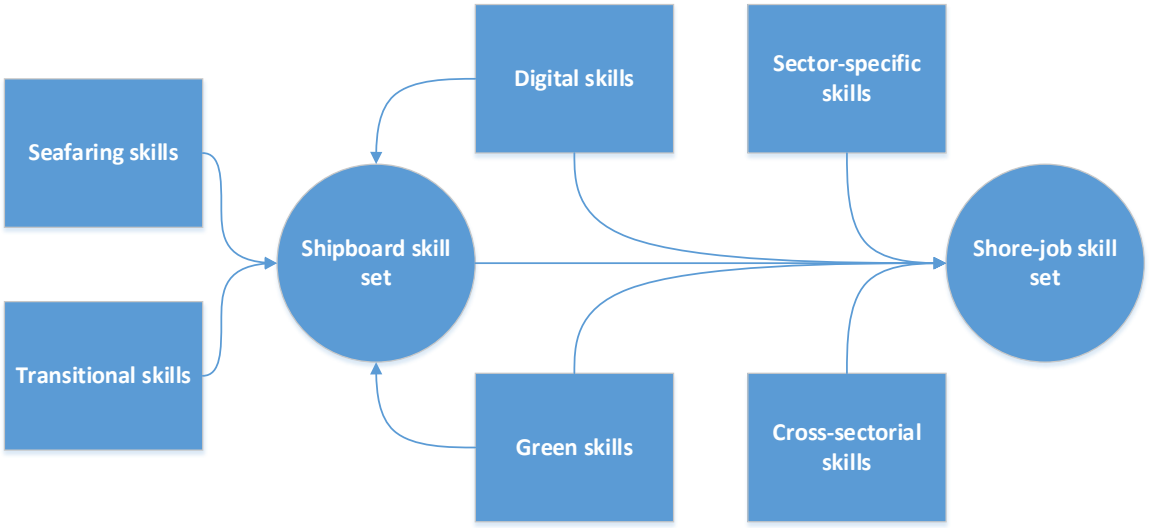

Figure 1 Different skill sets required for shipboard positions and shore-based jobs where the seafaring background is considered essential

Digital skills. Digital skills enable a person to use or interact with various digital services, either professionally or as a citizen. The number of digital services is constantly increasing, and the ability to use these services is becoming highly important. Recent technological developments clearly show the same process throughout the maritime industry, thus requiring maritime professionals to use these general-purpose services and particularly dedicated maritime services. On top of that, attention must be paid to the skills required to maintain cyber security, either onboard or on shore.

In recent years, digital competencies (general-purpose competencies, those required for dedicated maritime services and security-related competencies) have become a building block of the value chain, thus gaining importance in the shipping industry. Digital competencies are the main building block of advanced IT system implementations, integrated logistics, and the introduction of emerging technologies (such as blockchain), thus essential to improve value chain integration.

Green skills. Another important extension of the core skills set for maritime professionals is the green skill set. This set broadly consists of the skills required to limit pollution and environment-damaging emissions caused by the routine operations of ships or in the event of an emergency. The skills also cover the proper use of different tools and equipment to achieve these objectives and maintain energy efficiency.[14] Although not critical to the economic viability of business activity, these skills have become extremely important, mostly because of their impact on climate change, increasingly strict regulatory requirements, and the overall image of companies and industry.

It is important to note that these challenges affect various stakeholders differently, both in intensity and time. From the project's perspective, the key stakeholders are 1) the maritime sector, 2) maritime education and training providers, and 3) regulatory bodies.

The maritime sector is directly affected by a shortage of skilled maritime workers, especially in the case of shipboard personnel shortages. It is particularly emphasised in transport chains involving sophisticated ships or technologies, while the impact is less emphasised or delayed in other shipping sectors. Other parts of the maritime sector may experience delayed effects of workforce shortages, and scale may differ, depending predominantly on the company's main activity. As a rule, entities that depend on high-level

14 https://to2025.dnvgl.com/shipping/energy-efficiency-and-fuels/

expertise (where the available workforce pool is smaller) are more directly and rapidly affected. In any case, the effects are such that many shipping companies and companies providing supporting services have been forced to establish entities whose predominant task is to ensure an adequate workforce with the required skill sets (see more details in the following chapters).

Maritime Education and Training (MET) institutions provide education and training for shipboard positions and positions ashore. The level and sophistication of MET institutions vary enormously, from entities providing very basic training to institutions providing university-level education, even at the PhD level. Accordingly, their ability to provide the workforce with the required skill sets depends on several factors, the most important being the qualities and demands of the market they serve and the ability to attract expert and experienced instructors and lecturers on the subject(s) in question. The recent challenges significantly impact MET institutions, particularly those providing high-level education and training, requiring them to ensure adequate staff, equipment and teaching aids. In short, such challenges significantly increase the organisational and financial burden on MET institutions and necessitate a much more prompt reaction than in the past.

Regulators include various governmental entities responsible for implementing respective rules and regulations. The entities enforcing different rules and regulations act in different areas (such as economy and commerce, maritime safety, security and pollution prevention, education, and health) and at different levels and policy requirements (international, regional and national). In such a complex environment, any significant change in requirements may propagate through the system, possibly causing unexpected reactions and responses. Consequences, in some cases, may not be easily anticipated in due time.

Finally, new technologies and associated challenges may:

- provoke the emergence of new activities/actors in the arena (for example, cyber-security was not a major issue only a few years ago but is now an important part of the sector's activities) or
- convert activities once considered a minor into a significant part of the sector's activity (for example, the yachting industry was not considered a significant part of the maritime sector in the past, but today it is an important segment, both in fleet size, associated workforce and assets involved).

It is worth noting that the rate of new technologies and associated challenges the stakeholders have to deal with is accelerating, the number of stakeholders is increasing, and – most importantly – the relations among stakeholders are getting more complex than ever before.

It may be concluded that:

(1) The present and future challenges facing the maritime sector will create significant pressure on the present model of education, training and manning of 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 between key stakeholders, those active in the labour market(s), and others.

(2) Designing a future-proof skill set for management positions in the maritime sector is a difficult task. It is expected to be developed as a supplementary set of skills for those who already possess basic shipboard skills, accompanied by a balanced set of transitional, digital and green skills. The core part of the set should include a properly balanced set of sector-specific and cross-sectoral skills designed for different key jobs in the sector.

(3) Key stakeholders may expect to face numerous new challenges in the years ahead. Due to many new relationships and dependencies developing among stakeholders, traditional strategies may not be sufficient, particularly in the case of disruptive technologies.

3. METHODOLOGY

The term skills is commonly understood as the ability to do something well[15] or as 1) the ability to use one's knowledge effectively and readily in execution or performance, 2) dexterity or coordination, especially in the execution of learned physical tasks, 3) a learned power of doing something competently, a developed aptitude or ability.[16] If one searches scientific literature, it is easy to discover that there is no unambiguous and measurable definition of the term. It is particularly the case for the terms soft skills[17] [18] and social skills[19].

A very similar term is competency. In most dictionaries, it shares almost the same definition. For example, in Meriam Webster's Dictionary, it is defined (among other understandings) as the quality or state of having sufficient knowledge, judgement, skill, or strength (as for a particular duty or in a particular respect). In the maritime sector, the term is exclusively understood as defined in the STCW Convention as Standard of competence: the minimum knowledge, understanding and proficiency that seafarers must demonstrate to gain certification. Even more, the Convention specifies the standards of competence to be achieved by the seafarer, including methods for demonstrating competence and criteria for evaluating competence. Comparing this definition with Bloom's taxonomy (see Chapter 8.1.4), the term includes the first three levels but not those defined as higher orders of mental abilities, namely the ability to analyse, synthesise and evaluate. In that sense, the term is narrower than the term skill, which normally assumes higher-order mental abilities for certain tasks and jobs.

Consequently, the term skill here will be understood as a totality of cognitive, psychomotor and affective abilities required to successfully and within the given time person complete a task. The term competence will be understood as defined in the STCW Convention.

Accordingly, the skill set means a set of skills (abilities, competencies), some highly related and interdependent and some relatively independent, required for a particular task or job.

The skill gap is commonly understood as the difference in the skills required on the job and the skills possessed by the employee(s).

Skill gaps may occur at an individual, departmental or organisational level. Skill gaps are more visible if critical skills are lacking (usually defined as skills preventing task completion). Contrary to this, non-critical skill gaps 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 (upskilling) programmes to an overall restructuring of the process and resources used.

A skills gap analysis is usually defined as a set of methods, procedures and tools used to determine the skill requirements and to identify missing skills, i.e. skills needed to fill the skill gap. 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.

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15 English Dictionary, Oxford Languages, Accessed 02.02.2022.

16 https://www.merriam-webster.com/dictionary/skill Accessed 02.02.2022.

17 Miriam L. Matteson, Lorien Anderson, Cynthia Boyden, "Soft Skills": A Phrase in Search of Meaning, Johns Hopkins University Press, Volume 16, Number 1, January 2016

18 Barbara Cimatti, Definition, development, assessment of soft skills and their role for the quality of organizations and enterprises, International Journal for Quality Research 10(1) 97–130, 2016

19 Steven G. Little, John Swangler & Angeleque Akin-Little, Defining Social Skills, in Handbook of Social Behavior and Skills in Children, 2017

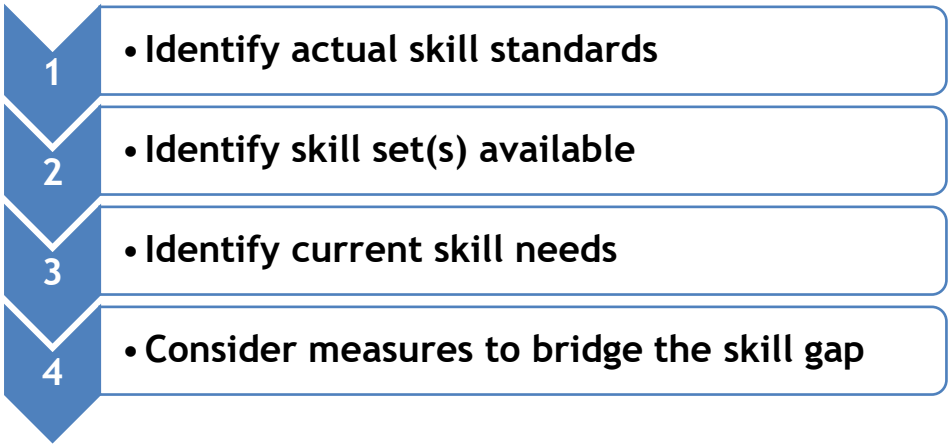

Figure 2 Standard skill gap analysis steps

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 (future) skill needs. The main difference lies in target subjects: in the case of current skills, the target subjects are actual or potential employees and technologies, while in the case of future skill needs, the target subjects are company managers, their goals and projections, and their long-term development plans. It is worth emphasising that future skill needs heavily depend on future technologies; thus, expected technological development is the most important factor in future skill needs estimations.

Following the preliminary analysis of the goals and subjects of the project task, it was evident that standard skill gap tools and methods are not applicable and will not yield the results expected.

The main goal of this task (D.1.1.2) is to map relevant skill needs and competencies required in the maritime industry. The task differs from the standard skill gap analysis in several aspects:

- The target subject of the analysis is the whole industry, not individuals or companies. In such cases, the labour market needs numerous different skill sets, and the associated workforce mostly offers those skills. If existing, the mismatch is not in skill sets available and those required (as is the case at the company levels) but in the proportions of the workforce having the required skill sets.
- The required skill sets are extensively regulated (for core shipboard positions and tasks), even at the international level. On the other hand, a significant portion of ship-specific jobs is not regulated (for example, skill sets in the offshore industry are mostly unregulated).
- The industry, particularly for shipboard positions, employs mostly on a short-term contractual basis (usually via crew management agencies). Such an approach significantly prevents effective skill management onboard.
- Collecting data on skill sets is generally difficult, or data does not exist. Additionally, there is no uniform description of the skill sets (except for regulated positions). Consequently, aggregating data or extracting trends is unreliable.

  Required skill sets are significantly variable, mostly trade-specific or ship-type-specific. For example, a skill set appropriate for a North Sea coaster only partially applies to large container ships trading globally. This significantly inhibits seafarers' mobility, particularly in positions requiring high-tech skills or extensive experience. More or less, the same applies to shore-based positions.

- Finally, standard skill gap analysis is based on clearly identified organisation (company) goals. When the whole industry is under consideration, one must deal with different stakeholders and their particular goals, sometimes even conflicting ones.

Consequently, modifying the standard skill gap analysis was necessary to accomplish the task. Accordingly, the following steps were envisaged:

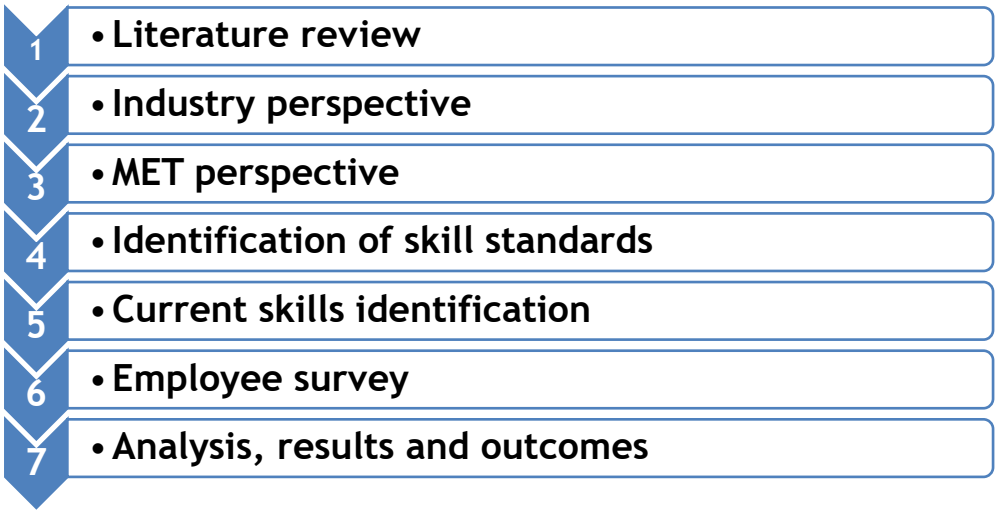

Figure 3 Modified skill gap analysis steps

In the adopted methodology, the first three steps aim to identify the state-of-the-art, i.e. to identify and analyse what has been done so far at the institutional level (literature review) and to characterise the key stakeholders' positions.

The next three steps aim to identify current skills needs, either those present and those that are not available at all, or not available in the proportions required or expected by the maritime sector. Identification is carried out via semantic analysis of various sources, including legal texts and seminal, encyclopaedic sources. The verification is conducted via an employee survey, including seafarers and shore-based employees. Interviews as a method were deemed too complicated and of limited usefulness due to two main reasons:

- The subject under consideration is too broad (it covers the whole maritime sector), and selecting a correct number and representation of interviewees is hard to attain or even impossible (particularly considering the project's international aspect).
- Focus group discussion, as a much more productive and attainable method, was already selected as a principal method for Task 1.1.3. Future skill needs.

Finally, the last step aims to integrate knowledge and understandings accumulated during the previous phases and to draw input for the following tasks and work packages.

4. LITERATURE OVERVIEW

A literature search was carried out to identify the most important projects and studies dealing with current and future skills, various aspects of maritime education and training, the horizontal transfer of workforce from ships to shore, and skills that may be required due to new technological developments.

Articles dealing with the same subjects found relevant for different aspects are cited in the text or referred to in the bibliographic notes.

4.1. PROJECTS

The following paragraphs briefly explain the most important projects dealing with the skills required or outlined in the maritime sector carried out since 2000.

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 of the CAMET project served as information providers to the METHAR partners. The 11 meetings of CAMET served as the discussion forum 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 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 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 (MET) and mobility of seafarers. This programme was carried out under the Fifth Framework Programme of the European Community for research, technological development and demonstration and 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 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 more efficient. Harmonised MET contents should help to 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 and help meet the existing demand for national ships' 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. *Extension* includes MET, comprising more detailed and more comprehensive STCW subjects. In other words, STCW does not detail

the requirements for all subjects, such as marine environmental protection. Other subjects not mentioned in STCW but 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 level considers the fact that increasingly more young MET graduates understand the shipboard career as a part of a long career within the maritime industry where seagoing experience is desired. MET institutions can develop their own enrichment profile, such as maritime economy, maritime law, or maritime technology. Finally, *Elevation* upgrades the MET system (postgraduate studies), thus fostering the European maritime knowledge base. 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.

KNOWME. The KNOWME[20] 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, which is 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 European countries.

Outputs of the project included:

- Best practices of maritime stakeholders related to social responsibility and sustainable development
- Strategy for using media as a means of improving the image of the industry
- Future demand for 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
- Development of a portal for career management and development[21]
- Development of three free e-courses (Cross-Cultural Training, Maritime Logistics and Supply Chain Management, and Environmental Management)[22]

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'.[23] The objective of the study was to provide, through the construction of a series of career maps

20 https://www.edumaritime.net/archived-pages/the-knowme-project-e-courses

21 www.go-maritime.net

22 www.go-maritime.net/e-courses

23 http://www.ecsa.eu/sites/default/files/publications/054.pdf

across a range of the Member States, an overview and 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 several differences became apparent. It was hoped that this study would contribute to understanding these parameters and that the individual Member States could 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.[24] 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).[25] This project aimed to explore the labour market's real needs in maritime transport and logistics, identify new knowledge and new interests, and develop proposals, occupational standards and qualifications standards following the principles of the Croatian Qualifications Framework and following 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 wider social context.[26]

EU-PORTRAItS. The project 'EUropean PORTWorkers TRAIning Scheme' (Centre for Research and Technology, Greece)[27] facilitates the implementation of a broad and open dialogue with the social stakeholders to establish a mutually recognisable framework for 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 the development of 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.

GMP Body of Knowledge. Body of Knowledge results from a joint project (The Global Maritime Professional Initiative) between the Nippon Foundation and the International Association of Maritime Universities (IAMU), 2019. The new concept of a Global Maritime Professional has been described as:

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24 https://www.ecsa.eu/images/files/Rapport_Maritime_Career.pdf

25 http://www.kiklop.eu/

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

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

"An individual who is a professional in the maritime industry and who is equipped with all the relevant technical competencies relevant to their specific operational role in the industry and as required by international requirements, with high-level academic skills including logical and critical thinking and who – in addition to their technical competency – exhibits a high level of professionalism and ethical behaviour, human relations skills, emotional intelligence and multicultural/diversity awareness and sensitivity. Such an individual exhibits significant leadership skills and is able to optimally work with teams and also take personal initiative. They additionally exhibit a high sense of environmental consciousness and the need for sustainable practices and have an excellent grasp of contemporary issues affecting the maritime industry."

The Body of Knowledge (BoK) sets out standards for educational processes and the detailed learning outcomes that should result in students exhibiting the learning outcomes for the GMP as defined in the text. The primary users of the BoK are the member universities, who should, by their academic freedoms and requirements, develop curricula (syllabi, learning activities, assessment methods etc.) taking into account the standards presented in the BoK. The learning outcomes in the BoK are associated with learning outcome taxonomies in three educational domains: cognitive, affective and psychomotor. They are related to different GMP tiers covering various levels of certificates of competency and academic degrees. Learning achievements are presented in several tables and guidelines on how universities may use the tables.

It is the only document found presenting maritime knowledge and education processes in a highly-structured manner and in line with updated Bloom's taxonomy.

4.2. REPORTS AND STUDIES

Finally, the most important 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 SBA Hamburg School of Business Administration for the International Chamber of Shipping (ICS) in 2018. The study aims to identify and highlight issues which 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 wellbeing and welfare (mental and physical). The conclusions are highly relevant for anyone aiming to design study programmes for shore jobs in the maritime industry, particularly those 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 that support port authorities in preparing themselves for technological progress. The study covers four transport modes: road, rail, waterways and aviation.

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 consequently significant employment opportunities. Interestingly, prospects involving shore-based jobs were seen as much more positive than those for 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 an important bearing on this Report. The Annex covers the PESTLE analysis,[28] 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 has provided annual reports since then. 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, training focus areas, training tools, resource allocation, and assessment practices. It allows each organisation to benchmark their practices, enabling governments and other regulatory agencies to be more informed and effective in their oversight and support of the industry. 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 ships' operators, seafarers and MET institutions. The last issue (2019) specifically deals 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 the implementation of technology and automation?

28 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.

The 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 volume of trade leads to more future transportation demand, while regional changes in transportation patterns are expected.
- With the gradual pace of the introduction of technology and the increased trade volume, their effects on employment are predictable. Low- and medium-skilled workers will be exposed to the high risk of automation. However, the pace of introduction and diffusion of technologies will 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 key factors highlights the gap between developed and developing countries.

The study describes the expected new technologies in detail and summarises expectations in the main areas, the most important one referring to the expected trends concerning employment and professional developments.

Therefore, it may be concluded that:

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

(5) The accelerating transformation of the sector can be recognised in all sources investigated. It is, therefore, beyond any doubt that the maritime industry is facing significant technological challenges.

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

(7) The concept developed in the METNET project, known as 4Es, is deemed appropriate for skill classification for different levels of expertise, onboard and ashore.

(8) Results of the study Transport 2040: Automation, Technology, Employment - The Future of Work (2019), in part dealing with the maritime sector, are deemed the best estimation of the future working conditions and job structure description.

5. INDUSTRY PERSPECTIVE

The term *maritime sector* in this report denotes two broad classes of business ventures: shipping companies and supporting industries. The term *shipping companies* include companies owning or operating ships in national and international trade. In this report, the term *supporting industries* include 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's gross tonnage and contributes approximately EUR 57 billion to the EU GDP.[29] It is important to note that the number of people employed by the EU shipping industry includes actual and former seafarers and employees with no maritime background. However, for the shore-based sector, masters and officers, both deck and engine, are important because they bring high-level expertise, maritime insight and experience to the industry.

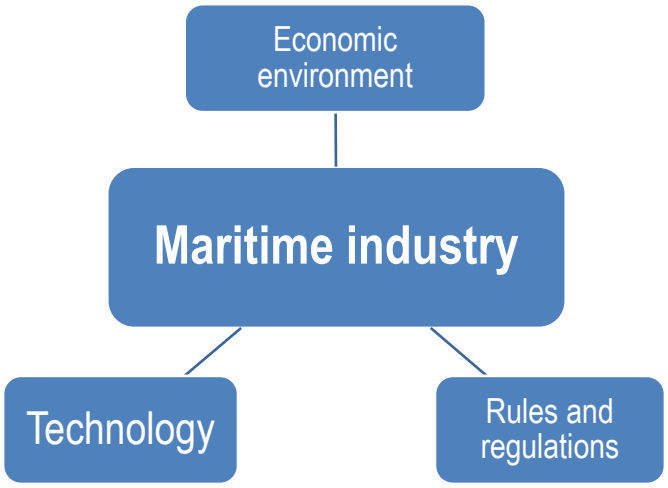

Figure 4 The most important drivers

Three main characteristics mark the maritime sector:

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 how the sector produces and distributes its services. All of these are, at least in part, beyond the reach of the main actors, forcing even the most influential actors to adapt to these forces constantly.
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 a business advantage over the competition. In that respect, using new technologies often means a better service for the clients and, consequently, a better market position. Conversely, implementing new technologies too early or not in a way acceptable to clients may cause significant losses.

29 ECSA Strategic priorities for EU shipping policy 2019-2024, 2019

3. Finally, the industry, particularly shipping, is intensely regulated. Today, rules and regulations, international, regional or national, set numerous restrictions on almost any activity at sea and also in ports. Areas significantly regulated include all safety, security or environmental protection activities. Regulatory actions can be recognised particularly for companies operating in the international market.

Consequently, the maritime sector is constantly changing. Mainstream business models and company policies prevailing several decades ago have significantly changed or, in some cases, are now non-existent. Subsequently, many important skills required for several decades have disappeared, or their significance is minimised (celestial navigation, for example) while other new skills have emerged (maritime security, for instance).

One of the most notable new trends is coopetition.[30] Coopetition is usually defined as cooperation between competing companies, which is common in high-tech industries. Probably the most notable examples in the shipping sector are ventures established by one shipping company (for example, to provide technical, personnel and administrative services for vessel owners and crews) offering services to other shipping companies. Another example includes ventures (shipping companies, classification societies, crew management agencies) extending their core activities by providing maritime education and training.

Consequently, the term ‘maritime sector’ includes innumerable forms of different business ventures and their relations with many actors, interests and influences. In addition, significant parts of the sector are highly internationalised, thus adding an additional layer of complexity (for example, many EU shipping companies employ low-wage seafarers from Far East countries, although their education and training is evaluated as not being up to EU standards[31]).

One constituent of the EU maritime industry must be particularly highlighted – the workforce, both ashore and aboard. Regarding shipboard personnel, the maritime industry employs many European seafarers and a significant number of non-EU seafarers. In that sense, it is a highly internationalised industry. According to a recent EMSA report,[32] 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 both 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 to 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 that it is possible to change crewing policy in a short time at the company level.

It is important to note that the same pool of seafarers serves not only ships flying EU flags but also ships flying non-EU flags, causing 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.

Generally, it is recognised that the safe and efficient operations of shipping companies (and the industry as a whole) significantly depend on a steady flow of knowledge and expertise from ships to shore-based

30 A portmanteau word is created by merging 'cooperation' with 'competition'.

31 See for example www.seatrade-maritime.com/regulation/philippines-expects-negative-emsa-stcw-report-confident-action-plan

32 Seafarers Statistics in the EU - Statistical review, 2022

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. It is, therefore, reasonable to assume that in the future, mostly due to the expected extensive use of sophisticated technological tools,[33] the effective transfer of knowledge and expertise from ships will be even more challenging.

Identifying the skills and competencies required in such a complex system is highly demanding and questionable. There are too many actors with different needs and capacities regarding the required skills (for example, shipping companies operating in low-revenue trades have limited capacity to employ expert crews or high-tech experts). Although certain segments are highly regulated, there are no unified regulations (actors operate in different legal systems and different economic environments but compete in the same market); therefore, no one source may provide direct indications of skills and competencies required or recommended for the particular position in the industry (except for essential shipboard positions).

In such circumstances, to identify key skills and competencies required, one needs to seek an alternative approach from that commonly used in the skill gap analysis applied at the company level.

One of the alternative ways, considered to be the most appropriate for the task goals, is to identify key skills and competencies by identifying keywords and key terms using semantic analysis. Semantic analysis is a process of understanding natural language (text) by extracting valuable information, such as context, key terms, phrases, etc., from available data. The method is based on the analyses of the grammatical format of sentences, including the arrangement of words, phrases, and clauses, aiming to determine relationships between different independent terms in a given context. As a rule, the data used are in the form of different files representing the subject under consideration. Data may include books, registers, web pages, reports or any other text form. Semantic analysis is carried out by analysing the grammatical format of sentences, including the arrangement of words, key terms, key phrases, and clauses, to determine relationships between different terms in a specific context. The process's final goal is to provide a clear understanding of the context. Being computationally demanding, the process is executed using dedicated software.

Although having certain drawbacks, such an approach is expected to provide an initial indication of key skills and competencies. The main areas subject to the semantic survey are 1) economic environment (maritime business), 2) maritime law, and 3) ship technology. The main goal of the survey is to provide a sound basis for developing a survey questionnaire, thus providing further insight into current skill needs.

To sum up, it may be concluded that:

(9) The maritime sector comprises highly dynamic industries exposed to numerous external influences. At the same time, it is a highly regulated sector, particularly shipping, at international, regional and national levels.

(10) The maritime sector is highly competitive, thus heavily dependent on the effective implementation of modern technologies. Due to numerous interrelations among actors, various business models are emerging, mostly highly related to new technologies.

(11) Identifying key skills and competencies required to sustain further development of the maritime sector is a demanding task, mostly due to complex interactions among stakeholders and the international nature of the sector.

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[33] The trend of extensive use of sophisticated and dedicated software tools (simulations, databases, ERM, etc) is evident in major shipping and logistic companies.

(12) Key skills and competencies in such a complex environment cannot be identified using methods and tools common to the standard skill gap analyses. Instead, an alternative approach has to be followed. The method adopted here is based on the semantic analysis of the main subject areas, i.e. keywords and key terms used to describe subjects, skills and competencies in maritime law, ships' technology, and economic environment (maritime business).

6. MET PERSPECTIVE

The training of seafarers was traditionally based on empirical knowledge acquired during shipboard work. During the 19th century, new challenges - the most important 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 this time maintained a military (regimental) 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 major development took place in the 1970s and 80s when numerous maritime schools, mostly 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 major difference being institutional participation in research programmes in most cases. In the 1980s, these MET establishments, though highly diversified in their status and formal goals, instigated international cooperation, firstly through the International Maritime Lecturers' Association (IMLA[34]) and later through the International Association of Maritime Universities (IAMU[35]). 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[36].

Maritime Education and Training 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 certain tasks onboard. While maritime education is mostly offered by maritime academies and universities and most commonly lasts several terms (semesters) or whole academic years, maritime training is offered by training centres, and the courses are shorter and relatively independent, with a strong focus on hands-on experience.

This is specifically 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 also under the supervision of (Higher) Education Ministries in addition to 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 landlocked ones) have one or several maritime institutions offering MET programmes. In almost all EU countries, the education part of the process is organised in accordance with the Bologna declaration,[37] 1999, i.e. the graduates receive a BSc-level degree. In many countries, MET

34 http://www.imla.co/

35 https://iamu-edu.org/

36 As of April 2019, IAMU has 66 members from 35 countries,

37 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

institutions are part of the local universities and offer post-BSc education, i.e. 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 mandatory practical training as a part of their programmes, while others rely on maritime training centres (or, in some cases, on private shipping/maritime industry training establishments). In addition, in several countries, onboard training, as required by the STCW Convention, is a part of regular education, while in others, it is the student's responsibility to find a placement onboard.

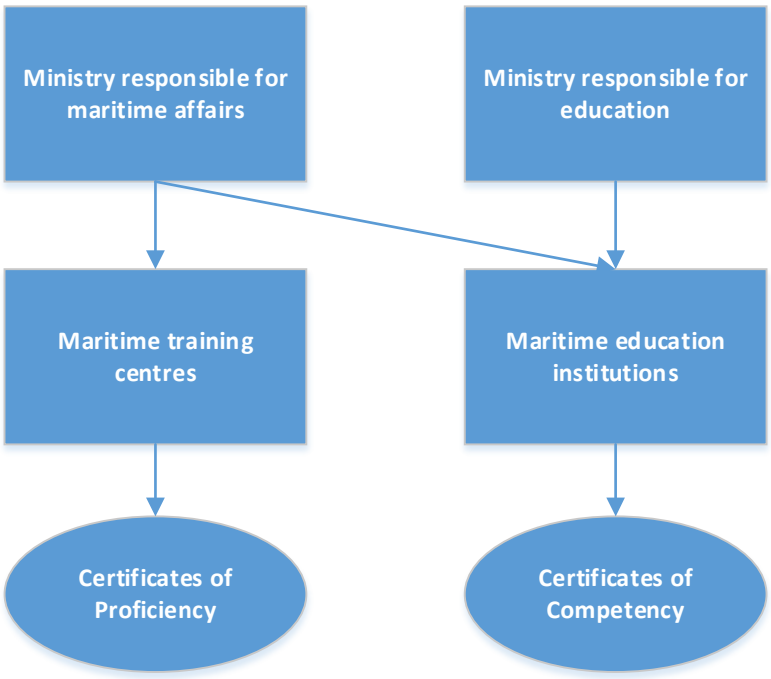

Figure 5 MET processes leading to CoC and CoP

In respect of the skill set offered to students, all EU MET institutions offer education 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 vary 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 important to note that programmes dealing with on-shore jobs are highly diversified and, in some cases, require onboard experience, while in others, shipboard experience is considered irrelevant.

It is important 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 maritime affairs. Such an approach guarantees that the education delivered follows the required quality standards and that the degrees are comparable to those offered by other higher education institutions.

According to the STCW Convention and the Bologna Declaration, the quality of education must be ensured. The task is primarily assigned to the national maritime authorities responsible for education. The responsibility is usually shared with national educational authorities for education that leads to operational

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.

and management levels (i.e., to Certificates of Competence or Certificates of Proficiency).

Using the engineering notation, the quality of the education process (Q) may be represented as a product of its constituents:

$$Q = C * A * F * M$$

Where:

C – suitability of the curriculum (concerning the students' entry level and target learning outcomes),

A – teaching competencies and expertise of the academic staff,

F – suitability of facilities (simulators, libraries, training facilities, etc.),

M – appropriateness of the management policies and procedures.

It is self-evident that required efforts and associated financial burden increase as the subject complexity level increases. Consequently, high-level education programmes and courses dealing with complex subjects are most commonly found close to the major technological centres or universities. Based on the recent technological advances, one should expect this trend to become more emphasised in the future.

Finally, it must be emphasised that *"… competence is not forever. Changes in policy, procedures, regulations, technology and equipment, business goals and objectives, all mean that workplace performance standards need to be modified and updated. And new standards must be developed for new job functions that may arise from the changes."*[38] 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 support the industry (if courses are offered on time and up to the expected level).

6.1. HIGHER EDUCATION MET INSTITUTIONS

Programmes offered by MET HE institutions are those delivering coherent STCW-related study programmes, mostly those leading to Certificates of Competency at the management level and non-STCW study programmes. The non-STCW programmes focus mostly on maritime trade and business, international shipping and logistics, maritime law, and related subjects.

MET institutions offering higher education are, as a rule, financed by the ministry responsible for education. In general, 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 external drivers and change is relatively slow.[39]

The 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.

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

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

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 only a few additional 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 training is a part of the process or not.

The second group of programmes are those offered by university-level institutions and are usually identified as Level 6 programmes according to the European Qualifications Framework. In addition to core STCW skills, these programmes commonly assume more in-depth knowledge of core professional skills (mathematics, mechanics, stability, etc.) and are extended with the maritime economy, technology and maritime law subjects.[40] Most institutions at this level are members of their respective universities (universities of applied sciences[41] or polytechnics[42]). Some are fully-fledged technical universities offering a wide range of programmes for the maritime industry.[43]

In many cases, particularly in EU member states, institutions offer top-up programmes for those willing to continue their careers on shore after serving as officers at management-level positions aboard.

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

6.2. MARITIME TRAINING CENTRES

Following the adoption of 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 mostly dealt with safety subjects, while the range of required courses subsequently included security issues and pollution prevention.

The short courses, although in many cases a part of regular education, instigated the development of maritime training centres – institutions offering these short courses mostly 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, completely or partially, by one or several shipping companies, and they provide training mostly to seafarers employed by these companies.[44] On the other hand, many MET institutions run their own maritime training centres as separate profit-oriented units,

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

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

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

43 Gdynia Maritime University, https://www.umg.edu.pl/en/

44 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,

offering short courses to their students as a part of the study programme and to shipping companies and seafarers.

The number of maritime training centres varies, and there are probably hundreds of such centres globally.[45] As entities financed by direct beneficiaries (either companies or individuals), their response to the industry's needs is prompt.

In the early 2000s, the largest number of maritime training centres mostly offered STCW-required training. More recently, many developed training programmes dealing with subjects proposed by the industry, going way beyond the requirements of the STCW Convention.

In the early 2000s, many companies started inviting their crews, mostly 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, but soon the range of subjects was increased to include mandatory programmes (i.e. STCW short courses) and programmes required as a consequence of new technological solutions.

In particular, seafarers serving on sophisticated ships may be required to attend numerous courses (besides those required by the STCW Convention) during their seagoing career. Very relevant evidence of this is provided in the analysis of the list of various certificates acquired by masters on LNG carriers and large passenger ships carried out in 2015 and refreshed for this report.[46]

It seems that a need for additional competencies is clearly recognised, but there is no consensus on which competencies are essential and how they should be formulated.

As pointed out by Manuel[47], "*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 gives much more emphasis to the acquisition of hands-on practical skills. On the other hand, academic education has been seen to be much more focused on the development of 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*."

It seems that these two opposing views are even more polarised in the case of highly sophisticated ships: on the one hand, 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 quite clear that the complexity of the environment and systems to be controlled and managed demands abilities and skills beyond traditional vocational training.

6.3. SPECIALISED MET ESTABLISHMENTS

Specialised MET establishments may be defined as institutions or establishments providing specialised or high-level education, mostly for people already working ashore in the maritime or shipping industry or for seafarers looking for a job. 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.

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45 For example, in Croatia there are 26 authorized maritime training centres, while in the Philippines 63 approved maritime training centres operate only in the Metro Manila area (https://www.seamanmemories.com/list-of-marina-accredited-maritime-training-centers-in-manila-2018/)

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

47 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

The courses offered may be of different duration, from a few days up to 18 months. Courses may be stand-alone or part of longer programmes, thus providing flexibility for participants regarding content, duration and awarded degrees. 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 predominantly include maritime law and finance, contracts and insurance, management, offshore (oil and gas mostly), 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 delivery are predominant, such as distance or blended learning.

Examples of internationally recognised MET establishments include the Lloyd's Maritime Academy (UK)[48] and STC Maritime & Logistics University of applied sciences (Netherlands).[49]

It seems that different entities with accumulated knowledge in a certain 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[50] and can also be noted among equipment producers (for example, Kongsberg[51]), associations (for example, IALA[52]), and maritime training solution providers (for example, Videotel, Seagull, Marlins etc.[53]). However, the programmes offered by those ventures usually remain close to their field of expertise and rarely offer courses from other fields.

