SKILLSEA

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TITLE: SKILLS AND COMPETENCE GAP BETWEEN CURRENT AND FUTURE NEEDS

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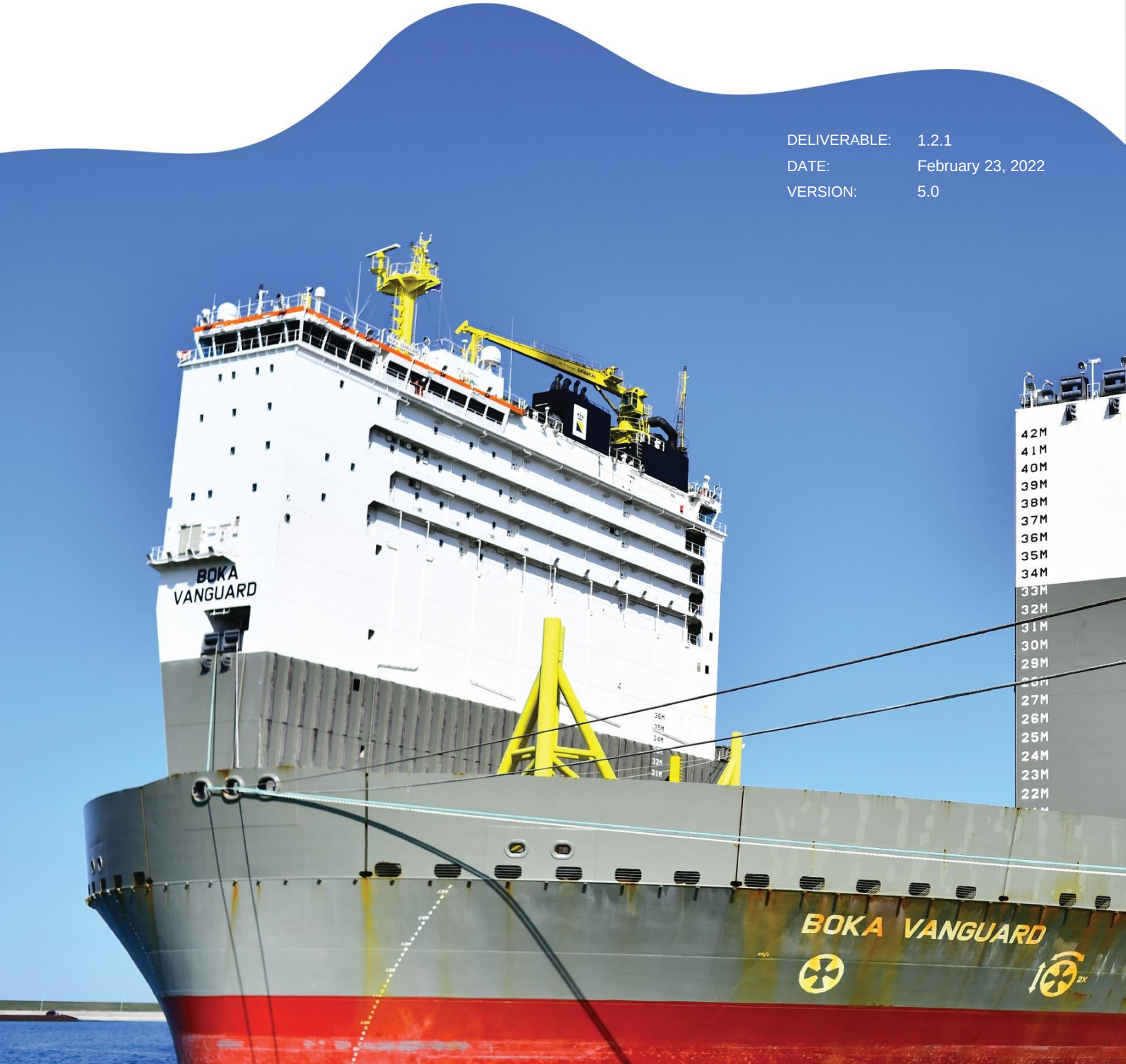

