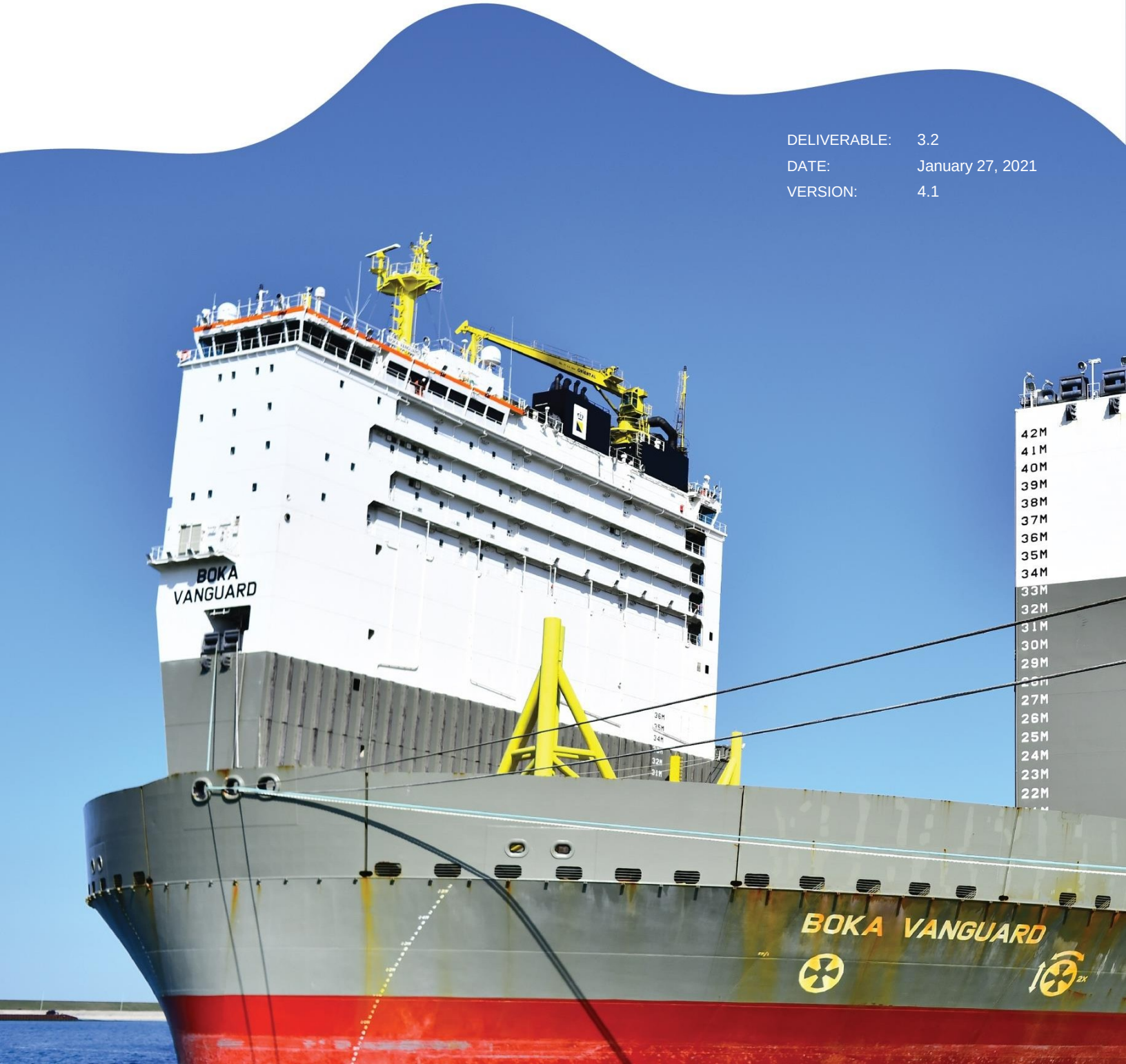
SKILLSEA

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

TITLE: MEASURING EVALUATION STRATEGIES IN MET

DELIVERABLE: 3.2
DATE: January 27, 2021
VERSION: 4.1



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DISSEMINATION LEVEL	PUBLIC

VERSION HISTORY			
VERSION	DATE	EDITOR	SUMMARY OF MODIFICATIONS
Outline	2020-03-10	EF Team	Draft
V1.1	2020-15-10	HBSA - EF Team	Updated
V1.2	2020-30-20	EF Team	Revised
V2.1	2020-30-10	HSBA - EF Team	Redrafted
V2.2	2020-11-6	HSBA - EF Team	Updated
V2.3	2020-11-16	EF Team	Redrafted
V2.4	2020-11-27	DMA, SIMAC	Reviewed
V3.1	2020-12-22	EF Team	STC Group
V4.1	2020-12-30	EF Team	Submission to STC Group (Coordinator)

Summary SkillSea Report

Deliverable: 3.2, version: 1.0, date: 30 December 2020

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.

