SKILLSEA

RECOMMENDATIONS FOR EDUCATION AND TRAINING

Project SkillSea

Document D1.3

Co-funded by the
Erasmus+ Programme
of the European Union

SKILLSEA

This report was developed through EC funded Erasmus+

SKILLSEA – Future-proof skills for the maritime transport sector.

Objective

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

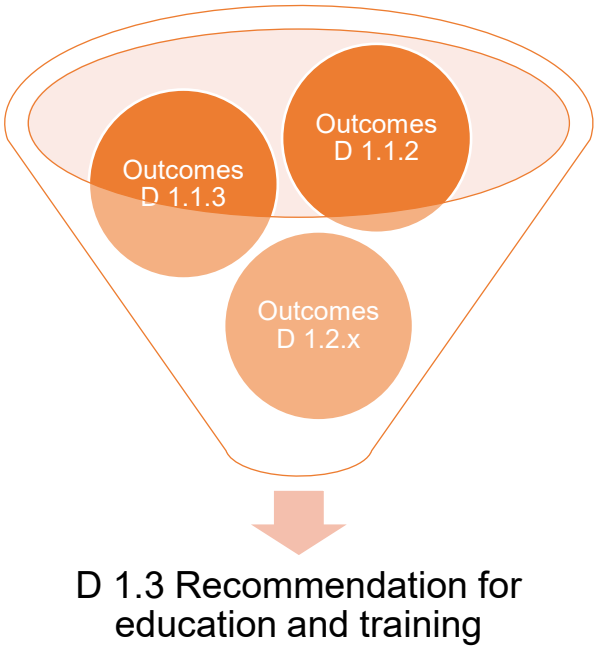
The future-proofing project is developed by the industry's social partners, the European Community Shipowners' Associations (ECSA) and the European Transport Workers' Federation (ETF) and are developed into a consortium with participants from national maritime authorities, shipping companies, shipowners' associations, maritime trade unions and maritime education providers from 16 countries in Europe.

Key aims and objectives include:

- Recommendations for new and updated curriculums to meet the shipping industry current and future needs.
- Recommendations on occupational profiles, implementation, setting up of education programs and specialisations.
- Recommendation on learning methods. State of the art methods, setting up a combination of local and blended training, on-the-job learning and e-learning.
- Overcoming barriers to the mobility of maritime professionals
- Improving cooperation and synergy between education providers, maritime authorities and the industry

PROJECT: SkillSea **PROJECT NO:** 601186

DATE: July 5, 2023 **PROJECT DURATION:** 2019 – 2021

Document information	
Short description	In this report we present recommendations for education and training for maritime professionals destined for employment in the shipping industry.
Work Package	WP 1
Workflow	For the recommendation for education and training, we extensively use the outcomes from our previous studies (D1.1.2, D1.1.3, D1.2.1, D1.2.2, and D1.2.3). Moreover, document analysis (reports, see Methodology report D1.1.1) is also used for triangulating purposes if overlaps of education and training programmes between current and future should be concerned.  .
Deliverable	Report D1.3 Recommendation for education and training
Dissemination level	Public / Project Website
Website link	https://www.skillsea.eu/index.php
Authors	A. Oksavik, H.P. Hildre, Y. Pan
Photo credits	Adobe Stock
Submission date	M36
Version	V1: 4th of November 2020 First draft V2: Jan. 2022 Revised after D1.1.3 finalized. V3: March 2023, updated after D1.1.2 were updated V4: June 2023, revised after comments from internal reviewer V5: July 2023, layout check

Executive summary

Shipping is an important source of direct as well as indirect employment in Europe, and the industry continues to play a key role in world trade and business. The profession of seafaring, especially as reflected in today's shipping industry, is one of the world's oldest. In the past, the skill needs of seafarers changed slowly, and the profession was learned while working, with expertise being passed on from experienced seafarers to apprentices.

Although the IMO STCW has resulted in standardized competency requirements, the Shipping Industry is requiring different and additional qualifications on board. These new skills and competencies put pressure on the IMO STCW Convention to change. However, extending skills and competencies is a key to competitiveness, so the shipping industry doesn't wait for international standards to change but adopt its standards. Maritime clusters promote collaboration with both private and public actors to generate this know-how that updates future skillsets.

We suggest that, if Europe aims to play a leading role in the future shipping industry, the human factor will be key. It is important to improve seafarers' skills concerning three trends: digitalization, sustainability, and soft skills. In the future, maritime professionals must possess key digital, green, and soft management skills to achieve competence at the highest competitive standard.

However, due to digitalisation, sustainable technologies, and globalisation, a lot of pressure to adapt is put on maritime education and training. Onboard seagoing vessels, technology becomes more and more complex, as is seen, through increased automation, autonomy, and digitisation. The possibility to acquire new skillsets through attending new training programs are becoming ever more urgent. Also, in the future, seafarers should have the opportunity to obtain skills that give a flexible and individual career path.

Currently, maritime training and education requirements are slow to adapt to future needs since such change must go through the IMO STCW Convention.

Through our deliverable D1.1.2, Current skills need, based on a survey of 1149 seagoing and 474 shore professionals in the shipping industries across the EU countries, we surveyed and analysed the present skills need. Obsolete skills in the STCW Convention are identified and important missing skills such as maritime economics, law, green shipping, digital, and transversal skills are listed. A list of present skills needed within these areas is identified:

- Maritime economy and business
- Maritime law
- Ship technology
- Digital skills
- Transversal skills
- Green skills

In our deliverable D1.1.3 Future skills and competence need, through a series of interviews with visionary shipping industry leaders, focus groups, literature review of reports on future developments, technology forecasts, and trend analysis, we identified significant future skills gap. The future maritime activity will integrate people and digital technology in a way that transforms how we operate and interact. A new operation paradigm needs to be created to meet these challenges. The key future skill gaps are green shipping skills, digital skills, and operation in highly digital systems. Also, innovation and transversal skills needed for smooth sea-land mobility are underlined as key skills:

- Green shipping skills
- Digital skills
- Operation in highly digital environments
- Innovation skills
- Sea-land mobility and talent attractiveness

As illustrated in the figure, the baseline competence, which includes the competence requirements established through the STCW convention, is expected to be under continuing revisions[1]. Skills gaps, present, and future, are identified in the figure and define the needed competence level at the highest competitive standard. We defined this curve as, **Higher Standard.** From our finding the gap will be growing if no actions are taken.

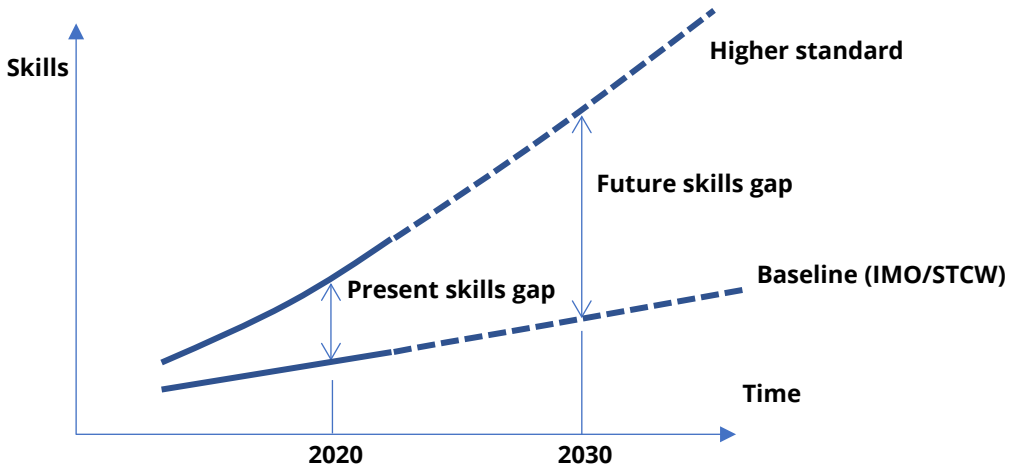


Table 1 in this document gives a summary of the finding and corresponding measures to close the skills gaps.

1 Ongoing minor revisions and a possible major amendment which may be expected in about ten years (2031+), is represented in a linear graph for ease of reference.

We have further followed recommendations for implementation:

1. We recommend a European certificate of Higher Standard as a supplement to the minimum training according to IMO STCW
2. We recommend an upskill course package for maritime professionals. We suggest course modules fulfil the industry's needs, *such as digital, language, and social literacy, as well as ship finance, law, insurance, and management competence* as described in D1.1.2 Current skills need and summarised in the document D1.2.1 Skills and competence gap. The sum of IMO STCW and course packages should correspond to a BSc degree and include in the Bologna qualification framework. The IMO STCW training is implemented differently among the member states in Europe and the recommended course packages may have different content and volume.
3. Skills to realise the maritime industries innovation potential. The future maritime activity will integrate people and digital technology in a way that transform how we operate and interact. A new operation paradigm needs to be created to meet these challenges. The key future skill gaps are green shipping skills, digital skills, and operation in highly digital systems. We suggest that, if Europe aims to play a leading role in the future shipping industry, the human factor will still be a key, but it is a need for a body that can act fast and bring training at the level of the technology development. It is a need, among the European member states and the national Maritime Authorities, to approve new technologies and new operation paradigms.
4. Recommendation for new learning methods and technologies. In terms of digital skills, we suggest utilising VR, AR, simulator-based learning, and other techniques to support the development of future skillsets.

SkillSea WP1 reports

Work Package 1 delivers the following reports: (**D** denotes Deliverable)

Number	Name	Content
D 1.1.1	Methodology	Outline of the methodology used in reports
D 1.1.2	Current skills need Also referenced as: • Current needs • Current skills	Skills need as found by surveying maritime professionals
D 1.1.3	Future skills and competence need Also referenced as: • Future skills • Future needs	Skills need as perceived by industry leaders and visionaries
D 1.2.1	Skills and competence GAP, current and future. Also referenced as: • Skills and competence gap	Summary of D 1.1.2 and D 1.1.3 above
D 1.2.2	Identification of mismatches on a structural basis	Reviewing findings in previous reports and relating them to the structure of obtaining skills in the shipping industry
D 1.2.3	Impact on occupational profiles	How findings in previous reports impact occupational profiles
D 1.3	Recommendations for Education and Training. Short: Recommendations for MET	Summary of findings of previous reports and impact and recommendations for METs

References to reports will be with name and number or name alone or number alone depending on context.