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VERSION HISTORY			
VERSION	DATE	EDITOR	SUMMARY OF MODIFICATIONS
V1	21. April 2020	Yushan Pan	First version, based on first versions of D1.1.2 and D1.1.3
V2	02. June 2020	Yushan Pan	Revised following feedback from partners. All partner meeting in Aalesund was cancelled due to Covid-19, rendering feedback digital-only.
V3	11. January 2021	Yushan Pan	Revised according to updated 1.1.3 and additional research
V4	30. September 2021	Max Johns	Revised for readability and comprehension. Aligned with other WP1 reports
V5	23. February	Hans Petter Hildre, Arnfinn Oksavik	Revised and slightly restructured aligning findings of current and future reports. Revised after comments from partners.

Summary SkillSea Report

Deliverable: D 1.2.1 version: 1.0, date: 18 February 2022

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 essential. In the future, maritime professionals must possess essential digital, green, and soft management skills to achieve competence at the highest competitive standard.

We have summarised the skills gaps, present and future, from the previous two reports – D 1.1.2 and D 1.1.3.

Our analysis of identified skills needs within the SkillSea project found that maritime training while delivering IMO STCW compliant education also responds to current competence requirements and STCW.

The analysis predicts that the gaps will be dynamic due to the rapid digital transformation and transition to green shipping. On the one hand, such dynamic changes will cause 'gaps' in the maritime training programmes. On the other hand, such dynamic changes will generate new demand for maritime training. In line with this, training courses should be flexible and adaptive.

We conclude that some skill needs in addition to STCW can be met through specialised training modules offered independently by METs. We also see that the volume of skills needs is growing and that individual seafarer cannot keep up. A coordinated effort is required to bring the workforce closer in line with industry needs. We suggest that this is done through industry/METs/EU/ cooperation to reach the desired skill level. We name this the '**Higher standard'.**

We have identified eight challenges. Measures to respond to the identified challenges, close the gaps, and achieve a Higher standard is suggested.

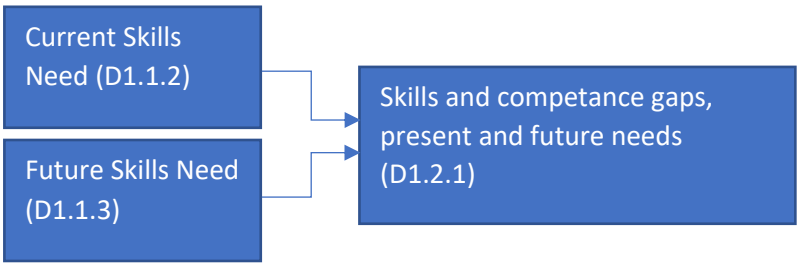
Future-proof skills for the maritime transport sector

Project SkillSea is co-funded by the Erasmus+ Programme of the European Union

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

Contents

Document information

Document information	
Short description	In this report, we have reviewed the results from D1.1.2 and D1.1.3. Comparing the two results indicates skills gaps and present and future needs.
Work Package	WP 1. Skills Need Identification
Workflow	To study the skills gaps: present and future needs, we extract the outcomes from the above two tasks – D 1.1.2 and D 1.1.3. We compare and conclude the possible skills gaps for the present and future needs. In addition, document analysis is also included in this task to triangle our comparison and conclusion. 
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SkillSea reports

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

Number	Name	Content
D 1.1.1	Methodology	Outline of 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 1.1.2 and 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, depending on context.

Introduction

Through our deliverable D 1.1.2, 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 needed. We found that STCW has successfully defined and established a common standard worldwide and that the shipping industry benefits from such a standard.

Our deliverable D 1.1.3 distilled future skills and competence needs through interviews with visionary shipping industry leaders, focus groups, literature review of reports on future developments, technology forecasts, and trend analysis. Significant gaps are identified.

As Figure 1 illustrates, 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 define this curve **Higher standard.** From our findings, the gap will grow if no action is taken.

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 critical. It is vital to improve seafarers' skills concerning three trends: digitalisation, sustainability, and soft skills. In the future, maritime professionals must possess essential digital, green, and soft management skills to achieve competence at the highest competitive standard.