The courses offered by MET establishments mostly target employees in shipping companies and supporting industries. The course subjects are flexible in terms of duration, scope and delivery. Consequently, most courses may be classified as Continued Professional Development (CPD) as it is defined by the Institute of Marine Engineering, Science and Technology (IMarEST), i.e. as "*the systematic maintenance improvement and broadening of knowledge and skill and the development of personal qualities necessary for the execution of professional duties throughout working life*."[54]

One should note that courses offered by specialised MET establishments and delivering high-tech competencies are similar to specialised higher university-level education in complexity, required previous knowledge, and delivery methods.

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48 http://www.lloydsmaritimeacademy.com/

49 In August 2021, taken over by the collaboration between STC and the Rotterdam University of Applied Sciences, which is called the Rotterdam Mainport Institute. https://www.rotterdamuas.com/programmes/master/shipping-and-transport-full-time/

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

51 https://training.km.kongsberg.com/course-category

52 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/

53 https://videotel.com/maritime-training-solutions

54 "Typical CPD activities include: attending in-house or external courses, work-based learning, distance learning programmes, self-directed private study, preparation and delivery of lectures and presentations, preparation of refereed papers, attendance at lectures, seminars or conferences, or watching IMarEST TV, acting as a mentor, relevant voluntary work, learning a new computer application or learning a foreign language. Really, any activity that you have found valuable in maintaining and enhancing your competence can be considered as contributing to your CPD." https://www.imarest.org/item/3670-what-is-cpd-continuing-professional-development

The most attractive courses cover maritime law, maritime economy and ships' technologies, the areas already indicated as the most important for the maritime sector as a whole.

It may be therefore concluded that:

(13) MET institutions offering education and training at all levels can generally respond to the industry needs and fill the skill gaps. However, the ability to provide different skills, particularly high-level skills, within the time and quality constraints may vary significantly between institutions and countries.

(14) 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.

(15) No EU-wide alliance (or similar form of association of institutions offering MET programmes) exists, although many institutions offering MET programmes at the MSc level are members of the International Association of Maritime Universities (IAMU).

(16) Different institutional forms offer maritime training and education, ranging from privately owned institutions offering only short courses to seafarers and shipping companies to independent maritime universities.

(17) In almost all EU member states, university-level study programmes dealing with international shipping and logistics, maritime law and business, and port management (i.e. programmes for the shore-based maritime industry) are identified.

(18) In most cases, MET institutions offering programmes leading to management-level Certificates of Competency are supervised by the ministries responsible for education and maritime affairs.

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

(20) No recognised EU-wide initiatives aim to harmonise maritime education programmes offered by different institutions or countries. 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.

(21) Thanks to ever-accelerating technological development and the increasing number of high-tech companies that 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.

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

(23) 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 in quantity and scope.

7. IDENTIFICATION OF SKILL STANDARDS

For this task, skill standards are defined as performance specifications that identify the knowledge, skills and competencies an operator needs to accomplish tasks required by the job assignment within the maritime sector.

Skill standards should inform future employees about required skill and performance achievement, employers about what to expect from employees and MET providers with themes to be included in the curricula. The skill standards, if properly defined, also facilitate international communication. In the subject under consideration, skill standards may facilitate communication between MET institutions, programmes and, in addition, provide a link between the MET system and the international maritime labour market.

A standardised and well-known technology and practice are necessary preconditions for developing skill standards. In that case only, a skill standard may be sufficiently precisely described. In cases where tasks are unique or assume different forms or underlying technology is rapidly evolving, an associated skill standard can be only indicative.

Skill standards may take different forms and refer to positions with different levels of complexity. It is particularly true for positions across the maritime sector, ranging from very simple and consequently not too complex skill standards to highly complex tasks and jobs with similarly complex associated skill standards. To be effective, skill standards should be based on the consensus within the industry but also with regulators. The consensus can be soft, expressed as a common understanding, may be more or less formalised (for example, in the form of recommendations formalised by professional association), or could be codified in the form of an officially approved code of conduct, either being a recommendation, or their implementation is mandatory (for example, IMO codes).

Consequently, in this chapter skills required for shipboard positions are considered, as well as skills required mostly for shore-based positions that benefit from extensive shipboard experience.

For this project, the skill standards will be categorised according to levels proposed in the Thematic Network on Maritime Education, Training and Mobility of Seafarers (METNET) project.

The concept known as 4Es stands for:

- Essentials
    - include skills satisfying the minimum requirements of the STCW Convention
- Extensions
    - include skills and shipboard qualifications beyond those described in the STCW Convention
- Enrichment
    - include additional skills and qualifications preparing a seafarer for shore-based jobs at the Bachelor of Science level or higher
- Elevation
    - include further improvements of previous skill sets at the Master of Science level or higher and unlimited certificates of competency

Enrichment and Elevation levels are considered together in the following text since both primary target shore-based jobs. In both cases, the subjects are the same but at different levels. For example, Elevation may even include research activities, i.e. PhD programmes, which are beyond this task assignment.

7.1. ESSENTIAL SKILLS

Skill standards for essential maritime skills are outlined in the 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 main 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 been significantly improved twice: 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 important aspect of the amendments adopted in 1995 and those adopted in 2010.

Essential skills are described in the relevant tables of competencies, notably in STCW Code A, Chapters II to VI. The STCW Code A is mandatory and must be implemented by each signatory of the Convention. Part B of the Code contains recommended guidance to help member states implement the Convention and the STCW Code. The measures suggested in Part B are not mandatory, and the examples given are only illustrative. However, the recommendations generally 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 for ease of use. The numbering of chapters is the same in both parts.

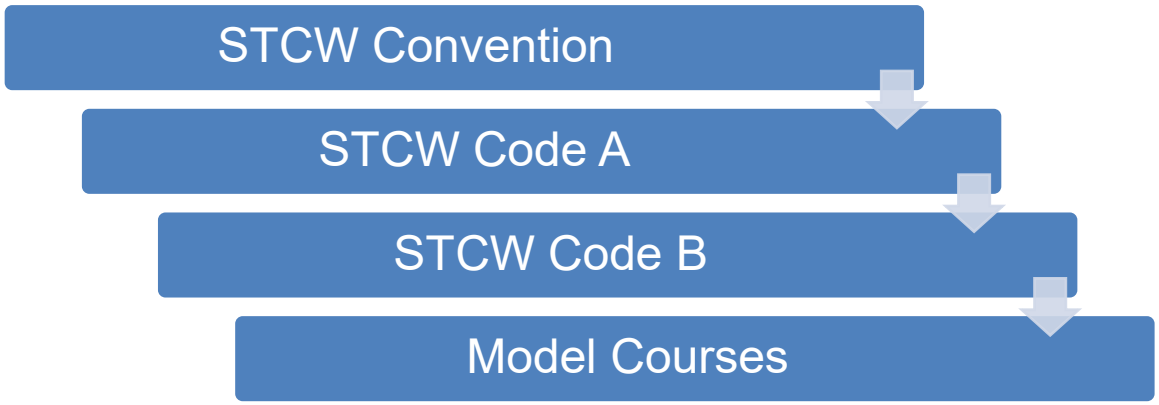

Figure 6 STCW Convention and related documents

In the STCW Convention, competencies (required skills)[55] are assigned to various ship operations (functions) at the support, operational and management levels.

Tables of competencies are related to different shipboard functions, 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

55 In this report the terms skill is understood as equivalent to the term competency as defined in the STCW Convention.

set required for Masters and Chief Officers consists of 129 different skills at the operational level and 142 skills at the management level. For the Chief and Second Engineer positions, the skill set consists of 100 different skills at the operational level and another 78 at the management level.

Table 1 STCW functions and levels of responsibility

FUNCTION		LEVEL OF RESPONSIBILITY		
		Management	Operational	Support
Deck	Navigation	•	•	•
	Cargo handling and stowage	•		
Deck & Engine	Controlling the operation of a ship and care for persons on board	•	•	
Engine	Marine engineering	•	•	•
	Maintenance and repair	•	•	
	Electrical, electronics and control engineering	•	•	
Radio	Radio communication		•	

In addition, the STCW Code A in Chapter III also contains 82 skills required for Electro-Technical Officer (ETO) as a seafarer performing tasks at the operational level.[56] The competencies (skills) are described in the form of learning outcomes, i.e. as statements describing what seafarers have to be able to perform.

Skills described in STCW Code A are further elaborated in STCW Code B and, in much more detail, in the associated Model Courses. The associated[57] 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)
- Officer in Charge of an Engineering Watch (Model course 7.04, 2014 Edition)
- Electro-technical Officer (Model Course 7.08, 2014 Edition)

Each Model Course consists of several sections, the most important 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 most important part of each Model Course is a detailed teaching syllabus, presented as a series of learning objectives. The learning objectives, therefore, describe in much more detail what the student must be able to do to demonstrate that the specified knowledge or skill has been transferred. Thus, each learning

56 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.

57 Based on the STCW Convention, IMO produce numerous other Model Courses for different shipboard positions, positions in the administration and MET institutions. Although these Model Courses encapsulate important knowledge and skills, sometimes even obligatory under the Convention, they are not considered as essential since these skills are either recommended or at support level or both.

outcome is supported by several performance elements related to the required proficiency and may be understood as a more detailed description of the core competencies defined in the STCW Code A tables.

Several Model Courses are supported with teaching materials (compendium).[58]

It is clear that STCW Code A and B and associated Model Courses ARE skill standards for respective job occupations.

The major drawbacks of the present text of the STCW Convention, associated STCW Codes A & B and Model Courses are as follows:

1. The skill sets described in the STCW Convention and associated texts were appropriate for ships sailing when the Convention was developed. At that time, differences between main ship types and trades were relatively insignificant, working procedures were less demanding, and communication with shore-based companies, management and authorities was 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. However, this is not the case anymore.
2. Skills, as defined in the STCW Convention, mostly refer 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 working environment concept is not considered in the Convention (although it is addressed in several documents presented at IMO meetings).
3. Today, technological differences between various ship types and trades are significantly larger. Because of that, skills are not easily transferrable, and short updates of knowledge or proficiency are insufficient, especially for technologically advanced ships (e.g. LNG ships, and offshore support vessels).

To conclude, the STCW Convention, Code A & B, and associated model courses define the skill standards for essential skills aboard. Thanks to extensive implementation over decades, the skill standards for conventional positions and shipboard technologies are satisfactory in a major part. Whether these skill standards are adequate for sophisticated ships or future technologies needs to be considered in the following work packages.

7.2. EXTENSIONS

Extension skills are required by different positions aboard to accomplish assigned tasks (i.e. non-degree MET). The need for extensive skills on modern ships arises due to several different and unrelated reasons, the most important being the following:

Sophisticated shipboard equipment

Modern ships are increasingly equipped with dedicated equipment, often developed as 'smart' equipment controlled by microprocessors and able to communicate with other 'smart' units. Such equipment can perform highly complex operations and offer numerous control options, thus requiring operators to understand the underlying principles and master operation modes to use the equipment efficiently. As a rule, the operators' training is left entirely to the company policy, even if it is coupled with critical equipment.

58 In October 2019 in total 79 Model Courses have been 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.

The ship's bridge and engine room control systems are the most important examples of such equipment.

Ship-type specific equipment and working routine

Modern ships are more specialised than ever before. They specialise in different cargoes, different navigational areas, and particular ports, services, and sometimes even customers. The number of general cargo ships is decreasing, and one may expect their eventual disappearance. High specialisation demands dedicated equipment and a working routine (procedures). Consequently, the working routine on different ship types is highly different. Even more important, essential procedures for proper operations on a particular ship type may not be needed on other ship types (skills are not transferable).

One notable example of high specialisation is job descriptions for different crew members on large passenger ships where a majority of crew members provide mostly hospitality and entertainment services to passengers, with no or very limited number of duties related to the standard shipboard functions as defined in the STCW Convention (except in case of emergencies).

Reduced manning levels

Cost optimisation pressures, along with emerging technological developments, instigated the minimisation of the manning scale of the ships. Automation, flags of convenience (FoC), more reliable and efficient equipment, and the transfer of tasks from shipboard to shore have contributed to a reduction in manning levels, sometimes causing unexpected effects (reduced manning and permanently available communication links with the office create a considerable administrative and communication burden on ships' officers).

For example, ship communications, once the radio officer's sole responsibility, are now a part of deck officers' duties. Another example is ship engineers, who must understand and control an ever-increasing number of shipboard systems due to reduced manning and technological progress.

Reduced manning caused a major shift in the nature, source and structure of tasks assigned to different positions on many ships. Task redistribution among seafarers considerably increases the required skills for all seafarers, especially for some positions.

Employment policy

Employment policies may significantly affect skills needed to maintain good working conditions aboard. If, for various reasons, the ship's crew includes many different nationalities (as is the case on many large passenger ships), in addition to other skills, crew members must be able to deal with high multiculturality and its effects. Skills needed to maintain good working and interpersonal conditions and prevent social conflicts are extremely important in such circumstances. Similar circumstances may also arise on ships with smaller crews, for example, if a significant portion of undereducated seafarers onboard shifts the workload to more skilled seafarers and eventually causes interpersonal conflicts.

It is worth noting that the STCW Convention is structured to ensure seafarers' generic education and training. Although the Convention has specific requirements for specialised ships (such as additional requirements for tankers and passenger ships, smaller ship sizes or different propulsions), the training provisions are still the minimum requirements for a particular category. Thereafter, it is the responsibility of the ship managers/company to require additional education and training for the seafarers.

It is fair to note that even if the regulators become willing to prescribe more detailed requirements to address additional skills, it will be unfeasible due to the high diversity of ship types and equipment onboard.

As a result of such circumstances, in the last few decades, ship managers/companies and various other professional organisations have developed dozens of different, mostly short, courses to extend the skill

sets of their seafarers. Some of these courses, in the meantime, have become a constituent part of the STCW Convention (such as Bridge Resource Management), while some others are still required for seafarers on a certain class of ships by different organisations or for certain business relations (for example, tanker vetting) but not formally included in the text of the Convention.

Unfortunately, data on these courses and the skills they provide are not easily available for several reasons. Firstly, a vast majority of the course providers are private profit-oriented entities, and the contents of the courses and added values they provide are what they sell in a highly competitive market. Publishing full details about courses in such an environment may be highly counterproductive. Secondly, many entities have close personal relations with one or more of the companies they serve. Sometimes, the managers/companies are even co-owners. In such circumstances, the courses provided are highly customised. Thirdly, companies managing a sufficient number of ships develop the required courses as in-house activities.

Consequently, although many course providers describe the available courses (and brief outlines of the learning outcomes, i.e. skills) on their websites, they 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 case.

Hence, a two-step approach is used to estimate the main features of those skills.

As the first step, several representative course providers are selected. The courses delivering these skills are qualitatively analysed based on the information published on their websites. The goal was to identify the main areas where the maritime sector needs additional skills; it is assumed that those areas will be dominantly promoted on the website.

It is worth noting that many websites visited advertise the STCW-required courses predominantly. These courses are attractive to a large number of actual and would-be seafarers. However, these courses and associated skills are considered irrelevant to extension skills. Therefore, several course providers' websites, offering mostly courses providing extension skills, were analysed, the most prominent being:[59]

- Maersk Training (https://www.maersktraining.com)
- Dynamarine Academy (https://www.dynamarine.com/services/academy)
- Offshore Petroleum Industry Training Organization – OPITO (https://opito.com)
- Northern Marine (https://www.nmg-stena.com/services)
- Nautical Institute (https://www.nautinst.org/ni-academy/short-courses.html)
- Lloyd Register (https://www.lr.org/en/training)
- Lloyd's Maritime Institute (https://www.lloydmaritime.com)
- Lloyds Maritime Academy (https://informaconnect.com/lloyds-maritime-academy)
- National Maritime College of Ireland (https://www.nmci.ie/commercial)
- World Maritime University (https://www.wmu.se/programmes/epex)

The second step targeted selected positions onboard ships to identify which areas are deemed most needed by the companies employing those seafarers. As a sample, two experienced masters from large LNG carriers and two masters from large passenger ships were interviewed. It was assumed that these

59 Project partners are excluded from the list.

positions are required to attend the largest number of short courses (all interviewed masters were long-term employees of the same companies). The accumulated list of certificates of attendance is presented in annexes to this report.

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

- Several courses are focused on dedicated equipment common for certain 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, Framo training courses).
- A large group of courses is dedicated to ensuring the safe and uniform implementation of complex procedures, mostly 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).

Courses attended by experienced masters indicate several important points:

- A significant overlapping is observed in subjects and goals.
- Most courses are designed to last between three and five days, but there are courses lasting up to two weeks.
- Many courses are simulator-based, with a great deal of hands-on training. Moreover, in several advanced maritime training centres, handling large, sophisticated ships is carried out using manned models to increase the reality of the training.
- One can easily observe differences in requirements for similar courses across different companies.

The collected information indicates[60] that extension skills, in general, include:

- skills related to one or more functions defined in the STCW Convention but extended in scope or expertise
- independent skills, i.e. skills not related to the functions defined in the STCW Convention

Skills related to one or more functions defined in the STCW Convention but extended in scope mostly include skills related to mandatory onboard equipment (for example, type-specific ECDIS training) and 'soft' skills, i.e. skills required to manage different processes onboard. Notable examples of 'soft' skills are the 'Train the trainer' course (aiming to educate senior officers on instruction techniques at different levels, mostly required on ships with large crews) or the AMOS Maintenance course (aiming to train senior staff to use sophisticated maintenance software).

The most prominent non-STCW subject areas are:

- the offshore industry, including exploration of oil,[61] gas and windfarms
- operation of large yachts/superyachts

60 One should bear in mind that findings are only indicative, mostly due to fact that samples (web-sites and seafarers who attended additional non-STCW courses) are limited and arbitrarily selected. In both cases, variability is so high that trying to create a representative sample for the subjects under investigation require enormous efforts, and still does not ensure required reliability of results. In addition, samples could not be quantified.

61 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.

- handling (manoeuvring) ships with unusual characteristics
- handling sophisticated shipboard equipment
- ship and cargo surveying
- hotel management
- operation of fishing vessels, etc.

An indicative, though not exhaustive, list of areas of expertise requiring upskilling is provided below:[62]

- 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 business policies, etc.

Levels of required expertise vary significantly, from very basic skills required only on certain ship types (for example, a crane operator in the offshore industry) to advanced levels (for example, DP operator).

From the information collected, it is apparent that no sources provide a skill standard in this case. In fact, the variability in levels of expertise and scope is extensive, indicating that courses providing extensive skills are a short-term response to industry needs or are needed by such a limited number of attendees that regular education is not feasible.

7.3. Enrichment and Elevation

The onboard experience, particularly managerial experience, makes seafarers well-suited for a range of shore-based jobs. The key to a successful career shift ashore depends on proper transitional education and qualifications. Depending on the job the seafarer is pursuing, specialised training (on-the-job training, short course/diploma study) or an advanced degree (MSc) will be required.[63] As a rule, less transitional education is required for a job more closely related to the roles onboard. In such cases, transitional skills acquired during on-the-job training will suffice. For more advanced assignments, on-the-job training is not enough, and more formal education is needed. In such cases, the ex-seafarer may enrol on a university programme dealing with transport technologies, logistics, maritime economy, law or similar.

In most cases, preference would be given to a flexible programme structure, delivered as a part-time programme that runs over two or more years. According to the current standards and practices at the universities and in industry, the primary mode of delivery is classroom lectures supplemented by a field study and research assignments. However, as already noted, a significant portion of courses is (or will be) transferred to distance learning methods.

Consequently, during the last two decades, numerous higher MET institutions in various EU countries have

62 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

63 Seafarers employed at the support level are not expected to seek more demanding jobs ashore in the sector. Therefore, their carrier shift ashore will not be analysed in-depth on the following pages

developed and offered new programmes that target students wishing to join the maritime industry and are also available to maritime professionals with onboard experience looking for a job ashore. These programmes, particularly those offered to professionals with onboard experience, are trying to bridge the skill gap between onboard jobs and jobs in the maritime industry and can be used as indicators of potential skill gaps.

In general, senior seafarers seeking employment ashore within the maritime sector typically consider one of three distinct fields:

- maritime industry (shipping companies, supporting companies, offshore industry, etc.)
- maritime-related administration and authorities
- MET institutions

It is worth noting that the maritime industry offers, by far, the largest number of various positions. The least number of positions are open in MET institutions. In addition, positions in MET institutions are more specialised and may require much higher levels of expertise (topmost positions at universities assume substantial research competencies). Accordingly, most programmes are focused on maritime law, economy and finance, logistics, management and safety as the most common elements in the currently available postgraduate programmes. Maritime safety is an important area, recently introduced in many programmes. Correspondingly, one can expect that subjects focused on green transition will be included extensively in the future. Combined, these elements provide the broadest range of employment opportunities.

Consequently, it seems reasonable to investigate skill standards existing in the maritime industry as a dominant field for ex-seafarers. Following the findings presented in Chapter 5, the main areas of activity where additional (transitional) skills may be needed are:

- economic environment (maritime business, finance, logistics)
- maritime law
- ship’s technologies
- research and education

While the maritime industry uses skills from all areas, maritime-related administrations, as regulators, mostly look for skills defined within maritime law, former maritime professionals and ship technology. Contrary to this, MET institutions are primarily focused on skills defined as a part of the ship technology and on research and education, mostly because STCW requirements focus on the proper use of available equipment onboard (STCW Code A does not contain subjects on maritime business and only sparsely on maritime law).

There are no recognised skill standards for mentioned areas of activity, especially not formalised up to the level of learning outcomes as it is done in the STCW Convention and STCW Code A for shipboard positions. Therefore, the skills required need to be identified indirectly via semantic analysis. In that course, the core text, i.e. text(s) covering the particular area of activity, has to be the subject of the analysis. The necessary core text(s) features are:

- selected text(s) must include all or almost all relevant subjects needed by a person performing tasks within the area of activity under consideration
- all subjects must be explained at approximately the same level of descriptiveness
- only proven solutions (equipment, technologies) should be included
- obsolete or speculative solutions should not be included (or should be deleted)

Consequently, the texts prepared and presented in the form of a compendium or encyclopaedia are the most appropriate for identifying key skills. The only exception is research and education. In this case, as a source of texts to be used for semantic analysis, presentations by MET staff at relevant conferences are deemed the most important. It is assumed that these presentations reflect the research interest of MET academic staff and, as such, indicate important future skills.

Again, levels of required expertise vary significantly in all areas under consideration, from basic skills required for entry-level jobs to the most advanced levels, including PhD degrees.

It may be concluded as follows:

(24) Skill standards applicable in the maritime sector should be classified according to the concept known as 4Es.

(25) Skill standards applicable in the maritime sector are well-defined for basic shipboard positions. However, there are no well-defined standards for more demanding positions (i.e. those on sophisticated ships or medium-to-top positions ashore). The skill gap identified at these levels is usually bridged by using on-the-job training (if appropriate) or dedicated training and education of various duration and expertise.

(26) The missing skills for well-defined shipboard positions may be identified by contextual and semantical analyses of associated skill standards (i.e. STCW Convention and associated texts). The missing skills for the enrichment and elevation levels can be broadly identified using semantic analyses of standard texts describing the most important subject areas.

8. CURRENT SKILLS IDENTIFICATION

Skills identification means qualitatively or quantitatively identifying and describing skills required to accomplish a given task.

At low-level tasks, skills are easily identifiable. In most cases, these skills are equal to the ability to correctly and, in a given time, execute a correct sequence of actions (working procedure). The steps needed to be taken can be easily described. Furthermore, if there is no interaction with the environment (external inputs do not affect the sequence of actions), the process is smooth (assuming that an operator follows the working procedure within tolerable margins). In this case, the skills required can easily be described using intended learning outcomes, i.e. abilities an operator has to master or a student has to acquire during an educational process.

As the tasks become more complicated, the required skills are more complex.[64] Accordingly, their identification and description also become more complex. Accordingly, the level of complexity increases if an operator needs to:

- follow a working procedure with a long sequence of actions
- supervise or react based on numerous sensors or information providers (such as maintaining an engine room watch on modern ships)
- supervise or react based on information provided by sensors feeding multiple streams of continuous data (for example, modern radar screens provide multiple continuous streams of data on relative positions and movement of numerous ships and coastal objects, and each stream needs evaluation and may require corrective action in a restricted time)
- supervise or react based on unreliable information (for example, sailing in restricted visibility without reliable radars)
- perform concurrent tasks, i.e. executing several tasks at the same time (for example, loading different liquid chemicals simultaneously)
- perform synchronously with other operators, i.e. perform multi-operator tasks (for example, during complicated manoeuvring as a bridge team member)

In most cases, a working procedure contains one or more branches (decision-making points), i.e. further steps depend on one or more external inputs.

Consequently, describing highly complex skills is a lot more complicated. Highly complex skills are usually described as aggregate skills (for example, "*The use of information from navigational equipment for maintaining a safe navigational watch*"). It is assumed that all involved fully understand such skills, although there is no detailed description of a corresponding working procedure.[65]

Probably, the most demanding skills involve human interactions, mostly because the exchange of information may easily become unreliable. For those skills, only the approximate description can be made.[66]

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64 According to the Oxford Reference a complex skills is defined as a skill that requires considerable thought and decision making, high levels of concentration, and a long attention span in order to perform it successfully. https://www.oxfordreference.com/display/10.1093/oi/authority.20110803095629351

65 Such understanding is known as heuristic knowledge. OECD defined heuristic knowledge as "the less rigorous, more experiential and more judgmental knowledge of performance or what commonly constitutes the rules of "good judgement" or the art of "good guessing" in a field." OECD Glossary of Terms Used in Statistical Data Editing, http://www.unece.org/fileadmin/DAM/stats/publications/editingglossary.pdf

66 These skills mostly include so-called transitional or transferable skills such as: problem solving, analytical reasoning, critical thinking, leadership, adaptability, teamwork, etc.

Methods to achieve these skills are not straightforward; acquiring them significantly depends on personal traits.

In the following sub-chapters, the most important current skills are identified. The process is based on the semantic analysis (networks) of different lexical corpuses relevant to the subject under consideration. The analysis for each corpus includes:

- identification of the most frequent words (verbs, nouns, collocations and multi-word units)
- the usage of action verbs identified as the preferred ones for use when developing Model Courses (IMO HTW, 2020)
- semantic network analysis

Corpus analysis enables the detection and description of typical patterns and frequent forms that would otherwise be unnoticed, showing highly structured patterns that are not random but cognitively motivated. The corpora compiled for this study target specific research questions and therefore had to be representative of the area under study and balanced in terms of diverse texts that were incorporated. To meet these requirements, the texts included in the corpora were selected according to the criteria recommended by the EAGLES group, encompassing external (non-linguistic) criteria, such as style and origin, and internal (linguistic) criteria, such as genre and topic.

The basic quantitative information corpora provide is the frequencies of different linguistic units. In particular, the frequency data about action verbs provided interesting insights into the presentation of different skills or required knowledge in different corpora.

In general, the action verbs belonging to the cognitive domain are most frequent in all corpora, while those from the psychomotor and affective domains have a smaller share. This is a consequence of the fact that the cognitive domain involves the understanding or recall of specific facts, procedures, and concepts directly related to the topics in the maritime domain. Therefore, they are more easily identified than abilities or attitudes related to the psychomotor and affective domains.

Furthermore, keyness score analysis was also conducted in Sketch Engine, which indicates the words or phrases typical or key in a certain context, i.e. characteristic for a specific text as opposed to another, in this case, the corpus of general English language EnTenTen20. Keyness is a textual feature providing insight into the main semantic domains of a certain text. The conducted keyness score calculation presented here singled out the key terms, which indicate the main areas the corpora are focused on.

Semantic relations among different words are calculated using WordIJ v3.0 software (distances are defined as exponential) and graphically presented using Gephi v.0.9 software. Word clouds are generated using Wordsmith v.7.0.

In the case of shipboard skills, the skills are identified using identified skill standards: STCW Convention and associated documents. In the case of shore-based skills, identification is carried out mostly using semantic analysis of relevant sources.

8.1. SKILLS REQUIRED FOR SHIPBOARD POSITIONS

A set of different semantic analyses has been carried out to identify skills required for shipboard positions. The results of these analyses follow.

8.1.1. STCW Code A Chapters II & III - competencies

The first level analysis focuses on the competencies of management level positions onboard ships. Consequently, the corpus consists of competencies defined in Chapters II & III of the STCW Convention.

The competencies are taken from relevant tables in the STCW Code A. The created corpus includes 13,382 tokens and 1,087 unique word forms, organised in 655 sentences.

Competencies were rearranged to form complete sentences, although, in the Code itself, some of them are abbreviated. An example of a complete sentence follows:

Knowledge of the fundamentals of radar and automatic radar plotting aids (ARPA)

Since skills assumed (competencies) are presented using a relatively high level of abstraction, the main goal was to identify key terms and establish main relations between different terms. Key terms are identified using Sketch Engine and graphically presented using Excel.

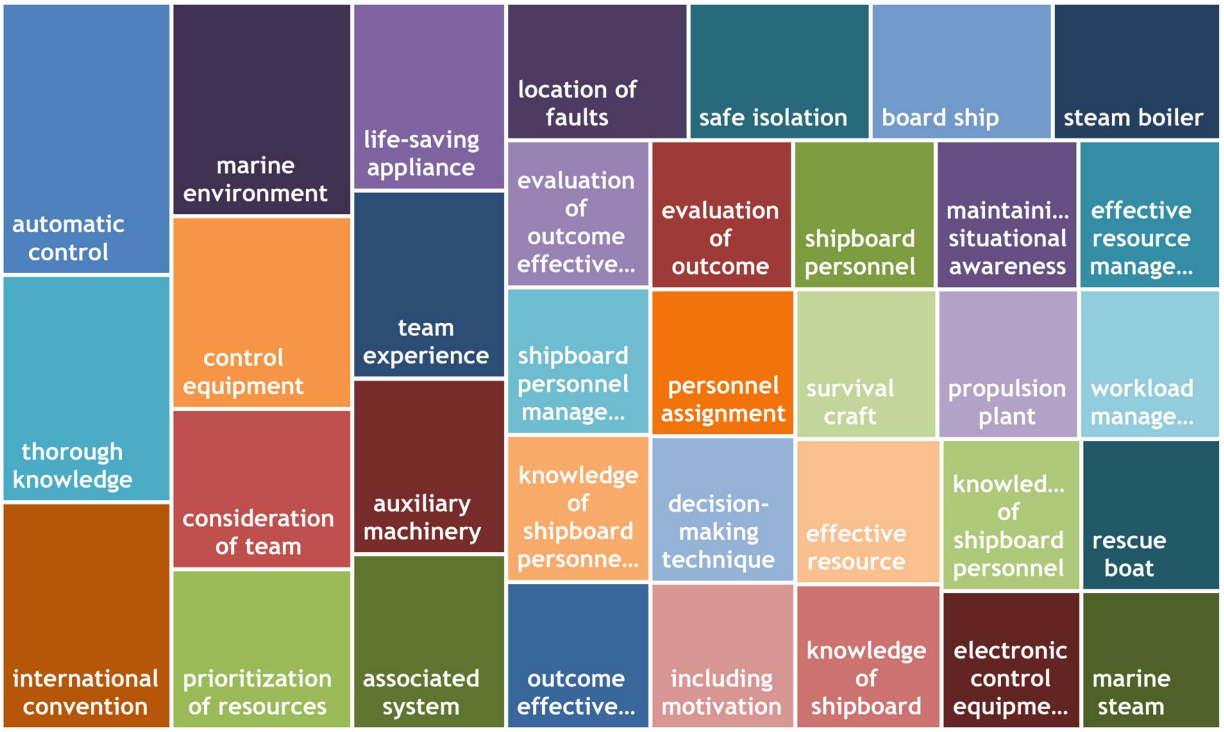

***Figure 7 Key terms STCW corpus*[67]**

Key terms, particularly multi-word terms, have been identified using the Simple Math method. The method uses a comparison of frequencies of keywords in two different corpora. In this case, the core STCW corpus has been compared with the standard English corpus.

All key terms presented here are sorted according to the calculated score and have at least 10 occurrences in the corpus.

It is worth noting that the most valued key term is *automatic control,* followed by *consideration of team* and *prioritisation of resources.* It is important to note that most multi-word key terms deal with soft skills. References to equipment or ship's construction emerge later on the list.

The next method aims to identify relations among key terms and their strength. The method aims to create a directional semantic network using the same corpus. The strength between particular keywords corresponds to the width of the connecting arrow.

67 Key terms hierarchy is arranged from top to bottom and from left to right. The area of the square corresponds to the score value.

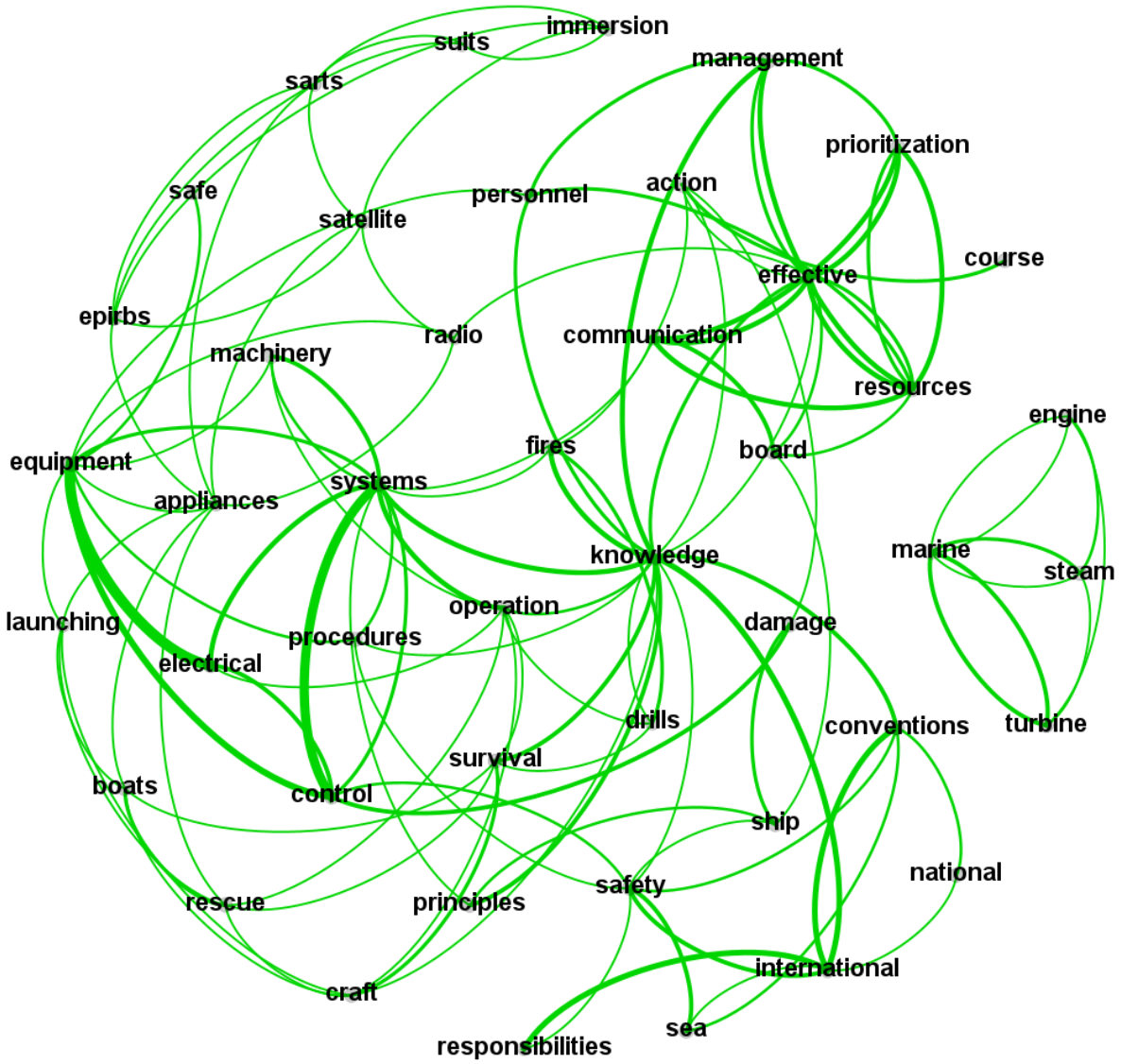

Figure 8 Semantic network - STCW A & B

The associated semantic network is relatively small; it consists of 323 nodes and 509 edges. The average degree is 1.576, while the graph density is 0.005.

The semantic network reveals several important areas of interest. The first one, probably the most important, is the term *knowledge*, which is clearly the corpus's dominant term, with connections to all other terms.

Other key terms include:

- the terms describing control systems, indicated by terms *equipment-electrical-systems-control*
- the terms describing the performance, indicated by the terms *effective-management-action-communication-resources-course-prioritisation*
- the terms referring to ship propulsion, indicated by *marine-engine-steam-turbine*

It is worth noting that the emphasis is on general, mostly procedural, knowledge significantly related to the ship's safety. Such orientation is expected due to the general nature of the text itself.

8.1.2. Deck department

The subsequent analyses focus on deck officers' education and competencies, i.e. Masters and Chief Mates on ships of 500 gross tonnage or more. The following sources were included in the corpus:

- 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), and
- Officer in Charge of a Navigational Watch (Model Course 7.03 – Part C)

It is assumed that masters' competencies (management level) include competencies prescribed for deck officers (operational level.

Table 2 List of most frequent words (without stop words) used to describe skills in the STCW Convention and associated Model Courses for deck functions

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%

The corpus includes 201,687 tokens organised in 3,234 sentences. In this case, the analysis focused on the knowledge 'chunks' that may be identified.