Figures

Tables

Glossary

This glossary does not provide official definitions, but explanations based upon recognised information sources.

Term	Definition
STCW	International Convention on Standards of Training, Certification and Watchkeeping for Seafarers
MET	Maritime Education and Training
EU	European Union
IMO	International Maritime Organisation
ISM	International Safety Management
EMSA	European Maritime Safety Agency
NMA	National Maritime Authority
NEA	National Education Authority
ICS	International Chamber of Shipping
MAIIF	Marine Accident Investigators' International Forum
BIMCO	The Baltic and International Maritime Council
OCIMF	Oil Companies International Marine Forum
NI	The Nautical Institute
ISF	The International Shipping Federation
IFSMA	International Federation of Ship Masters' Associations
IGP&I	International Group of P& I Clubs
IMPA	International Marine Pilots Association
CoC	Certificate of Competency
CoP	Certificate of Proficiency, maritime competency additional to CoC
CBT	Computer-based Training
EQF	European Qualification Framework
MASTER	Highest ranking deck officer on the ship, Captain
WBL	Work Based Learning

Contents

1 Introduction

Shipping is an important source of direct as well as indirect employment in Europe, and the industry continues to play a key role in world trade and business. The profession of seafaring, especially as reflected in today's shipping industry, is one of the world's oldest. In the past, the skill needs of seafarers changed slowly, and the profession was learned while working, with expertise being passed on from experienced seafarers to apprentices. Since the establishment of IMO in 1948, minimum international competence requirements have been established and updated since 1978 through the STCW convention for professional seafarers and are currently the standard that all MET academies deliver against.

The International Convention and Code on Standards of Training, Certification and Watchkeeping for Seafarers is a global regime for governing the minimum competence standard and certification requirements of seafarers. This global regime has now been in place for over 40 years.
Though seafaring is an age-old employment generating sector, as international trade has grown, we have seen from our reports on current and future skills that it has evolved into globalization and this favoured collaboration in the form of clusters. The clusters enabled increased recruitment of professionals and semi-skilled resources from different countries around the world. This has resulted in a shift from national to multinational crews. This change contributes strongly to shipping becoming more dynamic[2]. Although the IMO STCW has resulted in standardized competency requirements, the Shipping Industry is requiring different and additional qualifications on board. These new skills and competencies put pressure on the IMO STCW Convention to change. However, extending skills and competencies is a key to competitiveness, so the shipping industry doesn't wait for international standards to change but implement new standards at a faster rate. Maritime clusters promote collaboration with both private and public actors to generate this know-how that constitutes new and updated future skillsets[3].

2 Lee, P. and Cullinane K. Dynamic shipping and port development in the globalized economy. Palgrave Macmillan, 2016

3 EU. Cluster ACT Cluster ACT

The maritime labour market is changing. ‘Smart’ ships are coming into service, where machines and software take over tasks and create new demands for a generation of competent, highly skilled maritime professionals. We suggest that, if Europe aims to play a leading role in the future shipping industry, the human factor will be key. It is important to improve seafarers’ skills concerning three major trends: digitalization, sustainability, and soft skills. In the future, maritime professionals must possess key digital, green, and soft management skills to achieve competence at the highest competitive standard.

However, due to digitalisation, sustainable technologies, and globalisation, a lot of pressure to adapt is put on maritime education and training. Onboard seagoing vessels, technology becomes more and more complex, as is seen through increased automation, autonomy, and digitisation. The possibility to acquire new skillsets through attending new training programs are becoming ever more urgent. Also, in the future, seafarers should have the opportunity to obtain skills that give flexible and individual career paths as this is necessary to supply the shipping industry with a qualified workforce.

Currently, maritime training and education mandatory minimum requirements are slow to adapt to future needs since such changes require the approval of the IMO STCW Convention. The structure of implementing STCW through national maritime authorities and METS also implies that countries, while conforming to minimum requirements, implement the code differently, between countries and from vocational school to university. As a result, the minimum competence that comes with graduates from METs around Europe is not sufficient for many purposes.

Some countries require and facilitate sea-time, training and exams as an integrated program, others deliver all training during a continuous study program in anticipation of candidates acquiring sufficient on-the-job training and experience to fulfil certificate requirements. On the other hand, MET training programs that prepare seafarers to transition towards land-based jobs, contributing with their operational experience in shore-side jobs, are few or non-existent.

The initial level certificate of competence is awarded based on the STCW Code as implemented by a MET and on the condition of completing the minimum sea time. Further updates of certificates to higher competence levels are implemented differently by countries. In *D 1.2.2 Identification of Mismatches on a Structural Level*, we found that METs in EU countries offering basic education also offer additional training as short courses, for the majority of students/seafarers on a commercial basis with the cost covered either by the seafarer or the employer. We have found the amount of additional competence in STCW, termed Certificate of Proficiency - CoP and competence required by IMO in other codes and conventions as well as competence required by industry above and beyond STCW to constitute in effect a great barrier for seafarers to embark on learning the future skills we have identified in our current and future skills reports. We project that this barrier needs to be reduced or removed for seafarers to realistically update their skillset to meet future needs.

Thus, future seafarers need to orchestrate one’s own career including good seamanship as well as mastering new future technologies. The ships of the future will consist of advanced technology on all levels and will require different and more advanced technical knowledge and expertise than today. The seafarers’ skillsets must be updated continuously to enable a ‘systematic understanding’ of integrated technologies in line with the changes of procedures, such as the complex technologies and automation displayed from bridges to engine rooms.

Moreover, the seafarers’ skillsets must keep up with the rapid changes of shore-based technology and competencies, since seafarers transition to land-based jobs will be important for shore side shipping industries. Land-based jobs often quote sea-going experience as an advantage while requiring good additional skills, typically on BSc level, something few seafarers have acquired.

Altogether the effects outlined above contribute to seafarers being ‘forever-apprentices’ of technology. In a technological society, it is reasonable to expect that people will require training to adapt to technology, a process that needs to be in front of implementing the technological changes and not after they are in daily use.

As much as technology can replace humans’ work it is mostly helping and improving humans’ work and enabling great leaps in productivity and safety. Technology, therefore, continues to be embraced and adopted in work processes and implemented into new business models.

Taken together, these aforementioned factors, with their relationship to sustainable education and career paths, are unlikely to attract new generations to the shipping industry. Also, the concept of green shipping requires a close shipping industry that will introduce significant risks for shipowners to pay more for the technical challenges that we outline.

Chapter 2 presents recommendations for upskilling and future skills. Skills gaps are presented and measures to close the gaps are presented.

Recommendations to close the gaps are presented in chapter 3.

2 Skill needs recommendations

2.1 Previous conclusions

Through our deliverable D1.1.2, Current skills needs, based on a survey of 1149 seagoing and 474 shore professionals in the shipping industries across the EU countries, we surveyed and analysed the present skills need. We found that STCW has been successful in defining and establishing a common standard worldwide and that the shipping industry benefits from such a standard. Major gaps between qualifications according to STCW minimum and expectation in the maritime business are identified. Seafarers have reported that up to 30% of the curriculum in the STCW Convention cover skills that they consider obsolete[4]. Further it was found that seafarers considered important skills missing, such as maritime economics, maritime law, green shipping, digital, and transversal skills.

In our deliverable D1.1.3 Future skills and competence needs, through a series of interviews with visionary shipping industry leaders, focus groups, literature review of reports on future developments, technology forecasts, and trend analysis, we identified significant future skills gaps. The future maritime activity will integrate people and digital technology in a way that transforms how we operate and interact. A new operation paradigm needs to be created to meet these challenges. The key future skill gaps are green shipping skills, digital skills, and operation in highly digital systems. Also, innovation and transversal skills needed for smooth sea-land mobility are underlined as key skills.

In our D 1.2.1 report we summarised the findings in the two previous reports and looked for skills gaps that were identified in both or only one of the reports. If the gap is reported in only the *Current Skills Needs* report and we know that this skills gap is already present but it may pass as it is not found in the *Future Skills* survey. In only the *Future Skills* report and it is a gap that is not presently being experienced in the shipping community and therefore a pure future need. If present in both reports we know it is already being experienced and it is also seen as a future gap through the *Future Skills* survey.

In our D 1.2.2 report we investigated mismatches on a structural basis. By reviewing findings in previous reports and relating them to the structure of obtaining skills in the shipping industry we found three mismatches:

1. The industry need for competence materialises and is clearly visible through a large number of training courses and programmes offered by the shipping industry and associated METs to its members and the maritime professionals in general. There is no efficient pathway to communicate these industry needs in a coordinated manner to METs, maritime authorities and the IMO, who are all part of the process to establish such new competence courses and programmes.
    a) This leads to a huge variety and high number of courses that overlap in content and purpose, and there is no coordinated recognition of increased competence in terms of e.g. ECTS or similar.
2. Competence obtained towards or in addition to the STCW minimum is not recognised by higher education institutions unless it is part of a BSc or MSc education. When not part of a BSc/MSc study program the STCW education does not give credits (ECTS) towards a university degree.
3. Training that goes towards STCW certificate updates such as those resulting from the STCW 2010 Manila updates can only be conducted in the certificate issuing country. This means that seafarers that are working with certificate endorsements in other countries must travel back to their home country to conduct the additional training.

4 The obsolete competencies are likely such as: a) steam engine operation, rarely in use; Ability to determine the ship's position by use of celestial bodies, replaced by GPS; radio communication, replaced by telephone and e-mail)

In our D 1.2.3 Report *Impact on Occupational Profiles* we suggested competence updates to current occupational profiles and new occupational profiles. It has been mentioned in all reports the importance of STCW competence requirements and it can not be emphasised too much. In this report we find that 4 STCW competence profiles are not listed in ESCO and these are recommended as new profiles:

Current Profile	New Profile	STCW
Not in ESCO	Ratings forming part of a navigational watch	A-II/4
Not in ESCO	Ratings forming part of a watch in a manned engine-room	A-III/4
Not in ESCO	Electrotechnical officers	A-III/6
Not in ESCO	Electrotechnical ratings	A-III/7

Table 1: Suggested new occupational profiles in ESCO

A new profile not required by STCW is recommended.