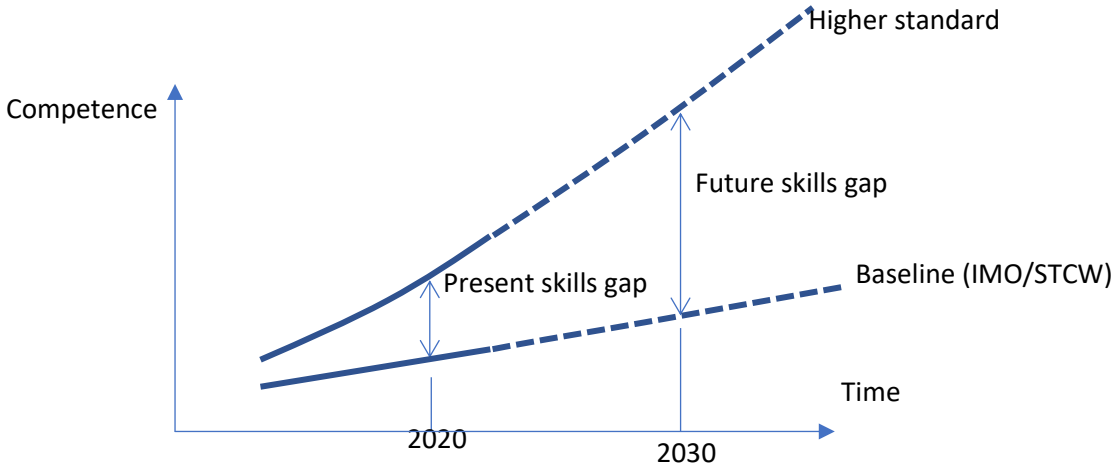

Figure 1: Previous studies on gaps in current and future skills

[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.

METs[2], vocational schools and universities respond to the demands from the shipping industry to provide the most appropriate training programmes to reduce the gaps (see Table 1).

The primary purpose is to deliver essential competences that the industry demands to operate safely while simultaneously reducing gaps created by new rules as they become implemented as part of the STCW Convention. Those courses are customised in response to requests from the industry.

This report is structured as follows: In chapter 3, we present the recognised skills needs within the SkillSea project as a **Higher standard**. The report concludes in chapter 4: Towards the future.

[2] METs - Maritime training and education programme and vocational school.

The missing skills

Present skills need

In the D1.1.2 report, we have identified six types of skill gaps:

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

Maritime economy and business

Skills related to various aspects of the maritime economy and business have been dropped from the regular programmes for educating seafarers, mainly because there is no such requirement in the STCW Convention. Consequently, numerous MET institutions and shipping companies do not consider these subjects sufficiently necessary to require inclusion into the programmes. Although highly welcome for onboard positions, these skills are mandatory for positions ashore, particularly for medium and top management in shipping. They represent core professional skills for shore-based management, although the importance of different aspects may vary significantly across different positions.

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 onboard but are not a mandatory requirement. Contrary to this, these skills are frequently compulsory for positions at the management level ashore. 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 programme for former seafarers needs to cover the subject area in at least several courses, being individually selectable and focused on the main functions of shipping companies or similar ventures (insurance, claims, etc.).

The subject area may be partitioned in different ways reflecting the previous knowledge of former seafarers, their work schedules, and selected modes of delivery.

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 exact three aforementioned and the maritime law topics that are the most essential for 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 mainly refer to technologies standards on ships trading in the mid-1990s, i.e. at the time when the first significant revision of the STCW Convention had been prepared.[3] Amendments adopted in later years focused mainly 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), extensively used 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.

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[4]). 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.

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

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

Digital skills

Digital skills required onboard may be divided into two broad groups: skills required to use dedicated software and skills connected with general information management. The skills belonging to the first category will be required only for seafarers specialising in maintaining 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 and those working ashore.

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

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, creating and modifying spreadsheets, creating documents using formatting options, and creating 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.

Seafarers 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 and only 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 mainly 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 designed. The shallow level of transversal skills required by the STCW Convention and associated Model Courses only represents 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.