Figure 9 The most frequently used words - Deck department

It is interesting to note that bulk cargo ships and their cargoes are recognised as highly important key terms.

Other types of ships are much less emphasised, probably because specialised knowledge to be used on these ships is specified in more detail in courses required in Chapter V of the STCW Convention. Also, it is worth noting that among the first 40 key terms, the majority refers to cargo operations or their consequences, while typical navigational duties are not emphasised.

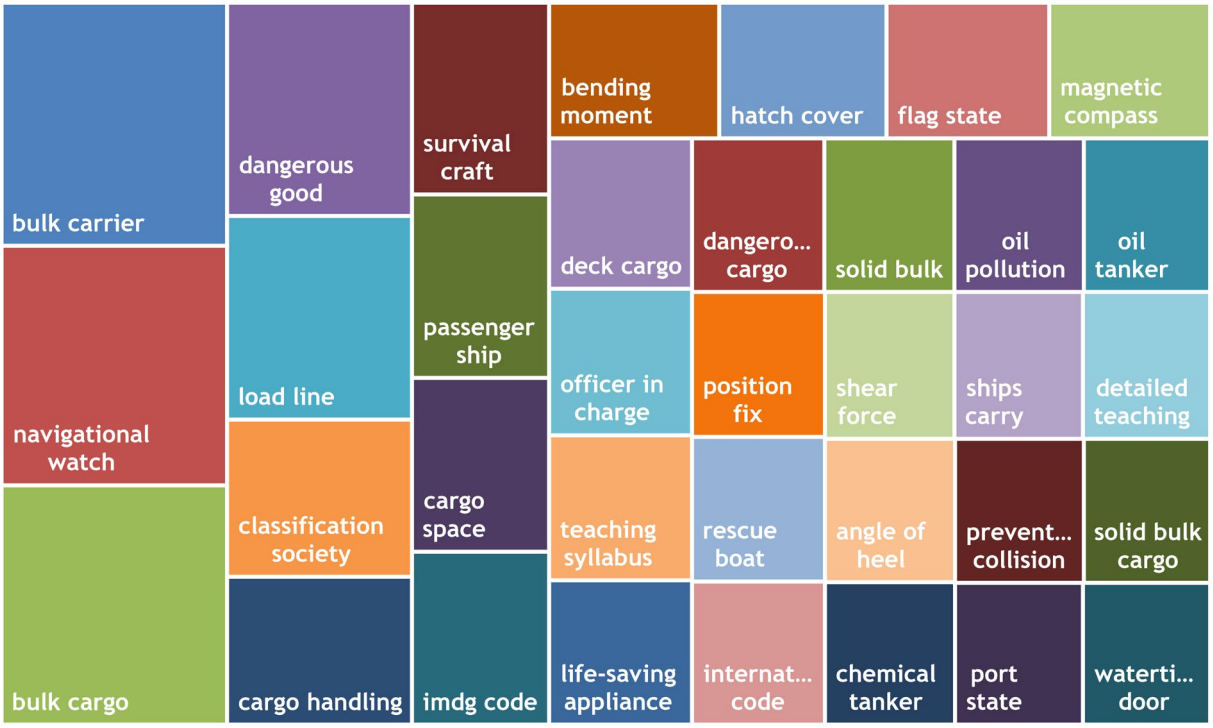

Figure 10 Multi-keywords for masters and deck officers

The associated semantic network consists of 3,776 nodes and 5,899 edges. Consequently, the network is substantially larger than the previous one. The average degree is almost the same as the previous one, i.e. 1.561.

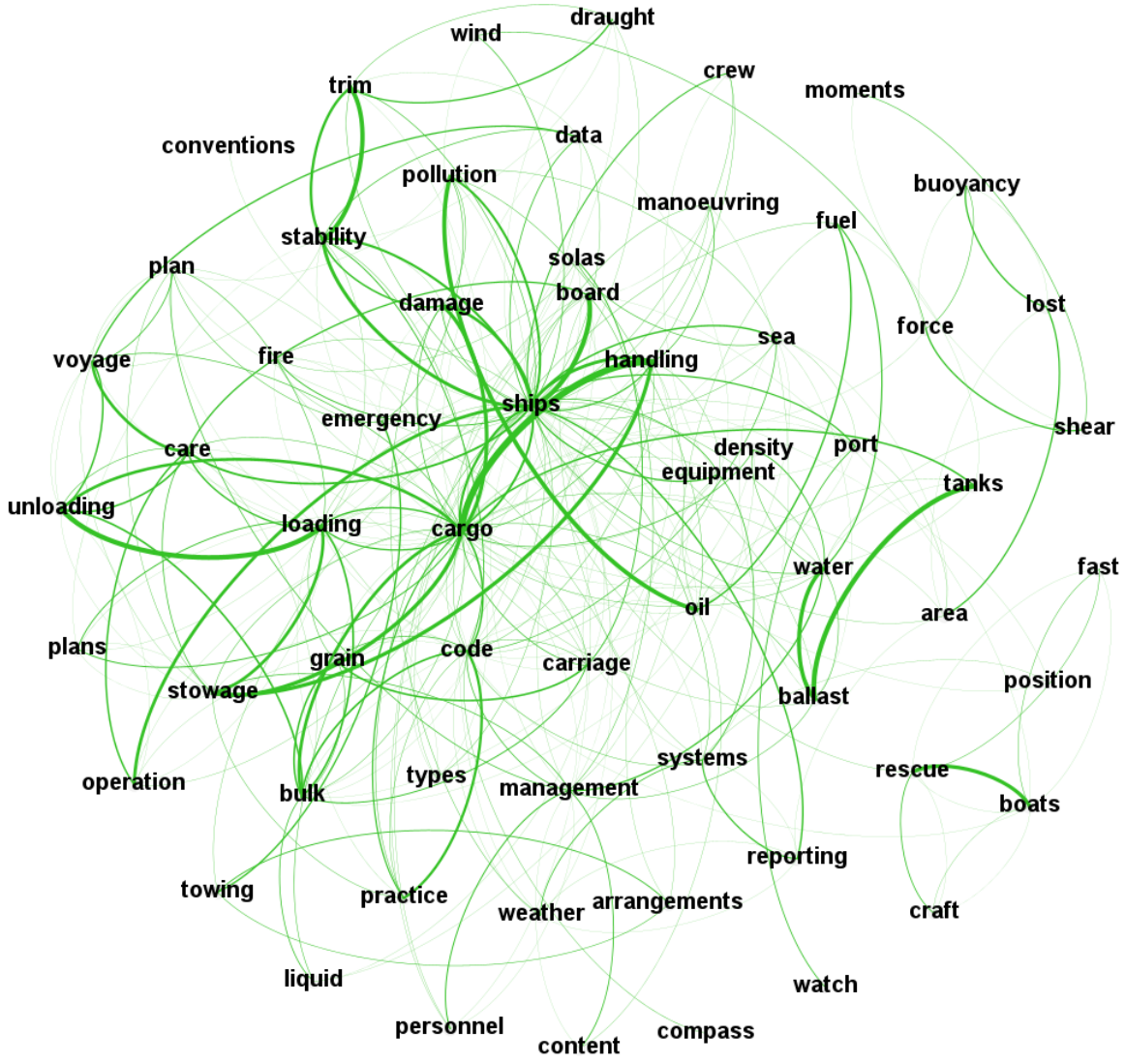

Figure 11 Semantic network - deck department

Semantic analysis reveals the same emphasis on cargo operations. The links between *ship, cargo,* and cargo-related terms are easily noticed. All other terms and their relations are significantly lower (except the references to ballast waters). Based on the available data, it is unclear whether it is intentional or not. In any case, the strict implementation of guidance given in associated Model Courses will result in significant time spent on cargo operations and minimal time dedicated to maritime business and law, although these subjects are closely related to cargo operations.

8.1.3. Engine department

The same approach used for the deck department has been used for the engine department. The corpus used includes the following texts:

- 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), and
- Officer in Charge of an Engineering Watch (Model Course 7.04 – Part C)

Table 3 List of most frequent words (without stop words) used to describe the skills in the STCW Convention and the associated Model Courses for engine room functions

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

The corpus includes 90,400 tokens organised in 1,322 sentences.

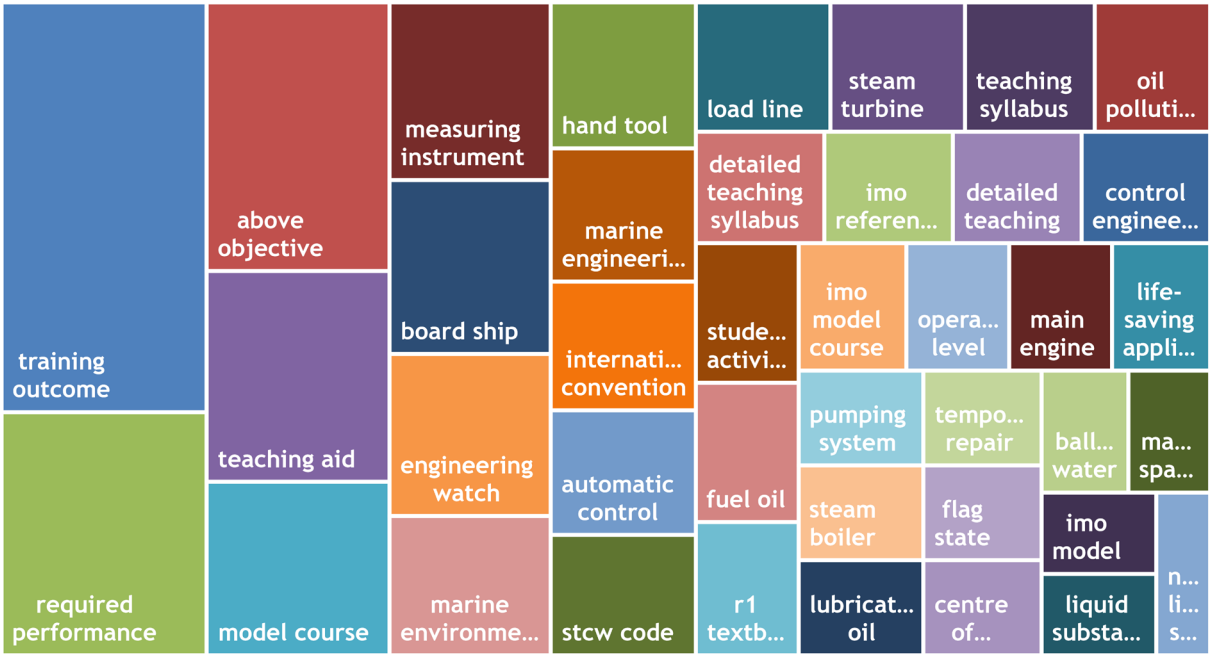

Figure 12 Identified keywords for the engine room department

Figure 13 The most frequently used words - Engine department

Key terms have been manually corrected to avoid repetition of key terms irrelevant to marine engineering

(for example, references to IMO as an organisation have been deleted).

As expected, the most relevant terms are general terms, followed by more engineering-oriented subjects. Terms not expected include *load line* and *steam turbine*, particularly because steam turbines are far from being the dominant type of ships engines. Terms related to pollution prevention are scarce, which is surprising given the importance of proper engine room management for pollution prevention.

The key terms include more than expected terms related to the ship's stability (although with a lesser overall score).

One can easily note the absence of any reference to digital skills or modern technologies (as in the deck department, too). It may be understandable since the last revision was in 2014. However, considering the pace at which new technology is changing modern ships, it is not clear how people who are educated and trained following these model courses can perform as they are supposed to.

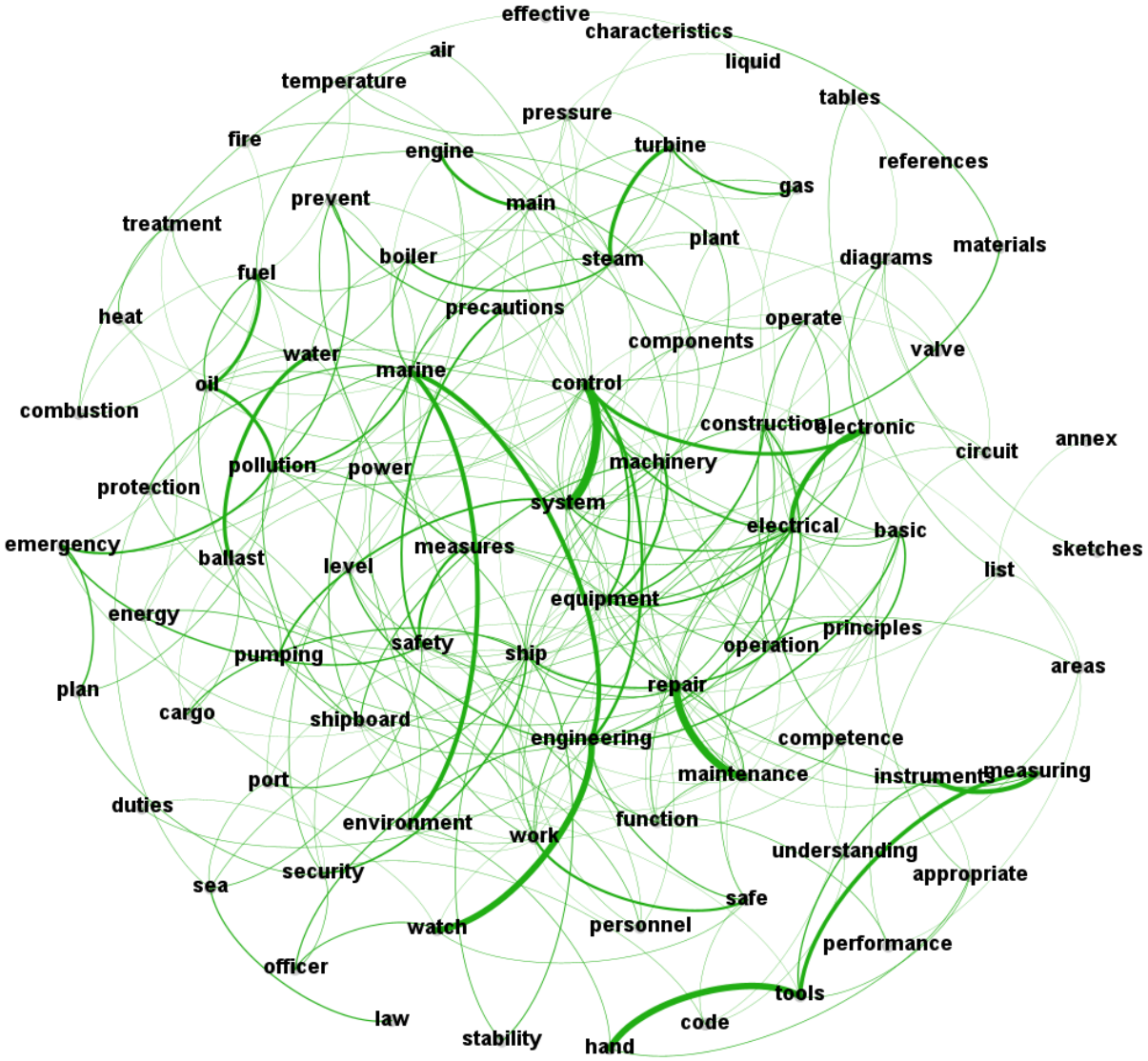

Figure 14 Semantic network - engine department

The associated semantic network consists of 2,390 nodes and 1,653 edges in a directed graph. The

average degree is 0.692.

The network reveals several important sequences:

- the most important one is *control-system*, being the core activity
- the second one, with almost the same strength, is the *repair-maintenance* sequence, followed by *hand-tools*

There are several other relevant sequences, such as *marine-engineering-watch* and *marine-environment*. One should note that the outer layer mostly refers to common engineering terms.

8.1.4. Shipboard skill level requirements

Skills (competencies) required to accomplish a task may demand different physical skills, performance expectation skills, and emotional and psychological functions (abilities). The level of required abilities mostly depends on particular task complexity. For a job under consideration, skills may be identified by analysing work procedures (tasks) or, in the case of well-defined working procedures and established associated study programmes, skills may be analysed using intended learning outcomes. Learning outcomes are measurable statements that articulate at the beginning what students should know, be able to do, or value as a result of taking a course or completing a programme.[68] Following the same line of reasoning, the STCW Convention and associated documents describe what certain onboard positions must be able to do. Thus, they indicate the level of complexity and intended scope of the associated learning programme and may be understood as minimal learning outcomes.

Learning outcome statements typically include three components:

- An introductory statement refers to someone who needs to demonstrate a certain ability (for example, 'The seafarer will be able to…')
- Action verb, i.e. a verb describing the action a person will be able to do. Action verbs broadly describe the required ability
- Performance, i.e. a minimum acceptable level of ability to be demonstrated or achieved. The focus should be on the quality of the performance and may be specified quantitatively (measurable) or qualitatively (descriptively) using generic performance indicators

Occasionally, learning outcomes may contain statements referring to context, conditions or settings assumed.

Learning outcomes, as a rule, follow Bloom's taxonomy[69]. They cover three different domains: cognitive, affective, and psychomotor.[70] Each domain consists of a hierarchy of increasingly complex processes that candidates are supposed to acquire.

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68 There are many similar definitions of learning outcomes. The one presented here is used at the Cornell University and differs from others because requires that statements must be measurable.

69 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.

70 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.

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

- Knowledge
- comprehension (understanding)
- application (proficiency)
- analysis
- synthesis, and
- evaluation[71]

It is assumed that each level is based on the previous one. Analysis, synthesis, and evaluation are considered to require higher-order mental skills.

In addition to the cognitive domain, there are two other domains in Bloom's taxonomy: the affective and psychomotor domains. The affective domain ('Feeling') is concerned with value issues; it involves attitudes. The psychomotor domain ('Doing') involves the coordination of brain and muscular activity.

For each domain and level, Bloom suggested certain action verbs characterising the ability to demonstrate achievements.[72] These verbs are 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, dramatise, 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*

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71 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.

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

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*

In February 2020, IMO HTW Sub-Committee adopted a modified taxonomy[73] for future Model Courses. The taxonomy covers all three areas (cognitive, affective, and psychomotor)[74].

To identify the current skill requirements, the STCW Convention and associated documents were analysed, particularly STCW Code A (where learning outcomes are defined), STCW Code B (where additional guidance is given), and the associated Model Courses. The results of the analyses follow.

The most important action verbs defined for deck departments (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 identified action verbs belong to the lowest part of Bloom's taxonomy. Only two verbs belong to the 'application' level – *calculates* and *demonstrates* – while only one belongs to the 'analysis' level ('*determines*'). The percentage of higher-level verbs is minimal.

It is interesting to note that the verb *causes*, used as a term, is located far away from the most important terms (mentioned 51 times). It seems that in the STCW Convention, analysing causal relations does not seem to be important, especially if compared with factual knowledge.

73 IMO SUB-COMMITTEE ON HUMAN ELEMENT, TRAINING AND WATCHKEEPING, 7th session, DEVELOPMENT OF AMENDMENTS TO THE REVISED GUIDELINES FOR THE DEVELOPMENT, REVIEW AND VALIDATION OF MODEL COURSES (MSC-MEPC.2/CIRC.15/REV.1)

74 See Annex 3.

The most important action verbs for the engine department (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 emphasised that this verb is used mostly in a technical ('*to measure*') or procedural sense ('*explain measures*'). Again, the percentage of higher-level verbs is minimal.

In addition, the source data was analysed to identify how well other domains are represented in different documents. It is assumed that using action verbs, even outside sentences representing learning outcomes, broadly indicates the required level of abilities.

In that respect, documents were divided into the following categories:

- STCW Core, i.e. learning outcomes as defined in the STCW Code A
- STCW Extended, i.e. STCW Code A and B, with excluded chapters I (it mostly deals with administrations' responsibilities)
- Model courses for deck and engine departments at operational and management levels

The following analyses present results for all domains.

Cognitive domain

The cognitive domain (Bloom, 1956) involves knowledge and the development of intellectual abilities. The domain includes the recall or recognition of facts, procedural sequences, and concepts. It also includes higher-level intellectual abilities and skills.

The major categories are listed, starting from the simplest to the most complex. It is assumed that they represent degrees of difficulties, i.e. the necessary condition for mastering a certain ability is adequate proficiency at the previous level.

Results presented here are normalised to make it possible to compare corpora with a different number of words.

As expected, the model courses dominate in lower-level action verbs. However, the STCW Core text emphasises the application, i.e. competence level. It also uses a very limited set of action verbs, particularly for the two lowest levels (*knowledge* and *understanding*). It is probably the result of the limited corpus and a general approach used in the STCW Code A.

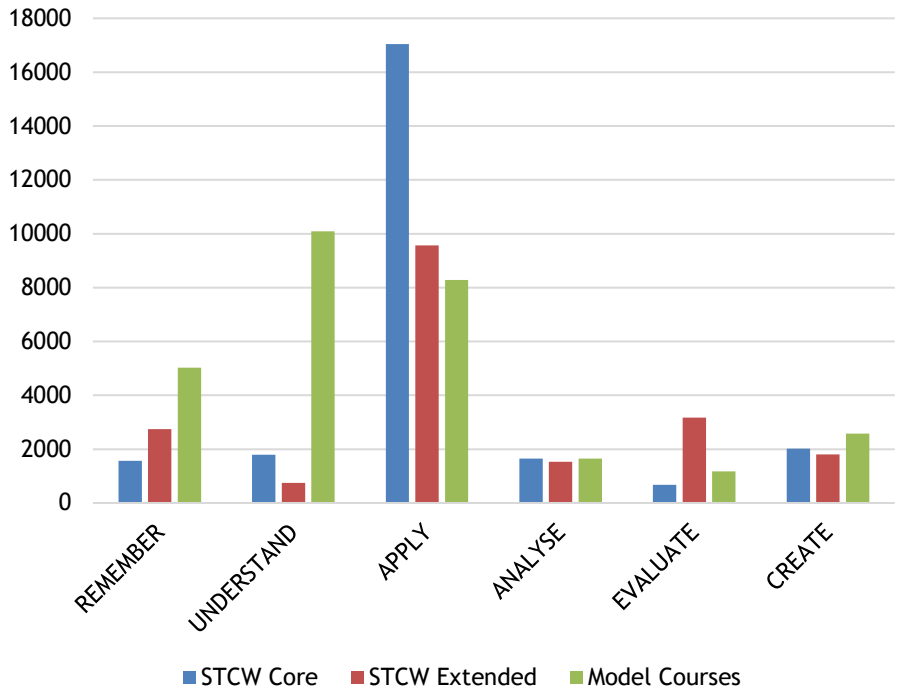

Figure 15 Levels within the cognitive domain (relative frequencies per million words)

As can be noted from the attached graph, the level of an application dominates among all levels. The verbs describing higher-order cognitive abilities are significantly under-represented. It is very much in line with a common understanding valid at the time the SCTW Convention was developed that shipboard jobs predominantly belong to vocational-oriented education.

Psychomotor domain

The psychomotor domain involves various physical actions and the use of the body's motor skills. It includes coordination of the movement and proper working posture. It requires various active mental processes before, during, and after movement. For example, hand-eye-ear coordination is an important part of the psychomotor domain.

Action verbs in this domain are significantly under-represented compared with those defined for the cognitive domain. This is surprising, since any vocational activity usually employs a significant part of the skills categorised within a psychomotor domain. It seems that the STCW Convention authors somehow forget to define learning outcomes in this domain, although these skills are commonly highly valued, especially for engineers.

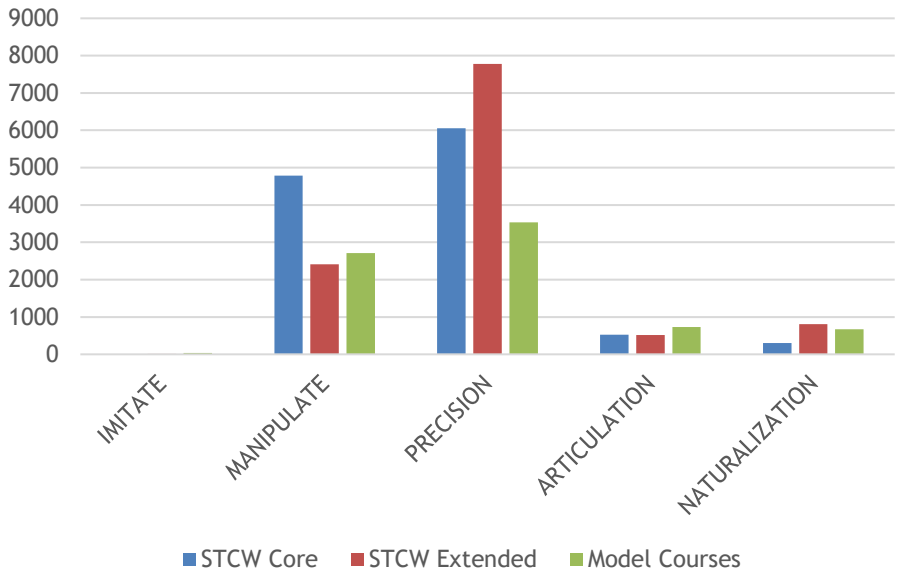

Figure 16 Levels within the psychomotor domain (relative frequencies per million words)

Even more surprising is that model courses, which are expected to give much more detailed guidance on acquiring practical skills, lag behind other sources (in relative frequencies). One can conclude that model courses did not fulfil the assumed goals in that respect.

Affective domain

According to developers, the affective domain includes how 'we deal with things emotionally, such as feelings, values, appreciation, enthusiasms, motivations, and attitudes'[75]. How to deal with these emotions can be taught. Consequently, one needs to acquire these skills to accomplish tasks involving emotional interactions. It can be done experientially, through everyday interactions, or these skills can be developed intentionally via different activities incorporated into the curriculum. These skills are generally grouped into five categories, from simpler to more complex.

- Receiving is commonly described as the person's ability to listen and be willing to hear others.
- Responding is usually described as an ability to participate in discussions, ask questions, and present information to others.
- Valuing is defined as an ability to internalise values, i.e. to use reasoning to act upon external stimulus and include, among others, appreciation, justification, and demonstration in different interpersonal situations.
- Organising is the ability to manage and organise conflicting messages by contrasting different viewpoints and creating and developing own value system.
- Characterisation is an ability to control behaviour based on a developed value system.

75 Krathwohl, D.R., Bloom, B.S., Masia, B.B. (1973). Taxonomy of Educational Objectives, the Classification of Educational Goals. Handbook II: Affective Domain. New York: David McKay Co., Inc.

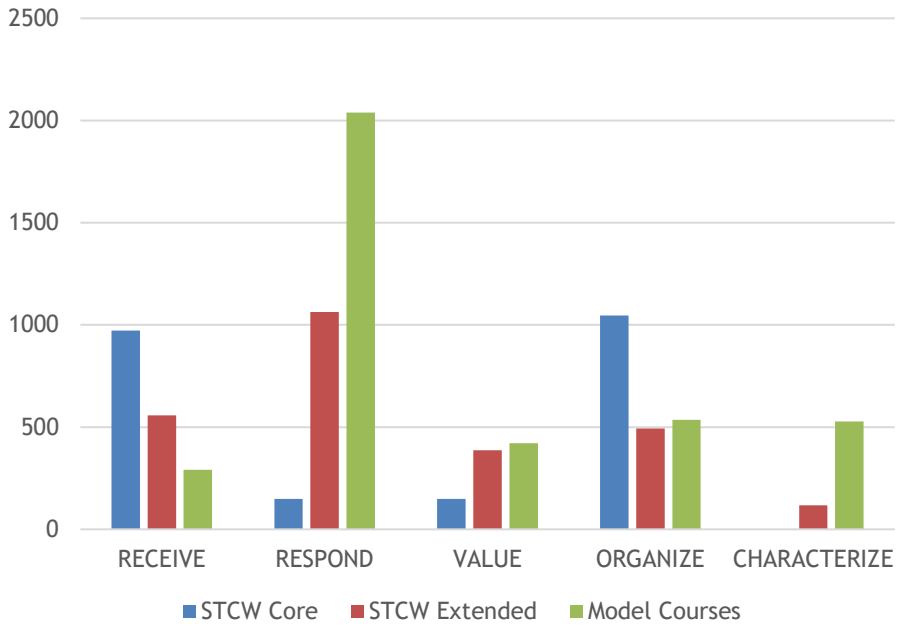

Figure 17 Levels within the affective domain (relative frequencies per million words)

Again, the number of action verbs aiming to develop skills from the affective domain is relatively low compared with other domains. One can easily conclude that even this domain is mostly left out. It is important to note that skills from this domain are often affected by different educational cultures and traditions, i.e. left to national authorities to deal with as they think is appropriate. However, it does not minimise their importance, particularly because most soft skills, if not all, are based on the skills defined within the affective domain.

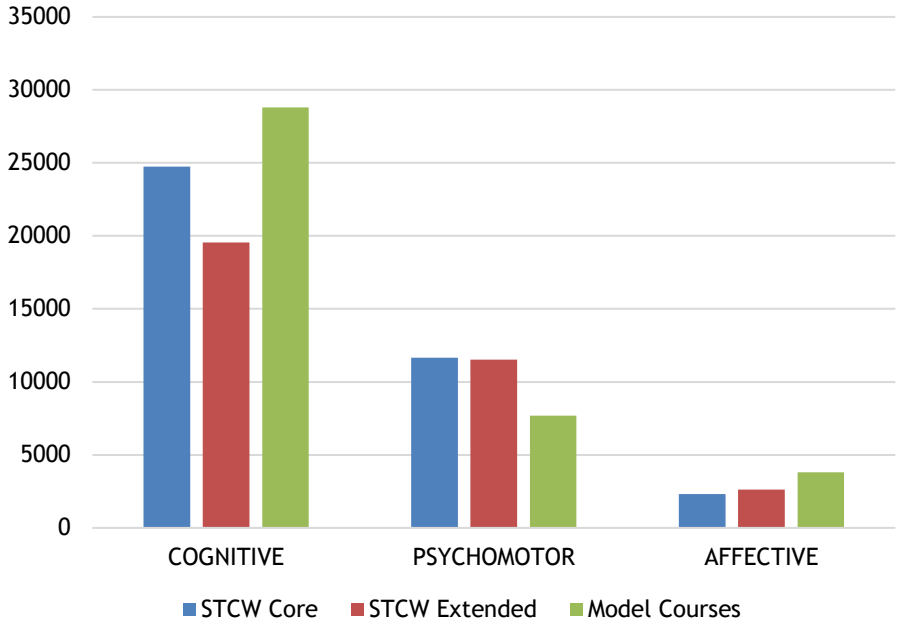

Figure 18 Comparison of relative frequencies for three domains

Finally, it is obvious that three different domains are not equally represented in the STCW Convention and associated documents. The cognitive domain is significantly more emphasised, while psychomotor and

affective domains are under-represented, particularly the affective domain, although there is strong evidence that skills in these two domains directly impact ship safety and security and environmental protection.[76]

The fact that psychomotor and even more affective domains are under-represented in all three documents clearly indicates the incompleteness of the STCW Convention and associated documents. Since no guidance exists in that respect, educators are left to cover these parts of the educational process as they may find suitable or not, thus causing differences in attained proficiencies.

Applicability

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

- 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 usable for any position aboard or ashore (translational skills), such as '*51. Development, implementation, and oversight of standard operating procedures.*'

A very extensive interpretation was applied to decide whether a specific skill applies to shore-based jobs and positions. This means that even the skills predominantly associated with shipboard jobs were equally 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. The authors prepared the classification and verified it by consulting external experts (two masters and two chief engineers with more than 20 years of sea experience).

Accordingly, Certificates of Competence at the management level provide:

- Ninety skills appropriate for onboard use, 32 skills equally usable aboard and ashore, and 10 skills for deck certificates, and
- Forty-two skills appropriate for onboard use, 55 equally usable aboard and ashore, and 10 skills for engine certificates.

The results of the exercise are not surprising: it is well known that engineer officers relatively easily find shore-based jobs thanks to competencies useful ashore.

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 (mostly management-related).

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

8.2. SKILLS REQUIRED FOR SHORE-BASED POSITIONS

The key to a successful career shift ashore depends on obtaining the right transitional education and qualifications. Depending on the type of job the mariner is pursuing, this will require either specialised training (on-the-job training, short course/diploma study) or an advanced degree such as a Master of Science (MSc).[77]

Skills required for shore-based positions cannot be identified using learning outcomes, mostly because there is no agreed standard skill set expressing these outcomes. Instead, one needs to analyse texts uniformly describing the required knowledge. It is reasonable to assume that the most important subjects and associated actions will be the most frequently mentioned in the relevant lexical corpus[78], i.e. the importance of the terms and expressions used is roughly equivalent to their frequency in the relevant text corpus. Therefore, semantic analyses may identify key terms for the main areas.

Consequently, the sources identified as appropriate (see minimal requirements in Chapter 7) have been selected and subjected to lexical analysis to identify the most important terms and expressions in each area influencing the maritime industry (identified in Chapter 5). The source corpus has been selected to reflect the subject's importance in the investigation area.

8.2.1. Economic environment

The corpus used to describe the economic environment is based on selected texts covering the maritime economy and business areas. The source texts are encyclopaedic, comprising most subjects typically understood as maritime economy and business. Texts are dedicated mostly to students and seafarers. The corpus comprises 730,861 tokens and 18,030 distinctive words (types) organised in 18,313 sentences. The results of the analysis follow.

The words most frequently used *(ship, cargo, regulation, code, port, certificate, vessel* and *master)* reflect the factors that mostly influence the maritime industry's economic efficiency. 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 external regulations on the industry's economic efficiency. The second term to be emphasised is *master*. This suggests that ship masters still play an important role in shipping operations, although opposite statements are quite frequently heard among active masters.

77 WP 1 Report of the Maritime Transport Coordination Platform (MTCP), the project commenced in 2004 and ended in 2007. The MTCP was supported by Directorate G, Directorate-General for Energy and Transport (DG Tren) Unit G3 / Motorways of the Sea and Intermodality the Commission under the Sixth Framework Programme, Priority 6 – Sustainable Surface Transport.

78 When selecting the texts to be included in the corpus, texts providing extended coverage are preferred to those providing more words. Considering the highly specialized subject under investigation, it is estimated that corpuses with more than 200.000 will return the most important keywords with satisfactory reliability. In addition, no text printed or published before 2000 is used in the corpus.

Figure 19 Most frequently used words to describe the economic environment

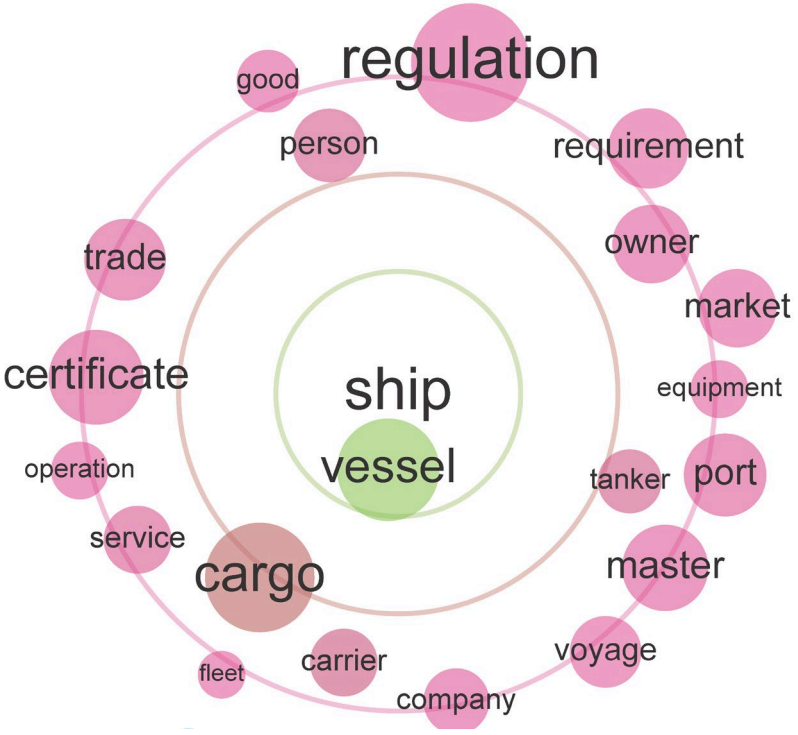

Figure 20 Relations between 'ship' and other related terms

Figure 21 Single keywords used to describe the economic environment

Among single keywords dominate those referring to main stakeholders (*charterer, shipowner, shipmaster, seafarer/seaman*), main maritime conventions (*solas, tonnage, stcw* and *marpol*) and ship types. Among multi keywords, more complex terms may be identified, such as *official log book, crew agreement, freight rate, general average*, etc.

Taken together, these terms highlight the most important subjects to be mastered by those looking for a position ashore.