- Digital/Cyber security officer

In addition we recommend to update the profiles as follows:

Current ESCO Position/Role	Added Role	STCW
Deck officer	Environmental officer	A-II/1, A-II/2
Deck officer	Compliance officer	A-II/1, A-II/2
Deck officer	Ship Security Officer	A-II/1, A-II/2

Table 2: Recommendation for profiles to update in ESCO

2.2 Recommendations

The STCW defines very strictly the minimum competence requirements to qualify for a certificate. This is achieved in EU countries through a minimum of two years educational programme and 12 months of onboard training/WBL. (The ratio of candidates completing a 3 year BSc program vs 2 year vocational training is 1:3; see D1.2.3 Chapter 7) The minimum STCW competence to achieve certification is demonstrated as not sufficient to become a “qualified seafarer” in order to obtain employment on a ship (see D 1.2.2 chapter 5.2) as a high proportion of ships require additional STCW training as well as ship owner specific training and ship type training. This is mostly delivered by METs.

In addition to the known training programs related to STCW minimum requirements, we identify some new and updated training which is required for occupational profiles, most notably Environmental officer, Compliance officer and Ship Security Officer.

We therefore suggest to solve this mismatch by offering a structured competence upgrade to seafarers. It will be for the later work packages of this project to explore and make final recommendations as to the details of these competence upgrades and how they can be implemented. Here we provide a limited set of recommendations.

As Figure 1 illustrates, the **Baseline competence,** which includes the competence requirements established through the STCW Convention, is expected to be under continuing revisions[5]. Skills gaps, present, and future, are identified in the figure and define the necessary competence levels. The level necessary to close the "Present skills gap" is named just that. The level to close the Future skills gap is named "Higher standard". From our finding the gap will be growing if no actions are taken.

Below in the following two chapters we have made recommendations in broad terms as to what should be included, in order to close the two skills gaps, **Present skills gap and Future skills gap (Higher standard)**

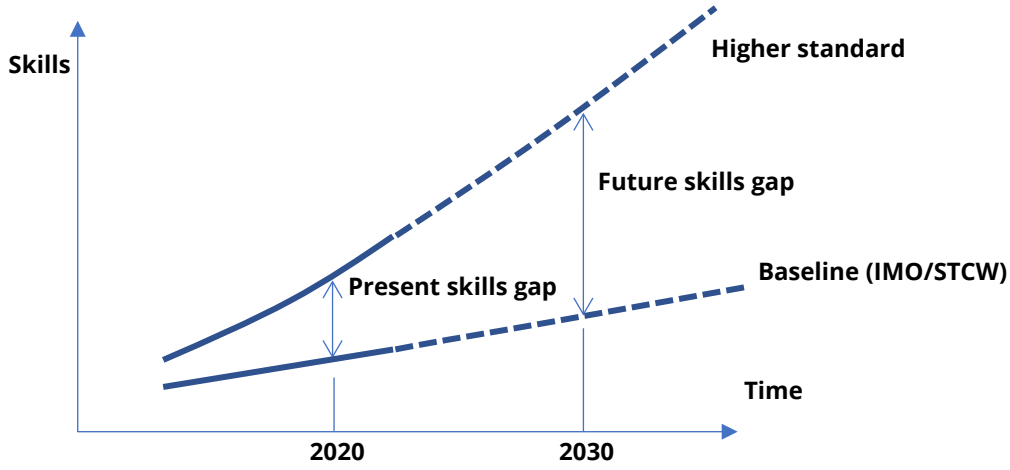


Figure 1: Previous studies on gaps in current and future skills

2.3 Present skills gap

In the D1.1.2 Current skills need report we have identified six types of skill gaps:

Maritime economy and business.

Skills related to various aspects of the maritime economy and business have been dropped from the regular programs for educating seafarers, mostly because there is no such requirement in the STCW Convention. Consequently, numerous MET institutions, as well as shipping are not considering these subjects as sufficiently important to require inclusion into the programs. These skills, although highly welcome for on-board positions, are mandatory for positions ashore, particularly for medium and top management in shipping. They represent core professional skills for shore-based management, although the importance of different aspects may vary significantly across different positions.

[5] Ongoing minor revisions and a possible major amendment which may be expected in about ten years (2031+), is represented in a linear graph for ease of reference.

According to the survey, the following topics are considered the most valuable to both seafarers and shore-based personnel:

- Maritime business and economy
- Safety and risk management
- Ship operations and crew management
- Maritime regulations and port operations

Maritime law

Although not all the skills related to various aspects of the 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. The skills in this group are welcomed on board but are not a mandatory requirement. Contrary to this, for positions at the management level ashore these skills are frequently compulsory. Since many 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 pro for former seafarers needs to cover the subject area in at least several courses, being individually selectable and focused on the main functions of shipping companies or similar ventures (insurance, claims, etc.). The subject area may be partitioned in different ways reflecting the previous knowledge of former seafarers, their work schedules, and selected modes of delivery.

According to the survey, the following topics are considered the most valuable:

- Rights of seafarers and maritime workers
- Insurance
- Claims

According to the survey, shore-based respondents selected the same maritime law topics as the most important seafarers. In addition, they believe the following topics are also valuable:

- Collisions
- Carriage of goods by sea

Ship technology

The skills related to ship technologies (particularly the use of different equipment) are the most frequent skills described in the present STCW Convention. However, these skills mostly refer to technologies' common on a ship trading in the mid-1990s, i.e. at the time when the first major revision of the STCW Convention had been prepared.[6] 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 will become obsolete. Consequently, these trends should be considered during the next revision of the STCW Convention.

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

When new technologies are being introduced, up-skilling of seafarers looking for the job ashore through numerous short courses depends on the intra-company training programs and the vessel type such company employs. A more helpful 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[7]). In this case, it would be possible to extend the scope of the courses beyond safety, security, and pollution prevention. According to the survey, currently, the following topics are considered the most valuable:

- Dynamic positioning operations
- LNG operations.

Digital skills

Digital skills required on-board 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 specializing in the maintenance of integrated and 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, as well as for those working ashore.

Presently, digital skills are not part of the STCW Convention. However, most active seafarers today already acquire a minimal set of digital skills (mailing, basic spreadsheet, and word processing). The level of acquired digital skills is left to each person, and it significantly depends on personal inclinations. To improve digital skills among seafarers, but also to recognize skills already acquired by seafarers, a formally recognized set of digital skills and assessment methods (standard of proficiency) should be developed. It may prescribe several levels of proficiency. To ensure effective implementation, the standard of digital proficiency could be included in the STCW Convention.

According to the survey, the following topics are considered the most valuable to seafarers:

- 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, create documents using formatting options, to create original drawings or illustrations.
- Shore-based respondents have chosen the same digital skill topics as seafarers.

Transversal skills

A key success factor for the career development of seafarers is the implementation of and training of transversal skills such as creative thinking, time management and problem-solving, Understanding corporate culture, knowledge of internal procedures, written communication skills (technical reports et.al.), and many others.

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

Maritime professionals onboard ships work in a structured hierarchy in which higher ranks have authority over lower ranks and, for a large part, the ships' crew is confined to staying together 24 hours a day. The ship's voyage and the maritime environment serve as strong common motivators to accomplishing tasks or facing collective wrath. Transitioning to shore means working in looser hierarchies, and leadership competence, such as motivating team members, becomes more prominent, as well as only being available during work hours.

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

If compared with lists of commonly accepted transversal skills, it is easy to identify that the program seafarers are required to attend deals only with a limited set of skills; most 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. If compared with the key competencies as recommended by the European Parliament, then almost all transversal skills are missing in the STCW Convention. Therefore, it seems that transversal skills of the presently active European seafarers are much more the outcome of primary and secondary education, company-specific training, culture, tradition, and personal inclination.

Regarding the transversal skills required for shore jobs in the maritime industry, the standard outlined in the STCW Convention appears below the industry's requirements. Consequently, additional opportunities to acquire these skills should be provided. Since such skills are useful in all situations and at all jobs, the development of an appropriate set of training programs and tools is recommended. The pro and tools should be developed with the industry needs in mind.

According to the survey, the following topics are considered the most valuable to seafarers:

- Teamwork and leadership
- English language
- Oral communication
- Aural communications

Shore-based personnel have chosen the same four topics but also have more expectations:

- Ability to use standard office software
- Understanding corporate culture
- Knowledge of internal procedures
- Ability to effectively write technical reports and similar documents
- Entrepreneurship

Green skills

According to CEDEFOP[8], "Developing a low-carbon economy depends [more] on improving existing skills rather than specialized green skills."

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

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

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

It is, however, important that the management level on board is aware of current environmental legislation, company strategies, and their translation into operations. It is a good example where ship- and shore-based management need to work closely together. Respective training courses are suggested in WP 2.

Concluding remarks

An important conclusion from this survey is that it is an urgent need for up-skill. Important topics are identified.

2.4 Higher standard (Future skills need)

In this section, we present a summary of future skills enhancement based on our study D 1.1.3 Future skills and competence need. The study is based on the voices of maritime experts, focus groups, literature review, technology forecast, and trend analysis. A common understanding is that ships will be smarter and greener.

Green shipping skills

A continuous stream of new technologies is being introduced in the shipping industry to ensure that it meets new operational limitations set by environmental regulations. For example, leading shipping companies (Maersk CMA CGM, MSC, and Hapag-Lloyd) team up to drive emission reductions faster than regulators. The CO_2 reduction targets and new sulphur emission limits are key drivers of these technology developments. As part of regulatory compliance, several technologies are likely to be improved - for example, hydrodynamics, new fuel, and energy sources, logistics, and methods for effective harbour operations.

Currently, the only technically applicable al fuel for this is liquefied natural gas (LNG) and sustainable advanced biofuel. In addition, systems to reduce emissions and particulate matter in harbours and the proximities to cities will be important.

8 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 survey, the following topics are considered the most valuable to seafarers:

- Measurement, calculation and documentation of emissions, EU, and international legislation
- Operation of complex hybrid and zero-emission machinery
- Environmental economics, performance management systems
- Logistics and optimization methods to achieve high vessel utilization
- Advanced routing, considering factors such as wind, current, and waves
- How to handle a variety of fuels (toxic content, explosion, etc.)