Compared with lists of commonly accepted transversal skills, it is easy to identify that the programme seafarers are required to attend deals only with a limited set of skills; the majority of transversal skills are

not covered. Finally, the subjects required (as they are represented in the respective Model Courses) assume relatively high levels of cognitive skills, clearly beyond the level assumed in the present revision of the STCW Convention. If compared with the critical competencies recommended by the European Parliament, almost all transversal skills are missing in the STCW Convention. Therefore, it seems that transversal skills of the presently active European seafarers are much more the outcome of primary and secondary education, 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 helpful in all situations and jobs, developing an appropriate set of training programmes and tools is recommended. The programmes 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[5], "Developing a low-carbon economy depends [more] on improving existing skills rather than specialised 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 clearly based on facts and understanding the causes and effects.

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

[5] 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)

Therefore, the leading causes and effects of processes in sea transport and influencing the environment should be clearly explained to shipboard and 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.

Future skills need

This section summarises future skills need based on our previous study D 1.1.3. The study is based on voices of maritime experts, focus groups, literature review, technology forecast and trend analysis. A common understanding is that ships will be smarter and greener.

The future maritime activity will integrate people and digital technology to transform how we operate and interact. A new operation paradigm needs to be created to meet these challenges.

We have identified the following types of skills gaps:

- Green shipping skills
- Digital skills
- Operations in a digital world
- Innovation
- Sea land mobility and attractiveness

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 alternative fuel for this is liquefied natural gas (LNG) and advanced sustainable biofuel. In addition, systems to reduce emissions and particulate matter in harbours and the proximities to cities will be necessary.

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 pieces of machinery
- 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 (harmful content, explosion etc.)

Digital skills

Ships will be smarter, data-driven, and connected to the rest of the world. We face a stream of new digital technologies, and we will see a new solution 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, etc.

In-depth skills to understand complex systems, onboard and onshore, are needed 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, for example

- 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 onboard 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 a digital world

Seafarers are becoming system managers. In- depth skills to understand complex systems, onboard and onshore, are needed 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. For example, vessel positions, manoeuvres, speed, fuel consumption, cargo condition, and so on can 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 and dispersed ship crew with other roles and responsibilities than we can see in current

operations. Soft skills are needed to master communication throughout the value chain.

The fixing of malfunctions onboard 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 socio-technical 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 is increasingly transferred to shore centres. Digital twins enable real-time data analytics by using 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 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, 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 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 contributed with operational maritime experience and knowledge to companies in the maritime sector for decades. 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 competences. 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 build up transversal competences and skills in the maritime sectors.

Consolidating the skills gap

From our findings in mapping current (D1.1.2) and future (D 1.1.3) skills gaps, we compare and look for gaps identified in both investigations and how they interrelate.

The Current skills report draws upon a survey of 1,149 seagoing personnel and 474 respondents from shore-based personnel. In other words, we investigate the current need mainly by surveying maritime professionals working in the shipping industry either at sea or ashore and investigate mainly what these professionals perceive as currently missing. Theoretically, if this perception is correct, an extrapolation into the future will give us the future need. We do not do that. We instead investigate what we can collectively call visionaries and decision-makers, what they see as skills needs in the future. We also conduct focus group reviews vital reports on the future from major shipping industry organisations, technology forecasts, and more.

In this report, we compare the two and see if what is pointed to as a gap today by maritime professionals is also pointed to by visionaries and decision-makers.

The Future skills need (report D1.1.3) confirm the findings in the report current skills need report. The significant differences are that the Future skills need to bring green shipping and digitalisation one step further.

The technology forecast confirms additional efforts into green shipping and interviews of maritime experts in the report D 1.1.3. More rapid adaptation to zero-emission technologies than expected has also occurred

following the climate action meeting in Glasgow. Various shipping companies and alliances have announced faster adaptation, such as CMA CGM: *The CMA CGM Group heads towards carbon neutrality by 2050*[6]. Also, the industry organisation ICS – International Chamber of Shipping have released a report outlining a path towards achieving "majority of vessels in operation will need to be zero carbon by 2050»[7]. It identifies 265 projects necessary to remove critical roadblocks to high-potential technologies and solutions, including hydrogen, ammonia, and electrification.