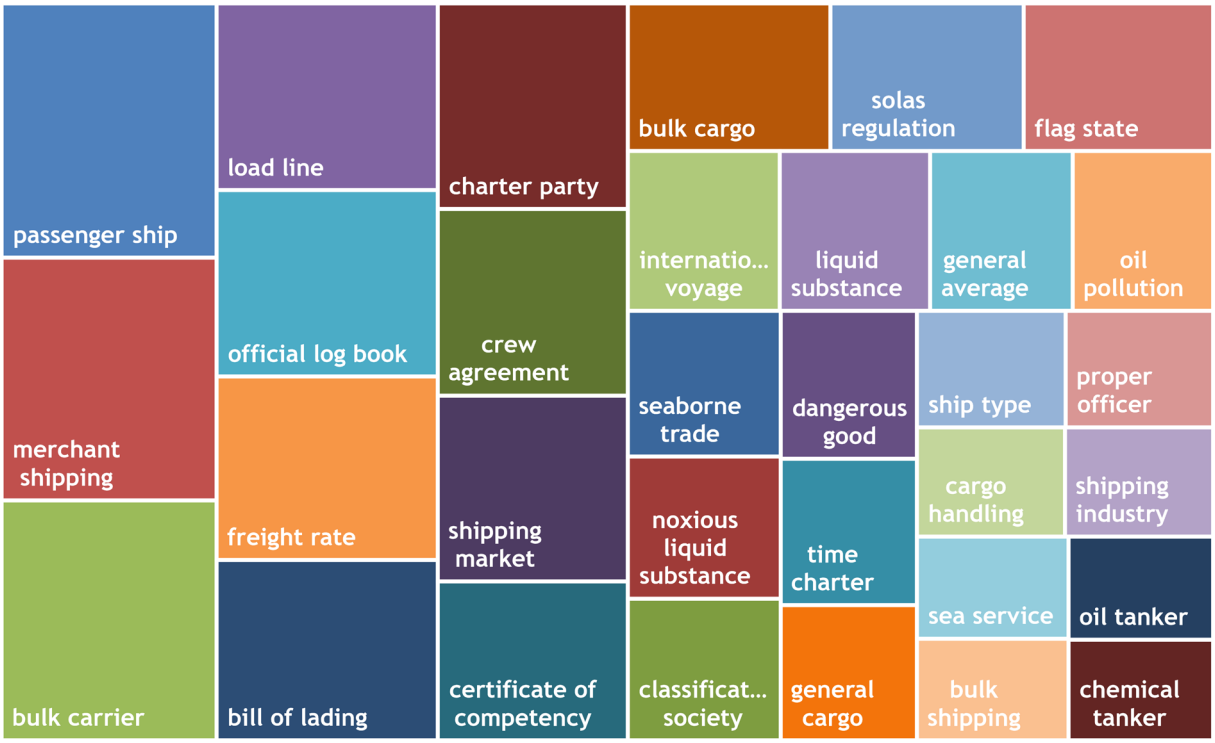

Figure 22 Multi keywords used to describe the economic environment

It should be noted that the several terms in this activity overlap with terms identified for a deck department. As expected, it confirms that shipboard education and experience when looking for a job ashore provide a certain advantage and may benefit the seafarer and company.

The associated semantic network consists of 2,009 nodes and 3,079 edges. The average degree is 0.533, with an average density of 0.001 and an average clustering coefficient of 0.116.

The semantic network reveals several important relationships:

- The strongest relationship between *shipping*, *merchant*, and *market* indicates the field's core relation.
- The next relationship connects *ships*, as the focal term, with *cargo* on one side and *regulations, master,* and *certificates* on the other side.
- The last easily recognised relationship connects *oil* and *pollution,* indicating the considerable importance of economic consequences in case of large-scale pollution by oil.

Other relationships, particularly in the case of large-scale network presentation (more terms presented), are more or less expected in terms of connecting terms and the strength of the connection. Accordingly, the density is relatively high. One can conclude that, apart from a few stronger relationships, the most significant relationships are relatively uniformly distributed. This indicates that there are no areas requiring particular attention.

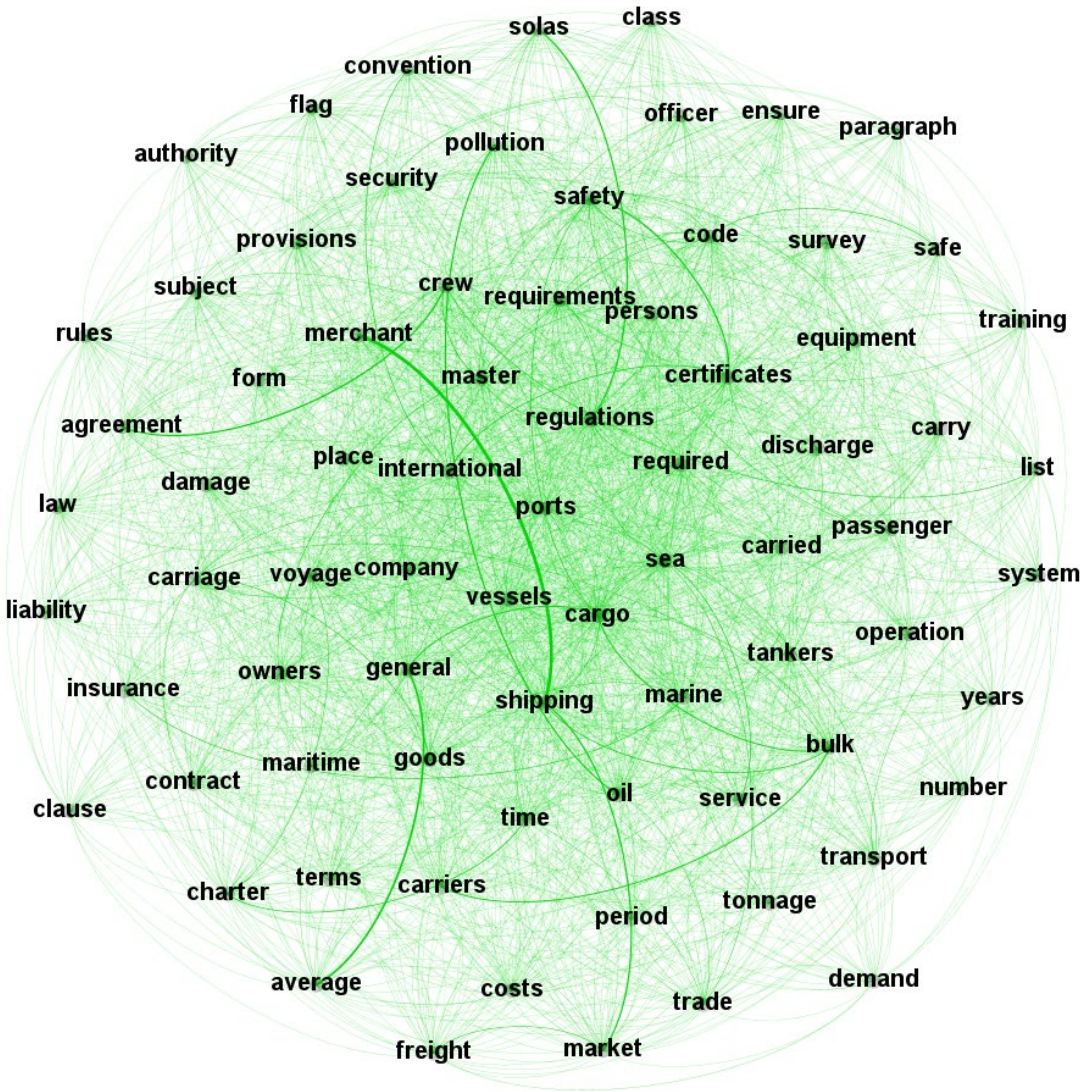

Figure 23 Semantic network – economic environment

It is important to note that the strength between nodes is well-balanced, with just a few more prominent links.

The keywords and semantic network align with programmes offered by most schools and universities providing education within the subject area,[79] although these programmes may differ in structure, organisation and level of education (from BSc up to PhD).

It is worth noting that the line between two main segments – i.e. supply chain (logistics) professionals and maritime business professionals – is unclear. Sometimes, these two streams are clearly divided and contain numerous overlapping subjects. Sometimes the education is an upgrade to the general-purpose education in business and economy; sometimes, it is offered as a stand-alone course, not requiring previous education in the field.

It seems (based on more than 20 programmes analysed) that this diversity is intentional, i.e. programme developers are trying to offer students something new and different from others, thus being more competitive in the education market.

As expected, deriving a well-defined set of skills in the field seems counterproductive. The student (or ex-seafarer) is expected to select the subjects and associated level of expertise that best suits his or her future career path. Or in other words, becoming an expert across the whole subject area does not seem justified for persons with significant shipboard experience.

Accordingly, based on the programmes' analysis and identified key terms and associated relations, the following subject areas are identified as the most important:

- Global trade and maritime economics
- Shipping markets and demand and supply cycles
- Marketing
- Ship operations and crew management
- Maritime regulation
- Marine operation and maintenance management
- Safety and risk management
- Marine insurance
- Chartering policy
- Financial management
- Port operations
- Market research

79 For example, Antwerp Management Schools (Maritime Transport Management), University of Plymouth (BSc (Hons) Maritime Business), Erasmus University Rotterdam (MSc Maritime Economics and Logistics), Gdynia Maritime University (Transport and Logistics Systems, Maritime Economics and Logistics), Copenhagen Business School (BSc in International Shipping and Trade) but also, Lloyd's Maritime Academy (Diploma in Maritime Business Management) and World Maritime University (Executive Maritime Management Postgraduate Diploma). It seems that there is no country (including even land-locked countries) without at least few universities or schools providing education in the maritime business or supply chain and logistics.

8.2.2. Maritime law

The corpus used to describe maritime law consists of 264,186 running words and 11,754 distinctive words. The sources are dedicated to legal experts, students and maritime professionals dealing with maritime legal issues. The corpus is approximately equally divided between the UK and USA legal frameworks.

The most frequently used words are present in the form of the word cloud, with a font size reflecting the frequency of the word.

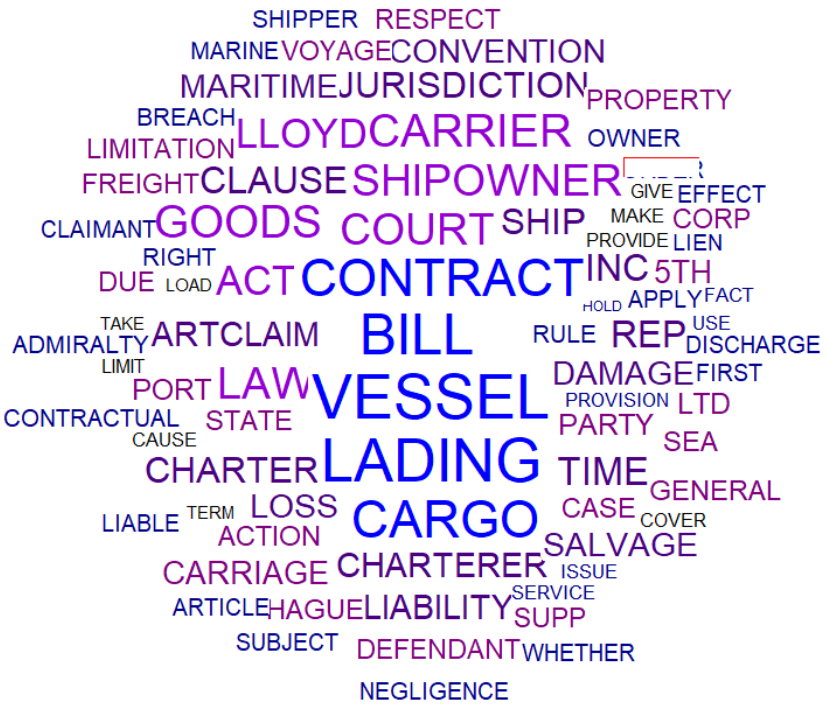

Figure 24 The most frequently used words used to describe maritime law

The words with the highest frequencies describe contractual relationships (*contract*, *bill*) among different stakeholders. The following group refers to the main stakeholders in the process (*ship-owner, carrier, court, charterer*, etc.).

It is important 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, including just a few verbs.[80]

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

Figure 25 Figure 17 Multi keywords used to describe the maritime law

The list of multi-keywords offers very similar terminology found in the previous list. The most prominent term is a *bill of lading*. It is followed by several important rules regulating different aspects of cargo contracting. Interestingly, key stakeholders (*vessel owner, cargo owner*) do not have such prominent positions.

Both presented graphs are clearly missing terms commonly identified in other corpora. It is particularly the case if compared with keywords found in the STCW core corpus. This indicates the minimal overlapping between two knowledge and skill sets. One can easily conclude that maritime law and other maritime areas are quite separate. Consequently, the likelihood that an ex-seafarer will pursue his/her shore-based career on jobs closely related to maritime law seems modest.

It has to be emphasised that the opposite is not valid. A deeper understanding or even expertise in certain sub-areas of maritime law may be highly beneficial for a seafarer looking for a job ashore. Almost all analysed programmes offered to seafarers as upgrade courses offer one or more subjects from the maritime law field. A good example is Lloyd's Maritime Academy, where law subjects are included in almost all programmes and levels.[81] However, the scope of maritime law subjects is highly variable. In some courses, the parts of the associated legal framework are quite extensive. In others, only the basic legal relations are presented.

The same conclusion may be reached based on the semantic network of the area. The associated semantic network consists of 4,827 nodes and 3,545 edges. The average degree is 0.734 with an average clustering coefficient equal to 0.027, indicating very low clustering effects, i.e. a large number of terms being linked only to one node.

81 The Academy offers three levels: certificate (12 to 16 weeks duration), diploma (12 months) or maritime postgraduate courses (16 to 24 months).

The number of words shared with other areas of activity is minimal. For example, in this network, the term *master* has relatively weak connections with other terms. In maritime economics and business, it is almost the central subject.

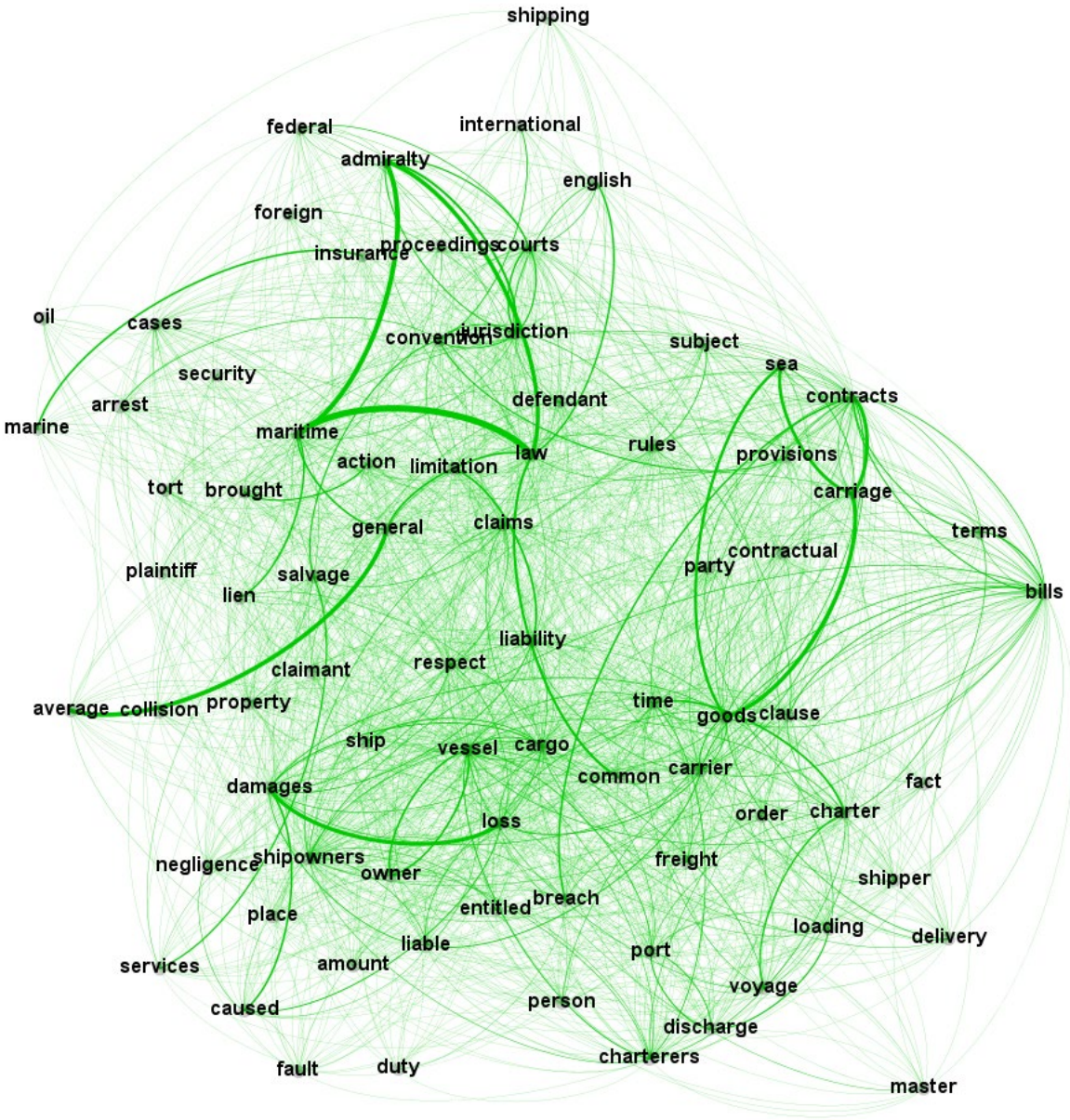

Figure 26 Semantic network – maritime law

The graph presented here shows only several terms with more emphasised relations. The graph in the upper part shows a cluster of words mostly connected with procedural proceedings, while terms in the lower part are more connected with various core subjects under dispute.

Accordingly, based on the programmes' analysis and identified key terms and associated relations, the following subject areas are identified as the most important:

- Carriage of goods by sea
- Charter parties

- General average
- Rights of seafarers and maritime workers
- Collisions
- Salvage
- Maritime liens
- Limitation of liability

8.2.3. Ship technology

The corpus used to describe ship technology consists of 355,340 running words and 24,372 distinctive words. It consists of two parts: a part dealing with transport technologies and a part dealing with dedicated shipboard equipment and its use. Sources can be divided into two distinctive groups:

- Encyclopaedic sources covering all areas of shipboard technologies, designed mostly to be used as reference documentation, and
- Sources describing transport technologies and modes, i.e. subjects covering interactions between shipboard technologies, ports and other shore-based technologies, mostly described shipboard types, modes of operations, relations with port operators, different markets, etc.

The most frequent keywords are present in the form of a word cloud, with increasing font size reflecting the frequency of the word.

Figure 27 The most frequently used words to describe ship technology

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 a *system*, obviously reflecting significant interdependence and connectivity of various types of onboard equipment.

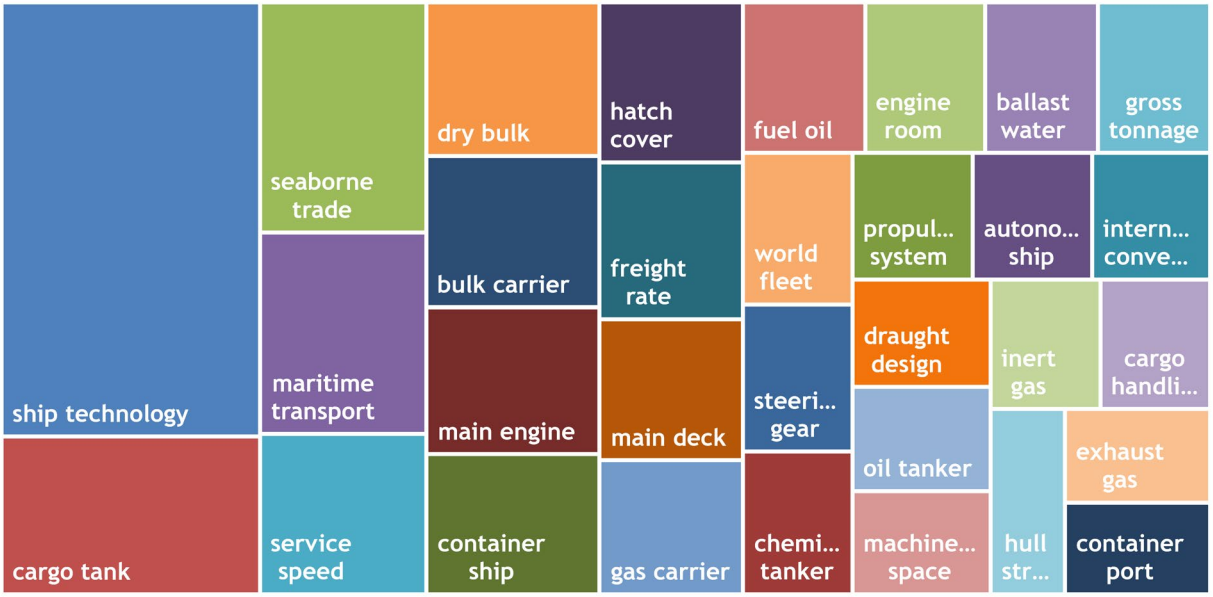

Figure 28 Multi keywords used to describe ship technology

The keywords identified via comparison with the standard English language refer to the most common technical systems onboard. One may be surprised that there are no modern buzzwords like digital or green transitions or technology. In fact, these new technologies are not bringing new systems onboard; instead, they change the way the basic functions are performed onboard ships. However, the term *autonomous ship* finds its way on the list. Although autonomous technology is still not in the production phase (at least not in international trade), its impact on different ships' subsystems needs to be considered from various standpoints.

For developing a semantic network representing the ships' technologies, the more general corpus was limited only to the part dealing with 'hard' technologies, i.e. technologies based on dedicated shipboard equipment. This corpus includes 280,344 tokens and 234,800 words, organised in 11,028 sentences. The part of the corpus related to transport technologies and transport management has been omitted.

The associated semantic network consists of 5,656 nodes and 4,374 edges. The average degree is 0.839, with an average clustering coefficient equal to 0.030, again indicating very low clustering effects.

As expected, the key terms are more or less the same as keywords identified using the previous methodology. Accordingly, there are no dominant terms (except a few expected, such as *ships, water,* and *cargo*).

However, the strengths between different key terms are much more balanced than in the previous networks. Also, the number of terms discarded due to the number of links is smaller than for economic environment and maritime law networks. In other words, using the same parameters, the graph includes more terms than the previous graphs.

The terms represented in the network may roughly be divided into two main areas:

- terms relating to transport technology (left side)
- terms relating to shipboard technologies and associated equipment (the rest of the network)

Again, digital and 'green' technologies are not recognised, although they significantly affect the core functions. Digital technologies mostly affect control functions, while 'green' technologies mostly restrict certain aspects of core operations.

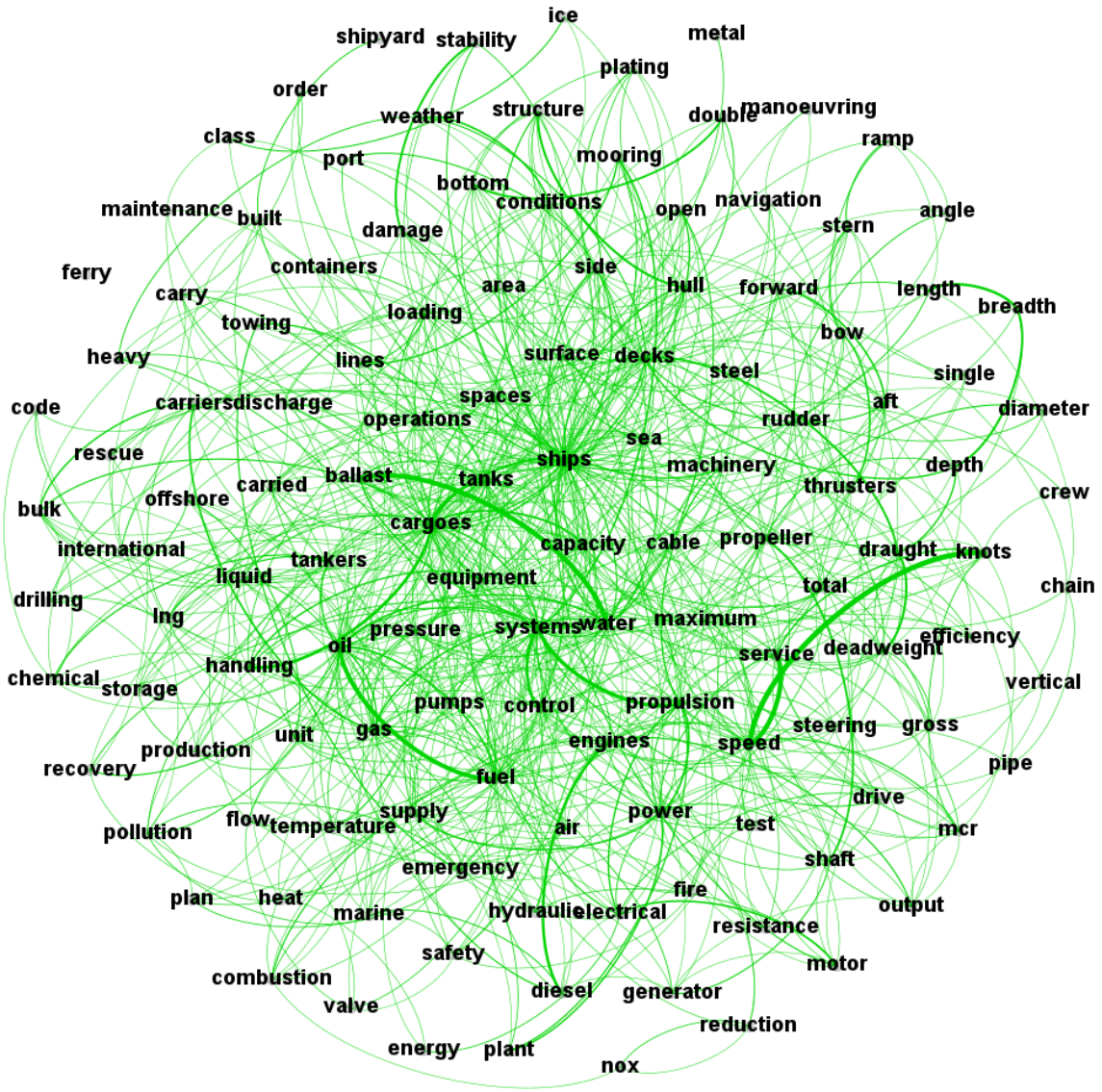

Figure 29 Semantic network – ships' technology

Finally, this network's terms seem to complement those found in networks representing deck and engine departments. Consequently, additional skill areas are those commonly found in maritime companies and supporting industries, such as technical superintendence, safety, quality and environment coordination, cargo planning and management, port operations, logistics, etc.

8.2.4. Research and education

The research and education corpus comprises 629,959 running words and 36,235 distinctive words. It consists of numerous papers presented at international maritime education and training conferences between 2019 and 2021.

The aim was to identify key concepts and main areas of interest among educators and researches, assuming that the most frequent keywords are those associated with the most important concepts in the maritime sector.

As expected, the most prominent keywords are those closely related to the two main areas:

- Education
- maritime technology

The most important representatives of the first group are *maritime education, industry* and *universities* and their 'relatives'.

Two keywords associated with ship's technology are *autonomous ships* and *emission factors*, as a keyterms associated with digitalisation and green transition. The list of important technological keywords includes *wave energy, alternate fuels, underwater vehicles* and *autonomous shipping*.

Keywords clearly indicate that the main subject of interest for those presenting papers at international conferences is influenced by the industry and regulatory framework of the International Maritime Organisation. However, key terms do not indicate any specific subject. It seems that interests are equally dispersed over all subjects under consideration.

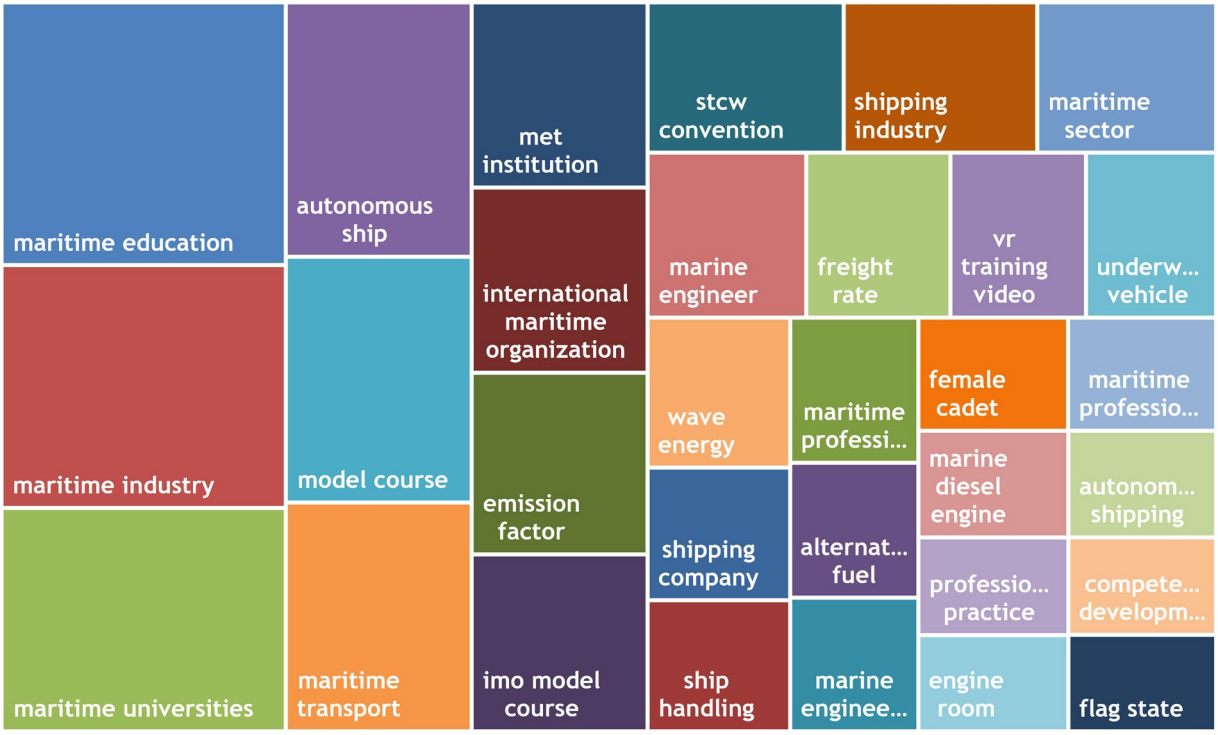

Figure 30 Multi keywords used to describe research and education

The associated semantic network consists of 4,827 nodes and 3,545 edges. The average degree is 0.734, with an average clustering coefficient equal to 0.027, indicating very low clustering effects, i.e. a large number of terms being linked only to one node.

The semantic network of the research and education activities seems much more useful. It evidently distinguishes three main areas of interest:

- the first part deals with the economic environment (the upper part of the semantic network indicated by the *maritime-transportation-industry* sequence)
- the second part deals with education, mostly located in the lower left part of the network (left and below of *education-training* node)
- the third part deals with technical issues and shipboard equipment, the most important being the triangle *management-systems-risks*, located mostly right of those terms

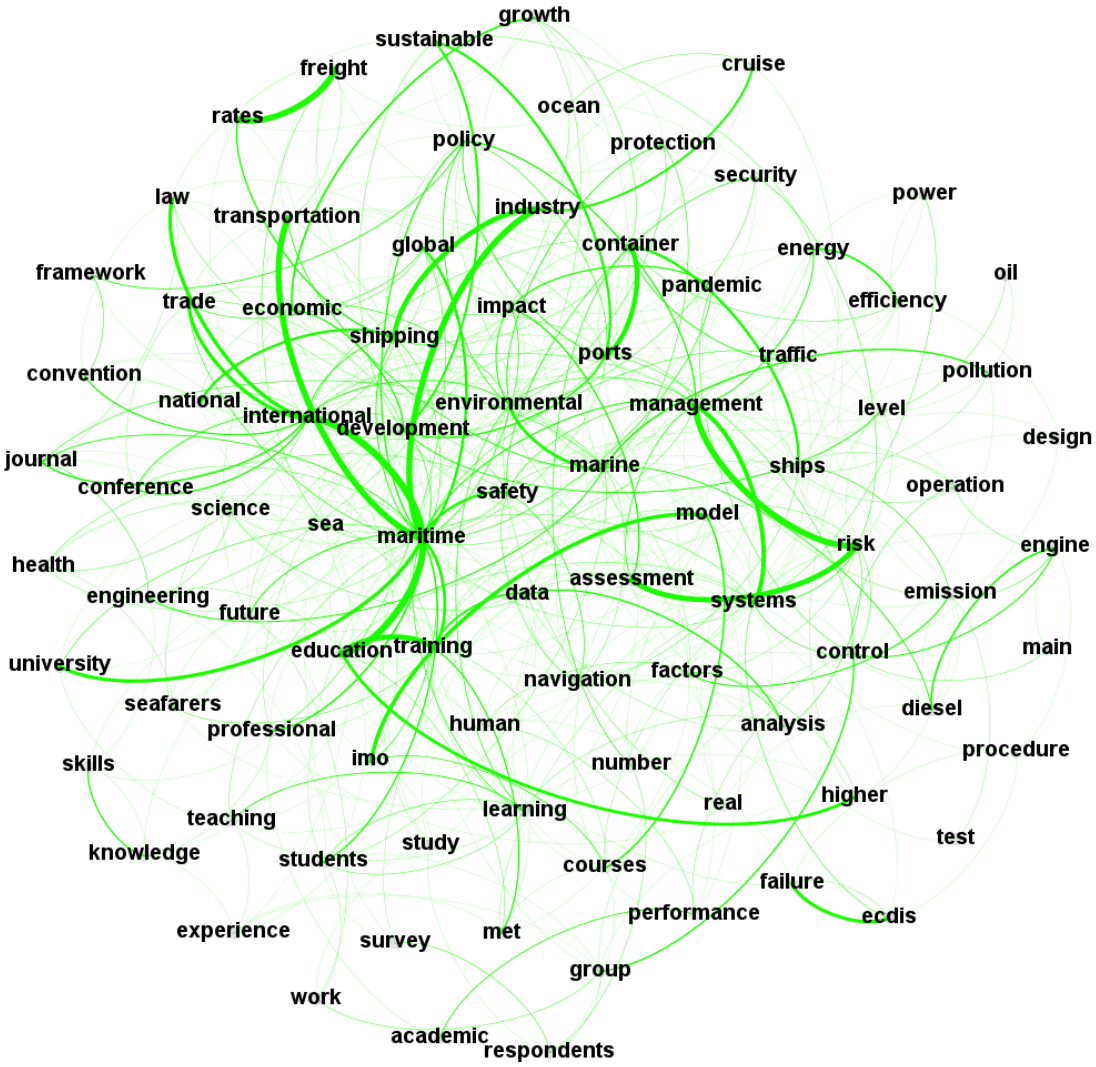

Figure 31 Semantic network – research and education

It is worth noting that the strength of connections dealing with economic environment subjects is weak. Contrary to this, terms commonly found in the semantic network dealing with maritime law are practically non-existent.

Consequently, based on this semantic network, several additional subject areas are added to the list of additional skills, such as crew management and training, research and development, and maritime education (including seafarers' rights).

It may be concluded that:

(27) Psychomotor and affective domains are clearly underrated in all considered documents. Although these domains are much more difficult to codify and formalise, their importance is significant, and further developments in these areas are highly welcomed.

(28) Most action verbs used to describe required knowledge deal with the application level. Although fully understandable and in line with the predominant understanding in the shipping industry in the past, it is highly questionable whether a focus on the application is sufficient to enable future seafarers to operate highly sophisticated ships or onboard systems. Such a low dedication to higher, more creative levels of a knowledge domain may impact the future transition to more sophisticated transport modes.

(29) 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. The STCW Convention does not require higher-level capabilities, such as analysis, synthesis and evaluation for positions at the management level.

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

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

(32) 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.

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

(34) Key terms identified within the economic environment and maritime law conform with subjects offered to ex-seafarers who want to extend their knowledge and continue their careers ashore.

(35) Key terms identified within ships technology do not indicate additional subject areas to be offered to those willing to pursue their career ashore. It seems that additional expertise highly depends on the requirements of the particular job, thus preventing effective clustering of related subject areas.

(36) Key terms identified as the most important in the research and education area show the broad interests, somewhat equally distributed between new technologies and demands (e.g. autonomous ships, emission factors, and cyber security) and educational subjects (e.g. model courses, MET institutions, learning outcomes).

9. EMPLOYEE SURVEY

The main objective of the employee survey was to identify missing skills as perceived by seafarers and shore-based personnel. The survey was designed following the key skill areas identified in previous chapters. In a way, it may be understood as a verification tool. However, as the understanding of missing skills is more observable by direct actors, the answers received present a much more in-depth understanding of missing skills.

The survey was accomplished using an electronic questionnaire form. Therefore, a minimal level of digital skills and internet connection was assumed. There were no control questions (i.e. questions related to other questions) within the questionnaire. It was assumed that there were no hidden agendas, and respondents would reply honestly.

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 mostly 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 were not considered in detail because the skills assumed with these positions are only rarely transferable to other occupations ashore.

Consequently, two separate surveys were developed – one for seafarers and one for shore-based personnel. Both questionnaires shared the same core set of questions, while the one for shore-based staff also included an additional set of questions, mostly related to expected developments in the maritime industry.

Both questionnaires were developed and distributed using the SurveyMonkey platform.[82] Participation was voluntary, and respondents were allowed not to answer a question or terminate their participation at any time. Since any questions could be skipped, the open questions were limited to what was deemed necessary and fruitful. By doing so, the respondents were 'forced' to consider the options offered, thus avoiding exotics and getting more meaningful answers. Finally, since focus groups were selected as a key methodology for determination future skill gaps, it was understood that more thoughtful considerations would be identified during that phase.

9.1. SHIPBOARD PERSONNEL

The questionnaire for seafarers was developed with a strong focus on active, seagoing, personnel. The target group was seafarers serving at operational and management level positions (masters and officers).