Digital skills

Ships will be smarter, data-driven and connected to the rest of the world. We are facing a stream of new digital technologies and we will see new solutions in the years to come. It is a precondition to master technologies such as digital communication and teamwork, sensors, IoT, networks, Ship 4.0, cyber security and so on.

In-depth skills to understand complex systems, onboard and onshore, is needed to be able to serve the needed redundancy of all systems. Skills to update, service and repair digital systems are also needed.

Seafarers should know how to interact with the computer systems to respond to challenges in the operation of automatic systems, such as when routes are changed, or ships are in hazardous waters.

According to the survey, the following topics are considered the most valuable to seafarers:

- Basic digital technology skills as
    - Sensors
    - IoT
    - Networks
    - Connectivity and
    - Cyber security
    - Ship 4.0/ Industry 4.0
- Advanced analytics and use of data in optimisation of the fleet
- Deep understanding of the complex systems on board and systems connected to the ship to be able to serve the needed redundancy of all systems
- Updating, servicing, and repairing digital systems

Operations in highly digital environments

Seafarers are becoming system managers. In-depth skills to understand complex systems, onboard and onshore, is needed to be able to serve the needed redundancy of all systems.

Distributed maritime capabilities where knowledge and competence are increasingly distributed to technology, procedures and regulations will change the role of the individual seafarers. Vessel positions, manoeuvres, speed, fuel consumptions, cargo condition and so on can for example be monitored in control centres. Fleet managers will then be able to analyse this data, enabling them to advise the captain and crew on navigation, weather patterns, fuel consumption and port arrival. We will have distributed maritime capabilities as well as dispersed ship crew with other roles and responsibilities than we can see in present operations. Soft skills are needed to master communication throughout the value chain.

The fixing of malfunctions on-board often requires outside expertise from the suppliers. While ships were traditionally autonomous organisational systems that the seafarers on board mastered alone, ships are now increasingly part of large networks of ships, several internal and external IT systems, control centres, yards, certification agencies and regulations. Common broker platforms and e-commerce will simplify and secure the supply chain and reduce the amount of paperwork in the value chain under the heading of blockchain technology. These advances enable integration of the business process and reduce transaction costs.

The complexity of sociotechnical systems into which ships are increasingly woven requires increasingly complex control systems. We have coined this transition distributed maritime capabilities and the use of dispersed teams.

Also, sensor data from onboard integrated machinery systems are being increasingly transferred to shore centres. Digital twins enable real-time data analytics by use of AI and machine learning tools to support rich management and operational view of the entire supply chain. This technology will enable a high degree of streamlining of operations from ship control centres.

According to the survey, the following topics are considered the most valuable to seafarers:

- Seafarers are becoming system managers. They need a deep understanding of complex systems.
- Seafarers should know how to interact with the computer systems to respond to challenges in the operation of autonomous ships, such as when routes are changed, or ships are in hazardous waters.
- The future fleet will be continually communicating with its managers that is continually monitoring vessel positions, manoeuvres, and speeds. Fleet managers will be able to analyse this data, enabling them to advise the captain and crew on navigation, weather patterns, fuel consumption, and port arrival.
- Distributed capabilities and dispersed teams. Sharing of work tasks due to shore-based control centres supporting ships and remote operations.

Innovation skills

Regions with good maritime education and training combined with surrounding industrial clusters of advanced companies will have a precondition to developing new competencies for the maritime industry's future workforce.

Maritime professionals (seagoing and land-based professionals) have for decades contributed with operational maritime experience and knowledge to companies in the maritime sector, and they are still crucial for realising much of the maritime industry's innovation potential. Close interaction between maritime professionals and researchers provides a faster and more precise path to innovations.

According to the survey, the following topics are considered the most valuable to seafarers:

- Understanding of business development taking advantage of digital technology (for example cargo tracking, cargo and machinery condition monitoring, logistics in digitally connected value chains, smart port operation, fleet management, e-brokerage, smart commerce with blockchain)
- Good maritime education and training located in strong industrial clusters will have a precondition to developing new competencies
- Close links between education institutions and industrial clusters can foster innovation as knowledge creation and strength of R&D

Sea-land mobility and talent attractiveness

A key finding from the expert group is the importance of transversal skills within future maritime competencies. These skills are vital to moving from one value chain to another. Lifelong learning programmes are needed to enable seafarers to work across industries and services in the maritime shipping sector.

Mobility and possibilities to enter a variety of occupations are needed to attract young talents.

According to the survey, the following topics are considered the most valuable to seafarers:

- Transversal skills needed to move from one value chain to another
- It is a need to establish suitable lifelong learning programmes that enable seafarers to work across industries and services in the maritime shipping sector
- Maritime clusters with a variety of job opportunities and career paths are a key to talent attractiveness
- Improved interface between seagoing and shore-based jobs can help with building up transversal competencies and skills in the maritime sectors.

Concluding remarks

The skills identified in our investigation (D1.1.3 Future skills and competencies) and presented in this chapter are first preparing the maritime professional to enhance their performance for a predicted future development. How digitalisation and sustainability are changing our society are key drivers for these skills. The role of maritime professionals in an industrial cluster is also highlighted.

2.5 Clustering of findings

A summary of D1.1.2 Current skills needs and D1.1.3 Future skills and competence needs is set up in document D1.2.1 Skill and competence gap. The findings are grouped according to the following 8 challenges:

1. Shortage of maritime professionals
2. Mobility issues and talent attractiveness
3. Communication, culture, and language issues
4. Core shipping management skills, including leadership
5. Digital skills
6. Operation in highly digital environments
7. Transversal skills
8. Green skills

A summary of the present of future skill gaps for each of the challenges is given in Table 1.

2.6 Recommended measures

In our D 1.2.1 report, we consolidated the findings in our current and future reports into a table of recommended measures that respond to identified challenges with the purpose to close the skills gaps. These are listed here in Table 1 for reference.

These measures are to be considered as early recommendations to be further considered by the later work packages of the project, implying that some of these recommendations may be followed and some may not.

2.6.1 Measures that respond to identified challenges with the purpose to close the gaps

Table 3: Measures that respond to identified challenges with the purpose to close the gaps.

Challenge	Present skill gaps (from D1.1.2)	Future skill gaps (from D1.1.3)	Recommended measures
Shortage of maritime professionals	Restricted ship-to-shore mobility Life-long learning (LLL) Educational programs are not adapted to seafarers needs (Lack of LLL and programs targeting seafarers, adapted to undertake onboard vessel or off duty) The public image of the profession	Lack of qualified maritime professionals Difficulty to attract and educate talents (few highly educated maritime professionals) Maritime clusters with a variety of job opportunities and career paths are a key to talent attractiveness	• Coordinated action (at EU level) should be initiated by strategy plan WP3, aiming to change public perception of the maritime industry, particularly in respect of seafarers. • Study programmes offered by MET institutions should include topics/courses covering subjects beyond and above STCW requirements. • MET institutions should be encouraged by strategy plan WP3 and implementation WP5 to increase the number and scope of study programmes aiming to up-skill seafarers • Maritime industry should cooperate more closely with maritime administrations and MET institutions to provide trainees with more opportunities for practical training. This should be planned and implemented in WP3 and WP5 • Maritime professionals should have easy access to Lifelong learning programs that enable them to move between value chains and work across industries and services in the maritime shipping industry. This should be planned and implemented in WP3 and WP5
Mobility issues	Resistance to relocate Labour competition Unfit communication Horizontal mobility of seafarers from ship to shore is often hampered by lack of information about on-shore job availability, recognition of maritime qualifications, training courses covering shore job	Need seafarers to work in multidisciplinary areas Limitation of qualified seafarers Need professionals skilled in digitalisation Understanding of innovation and business development taking advantage of digital technology	• The courses aiming to upgrade or re-skill shore workers associated with the maritime industry should be promoted by strategy plan WP3 and Toolkit WP2. • Student exchange between MET institutions across the EU should be further promoted by strategy plan WP3 to ensure an appropriate understanding of different cultures. • Academic staff exchange should be further promoted to accelerate the update of study programmes. They should be encouraged to gain ability in the use of new teaching methods

	requirements and by lack of horizontal skills required for shore jobs		to the up-skill workforce, i.e., an e-learning platform. This should be promoted by WP2, new courses for teachers • A qualification system is needed to achieve formal qualifications for land-based jobs and to enter higher educations at universities. This should be planned and implemented in WP5 • Therefore, to ensure the smooth development and steady delivery of a properly trained workforce, cooperation between knowledge providers and the industry, with authorities being heavily involved, is crucial.[9]
Communication, culture and language issues	The main reasons for unsatisfactory communication are usually attributed to different cultural and organisational schemes, caused mostly by very different drivers affecting various partners. Ability to effectively communicate in the English language	Ship-based leadership skills need to be transferred to shore-based jobs	• Courses aiming to upgrade seafarers' communication and language skills should be promoted by new courses in WP2. • EU-wide standards of proficiency in language skills for people working in the maritime industry should be considered and strategically planned by WP3. • EU-wide programmes of measures aiming to increase cultural awareness should be considered by both WP3 and WP5. • Courses aiming to upgrade management and leadership skills should be developed and promoted by WP2.
Core shipping management skills, including leadership	Lack core competencies concerning maritime economy, business, law and ship technology, mostly because there is no such requirement in the STCW Convention The approach applied in the present STCW Convention is to require seafarers, wishing to sail aboard sophisticated ships or to perform certain duties aboard[10], to attend additional short courses (lasting 3 to 5 days mostly) and to upgrade their skill sets.	Need people with core competencies concerning maritime economy, law, and ship technology	• Courses aiming to upgrade knowledge and skills of the maritime industry workforce should focus on linking up the interactions between seagoing positions and land-based occupations, covered by WP2. Courses should be modular and flexible in terms of duration, scope and delivery. • Courses aiming to upgrade the knowledge and skills of seafarers should be promoted by WP2. Courses should be modular and flexible in terms of duration, scope, and delivery. Degrees awarded should be comparable and based on the ECTS system.