The digital shift and need for new skills are also explored in the technology forecast and interview of maritime experts in the report D 1.1.3. Ships will be smarter, data-driven, and connected to the rest of the world. Seafarers are becoming system managers, and in-depth skill to understand complex systems is needed to serve all systems' redundancy. Seafarers should know how to interact with computer systems to respond to challenges in the operation of automatic systems. We will also see distributed capabilities between seafarers and control centres.

Learning methods are also taking one step further. Influence from the pandemic has pushed the development and adaptation of digital communications and training solutions that benefit the shipping industry.

- Adoption of digital tools such as Zoom and Teams to deliver training and communications remotely, including to ships and seafarers
- Simulators for training purposes have been migrated to online versions such as by Wärtsilä[8] and made available to course participants, including seafarers. This has enabled seafarers to complete training remotely, limiting travelling and assembling in groups to limit 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 purely digital online simulators offer much greater flexibility regarding schedule, such as Kongsberg offering simulator training "anytime and anywhere"[9].

We have consolidated our findings to eight challenges with the following characteristics:

1. Shortage of maritime professionals (Developing career paths)

   In Current Skills analysis, seafarer's education, although complying with STCW, does not consider a variety of needs in the shipping industry that can be fulfilled through higher education such as BSc & MSc programs. Future analysis confirms a strong need at sea or in corresponding roles to seagoing for seafarers educated beyond STCW in diverse technologies, including green, sustainable, and digital technologies.

2. Mobility issues and talent attractiveness

   In the Current Skills analysis, the desire for mobility emerges from the seafarer standpoint, but recognition of maritime qualifications and career paths are not accessible. Future analyses

[6] https://www.cma-cgm.com/news/3143/the-cma-cgm-group-heads-towards-carbon-neutrality-by-2050

[7] https://www.ics-shipping.org/wp-content/uploads/2021/11/A-zero-emission-blueprint-for-shipping.pdf

[8] https://www.wartsila.com/voyage/simulation-and-training/cloud-simulation

[9] https://www.kongsberg.com/digital/solutions/maritime-simulation/Cloudbasedtraining/

confirm a matching need on the shoreside for the seagoing experience of seafarers that transition through higher education to fill landside roles in the shipping industry.

3. Communication, culture, and language issues

   Current Skills report reveal seafarers experiencing inadequate capabilities in human factor areas such as D 1.1.2 conclusions 27 & 28. At the same time, future investigation confirms the shipping industry will need people with seagoing experience that have these skills.

4. Core shipping management skills, including leadership

   These skills are identified as missing by seafarers **concerning maritime economy, business, law and ship technology, mainly because there is no such requirement in the STCW. The need is confirmed by the shipping industry in the future analysis, e.g. chapter 7.4.4 of D 1.1.3 Key findings from focus groups, highlighting the need for** *Leadership, language skills and communication skills*

5. Digital skills

   Both reports point to digital skills being in great demand. Current skills point mainly to maritime professionals' ability to interact with computer programs, focusing on data analysis, computing skills, and data representations. Future skills point to the understanding and competence of handling integrated computer systems such as control centres and integrated process control such as power management systems and fuel optimisation systems. Cyber security is added as a future requirement from the Future Skills study.

6. Operation in highly digital environments

   This is not identified in the current skills survey but emerges from the future skills report. Seafarers are becoming system managers. In-depth skills to understand complex systems, onboard and onshore, is needed to be able to serve the requirements for redundancy of all systems.

7. Transversal skills

   Transversal skills have different definitions in the STCW convention and EU; see pages 77 & 78 of the Current Skills report. From the Current Skills survey, almost all Transversal Skills defined by the EU are missing, and the current level is below industry requirements. This is confirmed through the Future Skills study, which especially points to the need for future maritime professionals to have the skills to move from one value chain to another.

8. Green skills

   In the Current Skills survey, seafarers are not very aware of the needs for green skills. This is much more apparent in the Future Skills study. Here it is emphasised that knowledge concerning zero-emission and green technologies such as new fuels and new operational modes such as autonomous operation and its various degrees of autonomy will be in great demand in the future.