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 most important subjects in maritime law, maritime business and technology, and transitional skills

82 https://www.surveymonkey.com/

- views on the transition from onboard jobs to shore jobs, such as target jobs, required onboard experience, missing skills, and successfulness of the transition

The survey questionnaire was initially 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, the research included seafarers employed by companies residing in 51 different countries. Seafarers who answered this question are employed by companies based in 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%).[83]

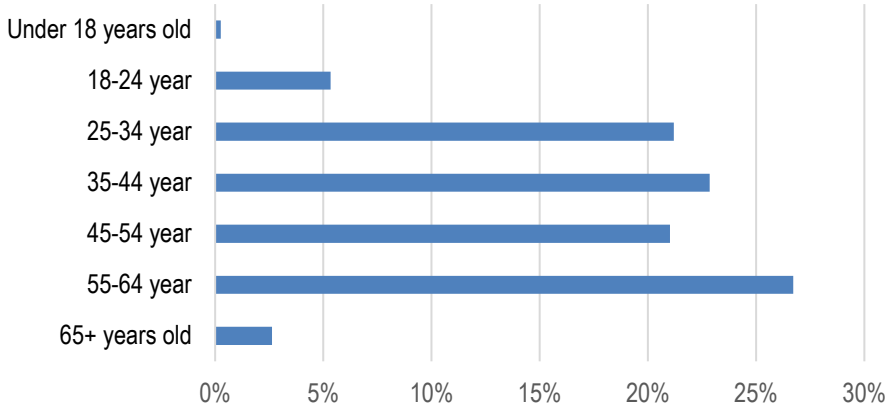

Figure 32 Age of the participants

The majority (27%) were in the age group from 55 to 63 years. Almost one-quarter of respondents were in the age group from 35 to 44 years (23%), while 21% 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 or older than 65). In this respect, the survey confirmed expectations and collected opinions from experienced seafarers.

As expected, most respondents had backgrounds in the deck (61%) and engine (33%) departments. Only 6% of the respondents were with other departments. These proportions were unsurprising and are considered as not biasing the overall results.

Almost half of the respondents had 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 an MSc level. This data (12% of the total population holding an 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 participating in the survey.[84]

83 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.

84 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.

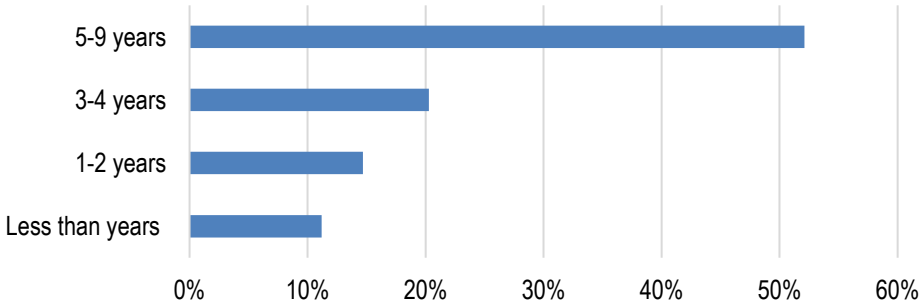

Figure 33 Respondents' onboard experience

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

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

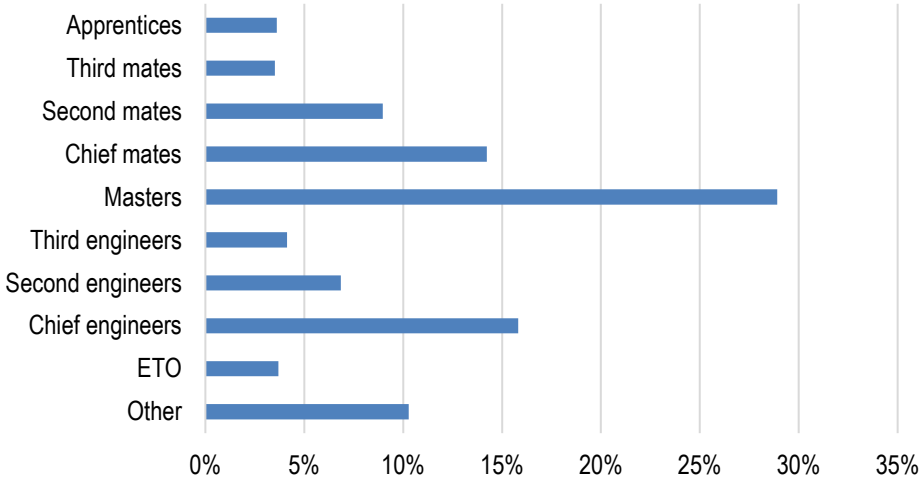

Figure 34 Respondents' onboard positions

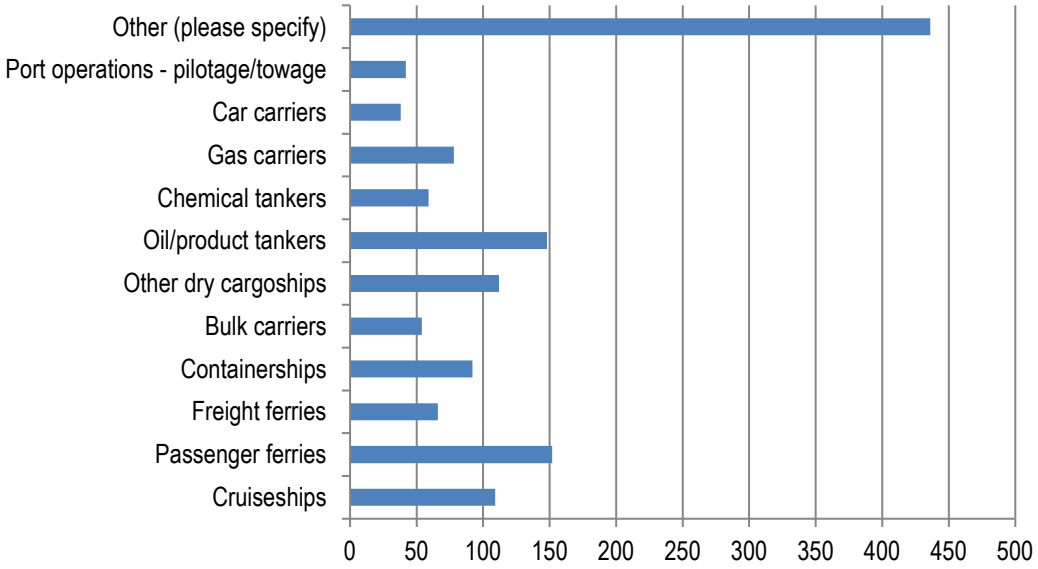

Figure 35: Field of trade in which the respondents' present companies predominantly operate

Regarding the field of trade, the respondents served in all the proposed trading areas. Most respondents served 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. By far, this group's most frequent field of trade was different types of vessels engaged in the offshore industry.

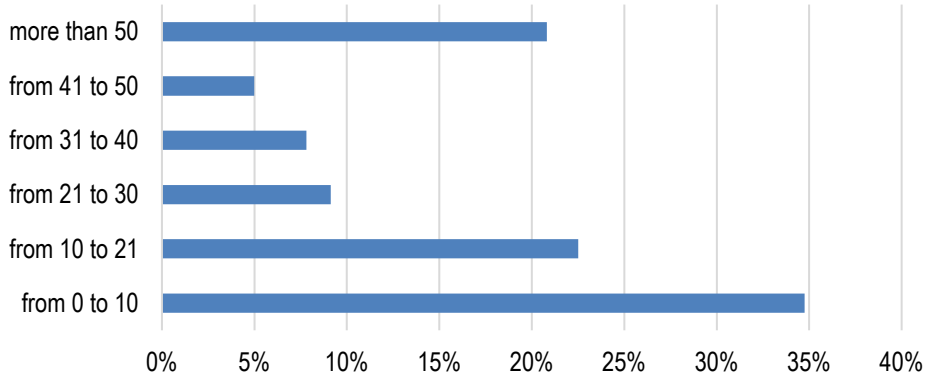

Figure 36 The size of the company's fleet

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

More than half of the respondents (57%) stated that the companies they were 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 were trading within European waters, thus indicating a well-balanced distribution of respondents in their predominant trade area.

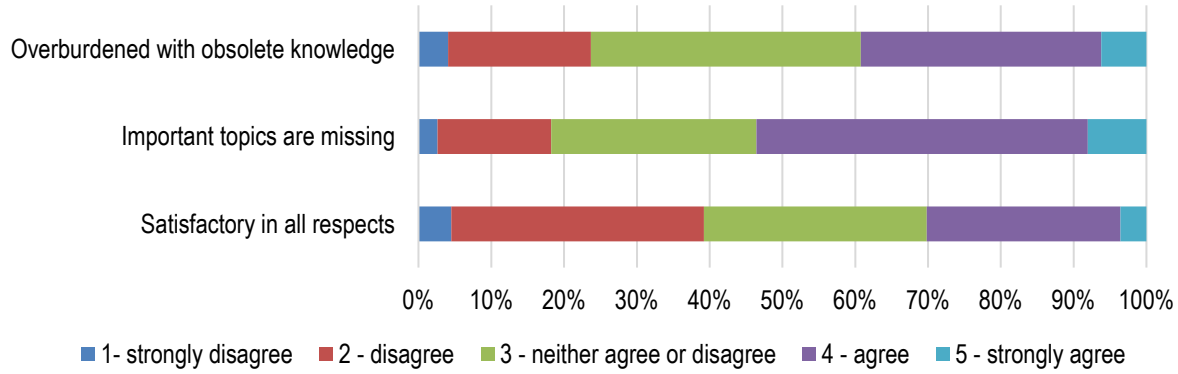

Figure 37 Respondents' position on professional education and competences as outlined in the STCW Convention

Respondents strongly questioned the validity of professional education and competencies as outlined in the STCW Convention. In that respect, many respondents (39%) indicated that professional education and competencies (as outlined in the STCW Convention) are not satisfactory, while 53% of all respondents emphasised that important topics are not dealt with in the STCW Convention. Finally, 38% of respondents agreed that professional education and basic competencies are overburdened with obsolete knowledge. It is important to note that presented 'disagreements' are equally distributed among respondents.

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

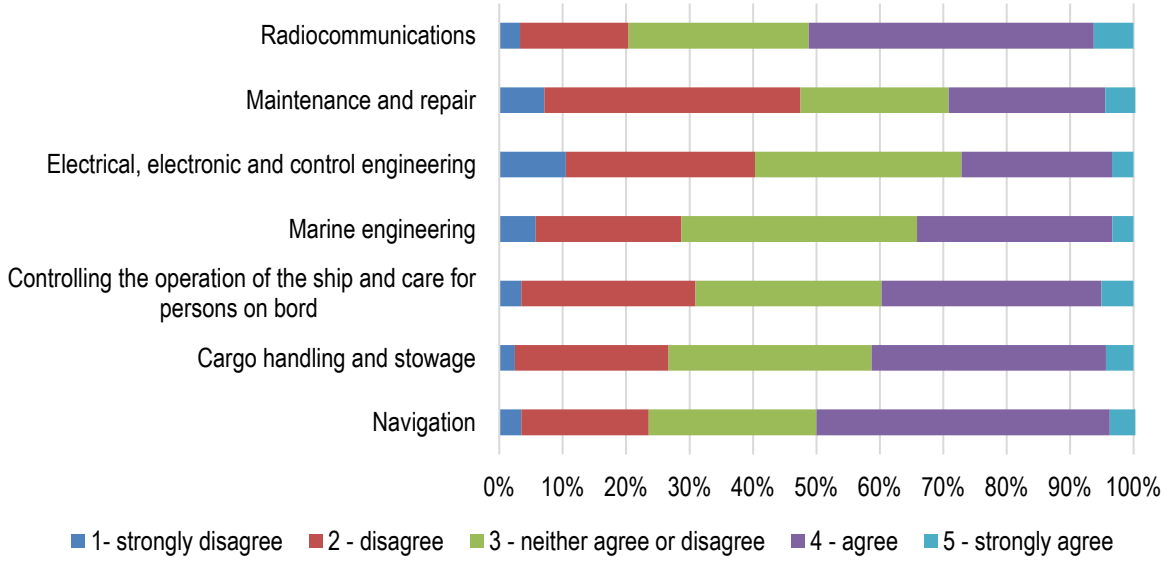

Figure 38 Respondents' position on compliance of professional competences (STCW functions) with actual onboard needs

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

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

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

Functions considered as mostly in accordance with onboard needs were *Radiocommunications* and *Navigation*. But even for these two functions, 20% and 24% of respondents considered these competencies to be not compliant 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 competences were considerably beyond expectations and served 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 the professional knowledge and skills of several distinctive groups. It should be noted that presented qualifications are not verified facts, although they are based on a quite large sample. Therefore, the answers presented here should be considered as 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%) was identified among officers older than 50.

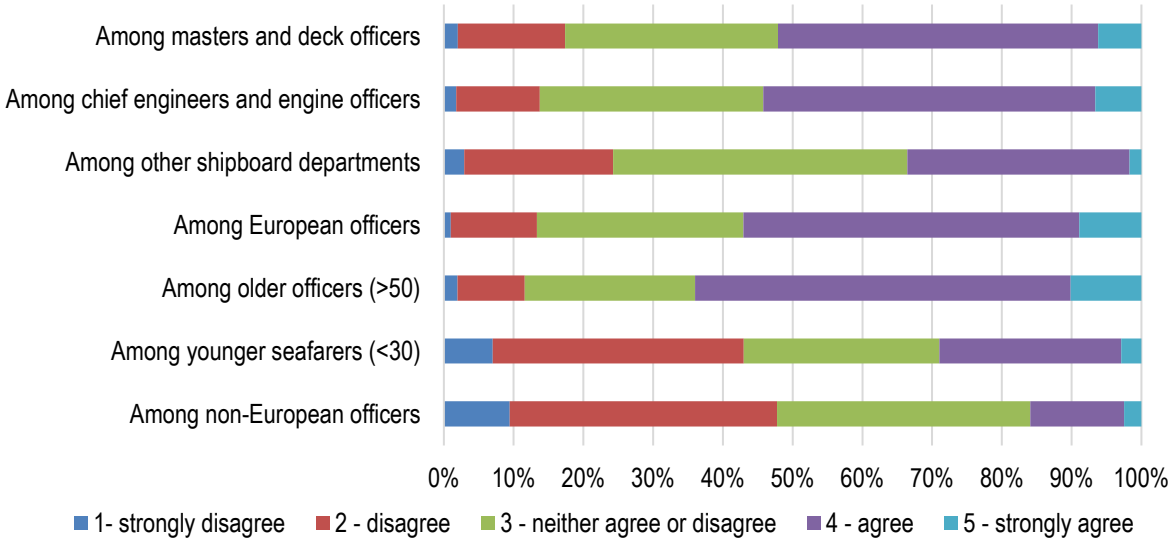

Figure 39 Respondents' position on the appropriateness of professional knowledge and skills among different groups

Noting that most respondents are senior European masters and officers, it is perhaps not surprising that these groups were 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 the effectiveness of MET processes.

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

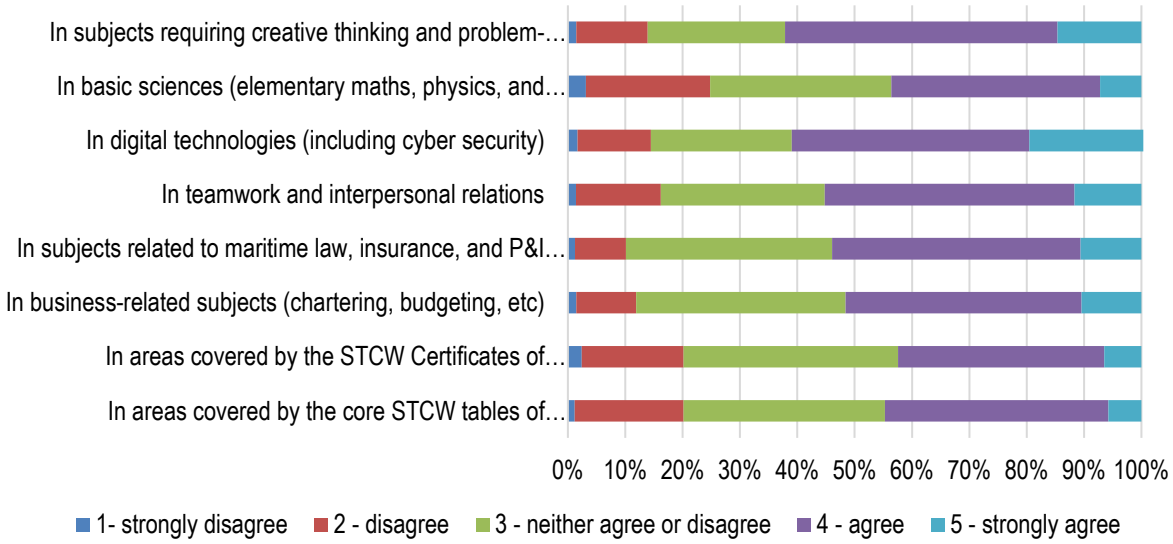

Figure 40 Subject areas with serious skill deficiencies

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 agreed 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 pinpointed transitional skills (i.e. non-professional skills; skills only modestly identified in the STCW Convention) as a group of skills where the most serious skill deficiencies are recognised.

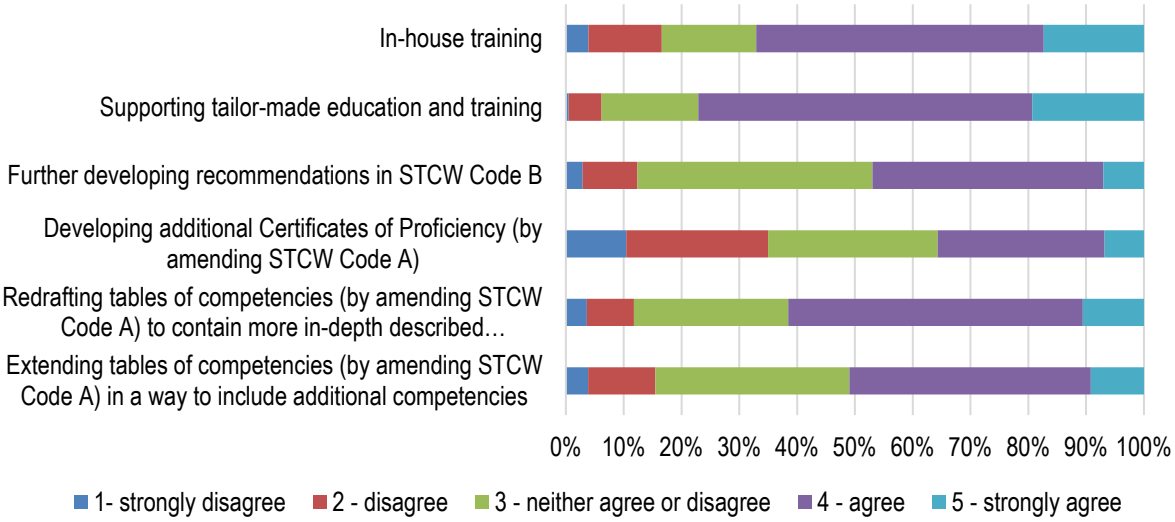

Figure 41 The most effective ways to improve STCW competences

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

It is important to note strong support for redrafting STCW Code A and including a more in-depth description of professional competencies (51% of respondents agreed with this proposal). Respondents also clearly opposed further development of Certificates of Proficiency by amending STCW Code A (29% agreed, while 25% disagreed and 10% strongly disagreed with this idea).

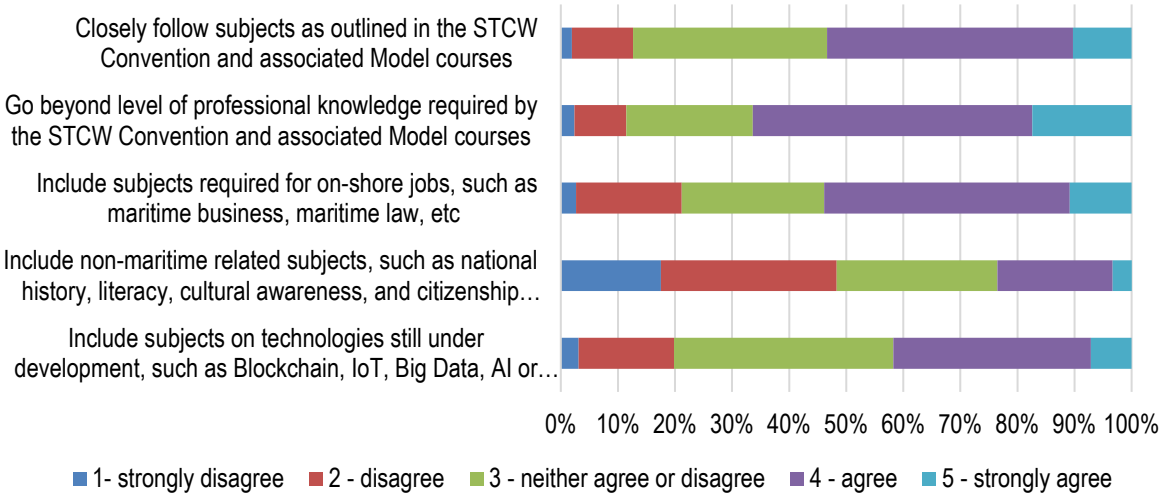

Figure 42 Preferred further development of MET institutions

In line with previous statements, most respondents suggested 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 disagreed with this statement.

However, the opinions on the next two questions were almost equally divided between those who suggested close adherence to the STCW Convention requirements and those who proposed to include subjects most appropriate for those who plan to continue their career ashore. It seems that these answers depended mostly on personal preferences.

It should be noted that non-maritime related subjects were not welcomed. Only 23% of respondents favoured these subjects, while 48% disagreed or strongly disagreed, indicating a desire for a strong focus on professional development.

Finally, there were mixed feelings about technologies still under development. Almost 39% of respondents had no opinion on the question, while 42% were in favour of including subjects addressing new technologies.

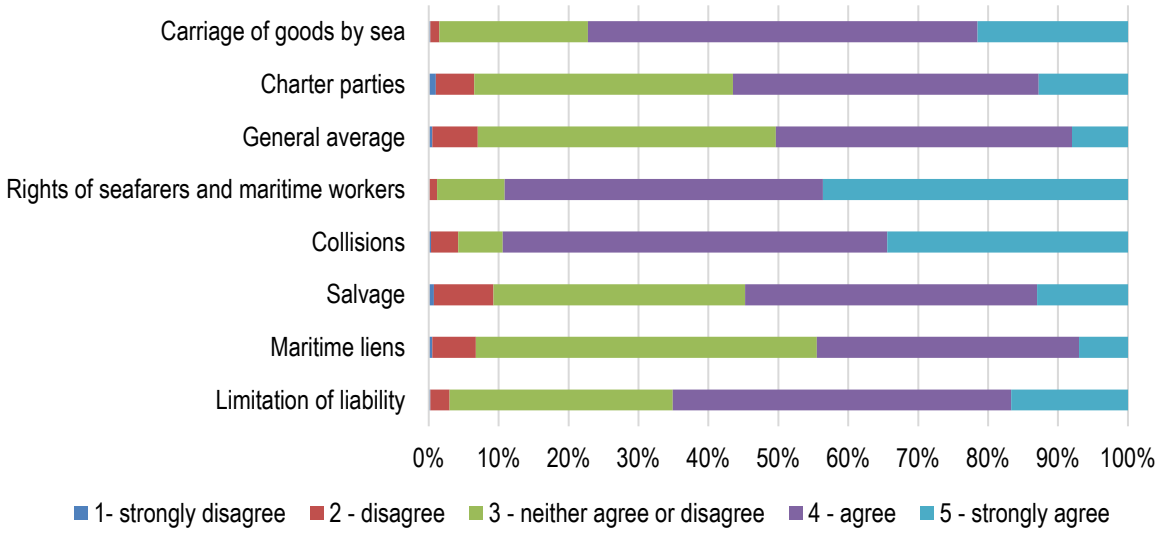

Figure 43 The most valuable topics in maritime law for shipboard management

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 considered the topic as not important. The next one, *Collisions*, was 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 important to note that these topics are not covered by the STCW Convention and are usually considered unimportant for seafarers. The same applies to the next two topics: *Charter parties* and *Salvage,* supported by 56% and 55% of all respondents.

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

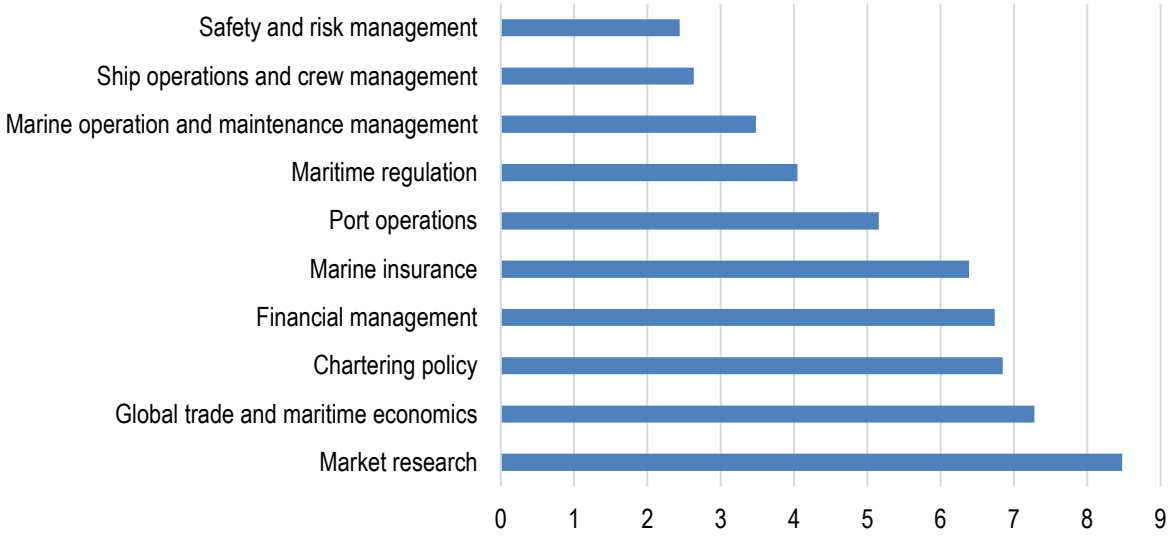

Figure 44 Subjects from the maritime business domain deemed the most valuable for shipboard management (ranked according to average values)

Regarding the maritime business domain, respondents were asked to rank the different subject areas they consider important for ship operations (1 being the most important and 10 being the least important). The priorities were averaged and presented on the graph.[85]

Accordingly, the most valuable topic in the maritime business domain is *Safety and risk management*. More than 48% of respondents rated this topic the most important (ranked 1). *Ship operations and crew management* was selected by 30% of respondents, who rated them as the most important. Approximately 14% of all respondents rated *Marine operation and maintenance management* as the most important. Contrary to this, 'pure' economic subjects (such as *Market research*) are of 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, where *Maritime regulations* and *Port operations* were next regarding their importance for shipboard management. In addition, these answers were in line with those given to previous questions. Again, most of the subjects are not covered by the STCW Convention, or at most, at an introductory level.

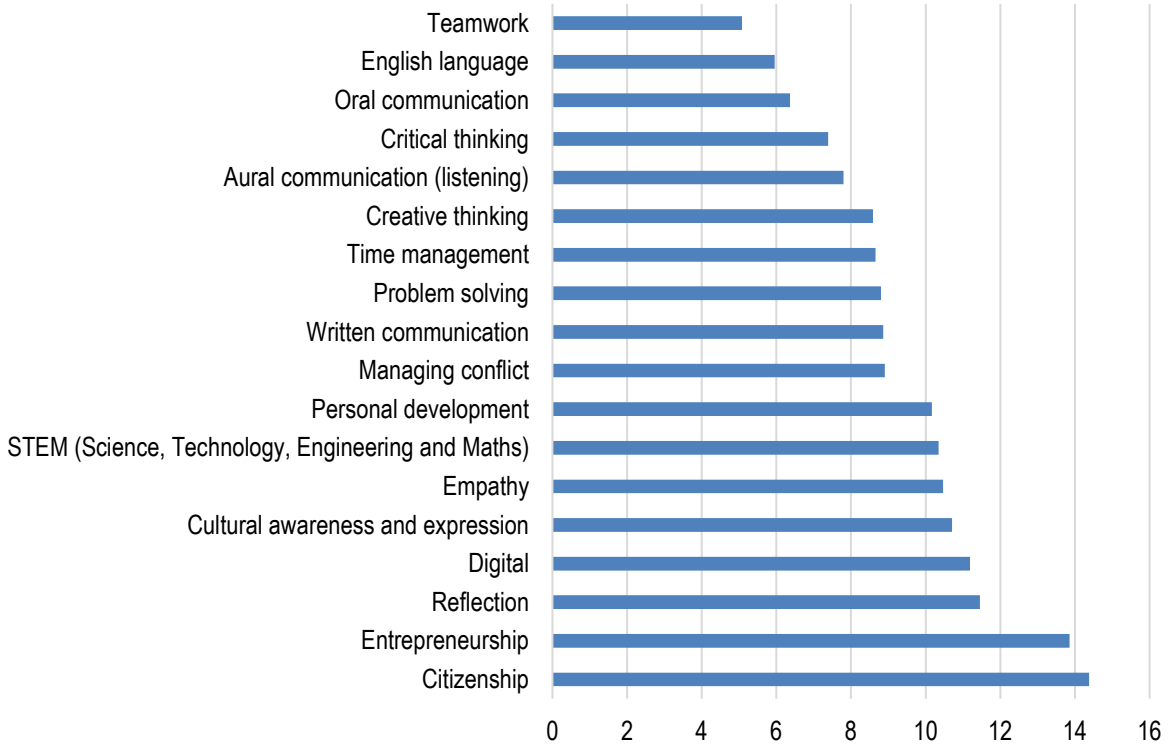

Figure 45 The most relevant (transitional) skills for modern ship officers (ranked according to average values)

In respect of the transitional skills that seafarers consider the most important, the respondents were asked to rank those skills according to their importance on a scale from 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 important by 18% of all respondents. The second one is the *English language,* selected as the most important by more than 21% of all respondents. However, the *English language* was also given a low priority by quite a large group of

85 The same approach applies for all following similar graphs.

respondents, causing the averaged priority to be lower than that assigned to *Teamwork*. It seems that communication issues (*English language, Oral communication, and Aural communications)* are valued as the most important transitional skills. The only exception is *Written communications*, being assigned a relatively low priority

A prominent group of skills are problem-oriented skills, i.e. *Critical thinking, Creative thinking, Time management* and *Problem-solving. Problem-solving* was selected as the most important skill by 11% of respondents, and *Critical* thinking by 8% of all respondents. It is important 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).

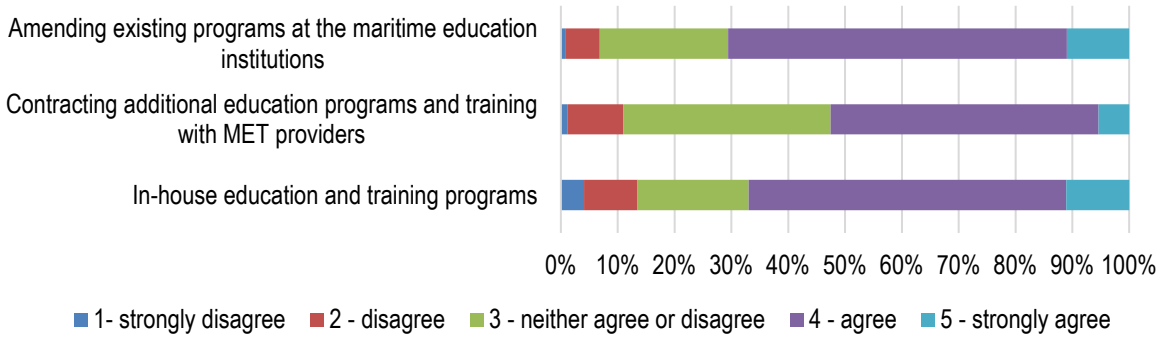

Figure 46 Modes of acquiring transitional (generic) skills

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

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

Regarding 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 important:

- Using a 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 the 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 important.

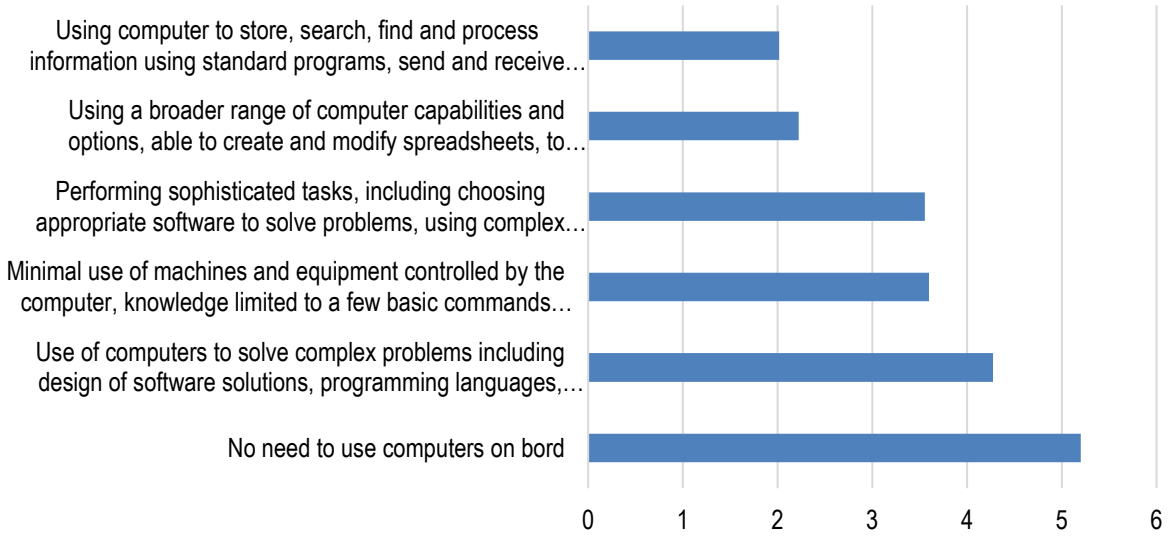

Figure 47 The level of digital abilities and computer literacy expected from shipboard management (ranked according to average values)

Notably, 8% of all respondents still believe there is no need to use computers onboard (who selected this option as the most appropriate). Although a relatively small percentage, this is an important finding when set 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).

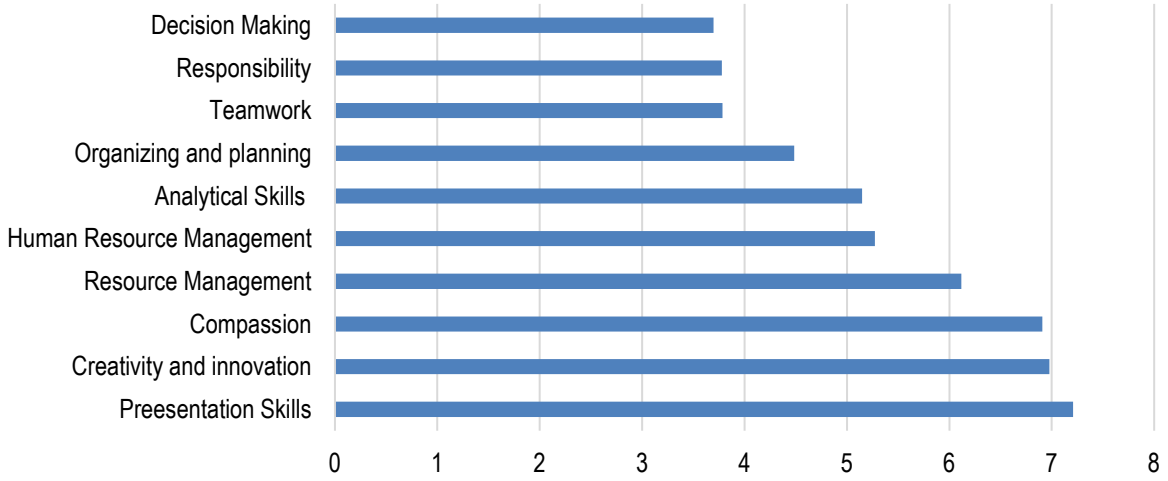

Figure 48 The most important abilities and skills according to their importance for shipboard duties (ranked according to average values)

Regarding the importance of abilities and skills for shipboard duties, seafarers were asked to assign the rank to each ability/skill on a scale from 1 (most important) to 10 (not important all). According to the respondents, the most important 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* - the ability to choose among options that will lead to the desired goal (20%)
- *Organising and planning* - the ability to set goals, plan performance, running time, and monitor work (10%)
- *Human resource management* - directing, coordinating, and monitoring the work of others and motivating and providing development opportunities (9%)
- *Presentation skills* - the ability to make a clear, fluid, and arguable transfer of ideas in oral or written form (5%)
- *Analytical skills* - the ability to collect and view various information and perspectives, verify assumptions and make conclusions/solutions (5%)
- *Resource management* - financial planning, material and equipment use, maintenance (4%)
- *Compassion* - the 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, seafarers seem to place the highest value on the abilities that effectively fulfil the target goals.

Accordingly, the seafarers were asked to select the most important personal qualities concerning their importance for shipboard duties.