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

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

			• Courses aiming to upgrade business management, economics and law should be developed and promoted in WP2. • Courses aiming to upskill seafarers in the use of integrated and complex systems should be developed and promoted in WP2. • Courses aiming to up-skill seafarers' analytical skills should be developed and promoted in WP2.
Digital Skills	Training of analytical tools and dedicated software is outside STCW. To improve digital skills among seafarers, but also to recognise skills already acquired by seafarers, a formally recognised set of digital skills and assessment methods (standard of proficiency) should be developed. 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.	Seafarers and maritime professionals need to use new technologies/methods to support operational modes Need people to use integrated systems with analytical skills, data representation, and computing skills Understanding of complex systems onboard and systems connected to the ship to be able to serve the needed redundancy of all systems Updating, servicing, and repairing digital systems	• Courses aiming to upskill seafarers in the use of standard software tools should be developed and promoted in WP2. They should be by the standard EU set of skills as planned by strategy WP3 (DigComp 2.0). • Courses aiming to upskill seafarers in remote monitoring, surveillance and control technologies should be developed and promoted in WP2. • Courses aiming to upgrade shore-based employees' skills in maritime information and control systems should be developed and promoted in newly developed courses by WP2. • Courses aiming to upskill seafarers in the use of new technologies/methods should be developed and promoted in new courses delivered by WP2, i.e., VR, Simulator and so on. • Courses aiming to upskill seafarers in data analysis, computing skills, and data representations should be developed and promoted by new courses delivered by WP2 for both teachers and students. • Courses in cyber security for seafarers and shore-based employees should be promoted by WP2

Operation in highly digital environments		Seafarers are becoming system managers. They need a deep understanding of complex systems. Seafarers should know how to interact with the computer systems to respond to challenges in the operation of autonomous ships, such as when routes are changed, or ships are in hazardous waters. The future fleet will be continually communicating with its managers that is continually monitoring vessel positions, manoeuvres, and speeds. Fleet managers will be able to analyse this data, enabling them to advise the captain and crew on navigation, weather patterns, fuel consumption, and port arrival. We will see distributed capabilities due to increased connectivity and the use of dispersed teams. Distributed capabilities and dispersed teams. Sharing of work tasks due to shore-based control centres supporting ships and remote operations.	• Curses aiming to upgrade or re-skill workers associated with complex systems automation systems and autonomy should be promoted by strategy plan WP3 and Toolkit WP2. • Courses aiming to upskill seafarers in interaction with advanced s systems to respond to challenges in the operations of autonomous ships should be developed and promoted by WP2. • Courses supporting distributed maritime capabilities where knowledge and competence are distributed to technology, procedures, and regulations as well as shared between the seafarers and land-based organisation should be promoted by strategy plan WP3 and Toolkit WP2. • Courses aiming to upgrade service and repair in cooperation with real-time cooperation with land-based suppliers should be promoted in WP2.
Transversal skill[11]	Minimal requirements for transversal skills, i.e. skills mostly used onboard are listed in the STCW Convention	Need maritime professionals to integrate with the existing workforce.	• Courses aiming to upskill seafarers in the human element, leadership and management skills beyond those already outlined in the STCW

11 The STCW 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 prioritization. 2) Knowledge and ability to apply effective resource management: allocation, assignment, and prioritization 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.

	Seafarers did not plan for lifelong learning, concerning constant upskilling. If compared with the key competencies as recommended by the European Parliament, then almost all transversal skills are missing in the STCW Convention Seaside communication and leadership are hierarchical by certificate. And landside is about leading and coaching. They are different environments.		Convention should be developed and promoted by WP2. • EU-wide programmes of measures aiming to promote "learning to learn" attitudes should be promoted in strategical plan WP3 and implementation WP5. • Courses aiming to widen seafarers' skills in collaboration with land-based personnel should be developed and promoted by WP2.
Green skills	Developing a low-carbon economy depends [more] on improving existing skills rather than specialised green skills. The main causes and effects of processes taking place in sea transport and influencing the environment should be clearly explained both to shipboard as well as to shore-based personnel	Need maritime professionals to understand why and know how to use high-tech equipment and integrated systems to protect the environment Measurement, calculation and documentation of emissions, EU, and international legislation Operation of complex hybrid and zero-emission machineries Environmental economics, performance management systems Logistics and optimisation methods to achieve high vessel utilisation Advanced routeing, considering factors such as wind, current, and waves How to handle a variety of fuels (toxic content, explosion etc.)	• EU-wide programmes of measures aiming to increase environmental awareness should be considered in the strategical plan in WP3 and implementation in WP5. • Courses aiming to upskill seafarers in procedures and operations of complex hybrid machinery should be developed and promoted in WP2. • Courses aiming to upskill seafarers in how to handle a variety of fuels (for example hydrogen and ammonia) and batteries concerning risks should be developed and promoted in WP2. • The courses aiming to upgrade or re-skill shore workers associated with the maritime industry should be promoted by strategy plan WP3 and Toolkit WP2.

2.7 Recommendations for occupational profiles

We have seen in previous reports that for the basic educational profiles of seafarers there are to some degree corresponding occupational profiles in ESCO. For positions requiring additional competence to CoC, both inside and outside of STCW there are no profiles listed in ESCO.

2.7.1 Occupational profiles in ESCO and STCW

From our report D 1.2.2 Impact on occupational profiles, we have the table 2, where occupational profiles in ESCO and in STCW, and in other IMO codes and conventions are identified. We see that several profiles that arise from STCW/IMO are not listed in ESCO.

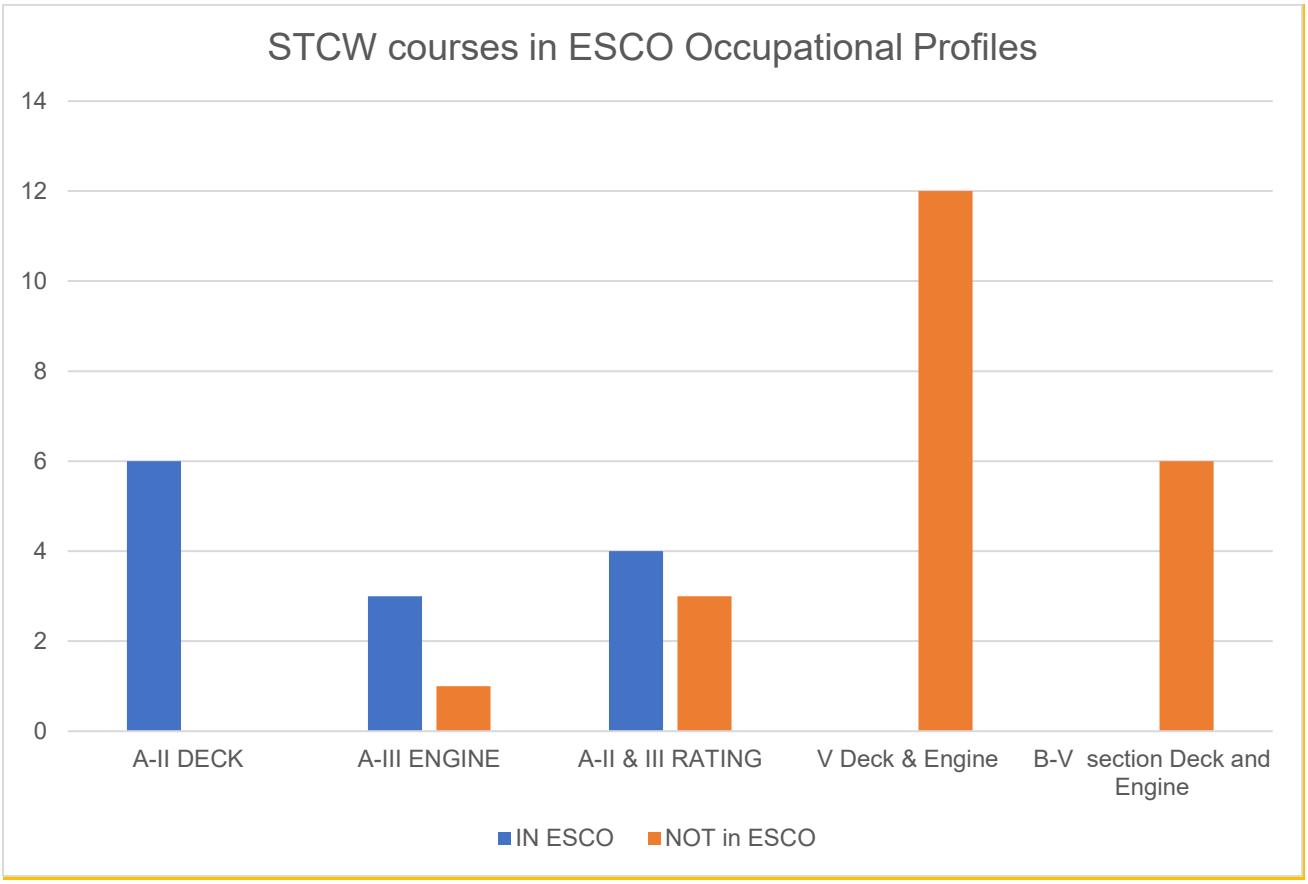


Figure 2 STCW qualifications in ESCO

2.7.2 Courses required by other IMO codes and conventions

The courses listed below are examples of training required through IMO codes which are not part of STCW but which are mandatory for seafarers when sailing on ships that are covered by those codes. The list of mandatory codes that is the origin of competence requirement can be found in D 1.2.3, chapter 9.4.

POSITIONS AS STATED	ESCO OCCUPATION	REFERENCE
Officer on Highs Speed Craft: HSC deck officer HSC engine officer	Not listed	IMO 2000 HSC Code
Deck officer, Engine officer – competency on security related equipment such as Winch and ECDIS (product specific)	Not listed	IMO ISM Code
Deck or engine Ship security officer	Not listed	ISPS Code
The international maritime dangerous goods code	Not listed	IMDG Code
Code for approval of ballast water management systems	Not listed	BWMS Code

Table 4: Occupational profiles from other IMO codes than STCW, and not listed in ESCO

2.7.3 Additional competence required by Industry

We have seen from our report on *Identification of Mismatches on a Structural Basis D 1.2.2*, that the shipping industry is requiring a wide range of additional competence, which is offered by the industry to its employees, to employees of member companies, and to the market in general.

This additional competence is widely fragmented and not coordinated across the many providers, other than within the various industry associations.