Conclusions - Towards the future

The IMO STCW Convention is established as the worldwide minimum standards of qualification, training, certification and watchkeeping for masters, officers and watch personnel on seagoing vessels of all types and classes.

We have found a gap between the level of competence required to operate ships today and the skills needed in the future to operate technologically advanced ships in a digital world where 0-emissions technologies prevail and competencies valued ashore, such as Shipping Management skills, becomes increasingly important.

Measures that respond to identified challenges with the purpose to close the gaps are suggested in Table 1.

Challenge	Present GAPS from D1.1.2	Future GAPS from D1.1.3	Possible 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 in attracting and educating 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 the EU level) should be initiated by strategy plan WP3, aiming to change public perception of the maritime industry, particularly in respect of seafarers. The study programme 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 The 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 onshore job availability, recognition of maritime qualifications, training courses covering shore job requirements and Table 1: Measures that respond to identified challenges with the purpose to close the gaps. by lack of horizontal skills required for shore jobs	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 use new teaching methods to the up-skill workforce, i.e., an e-learning platform. WP2, new courses for teachers should promote this A qualification system is needed to achieve formal qualifications for land-based jobs and enter higher education at universities. This should be planned and implemented in WP5 Therefore, cooperation between knowledge providers and the industry, with heavily involved authorities, is crucial to ensure an adequately trained workforce's smooth development and continuous delivery.[10]

Communication, culture and language issues	The main reasons for unsatisfactory communication are usually attributed to different cultural and organisational schemes, caused mainly through 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	New courses in WP2 should promote courses aiming to upgrade seafarers' communication and language skills. EU-wide proficiency standards in language skills for people working in the maritime industry should be considered and strategically planned by WP3. Both WP3 and WP5 should consider EU-wide programmes of measures aiming to increase cultural awareness. 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, mainly 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 specific duties aboard[11], 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 the 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 duration, scope and delivery. WP2 should promote courses aiming to upgrade the knowledge and skills of seafarers. Courses should be modular and flexible in duration, scope, and delivery. Degrees awarded should be comparable and based on the ECTS system. Courses aiming to upgrade business management, economics and law should be developed and promoted in WP2. Courses aiming to upskill seafarers in 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.

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

[11] These courses are collected in the STCW Chapters 5 and 6.

Digital Skills	Training of analytical tools and dedicated software is outside STCW. A formally recognised set of digital skills and assessment methods (standard of proficiency) should be developed to improve digital skills among seafarers and recognise skills already acquired. The standard of digital proficiency could be included in the STCW Convention (STCW Code B) to ensure effective implementation. Alternatively, the standard may be set up as an EU standard, voluntarily implemented by the industry.	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 standard software tools should be developed and promoted in WP2. They should be in accordance with 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 new technologies/methods should be developed and promoted in new courses delivered by WP2, i.e., VR, Simulator, etc. 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. WP2 should promote courses in cyber security for seafarers and shore-based employees

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, 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 dispersed teams. Distributed capabilities and dispersed teams. Sharing 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, for example, automation systems and autonomy, should be promoted by strategy plan WP3 and Toolkit WP2. Courses aiming to upskill seafarers in interaction with advanced socio-technical 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 and 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 genuine-time cooperation with land-based suppliers should be promoted in WP2.
Transversal skill[12]	Minimal requirements for transversal skills, i.e. skills mainly used onboard, are listed in the STCW Convention Seafarers did not plan for lifelong learning concerning constant upskilling. If compared with the critical competencies as recommended by the European Parliament, then almost all transversal skills are missing 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 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.

[12] 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.

	Seaside communication and leadership are hierarchical by certificate. The landside is about leading and coaching. They are different environments.		
Green skills	Developing a low-carbon economy depends [more] on improving existing skills rather than specialised green skills. Leading 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 pieces of machinery 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 types of machinery should be developed and promoted in WP2. Courses aiming to upskill seafarers in handling various 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.

Table 1: Measures that respond to identified challenges with the purpose to close the gaps.

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