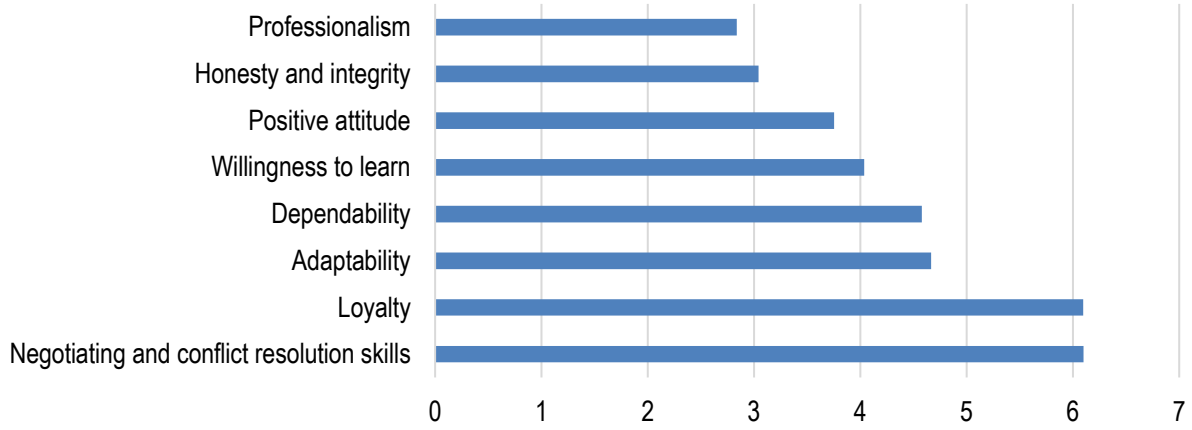

Figure 49 The most important personal traits in accordance with their importance for shipboard duties (ranked according to average values)

More than one-third of respondents ranked *Professionalism* as 1 on a scale from 1 (most important) to 6 (not important at all). The second-placed quality, *Honesty and integrity,* was selected by 28% of respondents. It is also worth noting that 15% of all respondents selected a *Positive attitude* as the most important personal trait.

Regarding the most attractive shore-based jobs, respondents expressed the greatest interest in the *Training of seafarers and Fleet management*, followed closely by *Shipbuilding, Classification societies, Technical superintendence, Project management, Port operations, and Research and development (including newbuildings)*. 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 were those related to *Finance and accounting, Sales and Chartering, and Market Research*, which are most clearly 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 seafarer selected *Technical superintendent* as the most attractive job, but it has by far the greatest number of high positions, indicating that understanding the attractiveness of shore-based jobs is a highly individual matter.

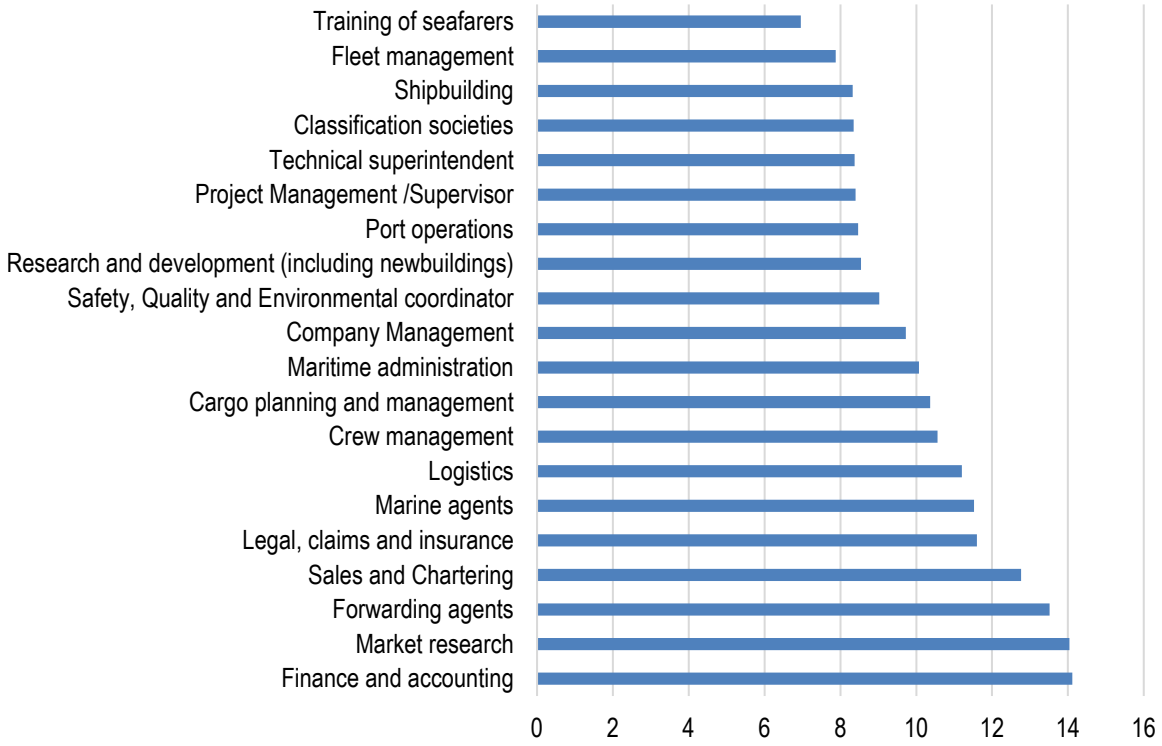

Figure 50 The most attractive shore-based jobs (ranked according to average values)

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

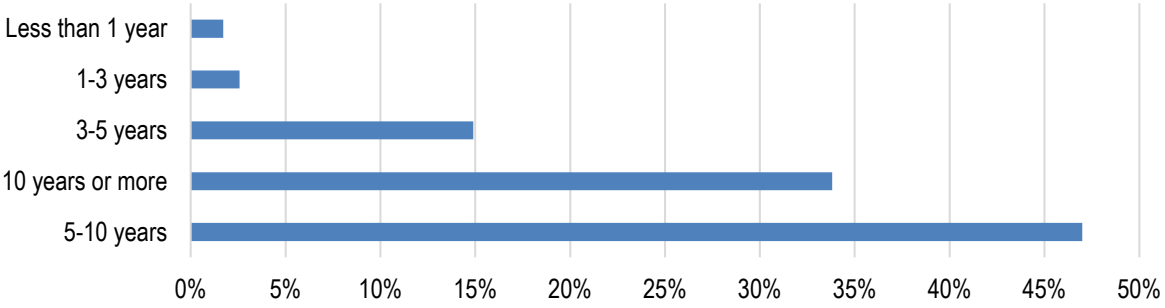

Figure 51 Onboard experience deemed the most appropriate for moving ashore

Almost half (47%) of respondents thought that moving to shore-based jobs should be considered only after

five to 10 years spent onboard, while 34% indicated more than 10 years of onboard experience to be an appropriate level of shipboard experience.

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

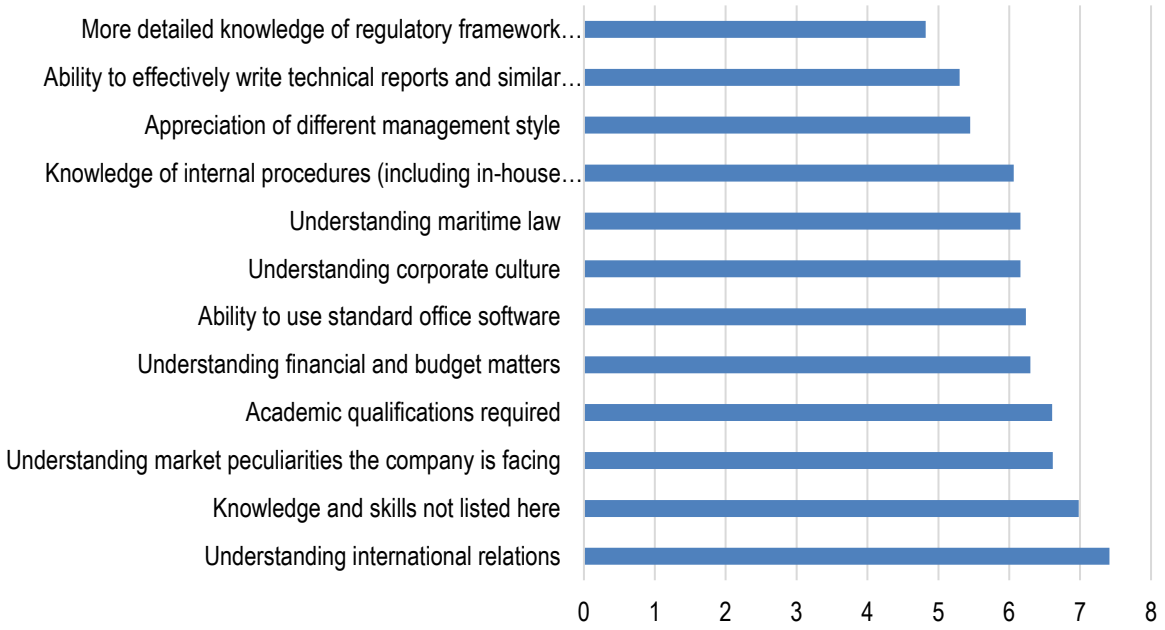

Figure 52 The most important skills serving seafarers should work on before moving to work ashore (ranked according to average values)

According to respondents, the most important 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[86]
- *Appreciation of different management styles* – 12% of respondents ranked this as the most important ability
- to effectively write technical reports and similar documents - 12% of respondents considered this the most important ability

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

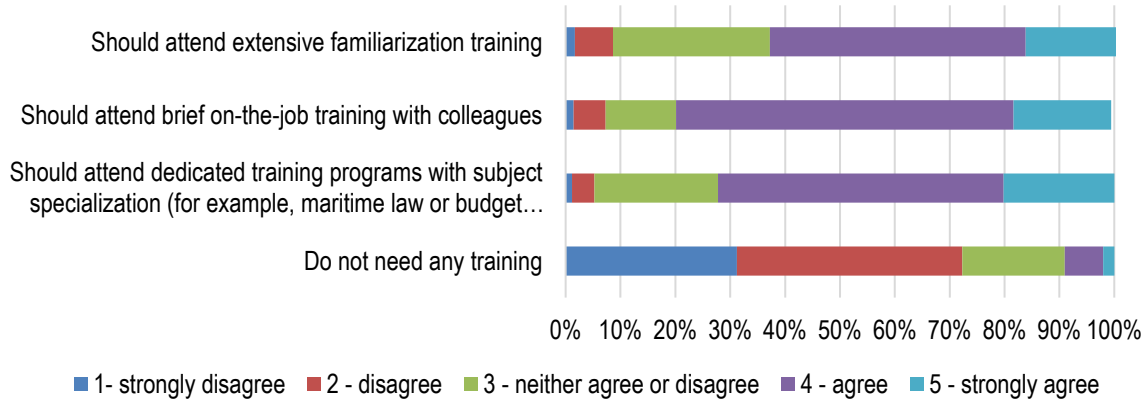

Figure 53 Actions preferred before assuming shore-based duties (if circumstances allow)

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

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

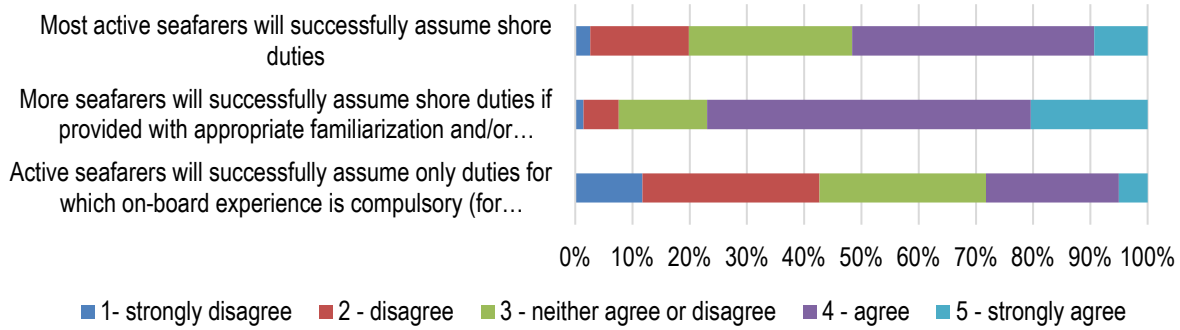

Figure 54 Expected outcomes after assuming shore-based duties

From the answers, it is obvious that most seafarers show high confidence about the transition to shore jobs if provided with familiarisation training. It is also clear that a significant majority express a noticeable reluctance to accept a job for which additional training and education are not provided.

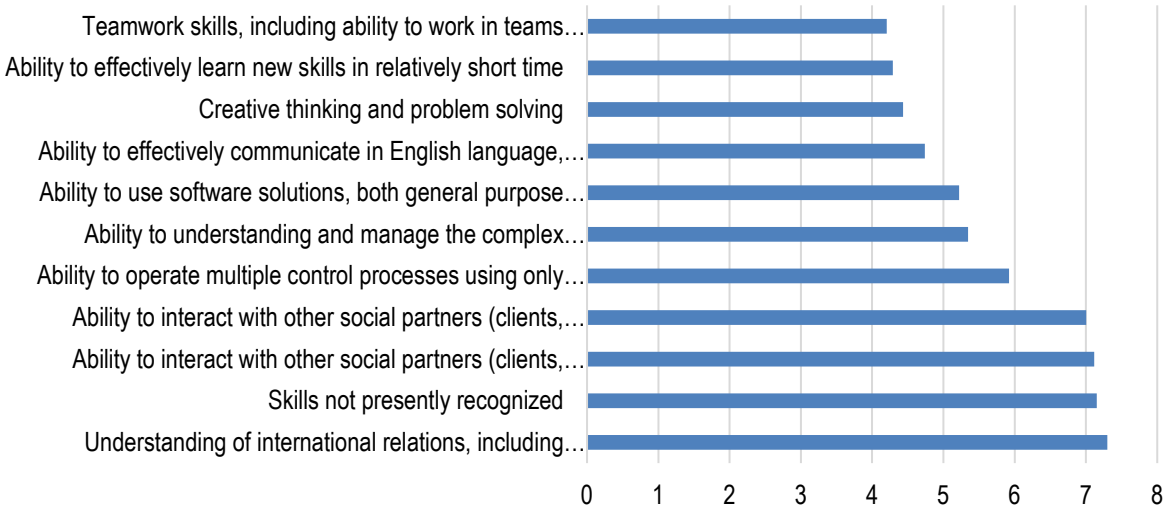

Figure 55 The most needed skills in the years ahead (ranked according to average values)

According to respondents, the most needed skills in the years ahead, ranked from 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 most important skills in the future. They are almost the same as those they now consider the most important.

9.2. SHORE-BASED PERSONNEL

The survey questionnaire for shore personnel was aimed at the technical and operational staff or executives next to the top management of the shipping companies and other maritime-related companies, i.e. heads of operations or technical departments or senior superintendents.

The questionnaire consists of 31 questions, split into several sections. It is an extended version of the questionnaire targeting seagoing personnel and comprises 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 most important subjects in maritime law, maritime business and technology, transitional skills

- comments on the transition from onboard jobs to shore jobs, such as target jobs, required onboard experience, missing skills, and the successfulness of the transition
- comments on expectations and opportunities, such as labour market trends, technology trends, environmental protection trends, and future skills

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

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

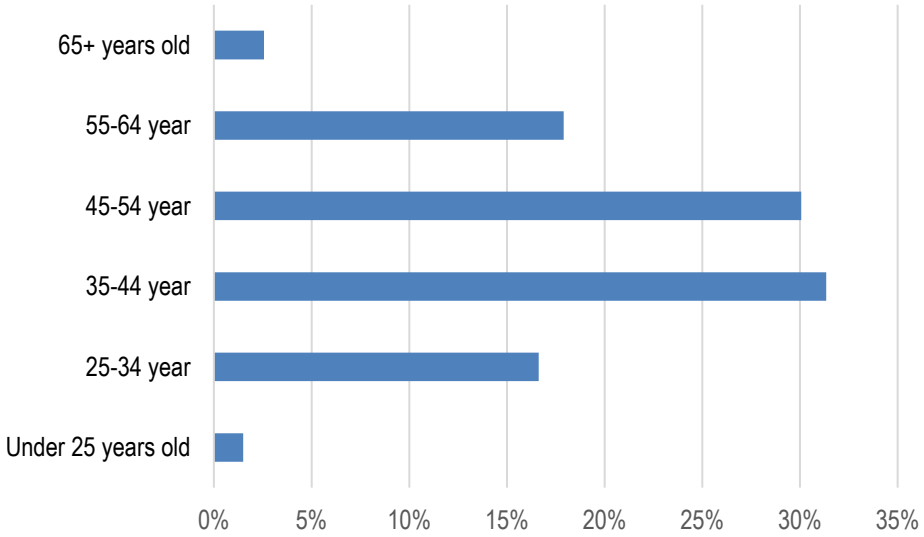

Figure 56 Age of respondents

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

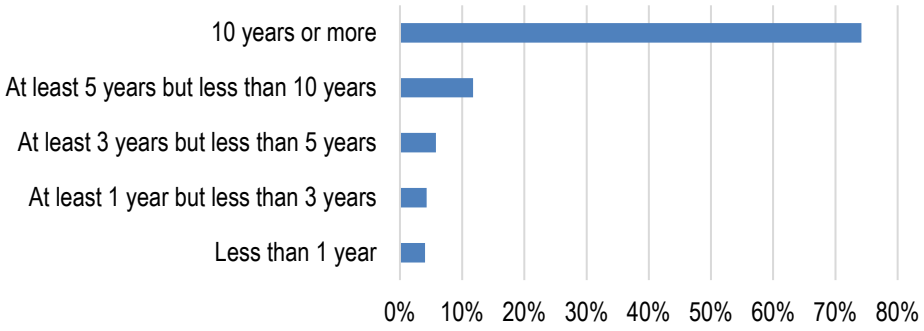

Figure 57 Respondents' experience in shipping and related industries

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

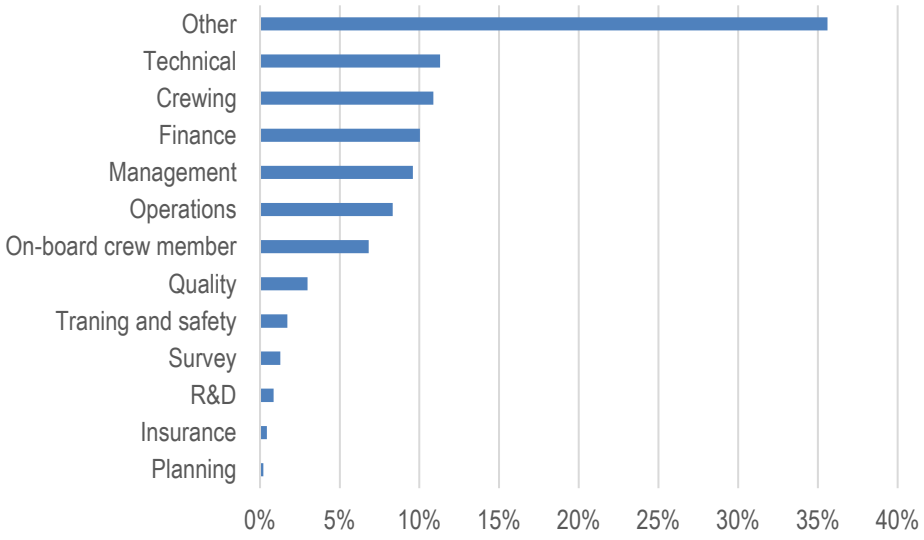

Figure 58 Respondents' departments

Many respondents (35,61%) worked in departments not listed as target departments in the questionnaire. As the most frequent answers, respondents selected *Administration* and *Accounting*. The most frequent answers among those specified in the questionnaire were *Finance* (10,02%), *Technical* (11,30%) and *Crewing* (10,87%).

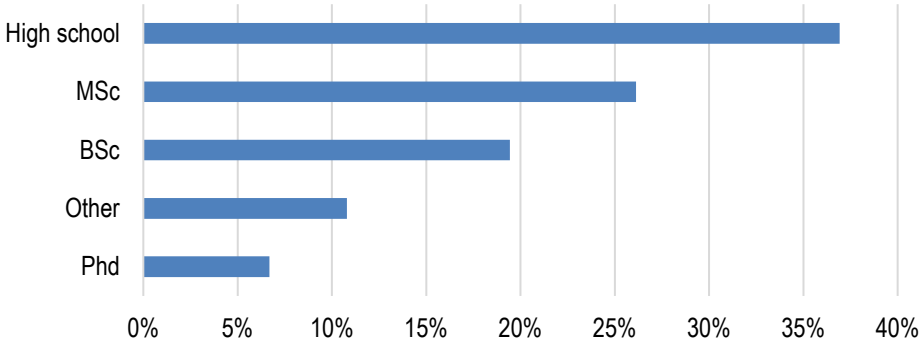

Figure 59 Respondents' education

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

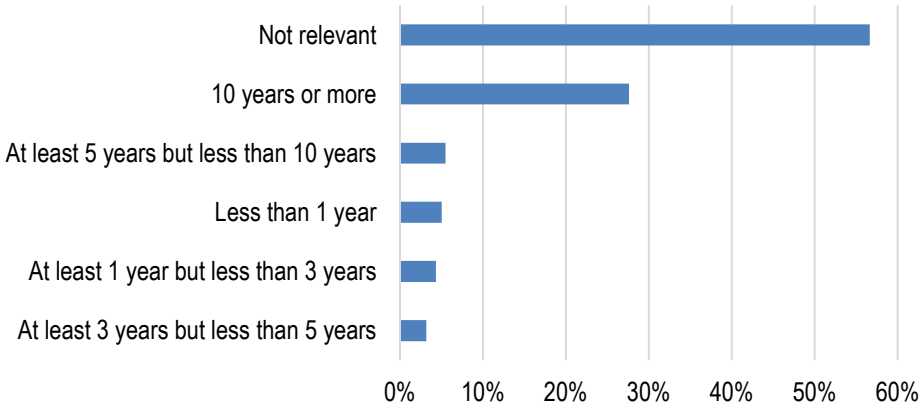

Figure 60 Respondents' onboard experience (total)

Most respondents (57%) stated that onboard experience is irrelevant, followed by 28% of respondents with more than 10 years of experience.

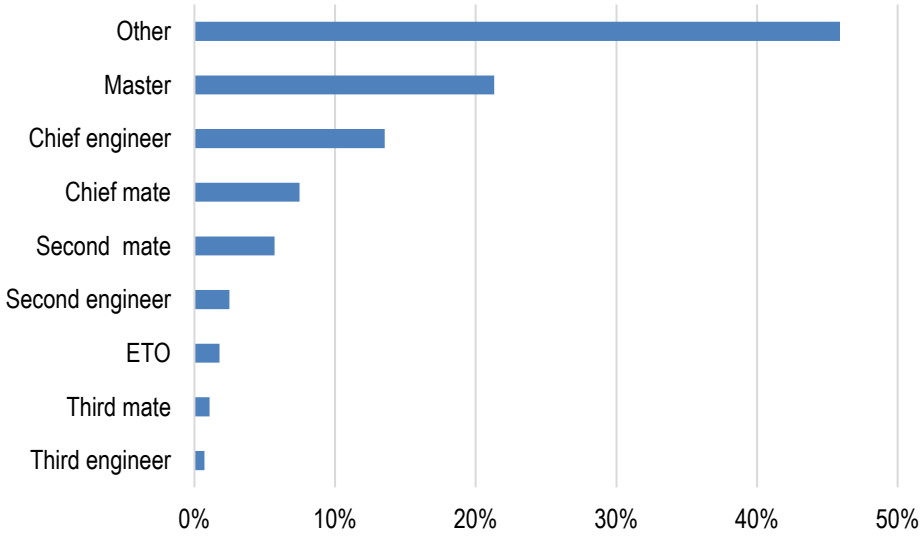

Figure 61 Respondents' onboard position (highest position served)

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

Consequently, most respondents were employed with private companies (88%), while others were 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 company's predominant geographical area of operation is global. Less than 5% of the respondents selected regional (2%) and national (3%) areas of operations as predominant.

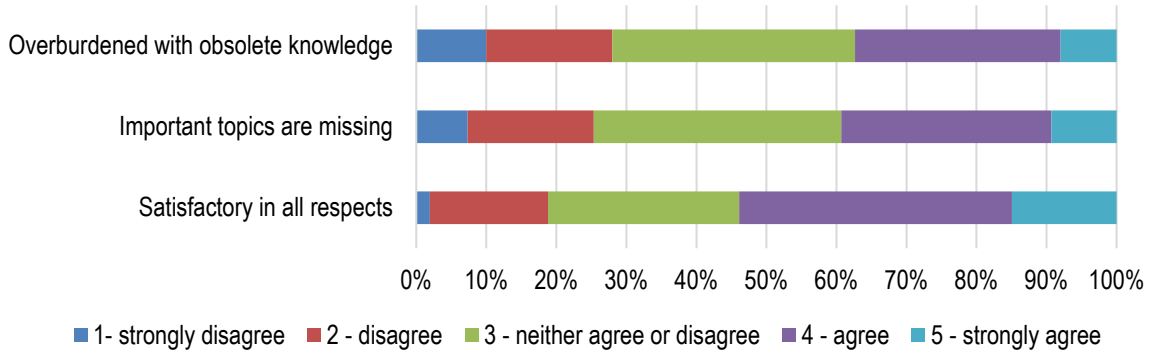

Figure 62 Respondents' opinions on present professional education and basic competencies (as outlined in the STCW Convention)

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

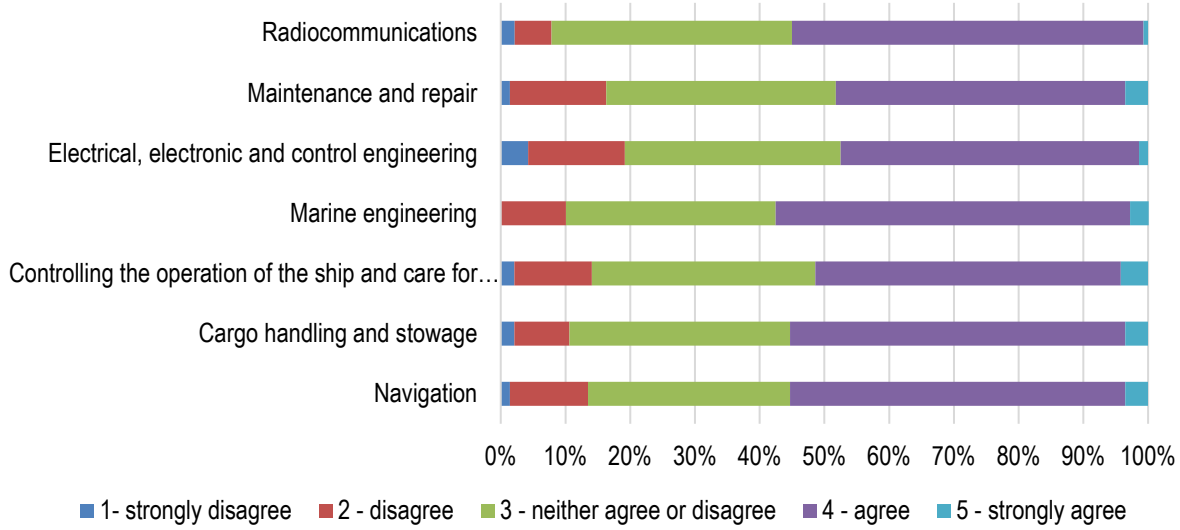

Figure 63 Respondents' position on compliance of professional competencies (STCW functions) with actual onboard needs

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 were much lower than those expressed by seafarers, indicating that issues related to the functions are not anticipated correspondingly.

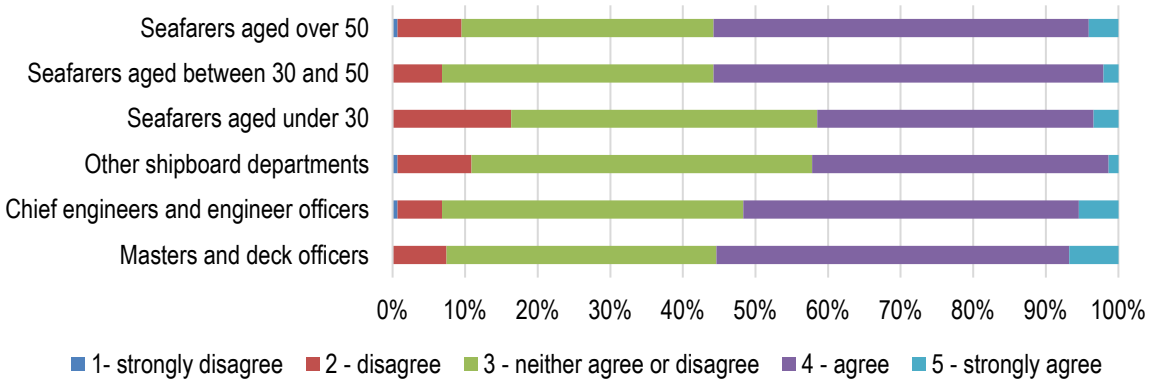

Figure 64 Respondents' position on the appropriateness of professional knowledge and skills among different groups of European seafarers

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

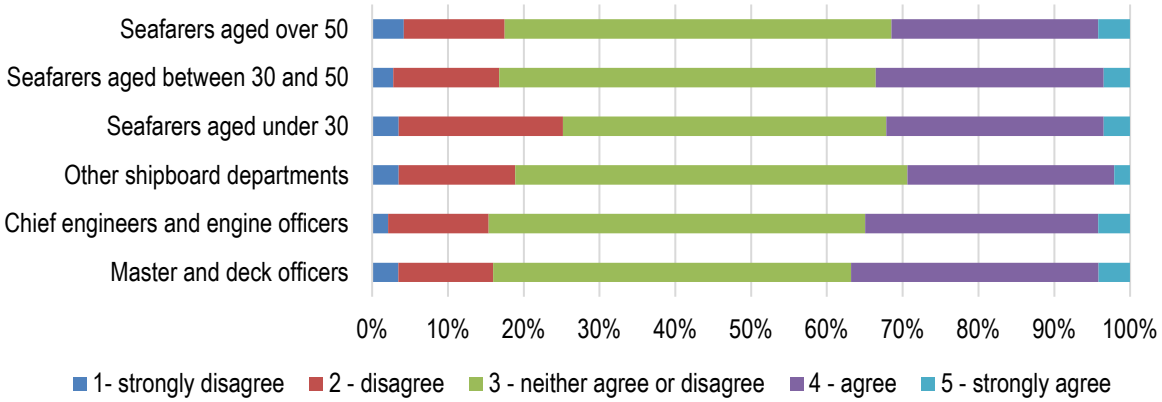

Figure 65 Respondents' position on the appropriateness of professional knowledge and skills among different groups of non-European seafarers

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 the longer 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 over 50 years (56% vs 32% of those who agreed or strongly agreed with the appropriateness of professional knowledge and skills).

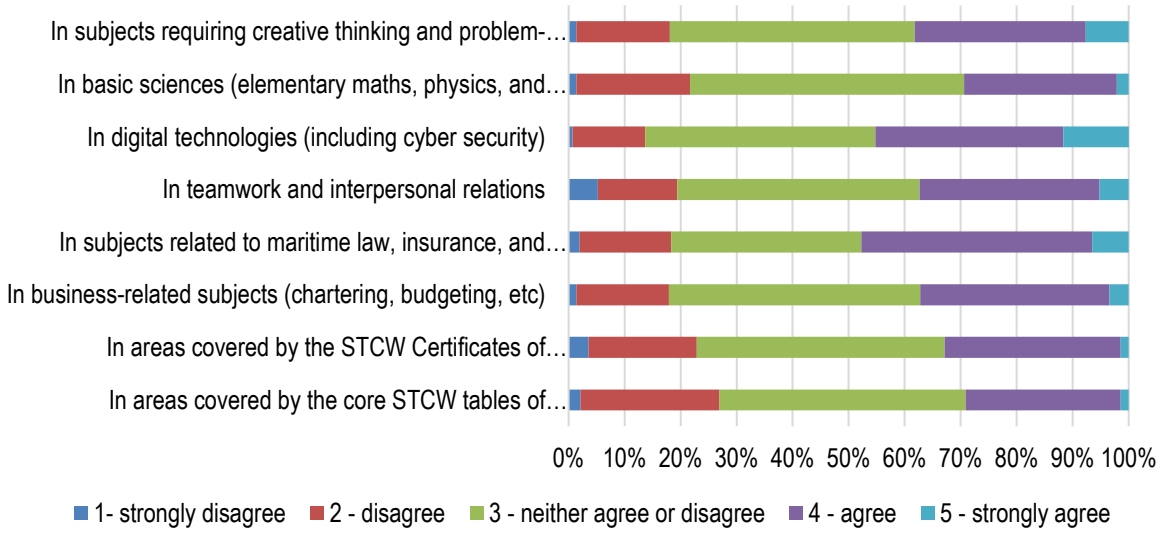

Figure 66 Areas where serious skill deficiencies can be recognised

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%).

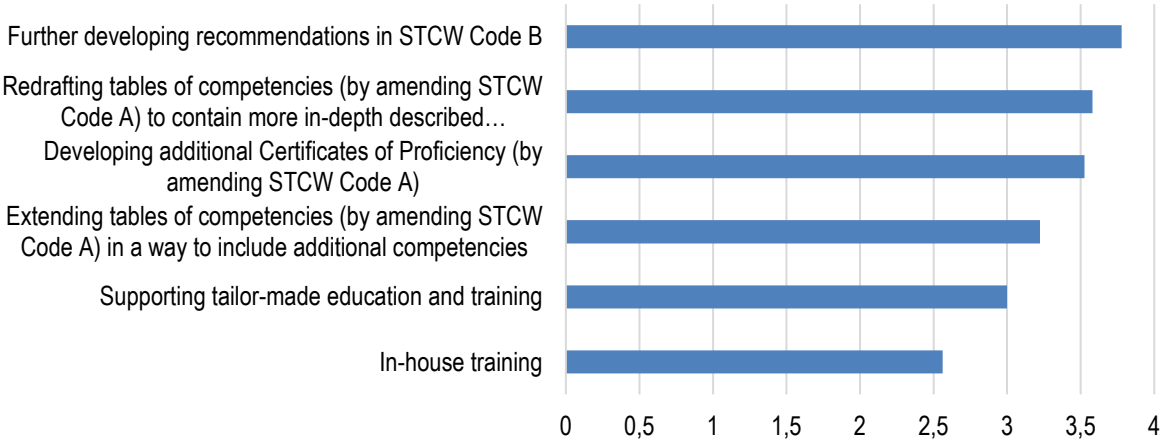

Figure 67 The most effective ways to improve STCW competencies[87] (ranked according to average values)

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 was not supported.

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

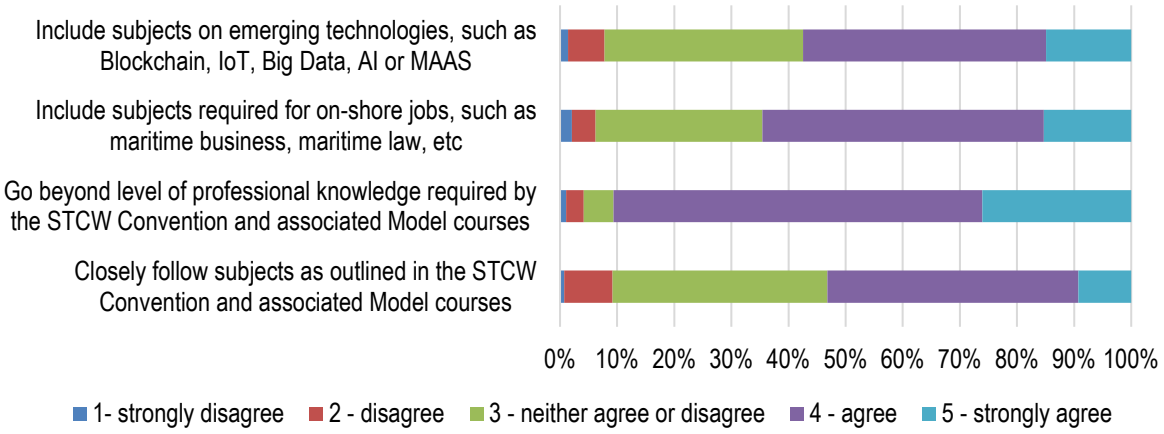

Figure 68 Preferred further development of MET institutions

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 supported this approach, thus recognising that professional knowledge and skills defined in the STCW Convention are insufficient.[88]

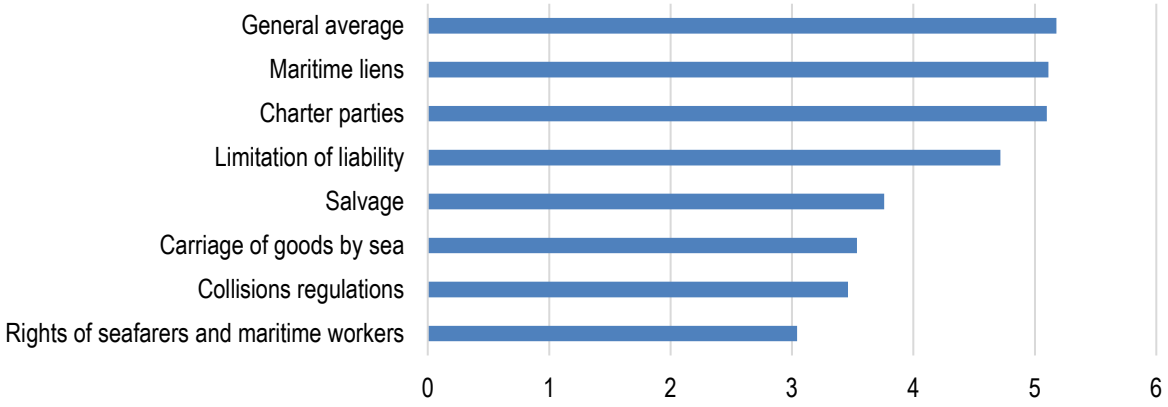

Figure 69 Topics in maritime law deemed to be the most valuable for shipboard management (ranked according to average values)

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

88 One respondent 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 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.'