2.8 Skills need for maritime occupation profiles

2.8.1 Sea

It seems consistent that educational authorities in all EU countries provide educational programs that fulfil the mandatory minimum requirements. This is evident from our analysis of the MET programs in EU countries in the report D 1.2.2. Identification of Mismatches on a Structural Basis.

The **mandatory minimum** is the competency required to achieve a Certificate of Competency, a CoC. For some ship types this is the actual minimum competence but as shipping has become more complex and more diverse, (SkillSea reports D1.1.2 & D1.1.3) additional competence is required that is not covered by the mandatory minimum CoC and is not part of the compulsory study program of METs. This must be added and depends mostly on what type of ship the seafarer is going to work on.

On the one side it is to be expected that governments are reluctant to finance education that go beyond the minimum requirements as these can add up to significant additional education which would then lead to longer and more expensive education, while much of it will not be immediately useful since this is for specific ship types. For example, conducting additional training for passenger ships if the student is going to sail on a chemical tanker and vice versa is not immediately useful.

On the other side, to deliver an education that portrays to deliver the mandatory competence to fill a position, but which turns out to be insufficient in a wide range of cases, is to a degree misleading. This is probably not intentional, but more a result of circumstances, where the mandatory minimum should be sufficient but turn out to not be so.

The situation that persists from this is that the additional competence of CoP and additional and beyond STCW competence is added later through short courses when the seafarer decides to take employment on a ship type that is not covered by the mandatory minimum. The seafarer then must finance this in order to be eligible for employment on this type of ship or the **shipowner/operator/crewing company** has to cover the cost.

We thus have a situation where an employer has to upskill its employees without any guarantee that the

employee will stay in the job. There is a possibility that the employee may get poached by a competitor or that certain competitors choose to 'steal' workers upskilled by others rather than bearing the cost of the upskilling itself. Such situations have been found to be a key cause for skills gaps[12]

The courses that are covered by STCW and a representative sample of courses that are offered by industry is listed in D 1.2.2, chapters 2.5.2, 2.9 and 5.1. In addition, there are programs within other codes than STCW in IMO that require training for seafarers but has not made it to STCW yet, some of these are listed in D 1.2.3, chapter 3, table 2: Other IMO codes alongside the STCW.

In summary, it is clear that seafarer basic education needs first to offer more training than today and that one should start with including the STCW CoP programs listed in sections A-V, A-VI, B-V/a-g and competence requirements listed in other codes such as the HSC – *International Code of Safety for High-Speed Craft, 2000 (2000 HSC Code),* which sets special training requirements for seafarers working on High-Speed craft.

The competence that is listed above is agreed upon internationally through IMO and even if they are not implemented in STCW yet, they are well aligned towards shipping industry needs.

Based on our findings, seafarers' education should be developed to include the skills outlined in the table below, where the key challenges are responded to with suggested measures and skills. However, we also find from our analysis, that seafarers are required to complete a high number of IMO courses, most of them described in STCW section A and B, and some courses due to other IMO conventions. This induces a great pressure and burden on the shipowner/operator to organise and pay for these training and on the seafarer to spend free time to upskill and for some to pay for the courses in order to be eligible for employment. We see this from the courses offered by MET academies that are not part of an educational program. When this situation persists, it will be very difficult for seafarers to embark on additional training modules on top of the ones mentioned above at their own or ship-owner/operator cost. So we suggest that the IMO CoP programs mentioned above become part of compulsory MET study programs so that seafarers are ready to conduct future-oriented training outlined in the table below.

Next, It is equally important to consider establishing educational programs and LLL programs that cover the elements listed in D 1.2.3 Impact on Occupational Profiles **Chapter 6**, **Skills update for sea-side occupations.**

Table 5: Skills impact on sea-side occupational profiles

Challenges	Possible measures (Abbreviated from D 1.2.1)	Skills update	Target group
Shortage of maritime professionals	Study programme offered by MET institutions should include topics/courses covering subjects beyond and above STCW **minimum** requirements.	Mobility Transversal Leadership Culture & comm. Green skills Operations in a digital world Digital	Seafarers

12 Journal of Vocational Education and Training, Vol. 59, No. 4, December 2007, pp. 467–484 Marine and maritime sector skills shortages in the South-West of England: Developing regional training provision. Julian Beer and Kevin Meethan* University of Plymouth, UK:
"One of the main barriers to overcoming skills gaps is the voluntaristic nature of VET provision within the UK, a situation where the training of the workforce is undertaken at the discretion of the employers, rather than on the basis of any national statutory requirement (Rees, 1997; Cooke et al., 2000; Sims et al., 2000; Cockrill, 2002; Hoque, 2003; Unwin, 2004; Unwin et al., 2004; Hoque et al., 2005). There are a number of immediate and recognised drawbacks with such a system. First is the danger that employers who invest in training staff run the risk of losing both money and workers if they are subsequently 'poached' by rival employers, who have not borne the cost."

	Maritime professionals should have easy access to Lifelong learning programs that enable them to move between value chains and work across industries and services in the maritime shipping industry.	Life-Long Learning	Seafarers
Communication, culture and language issues	EU-wide, regional or national programmes of measures aiming to increase cultural awareness should be considered	Culture skill with an assessment as part of a sea-farer certificate or diploma	Seafarers
	Courses aiming to upgrade leadership skills	Leadership skill with an assessment as part of the sea-farer certificate or diploma	Management level deck and engine officers
Core shipping management skills, including leadership	Courses aiming to upgrade knowledge and skills of seafarers. Courses should be modular and flexible in terms of duration, scope, and delivery. Degrees awarded should be comparable and based on the ECTS system	BSc in Shipping Management, with work based learning and additional LLL courses conducted as distance learning Mobility Transversal leadership Culture & comm. Green Operations in a digital world Digital	Management level deck and engine officers
	Courses aiming to upskill seafarers in the use of integrated and complex systems	Qualifications in integrated and complex systems	Management level and operational level deck and engine officers
	Courses aiming to up-skill seafarers' analytical skills	Analysis, critical thinking, systems engineering (transversal skills)	Sea-side officers
Digital Skills	Courses aiming to upskill seafarers in the use of standard software tools in accordance with the standard EU set of skills	Skills using standard software tools	Sea-side officers
	Courses aiming to upskill seafarers in remote monitoring, surveillance and control technologies should	Remote monitoring, surveillance and control technologies	Management level deck and engine officers

	be developed and promoted in WP2.		
	Courses aiming to upskill seafarers in the use of new technologies/methods, i.e., VR, Simulator and so on.	New technologies/methods, i.e., VR, Simulator and so on	seafarers
	Courses aiming to upskill seafarers in data analysis, computing skills, and data representations	Data analysis, computing skills, and data representations	seafarers
	Courses in cyber security for seafarers and shore-based employees	Cyber security skills	Seafarers
Operation in highly digital environments	Curses aiming to upgrade or re-skill workers associated with complex systems as for example automation systems and autonomy	Complex systems for example automation systems and autonomy	seafarers
	Courses aiming to upskill seafarers in interaction with advanced socio-technical systems to respond to challenges in the operations of autonomous ships	Advanced sociotechnical systems to respond to challenges in the operations of autonomous ships	seafarers
	Courses supporting distributed maritime capabilities where knowledge and competence are distributed to technology, procedures, and regulations as well as shared between the seafarers and land-based organisation	Supporting distributed maritime capabilities	seafarers
	Courses aiming to upgrade service and repair (equipment) in cooperation with real-time cooperation with land-based suppliers	Upgrade service and repair (equipment)	seafarers
	Courses aiming to upskill seafarers in the human element, leadership t skills beyond those already	Human element, leadership	seafarers

Transversal skill[13]	outlined in the STCW Convention		
	EU-wide programmes of measures aiming to promote "learning to learn" attitudes	"Learning to learn"	Seafarers
	Courses aiming to widen seafarers' skills in collaboration with land-based personnel	Workload management, communication, decision making	Seafarers
Green skills	EU-wide programmes of measures aiming to increase environmental awareness	Environmental awareness	seafarers'
	Courses aiming to upskill seafarers in procedures and operations of complex hybrid machineries	Complex hybrid machineries	seafarers
	Courses aiming to upskill seafarers in how to handle variety of fuels (for example hydrogen and ammonia) and batteries with respect to risks	How to handle variety of new and zero emission fuels	seafarers

2.8.2 Shore-Side

Shoreside need for competence is outlined in the table from D 1.2.3 Impact on Occupational Profiles Chapter 6.2, Skills update that impact land-side occupations.

13 The STCW 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 prioritization. 2) Knowledge and ability to apply effective resource management: allocation, assignment, and prioritization 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.

Table 6: Skills impact on shore-side occupational profiles

Challenges	Possible measures (Abbreviated from D 1.2.1)	Skills update	Target group
Shortage of maritime professionals	Study programme offered by MET institutions should include topics/courses covering subjects beyond and above STCW minimum requirements.	Mobility Transversal Leadership, culture & comm. Green skills Operations in a digital world Digital	MET Academics
	Maritime professionals should have easy access to Life-long learning programs that enable them to move between value chains and work across industries and services in the maritime shipping industry.	Life-Long Learning	MET teachers Shipping industry HR employees
Mobility issues	Courses aiming to upgrade or re-skill shore workers associated with the maritime industry.	Mobility Transversal Leadership, culture & comm. Green Operations in a digital world Digital	MET teachers Shipping industry employees
	Student exchange between MET institutions across the EU to facilitate appropriate understanding of different cultures.		MET teachers & Educational authority need competence in mobility.
	Academic staff exchange should be further promoted to accelerate update of study programmes. They should be encouraged to gain ability in use of new teaching methods to up-skill workforce, i.e., e-learning platform.		MET teachers need competence in new teaching methods (suitable to reach seafarers/seafarers needs)
	EU-wide standards of proficiency in language skills available for people working in the maritime industry should be considered	Language skill with assessment as part of the sea-farer certificate or diploma.	Language skill with assessment required for land-based positions
Core shipping management skills, including leadership	Courses aiming to upgrade knowledge and skills of maritime industry workforce should focus on linking up the interactions between seagoing positions and land-based occupations. Courses should be modular and flexible in terms of duration, scope and delivery.	For example, BSc in Shipping Management, with work based learning and additional LLL courses conducted as distance learning. Mobility Transversal Leadership, culture & comm. Green	Maritime industry workforce

		Operations in a digital world Digital	
	Courses aiming to upgrade business management, economics and law	Transversal Leadership, culture & comm. Green	Legal Finance
Digital Skills	Courses aiming to upgrade shore-based employees' skills in maritime information and control systems	Maritime information and control systems	shore-based employees'
	Courses in cyber security for seafarers and shore-based employees	Cyber security skills	shore-side employees
Operation in highly digital environments	Curses aiming to upgrade or re-skill workers associated with complex systems as for example automation systems and autonomy	Complex systems as for example automation systems and autonomy	shore-side employees
	Courses supporting distributed maritime capabilities where knowledge and competence are distributed to technology, procedures, and regulations as well as shared between the seafarers and land-based organisation	Distributed maritime capabilities	shore-side employees
	Courses aiming to upgrade service and repair (equipment) in cooperation with real time cooperation with land-based suppliers	Digital: Augmented reality Virtual reality Digital twins To upgrade service and repair (equipment)	shore-side employees
Green skills	EU-wide programmes of measures aiming to increase environmental awareness	Environmental awareness	shore-side employees
	The courses aiming to upgrade or re-skill in sustainable and green skills shore-side workers associated with the maritime industry		Shore-side workers

We see from the overview of training programs offered by the shipping industry outlined in D.1.2.2, Chapter 5.1 Shipping Industry that there is an enormous number of courses offered through a high number of providers.