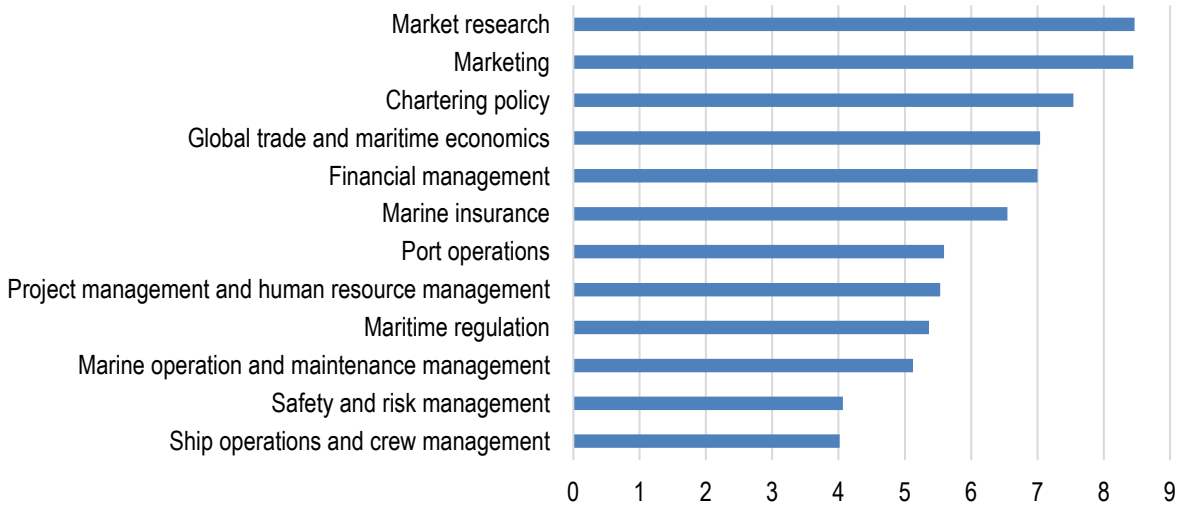

Figure 70 Maritime business subjects deemed the most valuable for shipboard management (ranked according to average values)

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 ranked as most important were similar for shore-based employees and seafarers. The only exception is that shore-based personnel slightly preferred S*hip operations and crew management* over *Safety and risk management*.

Figure 71 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 value the same skills but slightly prefer Problem-*solving* and *Critical thinking*. In respect of other skills, the differences are insignificant (the three least important skills are again the same).

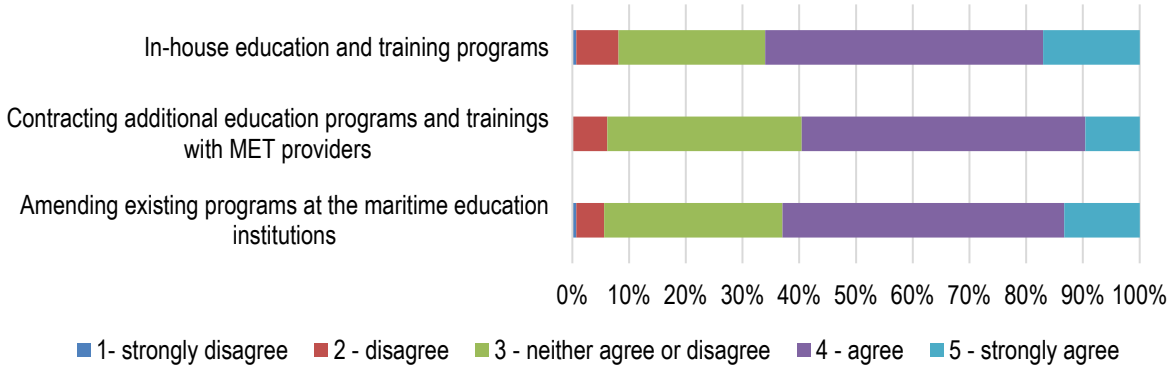

Figure 72 Modes of acquiring transitional (generic) skills

Respondents supported almost all the offered modes that may be used to improve various transitional skills. Only 6-8% of respondents disagreed with the proposed methods.

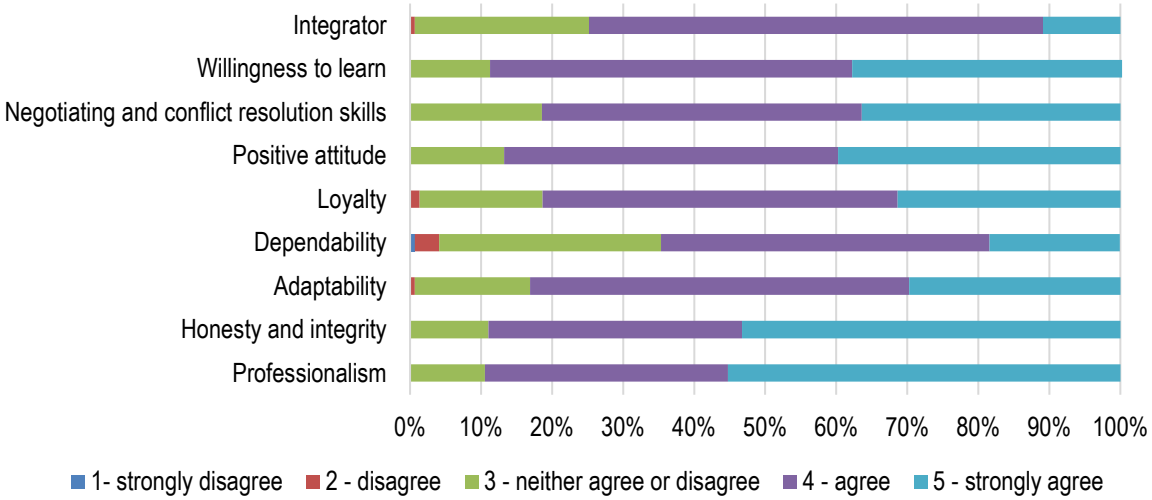

Figure 73 The most important personal traits in accordance with their importance for shipboard duties

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

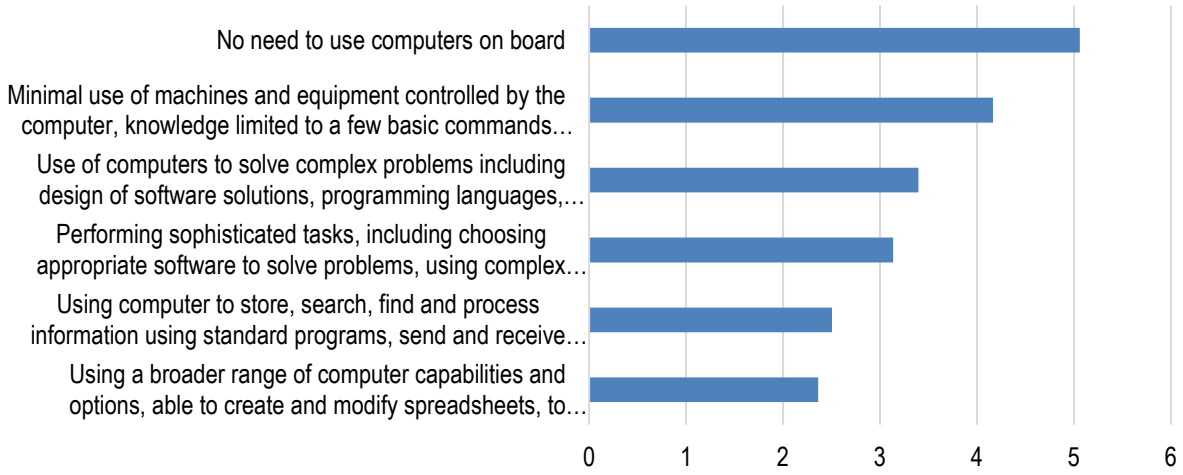

Figure 74 The level of digital abilities and computer literacy expected from shipboard management (ranked according to average values)

Regarding 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 important:

- Using a 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, able to create and modify spreadsheets, to create documents using formatting options, and to create 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 1.

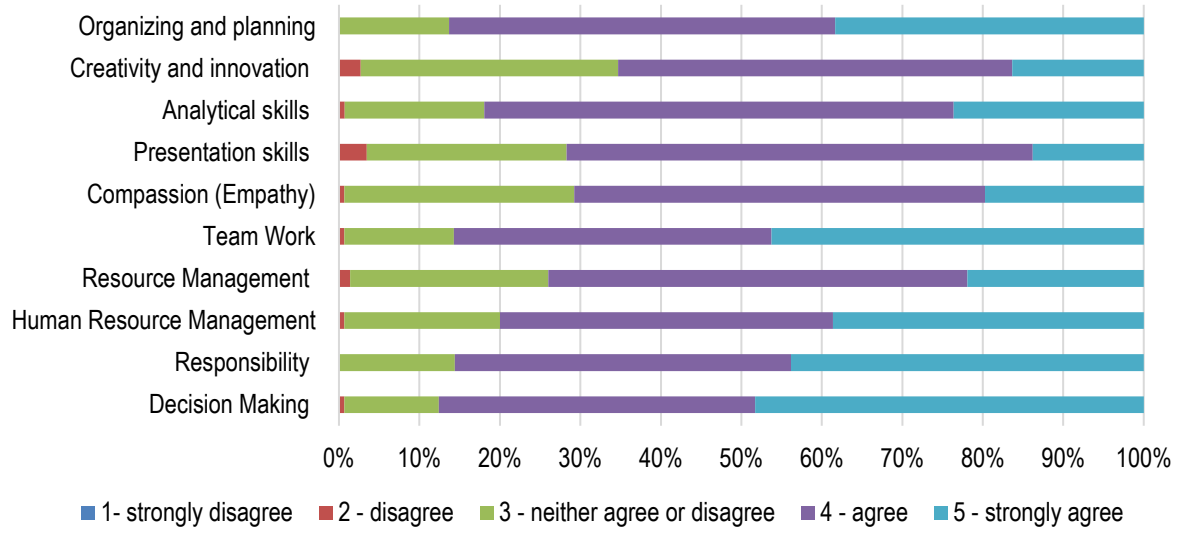

Figure 75 The most important abilities and skills according to their importance for shipboard duties (ranked according to average values)

According to the respondents, the most important abilities and skills for shipboard duties are *Decision Making* (88%), *Teamwork* (87%), and *Responsibility* (87%).[89] The importance assigned to these abilities was the same as those selected by shipboard personnel, once again suggesting that these two communities are very close and share the same professional values.

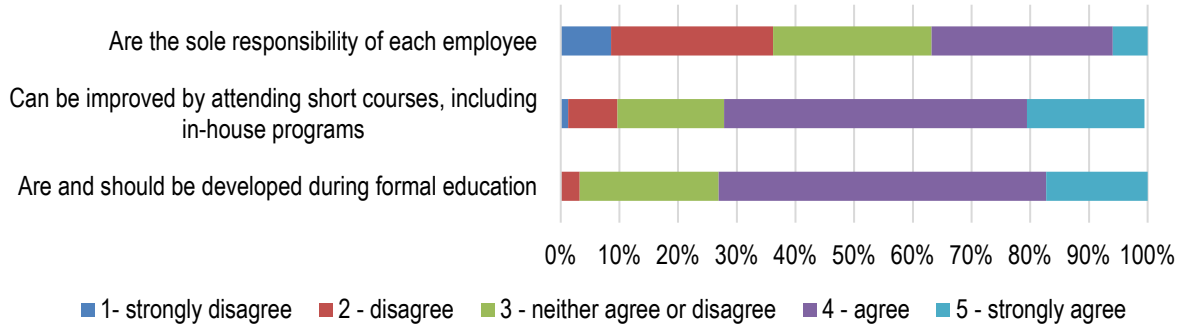

Figure 76 Modes to acquire certain abilities and skills

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

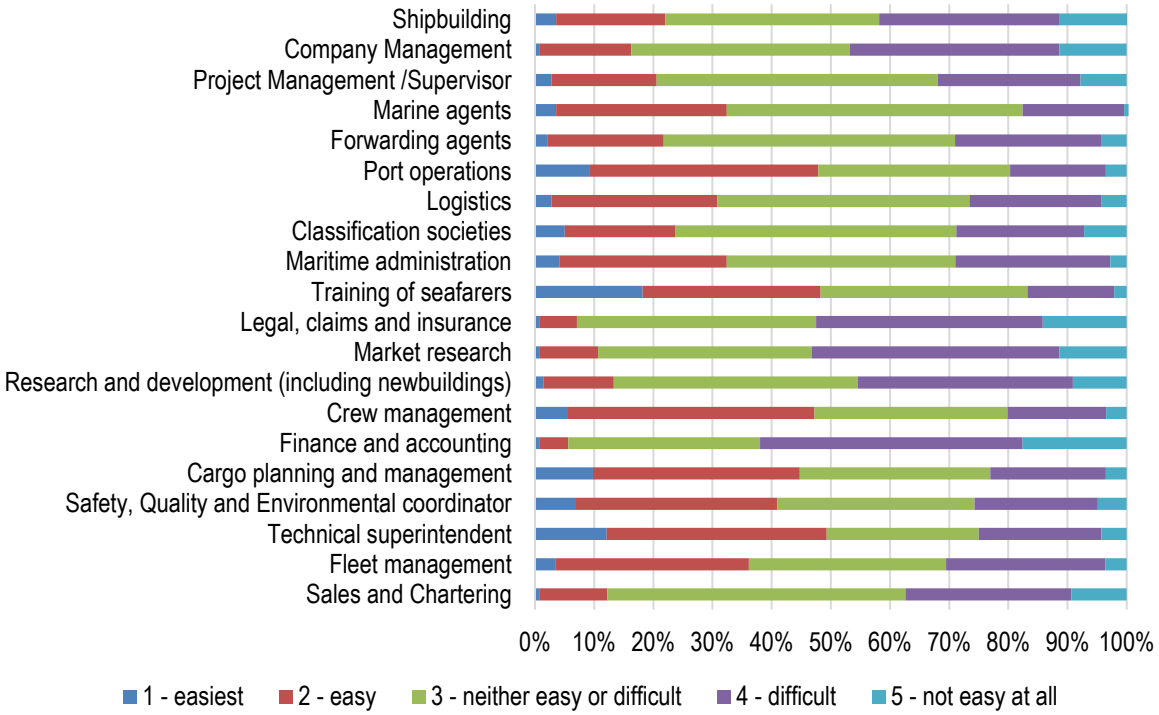

Figure 77 Transition of active seafarers at the management level to shore-based jobs

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

Respondents indicated that the easiest transition for active seafarers at the management level is to shore-based jobs: *Training of seafarers* and *Technical superintendent,* followed by *Port operations* and *Crew management*. Respondents did 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 the opinions expressed by seafarers.

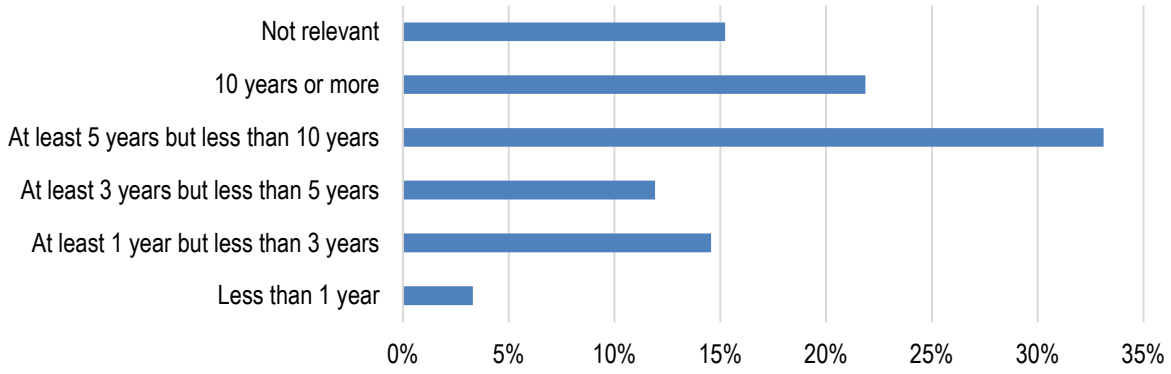

Figure 78 Onboard experience deemed the most appropriate for moving ashore (ranked according to average values)

Once again, shore-based and shipboard personnel fully agreed on the most appropriate levels of onboard experience for moving ashore. Approximately one-third of respondents considered the most appropriate time spent onboard before moving ashore to be at least five years but less than 10 years. Only 3% of respondents judged less than one year as an ideal duration of the onboard experience.

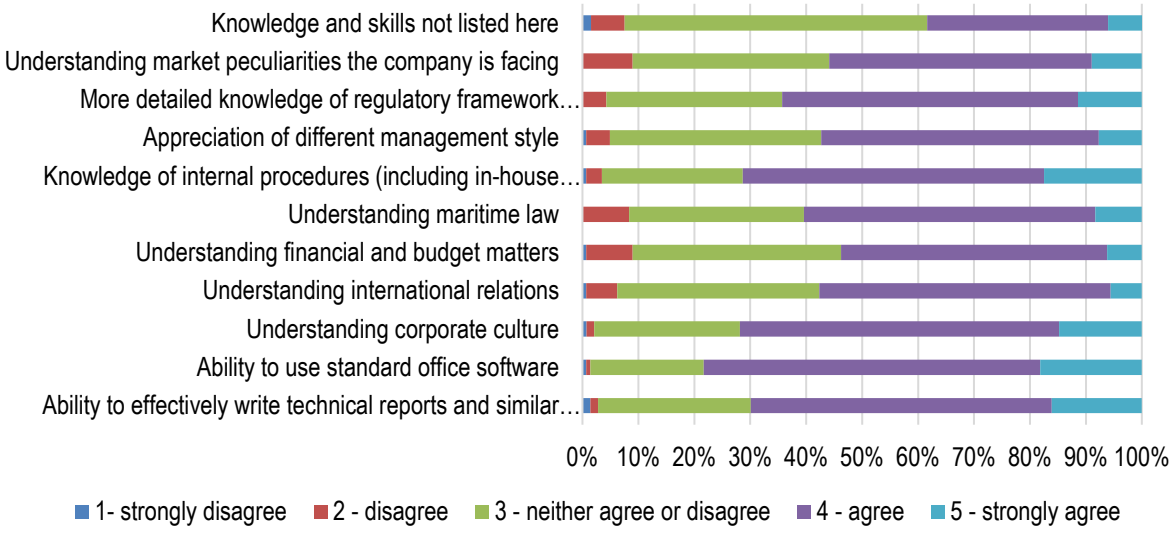

Figure 79 The most important skills serving seafarers should work on before moving to work ashore

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

- *Ability to use standard office software* – 78% of respondents agreed or strongly agreed
- *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 important when moving to work ashore.

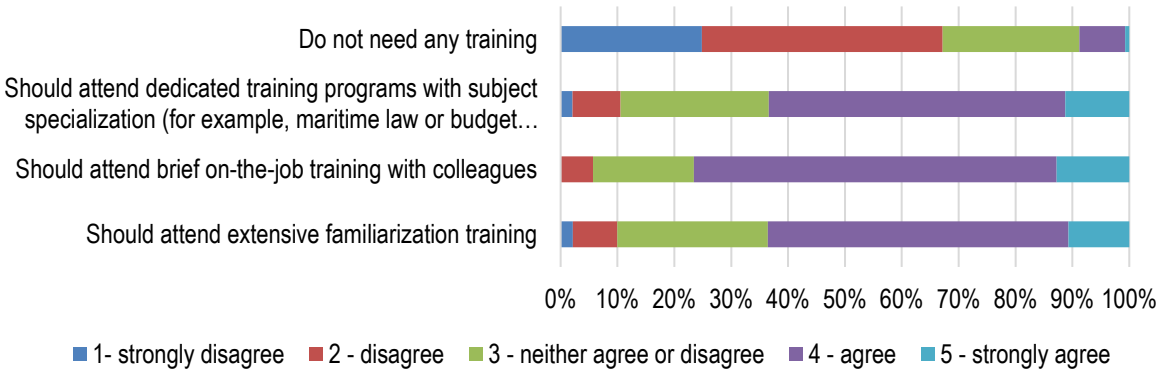

Figure 80 Actions preferred before assuming shore-based duties (if circumstances allow)

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

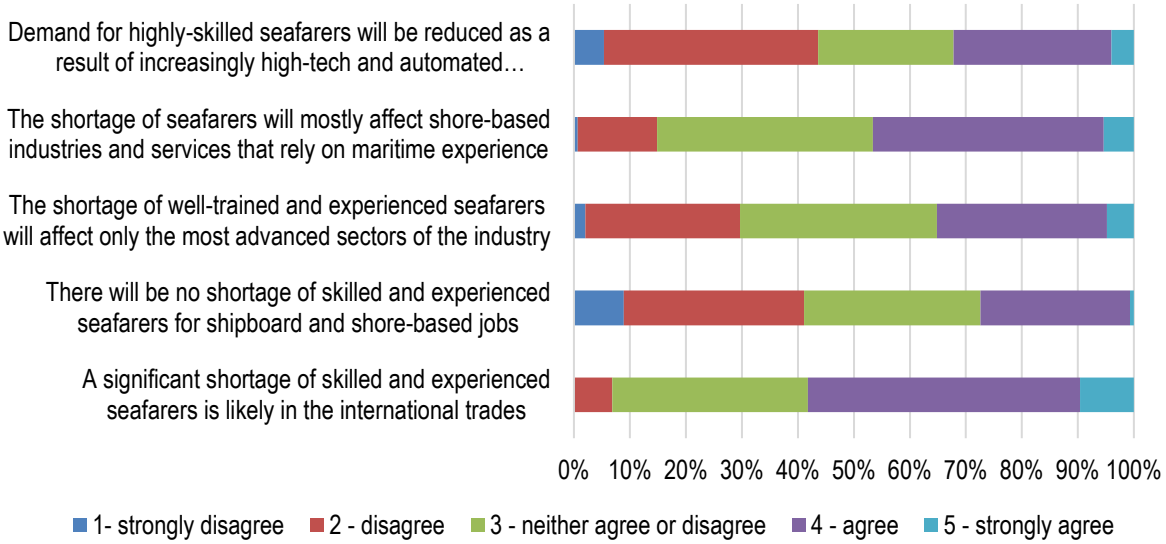

Figure 81 Future developments in the labour market

More than half of the respondents (59%) believed that a significant shortage of skilled and experienced seafarers is likely in the international trades within the next 10 years or so. This belief has been repeatedly expressed in the last few decades by different publications (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 agreed that the shortage of seafarers will mostly affect the shore-based industries and services that extensively rely on maritime experience. The proportion of respondents who considered that only advanced sectors of the industry would be affected by the shortage of experienced seafarers is approximately the same as those who did not agree with the statement.

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

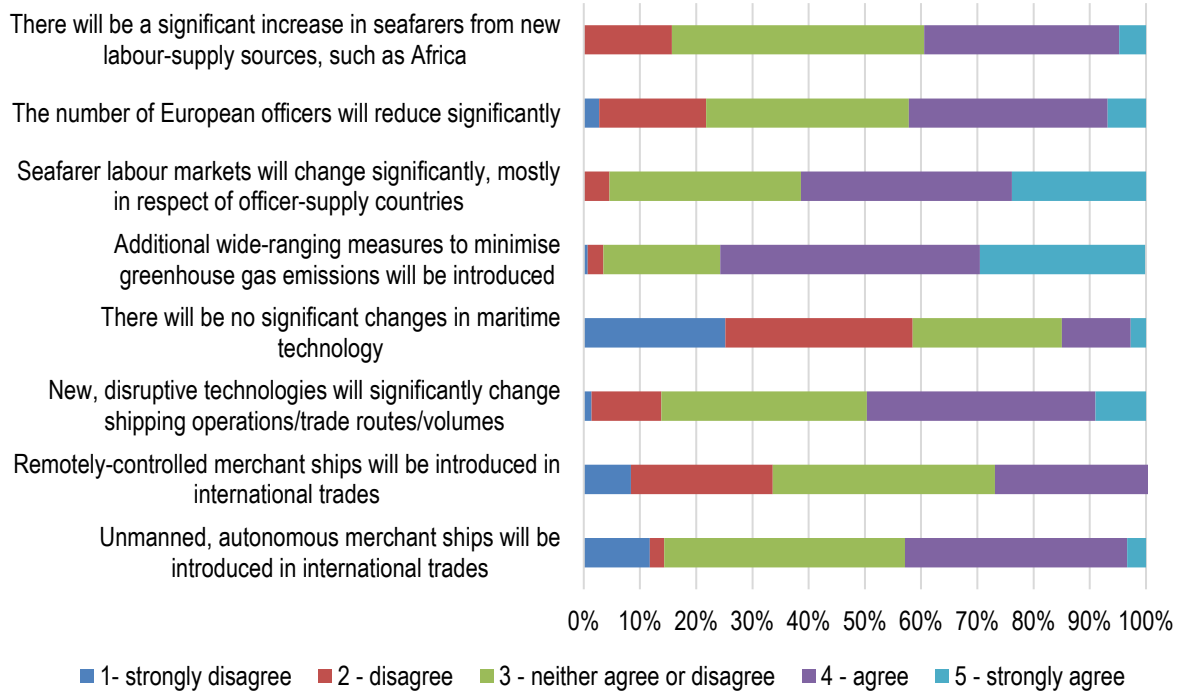

Figure 82 Expected labour market dynamics

In respect of future maritime labour market dynamics, more respondents believed that new labour-supply sources will emerge, probably from developing countries (39% vs 15%). The same expectations, although with different proportions, were shown regarding the number of European officers (42% believed that the number of European officers would decrease, while 22% believed it will not). 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 showed a large degree of agreement regarding future changes: 58% believed there would be significant changes in maritime technologies, while only 15% believed there would be no significant changes. Probably the most important 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 were expected by almost 50% of all respondents and considered unlikely by only 13%.

Finally, opinions were quite divided on remotely controlled merchant ships: 27% of respondents expected such ships within the next 10 years, but 34% did not. Moreover, 43% of respondents expected unmanned, autonomous ships to be introduced in international trade, while only 15% did not agree with the statement.

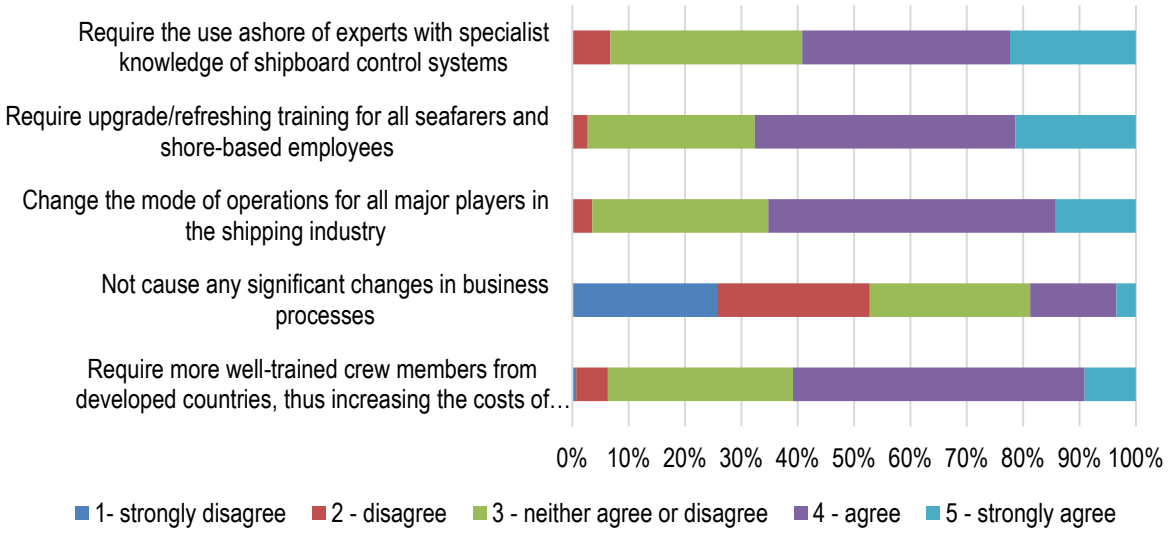

Figure 83 Effects of environmental requirements on shipping

Almost 60% of respondents agreed 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 was widespread agreement on the need for more well-trained crew members from developed countries (supported by 61% of respondents and only 6% opposing), thus increasing the operational costs.

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

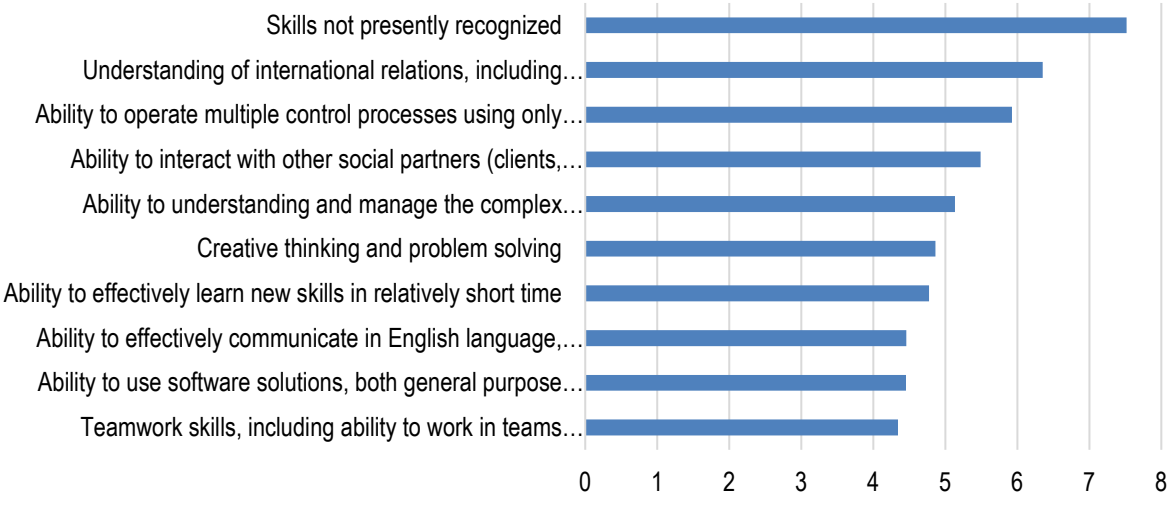

Figure 84 Skills expected to be the most needed in the years ahead (ranked according to average values)

Finally, respondents were asked to rank skills that will be required in the next 10 years or so. Accordingly, the most important 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 effectively communicate in English, oral and in writing*. Such results are not surprising.

It may be therefore concluded that:

(37) Considerable skill gaps are identified in the subject areas of ship operations, maritime economy and law, and transitional and digital skills – practically in areas only marginally included in the STCW Convention and associated Model Courses.

(38) The most important missing transitional skills are teamwork, personal communication and problem-solving.

(39) The most important 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.

(40) The most important subject areas related to maritime law, and requiring upskilling, are those dealing with seafarers' rights and collision regulations.

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

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

10. ANALYSIS, RESULTS AND OUTCOMES

Based on the previously described outcomes, the key skills (competencies) presented in this chapter 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 also deals with skills that are required or highly recommended when a seafarer, after serving at the management-level positions, looks for a job ashore in the maritime cluster. A lack of these skills might be understood as the main cause preventing higher mobility between onboard and shore-based jobs within the maritime industry.

In addition, the skills identified as the most needed must be made available to the industry within the shortest possible period (short-term upskilling), i.e. within the next three years. Consequently, skills not recognised as urgent should be provided to the maritime labour market as a part of a medium-term upskilling programme, i.e. in the period between five to 10 years.

Long-term skills, i.e. skills that will be required from 2030 and onward, could not be easily identified. These skills, in a significant proportion, depend on future technologies and the pace of their implementation. Therefore, based on the research presented here, long-term skills mostly belong to transitional skills. The importance of these skills will intensify as technology improves, systems become more complex, and more people will be employed in demanding jobs.

Maritime economy. Skills related to various aspects of the maritime economy and business have been dropped from the regular programmes for educating seafarers, mostly because there is no such requirement in the STCW Convention. Consequently, numerous MET institutions and shipping companies are not considering these subjects sufficiently important to require inclusion in the programmes. At the same time, dropping these subjects has reduced delivery costs, 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-level 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.

Based on the data collected, the most important skills (shore-term skills) are those dealing with Safety and risk management, Shipping markets and demand and supply cycles and Ship operations and crew management. Medium-term skills include those related to Maritime regulations and Marine operation and maintenance management.

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 the logistic aspects of sea trade and 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 delivery modes.

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 mostly left out is that dealing with contractual obligations, while the content dealing with statutory regulations has remained, and even increased in the last few years, thanks to numerous new regulations, mostly 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 delivery modes.

Accordingly, based on the data collected, the most important short-term skills are those dealing with the Rights of seafarers and maritime workers, Collision regulations and Carriage of goods by sea. Medium-term skills include those related to the Salvage and Limitation of liability.

Ship technologies. The skills related to onboard technologies (particularly the use of different equipment) are the most frequently described in the present STCW Convention. However, these skills mostly refer to technologies common on ships trading in the mid-1990s, i.e. when the first major revision of the STCW Convention had been prepared.[90] Amendments adopted in later years focused mostly on the 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), a method extensively used in the past to upgrade skill sets. In addition, a certain number of skills, quite important in the past, will probably become obsolete. Consequently, these trends should be considered during the next revision of the STCW Convention.[91]

The approach applied in the present STCW Convention is to require seafarers wishing to sail aboard sophisticated ships or to perform certain duties aboard[92], to attend additional short courses (lasting three to five days mostly) and to 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 to 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 certain technology remain with a company and on the same class of ships for a long time.

Since many of the courses identified for certain technologies are quite similar, these courses (or at least the 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 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

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90 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 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

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

92 These courses are collected in the STCW Chapters 5 and 6.

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[93]).

Accordingly, based on the data collected, the most important shorte-term skills are those dealing with the Training of seafarers and Fleet management. The medium-term skills should include skills related to Shipbuilding, Classification societies, Technical superintendency, Project management and supervision, and Port operations.

Green skills.[94] According to the **European Centre for the Development of Vocational Training (**CEDEFOP), 'Developing a low-carbon economy depends [more] on improving existing skills rather than specialised green skills.'[95]

As in other industries, green skills in shipping are based much more 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 a thorough understanding of the causes and effects.

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

Therefore, the main causes and effects of processes taking place in sea transport, influencing the environment, should be clearly explained to shipboard and shore-based personnel. The task can be accomplished 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.

93 The approach proposed is already implemented by the Lloyds Maritime Academy.

94 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,

95 CEDEFOP - BRIEFING NOTE Skills for green jobs, July 2010

Figure 85 Importance of "true" green skills relative to other transversal skills[96]

Accordingly, for the maritime industry, green skills mostly affect the mode of operations. As previously shown, specialised green skills are not part of the current programmes. However, it is commonly understood that environmental protection is an important part of everyday activities onboard and ashore. Probably the most significant impact will be a change of fuel used for power production onboard. But in that case, upskilling programmes will significantly depend on adopted technology and implementation dynamics.

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 specialised 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 seafarers executing functions at operational and management levels and those working ashore.

Presently, digital skills are not part of the STCW Convention. However, most active seafarers today have already acquired a minimal set of digital skills (mailing, basic spreadsheet and word processing). The level of acquired digital skills is left to each person, which 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 as a short-term goal. It may prescribe several levels of proficiency. To ensure effective implementation, the standard of digital proficiency could be included in the STCW Convention (STCW Code B). Alternatively, the standard may be set up as an EU standard, voluntarily implemented by the industry.

In any case, the standard should be designed following the needs of the maritime industry. Furthermore, it can be used 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.

96 ibid.

Transversal skills. Transversal skills[97] are the skills that may be used in almost any job. Minimal requirements for transversal skills, i.e. skills mostly used onboard, are listed in the STCW Convention[98]. 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.

If 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 they are represented in the respective Model Courses) assume relatively high levels of cognitive skills, clearly beyond the level assumed in the present revision of the STCW Convention. Compared with the key competencies recommended by the European Parliament, almost all transversal skills are missing in the STCW Convention. Therefore, it seems that the transversal skills of the presently active European seafarers are much more the outcome of primary and secondary education, culture, tradition and personal inclination than they are intentionally designed and developed.

The very low level of transversal skills required by the STCW Convention and associated Model Courses 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.

Based on the research presented here, the most important are those improving 'out of the box' thinking, such as critical and innovative thinking and skills required for multi-operator tasks, such as effective communications, decision-making and effective use of resources and teamwork and leadership.

Regarding the transversal skills required for shore jobs in the maritime industry, the standard outlined in the STCW Convention is below the industry's requirements.[99] Consequently, opportunities to acquire these skills should be provided. Since such skills are useful in all situations and at all jobs, developing an appropriate set of training programmes and tools (most probably using distance learning as a delivery method) is recommended. The programmes and tools should be developed with the industry's needs in mind.

Consequently, the development of transversal skills should be accomplished as a short-term, medium-term and long-term goal. Certain transitional skills may be introduced following relatively simple courses.

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97 There are numerous categorisations of the transversal skill. According to UNESO „'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

European Parliament and Council set out a recommendation on the key competences for lifelong learning. In the recommendation, they defined eight key competences that are considered important 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

98 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.

99 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 important 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.

However, a substantial step forward requires significant changes in educational programmes with more emphasis on skills (learning outcomes) defined as a part of higher-level cognitive and affective domains. Such change requires substantial efforts from all included (not only education providers) and can be executed only as a long-term goal.

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**	• Study programmes offered by MET institutions should include topics/courses covering subjects beyond and above STCW requirements. • An EU alliance of MET institutions should be proposed to promote harmonised workforce education for the EU maritime industry, both aboard and ashore. • Coordinated action (at the EU level) should be initiated to change the public perception of the maritime industry, particularly concerning seafarers. • MET institutions should be encouraged to increase the number and scope of study programmes to up-skill the maritime industry workforce.
Mobility issues	**Resistance to relocate** **Labour competition** **Inadequate communication**	• 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 a proper understanding of different cultures. • Academic staff exchange should be further promoted to accelerate the update and harmonisation of study programmes among different institutions.
Communication issues	**Inadequate communication** **Cultural differences**	• Courses aiming to upgrade seafarers' communication and language skills should be promoted. • EU-wide standards of proficiency in language skills for people working in the maritime industry should be considered. • EU-wide 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 the use of analytical tools** **Deficiency in dedicated software**	• Courses that upskill seafarers using standard software tools should be developed and promoted. They should be according to the standard EU set of skills (DigComp 2.0).[100] • 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 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 measures to promote 'learning to learn' attitudes should be promoted.
Green skills	**Inadequate understanding of the need to protect the environment**	• EU-wide measures aiming to increase environmental awareness among seafarers and shore-based staff employed in the maritime industry should be considered.

100 https://ec.europa.eu/jrc/en/digcomp/digital-competence-framework

	Insufficient knowledge of competencies needed to use tools and follow procedures to ensure appropriate environmental protection properly	• 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 to remove identified gaps should be supported as much as possible.

It may be therefore concluded that:

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

(45) Some upskilling measures can be performed as short-term goals. However, the most significant outcomes require significant upgrading of the maritime educational system and should be considered long-term goals.

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

11. CONCLUSIONS

The most important conclusions of this study are as follows:

(1) Current and future challenges faced by the maritime sector will create significant pressure on the present model of education, training and manning of 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) as well as others.

(2) Designing a future-proof skill set for management positions in the maritime sector is a difficult task. It is expected to be developed as a supplementary set of skills for those who already possess basic shipboard skills, accompanied by a balanced set of transitional, digital and green skills. The core part of the set should include a properly balanced set of sector-specific and cross-sectoral skills designed for different key jobs in the sector.

(3) Key stakeholders may expect to face numerous new challenges in the years ahead. Due to many new relations and dependencies developing among stakeholders, traditional strategies may not be sufficient, particularly in the case of disruptive technologies.

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

(5) The accelerating transformation of the sector can be recognised in all sources investigated. It is, therefore, beyond any doubt that the maritime industry is facing significant technological challenges.

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

(7) The concept developed in the METNET project, known as 4Es, is deemed appropriate for skill classification for different levels of expertise, onboard and ashore.

(8) Results of the study Transport 2040: Automation, Technology, Employment - The Future of Work (2019), in part dealing with the maritime sector, are deemed the best estimation of the future working conditions and job structure description.

(9) The maritime sector comprises highly dynamic industries exposed to numerous external influences. At the same time, it is a highly regulated sector, particularly shipping, at international, regional and national levels.

(10) The maritime sector is highly competitive, thus heavily dependent on the effective implementation of modern technologies. Due to numerous interrelations among actors, various business models are emerging, mostly highly related to new technologies.

(11) Identifying key skills and competencies required to sustain further development of the maritime sector is a demanding task, mostly due to complex interactions among stakeholders and the international nature of the sector.

(12) Key skills and competencies in such a complex environment cannot be identified using methods and tools common to the standard skill gap analyses. Instead, an alternative approach has to be followed. The method adopted here is based on the semantic analysis of the main subject areas,

i.e. keywords and keyterms used to describe subjects, skills and competencies in maritime law, ships' technology, and economic environment (maritime business).

(13) MET institutions offering education and training at all levels can generally respond to the industry needs and fill the skill gaps. However, the ability to provide different skills, particularly high-level skills, within the time and quality constraints may vary significantly between institutions and countries.

(14) 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.

(15) No EU-wide alliance (or similar form of association of institutions offering MET programmes) exists, although many institutions offering MET programmes at the MSc level are members of the International Association of Maritime Universities (IAMU).

(16) Different institutional forms offer maritime training and education, ranging from privately owned institutions (offering only short courses to seafarers and shipping companies) to independent maritime universities.

(17) In almost all EU member states, the university-level study programmes dealing with international shipping and logistics, maritime law and business, and port management (i.e. programmes for the shore-based maritime industry) are identified.

(18) In most cases, MET institutions offering programmes leading to the management-level Certificates of Competency are supervised by the ministries responsible for education and maritime affairs.

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

(20) No recognised EU-wide initiatives aim to harmonise maritime education programmes offered by different institutions or countries. The only formal contact identified among MET institutions in respect of study programmes is a partial comparison of courses delivered by two institutions at the university level within the ERASMUS student exchange programmes.

(21) Thanks to ever-accelerating technological development and the increasing number of high-tech companies that 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.

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

(23) 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 in numbers and scope.

(24) Skill standards applicable in the maritime sector should be classified according to the concept known as 4Es.

(25) Skill standards applicable in the maritime sector are well-defined for basic shipboard positions. However, there are no well-defined standards for more demanding positions (i.e. those on

sophisticated ships or medium-to-top positions ashore). The skill gap identified at these levels is usually bridged using on-the-job training (if appropriate) or dedicated training and education of various duration and expertise.

(26) The missing skills for well-defined shipboard positions may be identified by contextual and semantical analyses of associated skill standards (i.e. STCW Convention and associated texts). The missing skills for the enrichment and elevation levels can be broadly identified using semantic analyses of standard texts describing the most important subject areas.

(27) Psychomotor and affective domains are clearly underrated in all considered documents. Although these domains are much more difficult to codify and formalise, their importance is significant, and further developments in these areas are highly welcomed.

(28) Most action verbs used to describe required knowledge deal with the application level. Although fully understandable and in line with the predominant understanding in the shipping industry in the past, it is highly questionable whether a focus on the application is sufficient to enable future seafarers to operate highly sophisticated ships or onboard systems. Such a low dedication to higher, more creative levels of a knowledge domain may impact the future transition to more sophisticated transport modes.

(29) 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. The STCW Convention does not require higher-level capabilities, such as analysis, synthesis and evaluation for positions at the management level.

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

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

(32) 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.

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

(34) Key terms identified within the economic environment and maritime law conform with subjects offered to ex-seafarers who want to extend their knowledge and continue their careers ashore.

(35) Key terms identified within ships' technology do not indicate additional subject areas to be offered to those willing to pursue their career ashore. It seems that additional expertise highly depends on the requirements of the particular job, thus preventing effective clustering of related subject areas.

(36) Key terms identified as the most important in the research and education area show the broad interests somewhat equally distributed between new technologies and demands (e.g. autonomous ships, emission factors, and cyber security) and educational subjects (e.g. model courses, MET institutions, learning outcomes).

(37) Considerable skill gaps are identified in the subject areas: ships operations, maritime economy and law, and transitional and digital skills – practically in areas only marginally included in the STCW Convention and associated Model Courses.

(38) The most important missing transitional skills are teamwork, personal communication and problem-solving.

(39) The most important 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.

(40) The most important subject areas related to maritime law, and requiring upskilling, are those dealing with seafarers' rights and collision regulations.

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

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

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

(44) Some upskilling measures can be performed as short-term goals. However, the most significant outcomes require significant upgrading of the maritime educational system and should be considered long-term goals.

(45) 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[101]

Course subject	Days	Hours [102]	Core[103]	Generic [104]	Other [105]
Voyage planning					
Dynamic Positioning – Induction course	5	40	100%	0%	0%
Octopus – on-board 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					

101 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.

102 Duration of the course in working hours.

103 Estimated percentage of the course content characterized as a part of the core skill set.

104 Estimated percentage of the course content characterized as a part of the generic (transversal) skill set.

105 Estimated percentage of the course content characterized as a part of the sectoral and cross-sectoral skill set.

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%
On-board 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%
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%

Annexe 3 Action verb taxonomy for Model Courses

Cognitive learning (Knowledge, Understanding & Analysis)					
Remember	**Understand**	**Apply**	**Analyse**	**Evaluate**	**Create**
Learner retains information	*Learner knows the direct meaning of the information learnt*	*Learner is able to use the information for its intended purpose*	*Learner is able to critically examine information*	*Learner is able to make a judgement about the validity based on a set of criteria*	*Learner is able to develop new information based on analysis of multiple sources*
display enumerate find identify itemize label list locate name present quote recite recognize record remember state tabulate	clarify contrast describe explain generalize illustrate indicate interpret report represent rewrite translate	apply calculate carry out communicate distinguish execute handle implement keep maintain mark measure perform prepare prevent schedule select summarize use write	analyses appraise classify compare conclude determine differentiate discriminate divide focus inspect relate separate structure troubleshoot	assess categorize check coordinate criticize diagnose estimate evaluate judge modify monitor review systematize validate	construct create design develop devise engineer generate hypothesize improve initiate innovate integrate make manufacture plan process set up

Psychomotor learning (Skill Learning)				
Imitate	**Manipulate**	**Precision**	**Articulation**	**Naturalization**
Learner is able to replicate a skill or task under the guidance of others	*Learner is able to perform a fundamental skill or task*	*Learner is able to perform a skill or task fully independently*	*Learner is able to perform skill or task in different situations*	*Learner is able to instruct others to perform this skill or task*
copy duplicate imitate notice recollect recount repeat	arrange associate collect connect cut draw follow hoist install manipulate model practice release rig secure start switch throw transmit wear	compute control carry out demonstrate detect examine manoeuvre modify monitor operate perform revise simulate splice steer test	adapt adjust alter assemble change combine correct deconstruct dismantle repair transfer	compose exemplify exhibit instruct manage originate supervise synthesize teach train

Affective learning (Behavioural Development)				
Receive	**Respond**	**Value**	**Organize**	**Characterize**
Learner is exposed to a new behaviour	*Learner reacts to behaviour seen*	*Learner is aware of the benefits of that behaviour*	*Learner adopts that behaviour as normal practice*	*Learner role models relevant behaviour*
attend locate receive select	answer behave comply cooperate discuss do express obey reproduce respond show sketch underline	accept adapt infer justify note prefer seek value	balance complete customize internalize organize solve	authenticate characterize defend formulate habituate influence invent produce represent verify

Annexe 4 Questionnaire – Shipboard personnel

PLEASE TAKE 10 MINUTES TO CONTRIBUTE TO THE FUTURE OF SHIPPING

BY RESPONDING TO THIS QUESTIONNAIRE, YOUR VIEWS WILL BE TAKEN INTO ACCOUNT WHEN WE DEVELOP THE EDUCATIONAL PROGRAMS TO MEET THE FUTURE NEEDS OF SHIPPING INDUSTRIES IN EUROPE.

Dear XX

The European Union's SkillSea project, launched in January 2019, seeks to find ways of future-proofing EU maritime skills, attracting more young people into the sector, and overcoming barriers to individual career development and progression within the wider maritime cluster – both at sea and ashore.

To take our work forward and to ensure that the outcomes are relevant, we need your help!

An important part of the SkillSea project is an analysis of current and future needs for maritime skills. We want to examine whether there are gaps and mismatches in current maritime education and training programmes in Europe – with special regard to the impact of the many technological developments affecting the way ships are operated and potentially changing the nature of your work.

Your feedback will help us to identify shortfalls in the existing system and whether new skills need to be taught. Your insight will help the project to develop proposals for the design and delivery of the vocational education and training needed to maintain European maritime know-how.

This questionnaire seeks to gather views and opinions from serving seafarers. Therefore, we invite you to help us and share your knowledge, experience, and suggestions.

On behalf of the SkillSea Work Package 1 team, we thank you in advance for your cooperation and time!

Norwegian University of Science and Technology

Ålesund, 1 June 2019

INFORMATION ABOUT YOU

Age

Years

Experience in shipping and related industries

Years

Department

Engine department – Deck department – Other[106]

Education

High school – College - University - Other

Seagoing experience (total)

Years

On-board position (highest position served)

Master - Chief mate - Second mate - Third mate - Chief engineer - Second engineer - Third engineer – ETO - Rating – Other

106 Slash between multiple choices is used to denote selection from dropdown list.

GENERAL INFORMATION ABOUT YOUR PRESENT COMPANY

Country of residence of the company[107] you are presently employed with

Select from list

What sort of ships does your company predominantly operate (several options are acceptable):

Cruise ships – Ro-ro ferries – Containerships – Bulk carriers – General cargo ships – Crude oil – Chemicals – LNG – LPG – Offshore – Dredgers – Car carriers - Port operations – Other (please state)

How many ships does your company operate (total)?

number

What is your company's main trading area?

Global – Europe – Regional – National

107 The company is a legal entity holding the respective Document of Compliance and Safety Management Certificate.

ON-BOARD SKILLS AND COMPETENCIES

On a scale of 1 to 5 (1 = Strongly disagree, 2 = Disagree, 3 = Neither agree nor disagree, 4 = Agree, 5 = Strongly agree), please state whether you consider professional education and basic competencies (as outlined in the STCW Convention) are:

Satisfactory in all respects	1……5
Important topics are missing	1……5
Overburdened with obsolete knowledge	1……5

Using the same scale, please state whether professional competencies (STCW functions) are well designed and meet actual onboard needs (please respond for functions you are certified for):

Navigation	1……5
Cargo handling and stowage	1……5
Controlling the operation of the ship and care for persons on board	1……5
Marine engineering	1……5
Electrical, electronic and control engineering	1……5
Maintenance and repair	1……5
Radiocommunications	1……5

Miscommunications these days may cause significant damage to people, the environment, and property. On a scale of 1 to 5 (1 = Strongly disagree, 2 = Disagree, 3 = Neither agree nor disagree, 4 = Agree, 5 = Strongly agree), please list the main reasons that you consider to be the main cause of miscommunication: [108]

Lack of professional knowledge or understanding	1……5
Lack of information sharing	1……5
Lack of communication skills	1……5
Lack of digital skills (not familiar with computer or software)	1……5
Other reasons (please specify)	

108 Ranges from 1 to 5 (Likert scale) are used to denote level of agreement with a particular statement (1 = Strongly disagree, 2 = Disagree, 3 = Neither agree nor disagree, 4 = Agree, 5 = Strongly agree).

Using the same scale, please state whether you consider there is an appropriate level of professional knowledge and skills within the following groups;

Among non-European officers	1……5
Among European officers	1……5
Among masters and deck officers	1……5
Among chief engineers and engine officers	1……5
Among other shipboard departments	1……5
Among older officers (>50)	1……5
Among younger seafarers (<30)	1……5

Using the same scale, please state whether you consider that serious skill deficiencies can be recognized within the following categories:

In areas covered by the core STCW tables of competencies	1……5
In areas covered by the STCW Certificates of Proficiency	1……5
In business-related subjects (chartering, budgeting, etc.)	1……5
In subjects related to maritime law, insurance, and P&I coverage	1……5
In teamwork and interpersonal relations	1……5
In digital technologies (including cyber security)	1……5
In basic sciences (elementary maths, physics, and chemistry)	1……5
In subjects requiring creative thinking and problem-solving	1……5
Other (please state)	

Using the same scale, please state whether you consider STCW competencies may be most effectively improved by:

Extending tables of competencies (by amending STCW Code A) in a way to includes additional competencies	1……5
Redrafting tables of competencies (by amending STCW Code A) to contain more in-depth described professional competencies	1……5
Developing additional Certificates of Proficiency (by amending STCW Code A)	1……5
Further developing recommendations in STCW Code B	1……5
Supporting tailor-made education and training	1……5
In-house training	1……5
Other (please state)	

Using the same scale, please state whether you consider maritime education and training institutions should:

Closely follow subjects as outlined in the STCW Convention and associated Model courses	1……5
Go beyond the level of professional knowledge required by the STCW Convention and associated Model courses	1……5
Include subjects required for on-shore jobs, such as maritime business, maritime law, etc	1……5
Include non-maritime related subjects, such as national history, literacy, cultural awareness, and citizenship competencies	1……5
Include subjects on technologies still under development, such as Blockchain, IoT, Big Data, AI or MAAS	1……5
Other (please state)	

Please rank which maritime law topics you consider most valuable for shipboard management.

Carriage of goods by sea	1
Charter parties	2
General Average	3
Rights of seafarers and maritime workers	4
Collisions	5
Salvage	6
Maritime liens	7
Limitation of liability	8

Please rank which maritime business subjects you consider the most valuable for shipboard management.

Global trade and maritime economics	1
Shipping markets and demand and supply cycles	2
Marketing	3
Ship operations and crew management	4
Maritime regulation	5
Marine operation and maintenance management	6
Safety and risk management	7
Marine insurance	8
Chartering policy	9
Financial management	10
Port operations	11
Market research	12
Other (please state)	

Please rank the most relevant (transitional) (should we explain what is meant by transitional – or do we even need the term?) skills for modern ship officers:

Basic sciences (maths, physics, chemistry)	1
English language	2
Digital skills	3
Personal, social, and learning-to-learn skills	4
Teamwork	5
Creative thinking and problem solving	6
Literacy competences	7
Citizenship competences	8
Entrepreneurship competences	9
Cultural awareness and expression competences	10
Other (please state)	

On a scale of 1 to 5, please state whether you consider transitional (generic) skills can be most easily provided by:

Amending existing programs at the maritime education institutions	1…….5
Developing new and/or additional education programs and training with MET providers	1…….5
In-house education and training programs	1…….5
Other (please state)	

What level of digital abilities and personal computer literacy do you expect from shipboard management? (to be selected from the dropdown menu)

No need to use computers on board
Minimal use of machines and equipment controlled by the computer, knowledge limited to a few basic commands without any knowledge of computer programs
Using a computer to store, search, find and process information using standard programs, send and receive electronic mail, use word processing, and manage files
Using a broader range of computer capabilities and options, able to create and modify spreadsheets, to create documents using formatting options, to create original drawings or illustrations

Performing sophisticated tasks, including choosing appropriate software to solve problems, using complex software packages, creating publications or presentations with embedded objects created in other programs, creating databases
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
Other (please state)

Please rank the following abilities and skills according to their importance for shipboard duties.

DECISION MAKING (ability to choose among options that will lead to the desired goal)	1
RESPONSIBILITY (conscientiously, properly performing work tasks, considering personal rights and obligations as well as rights and obligations of others and the environment)	2
HUMAN RESOURCE MANAGEMENT (directing, coordinating, and monitoring the work of others, and motivating and providing development opportunities)	3
RESOURCE MANAGEMENT (financial planning, material and equipment use, maintenance)	4
TEAMWORK (participation in working with others that involves understanding, respecting differences, listening, and consulting)	5
COMPASSION (EMPATHY) (ability to understand the feelings of other people and respond adequately to them)	6
PRESENTATION SKILLS (ability to make a clear, fluid, and arguable transfer of ideas in oral or written form)	7
ANALYTICAL SKILLS (ability to collect and view various information and perspectives, verify assumptions and make conclusions/solutions)	8
CREATIVITY AND INNOVATION (creating new ideas, services, products, ways of working and their application)	9
ORGANIZING AND PLANNING (ability to set goals, plan performance, running time, and monitor work)	10
Other (please state)	

Please rank the importance of the following personal qualities:

Professionalism	1
Honesty and integrity	2
Adaptability	3
Dependability	4
Loyalty	5
Positive attitude	6
Negotiating and conflict resolution skills	7
Willingness to learn	8
Other (please state)	

ON-SHORE SKILLS AND COMPETENCIES

Please rank the attractiveness of the shore jobs you might wish to consider (1 = not interested, 5 = very much interested)

Sales and Chartering	1……5
Fleet management	1……5
Technical Superintendent	1……5
Safety, Quality and Environmental coordinator	1……5
Cargo planning and management	1……5
Finance and Accounting	1……5
Crew management	1……5
Research and development (including newbuildings)	1……5
Market research	1……5
Legal, claims and insurance	1……5
Training of seafarers	1……5
Maritime Administration	1……5
Classification societies	1……5
Logistics	1……5
Port operations	1……5
Forwarding agents	1……5
Marine agents	1……5
Project Management /Supervisor	1……5
Company Management	1……5
Shipbuilding	1……5
	Other (please state)

How much onboard experience do you consider to be the most appropriate for taking up a shore-based job in the maritime sector?

Years

Are you interested in moving to a shore-based job?

Yes - No

What are the most important skills active seafarers should work on before moving into shore-based jobs? Please rank according to importance (1 = the most important).

Ability to effectively write technical reports and similar documents	1
Ability to use standard office software	2
Understanding corporate culture	3
Understanding international relations	4
Understanding financial and budget matters	5
Understanding maritime law	6
Knowledge of internal procedures (including in-house software)	7
Appreciation of different management styles	8
More detailed knowledge of regulatory framework (relations with class societies, port state control, etc.)	9
Understanding market demands on the company	10
Other knowledge and skills not listed here (please state)	

On a scale of 1 to 5, please state the degree to which you consider serving seafarers before assuming shore-based duties if circumstances allow:

Should attend extensive familiarization training	1…….5
Should attend brief on-the-job training with colleagues	1…….5
Should attend dedicated training programs with subject specialization (for example, maritime law or budget management)	1…….5
Do not need any training	1…….5

According to your experience:

Most active seafarers will successfully assume shore duties	1……5
More seafarers will successfully assume shore duties if provided with appropriate familiarization and/or training as appropriate	1……5
Active seafarers will successfully assume only duties for which onboard experience is compulsory (for example, marine pilots)	1……5

Please rank the skills that you consider will be most needed in the years ahead:

Ability to use software solutions, both general-purpose office software and dedicated software (for example, ship maintenance software or software for remote failure analyses)	1
Teamwork skills, including the ability to work in teams involving team members located ashore	2
Creative thinking and problem solving	3
Understanding of international relations, including economic issues	4
Ability to interact with other social partners (clients, cooperatives) using social media and other (sophisticated) modes of communications	5
Ability to effectively communicate in the English language, oral and in writing	6
Ability to understand and manage the complex control systems	7
Ability to effectively learn new skills in a relatively short time	8
Ability to operate multiple control processes using only interfaces and with no physical contact	9
Skills not presently recognized (please state)	

Dear YX,

The SkillSea team will appreciate any comment or suggestion relating to future maritime education and training or promotion of careers in the maritime industry. Kindly post your comments in the box below.

If you would like to receive the results of the research activity, please fill in the following fields:

E-mail

First name

Family name

Thank you for your time and cooperation!

Annexe 5 Questionnaire – Shore-based personnel

PLEASE TAKE 10 MINUTES TO CONTRIBUTE TO THE FUTURE OF SHIPPING

BY RESPONDING TO THIS QUESTIONNAIRE, YOUR VIEWS WILL BE TAKEN INTO ACCOUNT WHEN WE DEVELOP THE EDUCATIONAL PROGRAMS TO MEET THE FUTURE NEEDS OF SHIPPING INDUSTRIES IN EUROPE.

Dear XY,

The questionnaire presented here is a part of the project 'FUTUREPROOF SKILLS FOR THE MARITIME TRANSPORT SECTOR (SKILLSEA)'.

The project, supported by the European Commission, aims to identify and meet the future skills needs of the maritime sector and attract greater numbers of Europeans to careers in the sector. The four-year project was launched in January 2019.

The project has been awarded to the Europe-wide consortium established by the industry's recognised social partners, the European Community Shipowners' Associations (ECSA) and the European Transport Workers' Federation (ETF), and led by the Rotterdam-based company STC Group. It comprises 27 partners, including national maritime authorities, shipping companies, shipowners' associations, maritime trade unions and maritime education providers from 16 European countries.

The main goal of the "SkillSea" project is to produce a sustainable skills strategy for the maritime sector and related activities both at sea and ashore. It aims in particular to:

- Increase the number of European maritime professionals
- Map out technological developments in ship operation and their effect on the industry's skills requirements
- Overcome barriers to the mobility of seafaring labour
- Improve cooperation between education providers, competent authorities, and industry

This questionnaire is part of the Work Package 1 'SKILLS NEEDS IDENTIFICATION' task 1.1.2. "Current and future skills needs (Reality and Mapping)". The Work Package goal is to analyse **the maritime sector's current and future skills needs** (both on the EU and regional/national levels). Based on the analysis of identified gaps and mismatches in the sector (on a structural basis), the potential impact on current occupational profiles or the identification of new ones will be carried out. The potential effects on growth and employment in the sector will be estimated as the last step. Based on the skills needs identification, the activities regarding the design and delivery of vocational education and training will be exploited and proposed.

By sending this questionnaire to a selected group of managers and technology leaders, we are trying to gather the views and opinions of those who are or will be responsible for managing human resources and new technologies successfully.

For that reason, we invite you to help us and share your knowledge, opinions, and suggestions.

On behalf of the Work Package 1 team, we thank you for your cooperation and time!

Norwegian University of Science and Technology

Norway

Ålesund, 1st of June 2019

GENERAL INFORMATION ABOUT THE COMPANY/INSTITUTION

Country of company residence

Select from list

Number of employees (total)

Number of employees (employed or under management)

Enterprise category

Large - Medium - Small - Micro[109]

Ownership

Private - Public - Trust - Association - Union - Other

Predominant activity

Ship owner – Ship operator – Ship management – Crew manager - Education - Training - Classification - Union - Agent - Pilot - Insurance - Logistics - Ship-building - Equipment manufacturing – Cargo survey - Maritime administration - Offshore - Other

Active in the maritime sector (years)

Input years

Predominant areas of operation:

Local - Regional - National - EU - Global

109 Slash between multiple choices is used to denote selection from dropdown list.

INFORMATION ABOUT INTERVIEWEE

Age

Years

Experience in shipping and related industries

Years

Sector / department (present)

Management - Operations - Technical - Crewing - R&D - Quality - Planning - On-board crew member - Survey - Construction - Finance – Insurance – Other

Position (present)

Background

Engine department – Deck department - Finance - Management – Law - Other

Education

BSc - MSc - PhD - Other

On-board experience

Years

On-board position (highest position served if any)

Master - Chief mate - Second mate - Third mate - Chief engineer - Second engineer - Third engineer – Other - None

ON-BOARD SKILLS AND COMPETENCIES

Professional education and basic competencies (as outlined in the STCW Convention) are:

Satisfactory in all respects	1……5
Important topics are missing	1……5
Overburdened with obsolete knowledge	1……5

Professional competencies (STCW functions) are well designed and balanced with actual on-board needs in:

Navigation	1……5
Cargo handling and stowage	1……5
Controlling the operation of the ship and care for persons on board	1……5
Marine engineering	1……5
Electrical, electronic and control engineering	1……5
Maintenance and repair	1……5
Radiocommunications	1……5

Level of professional knowledge and skills are appropriate:

Among non-European officers	1……5
Among European officers	1……5
Among masters and deck officers	1……5
Among chief engineers and engine officers	1……5
Among other shipboard departments	1……5
Among older officers (>50)	1……5
Among younger seafarers (<30)	1……5

Miscommunications these days may cause significant damage to people, the environment, and property. On a scale of 1 to 5, please list the main reasons that you consider to be the main cause of miscommunication:[110]

Lack of professional knowledge	1……5
Lack of communication skills	1……5
Lack of digital skills (not familiar with computer or software)	1……5
Other (please state)	

Serious skill deficiencies are recognized:

In areas covered by the core STCW tables of competencies	1……5
In areas covered by the STCW Certificates of Proficiency	1……5
In business-related subjects (chartering, budgeting, etc.)	1……5
In subjects related to maritime law, insurance, and P&I coverage	1……5
In teamwork and interpersonal relations	1……5
In digital technologies (including cyber security)	1……5
In basic sciences (elementary maths, physics, and chemistry)	1……5
In subjects requiring creative thinking and problem-solving	1……5
Other (please state)	

110 Ranges from 1 to 5 (Likert scale) are used to denote level of agreement with a particular statement (1 = Strongly disagree, 2 = Disagree, 3 = Neither agree nor disagree, 4 = Agree, 5 = Strongly agree).

STCW competencies may be most effectively improved by:

Extending tables of competencies (amending STCW Code A) in a way to includes additional competencies	1……5
Redrafting tables of competencies (amending STCW Code A) to contain more in-depth described professional competencies	1……5
Developing additional CoPs (amending STCW Code A)	1……5
Further developing STCW Code B	1……5
Supporting tailor-made education and training	1……5
In-house training	1……5
Other (please state)	

Maritime education and training institutions should:

Closely follow subjects as outlined in the STCW Convention and associated Model courses	1……5
Go beyond the level of professional knowledge required by the STCW Convention and associated Model courses	1……5
Include subjects required for on-shore jobs, such as maritime business, maritime law, etc	1……5
Include non-maritime related subjects, such as national history, literacy, cultural awareness, and citizenship competencies	1……5
Include subjects on technologies still under development, such as Blockchain, IoT, Big Data, AI or MAAS	1……5

Please rank maritime law topics you consider the most valuable for shipboard management.

Carriage of goods by sea	1
Charter parties	2
General Average	3
Rights of seafarers and maritime workers	4
Collision	5
Salvage	6
Maritime liens	7
Limitation of liability	8

Please rank subjects from the maritime business domain you consider the most valuable for shipboard management.

Global trade and maritime economics	1
Shipping markets and demand and supply cycles	2
Marketing	3
Ship operations and crew management	4
Maritime regulation	5
Marine operation and maintenance management	6
Safety and risk management	7
Marine insurance	8
Chartering policy	9
Financial management	10
Port operations	11
Market research	12

Please rank the most relevant (transitional) skills for modern ship officers:

Basic sciences (maths, physics, chemistry)	1
English language	2
Digital skills	3
Personal, social, and learning-to-learn skills	4
Teamwork	5
Creative thinking and problem solving	6
Literacy competences	7
Citizenship competences	8
Entrepreneurship competences	9
Cultural awareness and expression competences	10

Transitional skills can be most easily provided by:

Amending existing programs at the maritime education institutions	1…….5
Contracting additional education programs and training with MET providers	1…….5
In-house education and training programs	1…….5
Other (please state)	

What level of digital abilities and personal computer literacy do you expect from shipboard management? (to be selected from the dropdown menu)

No need to use computers on board
Minimal use of machines and equipment controlled by the computer, knowledge limited to a few basic commands without any knowledge of computer programs
Using a computer to store, search, find and process information using standard programs, send and receive electronic mail, use word processing, and manage files
Using a broader range of computer capabilities and options, able to create and modify spreadsheets, to create documents using formatting options, to create original drawings or illustrations
Performing sophisticated tasks, including choosing appropriate software to solve problems, using complex software packages, creating publications or presentations with embedded objects created in other programs, creating databases
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

Please rank the following abilities and skills according to their importance for shipboard management personnel.

DECISION MAKING (ability to choose among options that will lead to the desired goal)	1
RESPONSIBILITY (conscientiously, properly performing work tasks, considering personal rights and obligations as well as rights and obligations of others and the environment)	2
HUMAN RESOURCE MANAGEMENT (directing, coordinating, and monitoring the work of others, and motivating and providing development opportunities)	3
RESOURCE MANAGEMENT (financial planning, material and equipment use, maintenance)	4
TEAMWORK (participation in working with others that involves understanding, respecting differences, listening, and consulting)	5
COMPASSION (EMPATHY) (ability to understand the feelings of other people and respond adequately to them)	6
PRESENTATION SKILLS (ability to make a clear, fluid, and arguable transfer of ideas in oral or written form)	7
ANALYTICAL SKILLS (ability to collect and view various information and perspectives, verify assumptions and make conclusions/solutions)	8

CREATIVITY AND INNOVATION (creating new ideas, services, products, ways of working and their application)	9
ORGANIZING AND PLANNING (ability to set goals, plan performance, running time, and monitor work)	10

Creative thinking and problem-solving skills:

Are and should be developed during formal education	1…….5
Can be improved by attending short courses, including in-house programs	1…….5
Are the sole responsibility of each employee	1…….5

Rank the importance of the following personal traits:

Professionalism	1
Honesty and integrity	2
Adaptability	3
Dependability	4
Loyalty	5
Positive attitude	6
Negotiating and conflict resolution skills	7
Willingness to learn	8
Integrator	9

ON-SHORE SKILLS AND COMPETENCIES

How easy is it, do you believe, for active seafarers at the management level to transition to the following shore-based jobs?

Sales and Chartering	1……5
Fleet management	1……5
Technical Superintendent	1……5
Safety, Quality and Environmental coordinator	1……5
Cargo planning and management	1……5
Finance and Accounting	1……5
Crew management	1……5
Research and development (including newbuildings)	1……5
Market research	1……5
Legal, claims and insurance	1……5
Training of seafarers	1……5
Maritime Administration	1……5
Classification societies	1……5
Logistics	1……5
Port operations	1……5
Forwarding agents	1……5
Marine agents	1……5
Project Management /Supervisor	1……5
Company Management	1……5
Shipbuilding	1……5

How much onboard experience would you look for from active seafarers before they move into a job in the shipping company?

Years

What are the most important skills active seafarers should work on before assuming shore-based jobs?

Ability to effectively write technical reports and similar documents	1……5
Ability to use standard office software	1……5
Understanding corporate culture	1……5
Understanding international relations	1……5
Understanding financial and budget matters	1……5
Understanding maritime law	1……5
Knowledge of internal procedures (including in-house software)	1……5
Appreciation of different management styles	1……5
More detailed knowledge of regulatory framework (relations with class societies, port state control, etc.)	1……5
Understanding the market peculiarities the company is facing	1……5
Knowledge and skills not listed here (please state)	

Active seafarers, before assuming shore-based duties, if circumstances allow:

Should attend extensive familiarization training	1……5
Should attend brief on-the-job training with colleagues	1……5
Should attend dedicated training programs with subject specialization (for example, maritime law or budget management)	1……5
Do not need any training	1……5

According to your experience:

Most active seafarers successfully assumed shore duties	1……5
Active seafarers successfully assumed shore duties if provided with appropriate familiarization and/or training, as appropriate	1……5
Active seafarers successfully assumed only those duties for which onboard experience is compulsory (for example, marine pilots)	1……5

According to your experience, active seafarers employed in office jobs mostly:

Return to sea (not able to adapt to the new working environment)	1……5
Return to sea (not satisfied with shore salaries)	1……5
Remain in the office	1……5
Look for another shore job	1……5

EXPECTATIONS AND OPPORTUNITIES

In the future (within the next ten years or so):

A significant shortage of skilled and experienced seafarers serving international trades is expected	1……5
The shortage of well-trained seafarers will be experienced only in the most advanced segments of the industry	1……5
The shortage of well-trained seafarers will be experienced mostly among the shore jobs that depend on shipboard experience	1……5
The seafarers will not need advanced skills, thanks to the high-tech systems on board	1……5
There will be no labour shortage on board and on-shore	1……5

Within the next ten years or so:

Seafaring labour markets will significantly change, mostly in respect of officer-supplying countries.	1……5
Several disruptive technologies will significantly change volumes, trade routes and modes of shipping operations.	1……5
Remotely controlled merchant ships in international trade are expected	1……5
Unmanned merchant ships (no crew on board) in international trade are expected	1……5
There will be no significant changes in marine technology (apart from measures already adopted, for example, those adopted within MARPOL IV)	1……5
Additional wide-ranging measures to minimize GHG emissions (beyond amendments to be applied in 2020) are expected	1……5
A significant increase of seafarers from countries presently not providing significant numbers of seafarers is expected in central Africa, for example)	1……5
The number of European officers will significantly drop, including present supplying countries (for example, Croatia, Greece, Ukraine, and Russia)	1……5

Significant pressure to minimise environmental impact will:

Require upgrade courses for all crew members and shore employees	1……5
Require upgrade courses for crew members only	1……5
Require hiring experts with specialized knowledge of shipboard control systems in the office	1……5
Change the mode of operations for all major players in the shipping arena	1……5
Require more well-trained crew members from developed countries, thus increasing the costs of operations	1……5
Not cause significant changes in the business processes	1……5

Please rank the most needed skills in the years ahead:

Ability to use software solutions, both general-purpose office software and dedicated software (for example, ship maintenance software or software for remote failure analyses)	1
Teamwork skills, including the ability to work in teams involving team members located ashore	2
Creative thinking and problem solving	3
Understanding of international relations, including economic issues	4
Ability to interact with other social partners (clients, cooperatives) using social media and other (sophisticated) modes of communications	5
Ability to effectively communicate in the English language, oral and in writing	6
Ability to understand and manage the complex control systems	7
Ability to effectively learn new skills in a relatively short time	8
Ability to operate multiple control processes using only interfaces and with no physical contact	9
Skills not presently recognized	10

Dear YX,

The SkillSea team will appreciate any comment or suggestion relating to future maritime education and training or promotion of careers in the maritime industry. Kindly post your comments in the box below.

If you would like to receive the results of the research activity, please fill in the following fields:

E-mail

First name

Family name

Thank you for your time and cooperation!