Recommendations

1. IMO STCW minimum is not sufficient to operate in the modern fleet.
2. Skill gaps and recommended measures are listed in Table 1.
3. New skills and skills to be updated for occupation profiles are listed in Tables 4 and 5.
4. We need to find solutions to the following obstacles:
    a. From our analysis in *D 1.2.2 Identification of Mismatches on a Structural Basis and D 1.2.3 Impact on occupational profiles,* we have seen that seafarers are facing several challenges caused by the global drivers with the resulting challenges and measures, as outlined in the previous sections in this chapter.
    b. Seafarers are also faced with a high number of courses in addition to the STCW mandatory minimum, with detailed competence requirements in the STCW code and in codes additional to STCW in IMO[14]. These training requirements are already in force and applies mostly to seafarers in service on certain ship types, carrying certain cargoes or sailing in specific regions.
    c. Finally, seafarers are required to complete a high number of trainings specified by the shipping industry itself, above and beyond IMO STCW, mostly related to the safety of the crew and the ship including cargo.

Although we in the SkillSea project primarily are concerned with investigating the current and future skills gap we find that the competence requirements in b) and c) above are obstacles that need to be removed before seafarers can begin the real job of acquiring the future skills of a).

3 Closing the skills gaps

3.1 Higher Standard qualification as a supplement to IMO STCW

The IMO STCW minimum mandatory standard of training provides a common level of competence for seafarers worldwide. It is used by all MET academies when creating curricula and constitutes seafarer occupational profiles. The A section contains the requirements for both general certificate levels, specific ship type competence requirements, and sailing area and ship type competence. As such, a student graduating with, for example, an *Officer Of the Watch (OOW)* certificate, has completed training that fulfils the same requirements regardless of which MET is attended.

In addition to the mandatory minimum requirements, there are additional requirements that are not compulsory unless you are sailing a type of ship or in an area requiring this type of competence. Examples of this are the training specified in section A-V/3&4: IGF training for LNG-fuelled ships, Polar Code training for sailing in Arctic or Antarctic regions and further in the B-V/g section, recommendations on Dynamic Positioning training for DP class ships are outlined and in the separate IMO HSC 2000 code (not implemented in STCW), training requirements for crew manning High-Speed Craft[15]. These are only some examples of the additional training programmes that are required through IMO.

14 For example the training as per the High Speed Craft – HSC code and the International Safety Management– ISM code.

15 High Speed Craft: Passenger vessels exceeding 20 knots and more than 12 passengers

The B section contains recommendations on training that if implemented by a MET will likely meet the corresponding requirements in the A section, in addition, model courses are issued that constitute a recommendation on training to comply with the code.[16]

A seafarer that graduates by only fulfilling the minimum certificate requirements will soon need to take additional training at or outside of a MET academy. The IMO resolution Principles of safe manning notes that safe manning is a function of the number of qualified and experienced seafarers necessary for the safety and security of the ship, crew, passengers, cargo, and property and the protection of the marine environment. Actual workload and competence need on the vessel may vary greatly depending on the type of vessel, market segment, route and traffic, the technology supporting the crew etc. The shipowner has thus a duty to repeatably make assessments of the manning of the vessel.

Depending on trade and market conditions, this additional training is covered by the employer, by the seafarer or by a third-party sponsor or public funding.

Recommendation

We recommend a European certificate of Higher Standard as a supplement to the minimum training according to IMO STCW.

3.2 Upskill module course package

STCW is mainly about the safe navigation of ships and less about business and being efficient. By offering specialised training (module courses) in addition to STCW, we provide an opportunity for maritime professionals to gain a higher competence[17]. This will help maritime professionals to enhance their skills and employability. Such specialised training will act as a 'dynamic system' to help to close the skills gap, as well as an extra aid to respond to the ongoing changes of IMO STCW.

In such a module course package, we suggest new course modules to fulfil the industry's needs, *such as digital, language, and social literacy, as well as ship finance, law, insurance, and management competence*. However, it should be borne in mind that member countries should only take our suggested module course package as a framework. Thus, for specialisations in present occupations, each country could develop module courses that fit the context of their countries in various formats, such as degree-oriented (i.e., BSc or MSc) and non-degree-oriented training (i.e., certificates).

For cross-functional skills and soft skills, each country can decide which comes first in the model course package. The fundamental is to provide more training paths for seafarers to broaden their skills, both on land and at sea. In that case, we fully address maritime training initiatives with additional focus on the internationally agreed training of seafarers regarding IMO standards, while also offering new chances for seafarers towards the knowledge-based industry.

16 For example the Model Course for the Polar Code, which consists of 40 hours of Basic training, 3 months of sea-time in waters covered by the Polar Code and subsequent 40 hours of Advanced training, 80 hours plus sea-time in total. By implementing this course, a MET Academy is in line with what IMO sees as sufficient to fulfil the Polar Code requirements in the A section. It is not the IMO that approves, but the National Maritime Administration (NMA) in each IMO member country. Now, each NMA may issue or approve different ways, as compared to Model Courses, of complying with IMO certificate requirements. For the example above, this means that Norway's and Sweden's NMAs have approved 20 hours of Polar Code Basic training and immediately the Advanced training programme of 20 hours to comply with the Polar Code requirements (40 hours total instead of 80, and no sea-time in between but a requirement to document previous sea-time in ice/polar waters) based on national considerations.

17 More details about future training can be find in D1.2.1 and D1.2.3.

Recommendations

- Up-skill modules package for maritime professionals. We suggest course modules fulfil the industry's needs, *such as digital, language, and social literacy, as well as ship finance, law, insurance, and management competence* as described in Table 2 and Table 3.
- The sum of IMO STCW and course packages should correspond to a BSc degree and include in the Bologna qualification framework.
- The IMO STCW training is implemented differently among the member states in Europe and the recommended course packages may have different content and volume.

3.3 Advanced skill training to realise the maritime industries innovation potential

Maritime professionals have for decades contributed with operational maritime experience and knowledge to companies in the maritime sector, and they are still crucial for realising much of the maritime industry's innovation potential. Seafarers can spot concrete innovation suggestions to shipping, ship design and equipment manufacturers, finance, and port operations, as well as to researchers who know the challenges presented by specific maritime innovations. Close interaction between users and researchers provides a faster and more precise path to new technology and solutions. If the European maritime industry is to continue to be a world leader, good education, and research institutions, as well as the right competencies, are crucial.

Advancements in wireless communication, sensor technology and advanced analytics are fuelling the digital transformation. Connectivity is undergoing an evolutionary change in most parts of the world and enhancement in satellite communication opens for rich cooperation between ship and land-based organisations. With increasing ship to shore connectivity comes huge amounts of data that shipping companies can extract insight and value from to make data-driven business decisions and optimise operations at all levels. Every aspect of operations and across the fleet can be optimized – from vessel tracking and predictive maintenance to crew safety and welfare.

The International Chamber of Shipping (ICS) has been considering the question of how the current IMO STCW regime is adequate. In 2019, the ICS Board endorsed a recommendation by the ICS Manning and Training Sub-Committee that ICS should request IMO to conduct a comprehensive review of the STCW regime[18]. Also, ICS raises questions as to whether the Convention continues to meet the requirements of the industry in the 2020s.

Some are calling for a revision sooner rather than later, such as the chairman of the global ship owners' organisation, the International Chamber of Shipping (ICS), who expressed in a speech in January 2019 and reported by safetyatsea.net[19]:

> *"...it was common for employers to routinely provide additional training and assessments before the convention was "still fit for purpose in the 21st century".*
>
> *He called for a "fully revised" STCW regime that would allow the industry to adapt more effectively to fast-paced changes in technology, including increased automation."*

18 https://www.ics-shipping.org/current-issue/a-review-of-the-stcw-convention-2020/

19 https://safetyatsea.net/news/2019/shipowners-call-for-stcw-revision/

This is further elaborated in a publication by ICS named “A review of the STCW Convention 2020[20]”. Here the powerful ICS states without reservation:

> *ICS members have concluded that a fully revised STCW regime would allow the industry to adapt much more effectively to fast-moving technological developments, including increased automation. A revised Convention could provide a structure with sufficient flexibility to meet the demands of a rapidly evolving world fleet, and could permit a more modular approach to competency accumulation and certification than is possible under the current regime. The arrival of new technology, with respect to navigation, engineering and propulsion systems (including the use of alternative fuels) is already changing the functions that seafarers perform on board ships and the competencies and training which they now require.*
>
> *Most importantly, ICS believes that a comprehensive revision of the STCW Convention should seek to improve transparency and the robustness of implementation oversight about the obligations of the IMO Member States that are responsible for the quality of their national training and certification systems.*
>
> *This includes ensuring strict adherence by individual training institutes to delivering IMO competence standards, and a tightening of the approval process by governments of training colleges, especially those engaged in operational level ships’ officer training*
>
> *Unfortunately, it is still commonplace for employers to need to provide additional training and assessments prior to the deployment of many officers who have been issued with*

Distributed maritime capabilities where knowledge and competence are increasingly distributed to technology, procedures, as well as land-based organisations, will change the work tasks of the individual maritime professionals. Vessel positions, manoeuvres, speed, fuel consumptions, cargo condition and so on can for example be monitored in control centres. Fleet managers will then be able to analyse this data, enabling them to advise the captain and crew on navigation, weather patterns, fuel consumption and port arrival. We will have distributed maritime capabilities as well as dispersed ship crew with other roles and responsibilities than we can see in present operations. Soft skills are needed to master communication throughout the value chain.

Also, sensor data from onboard integrated machinery systems are being increasingly transferred to shore centres. Digital twins enable real-time data analytics by use of AI and machine learning tools to support rich management and operational view of the entire supply chain. This technology will enable a high degree of streamlining of operations from ship control centres.

The fixing of malfunctions on-board often requires outside expertise from the suppliers. While ships were traditionally autonomous organisational systems that the maritime professionals on board mastered alone, ships are now increasingly part of large networks of ships, several internal and external IT systems, control centres, yards, certification agencies and regulations. Common broker platforms and e-commerce will simplify and secure the supply chain and reduce the amount of paperwork in the value chain under the heading of blockchain technology. These advances enable integration of the business process and reduce transaction costs.

The complexity of sociotechnical systems into which ships are increasingly woven requires increasingly complex control systems. We have coined this transition distributed maritime capabilities and the use of dispersed teams.

20 https://www.ics-shipping.org/current-issue/a-review-of-the-stcw-convention-2020/

Recommendation

- The future maritime activity will integrate people and digital technology in a way that transform how we operate and interact. A new operation paradigm needs to be created to meet these challenges. The key future skill gaps are green shipping skills, digital skills, and operation in highly digital systems.
- We suggest that, if Europe aims to play a leading role in the future shipping industry, the human factor will still be a key, but it is a need for a body that can act fast and bring training at the level of the technology development.
- It is a need, among the European member states and the national Maritime Authorities, to approve new technologies and new operations paradigms.

3.4 Recommendations for new learning methods and technologies

In the future, the skillset of maritime professionals should give flexibility to individual learning paths. With e-learning and simulation-based training, lifelong learning becomes more available and enable those who work at sea to expand their knowledge and acquire transversal skills.

Covid 19 disrupt the classical learning methods and the privilege of close physical interaction. MET, colleges and universities responded very quickly, and the training program turned into partly digitally and partly physical sessions. We have seen tremendous development in tools allowing cooperation as MS Teams and Z as well as the introduction of many new learning management platforms.

Simulation-based learning has traditionally been used to train navigational competence and engine room competence. It is becoming increasingly available for more demanding scenarios that are too dangerous or too expensive to rehearse in real life. This allows maritime education and training to prepare seafarers for new technology while also assisting maritime professionals invalidating their new developments. Simulators for training purposes have been migrated to online versions such as by Wärtsilä[21] and made available to course participants, including seafarers. This has enabled seafarers to complete training remotely limiting travelling and assembling in groups to transmitting Covid 19 virus. The positive added effects are many, such as reduced cost by eliminating time to travel cost associated with travelling and hotel stay. Also, the online simulators being purely digital offer much greater flexibility regarding schedule, such as Kongsberg offering simulator training “anytime and anywhere”[22].

Education trends will ride the wave of increased internet capabilities and higher network bandwidth, bringing advanced technology into schools with greater ease. Extended Reality (XR) technologies will be key trends to watch out for in 2021 and beyond. We are likely to see a landslide of innovative products, applications, and use-cases delivering ever more realistic immersive experiences.

Augmented reality devices enhance real-world materials, such as making a map jump off a page, while virtual reality products create an immersive digital world in which students interact in virtual 3D worlds that enhance learning experiences.

In addition, e-learning methods provide significant opportunities to effectively improve lifelong learning,[23] particularly in the case of seafarers who are a significant p away. They may considerably promote seafarers’ career evolution professionally and personally, enhancing productivity, employability, and social stability. E-learning platforms enable more flexible lifelong learning, making it accessible from ships, homes or while away, whether at sea or ashore.

Finally, it must be stressed that e-learning methods are not a cure-all solution. Proper implementation requires much more rigorous considerations, preparation, and assessment compared with a traditional approach and

21 https://www.wartsila.com/voyage/simulation-and-training/cloud-simulation

22 https://www.kongsberg.com/digital/solutions/maritime-simulation/Cloudbasedtraining/

23 See Jeannette Edler and Virginia Infante: Maritime and Other Key Transport Issues for the Future – Education and Training in the Context of Lifelong Learning, Trans. marit. sci. 2019

learning methods. Although options seem infinite and use looks trouble-free, the target learning outcomes are ensured only if the selected e-learning methods are consistent with the course structure, learning objectives, outcomes and assessment methods. Therefore, it is assumed that MET institutions will need to invest substantial resources [24] to bring their courses to the level where e-learning methods and associated technologies will guarantee the effective achievement of the learning outcomes across all courses and programs offered.

Recommendation

In terms of digital skills, we suggest utilising VR, AR, simulator-based learning, and other techniques to support the development of future skillsets.

24 See Ally, M. Competency Profile of the Digital and Online Teacher in Future Education. International Review of Research in Open and Distributed Learning, 20(2). 2019

4 Conclusion

IMO STCW minimum is not sufficient to operate in the modern fleet.

1. **Skill gaps and recommended measures are listed in Table 1.**
2. **New skills and skills to be updated for occupation profiles are listen in Table 1 and 2.**
3. **We recommend to consider a European certificate of Higher Standard as a supplement to the minimum training according to IMO STCW.**
4. **We recommend an up-skill module package**
   - Up-skill modules package for maritime professionals. We suggest course modules that fulfil the industry's needs, primarily green/sustainable skills, digital skills, language, leadership and social competency, as well as ship finance, law, insurance, and management competence as described in Table 2 and Table 3.
   - The IMO STCW and additional course packages should either lead to a a BSc degree or be credited with ECTS towards a BSc/MSc degree (in line with the Bologna qualification framework).
   - The IMO STCW training is implemented differently among the member states in Europe and the recommended course packages may have different content and volume.
5. **We recommend advanced skill training to realise the maritime industries innovation potential**
   - The future maritime activity will integrate people and digital technology in a way that transform how we operate and interact. A new operation paradigm needs to be created to meet these challenges. The key future skill gaps are green shipping skills, digital skills, and operation in highly digital systems.
   - We suggest that, if Europe aims to play a leading role in the future shipping industry, the human factor will still be a key, but it is a need for a body that can act fast and bring training at the level of the technology development.
   - It is a need, among the European member states and the national Maritime Authorities, to approve new technologies and new operations paradigms.
6. **We recommend exploring novel technologies to deliver training in a more flexible fashion where crews on ships may participate such as VR, AR and other distributed technologies**

5 Appendix

5.1 Table of STCW positions listed in ESCO

POSITION	ESCO OCCUPATION	STCW REFERENCE
DECK		
Officers in charge of a navigational watch (operational level) Chief mate (Management level)	deck officer	a) A-II/1 b) A-II/2
Master mariner (Management level)	ship captain	A-II/2
Officers in charge of a navigational watch (operational level)	helmsman	a) A-II/1
Officer of the watch (operational level)	maritime pilot	Master, Chief mate A-II/2
Master mariner (Management level)	skipper	Master, A-II/2
ENGINE		
Officers in charge of an engineering watch (operational level)	ship duty engineer	A-III/1
Chief engineer officers and second engineer officers (Management level)	marine chief engineer	A-III/2
Officers in charge of an engineering watch (operational level)	Ship assistant engineer	A-III/1
Electro technical officers (operational level)	Not listed	A-III/6
RATING		
Ratings as able seafarer engine	engine minder	A-III/5
Ratings as able seafarer deck	matrose	A-II/5
	ordinary seaman	
	Sailor	
Ratings forming part of a navigational watch	Not listed	A-II/4
Ratings forming part of a watch in a manned engine-room	Not listed	A-III/4
Electro technical ratings	Not listed	A-III/7
POSITIONS AS STATED		
Masters, officers and ratings, basic oil and chemical tankers	Not listed	V/1-1-1:
Masters, officers and ratings, advanced oil tanker cargo	Not listed	V/1-1-2:
Masters, officers and ratings, advanced chemical tanker cargo	Not listed	V/1-1-3:
Masters, officers and ratings on liquefied gas tankers	Not listed	V/1-2:
Masters, officers and ratings on basic liquefied gas tankers cargo ops	Not listed	V/1-2-1:
Masters, officers and ratings on advanced liquefied gas tankers ops.	Not listed	V/1-2-2:
Masters, officers, ratings and other personnel on passenger ships, crowd control	Not listed	V/2-1:
Masters, officers, ratings and other personnel on passenger ships, crisis management	Not listed	V/2-2:
Masters, Officers and Ratings on ships subject to IGF code Advanced training	Not listed	V/3-1:
Masters, Officers on ships subject to IGF code Advanced training	Not listed	V/3-2:

Masters and deck officers on ships operating in polar waters, Basic Training (Polar Code)	Not listed	V/4-1:
Masters and deck officers on ships operating in polar waters Advanced training (Polar Code)	Not listed	V/4-2:
STCW B		
Guidance regarding additional training for masters and chief mates of large ships and ships with unusual manoeuvring characteristics	Not listed	B-V/a
Guidance regarding training of officers and ratings responsible for cargo handling on ships carrying dangerous and hazardous substances in solid form in bulk	Not listed	B-V/b
Guidance regarding training of officers and ratings responsible for cargo handling on ships carrying dangerous and hazardous substances in packaged form	Not listed	B-V/c
Guidance on application of the provisions of the STCW Convention to mobile offshore units (MOUs)	Not listed	B-V/d
Guidance regarding training and qualifications of masters and officers in charge of a navigational watch on board offshore supply vessels	Not listed	B-V/e
Guidance on the training and experience for personnel operating dynamic positioning systems **	Not listed	B-V/f

Table 7: Occupational profiles ESCO, STCW