The interim report for D3.2 addresses evaluation strategies as a strategic mechanism and a tool within the SkillSea strategic toolset for developing an optimum and well-received educational package solution as part of the LOT3 undertaking of the project. In this context, the report points to the potential of the role of evaluation in the current landscape of European Maritime Education and Training (MET) provision while also focusing on issues emerging through ad hoc surveys. The analysis of these survey results highlights existing gaps in MET education provision and is set against the role that evaluation strategies can play in promoting the role of MET in supporting emerging shipping trends and future-proof required skills.

The report highlights the strategic role of evaluation in adapting educational provision to directions set by sustainable development goals (SDG) and emphasizes the continuous feedback relationship between evaluation measurement criteria and methodologies on one side and effective evaluation strategies on the other. The operability of a designed tool for evaluating proposed new MET packages and progress between evaluations based on an adapted Analytic Hierarchy Process (AHP) multiple criteria decision-making (MCDM) approach have been validated in the context of SkillSea through an interactive two-stage evaluation workshop. This was coordinated with the support of new technologies, with SkillSea WP2 partners involved in early piloting of the educational package blueprint template.

Related feedback and cross-validation of results obtained have been used to underline the strategic role MET can play, through future-proof MET provision, in shaping the sustainability-based profile of future shipping as set by SDGs. Workshop feedback has also been used to validate proposed evaluation criteria in the context of using MCDM methodologies and tools for measuring through evaluation the strategic evolution of MET provision under specific scenarios of speed of change.

Conclusions of the report revolve around assisting MET to align to the needs of future shipping through the use of the proposed specifically adapted Strategic Evaluation MET Tool (ST.E.ME.T) for measuring evaluation strategies in a dynamic perspective.

Contents

Acknowledgements

The contributors to this deliverable would like to acknowledge the feedback of WP3 partners, especially the STC Group, and in particular the Danish Maritime Authority and SIMAC for the external review of the report draft, as well as all WP2 partners for their cooperation and also partners across SkillSea for valuable inputs. Thanks, are also expressed to the Erasmus+ Programme and the EU Commission for financial support.

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LIST OF ABBREVIATIONS

Abbreviation	Definition
AHP	Analytic Hierarchy Process
BIMCO	Baltic and International Maritime Council
CBT	Computer Based Training
CBTA	Computer Assisted Training and Assessment
CEDEFOP	Centre for the Development of Vocational Training
CoC	Certificate of Competency
Dx.x	Deliverable per Work Package
ECVET	European Credit system for Vocational Education and Training
ECTS	European Credit Transfer and Accumulation System
EEA	European Economic Area
EMSA	European Maritime Safety Agency
EQF	European Qualifications Framework
ETF	European Transport Workers' Federation
EU	European Union
GMDSS	Global Maritime Distress and Safety System
GMU	Gdynia Maritime University
HE	Higher Education
IAME	International Association of Maritime Economists
IAMU	International Association of Maritime Universities
ICS	International Chamber of Shipping
IMLA	International Maritime Lectures Association
IMO	International Maritime Organization
KPI	Key Performance Indicator
MCDM	Multiple-Criteria Decision Making
MET	Maritime Education and Training
MTC	Maritime Training Center
MoU	Memorandum of Understanding
MOOC	Massive Online Open Course
PAES	Peer Assistance Self Evaluation
PBL	Problem Based Learning
SMCP	Standard Maritime Communication Phrases
STCW	Standards of Training, Certification and Watchkeeping
ST.E.ME.T	Strategic Evaluation MET Tool
STRA.D.L.	Strategy Direction Location
T.OP.S.I.S	Technique for Order of Preference by Similarity to Ideal Solution
Trans.I.T	Transcript International Transfer
UNCTAD	United Nations Conference on Trade and Development
VET	Vocational Education and Training
WP	Work Package

1. INTRODUCTION: EVALUATION AS A STRATEGIC GUIDE FOR MET

1.1. Evaluation as strategic direction and tool for future-proof MET

This D3.2 report – in the context of the Strategy Work Package 3 of SkillSea – has a focus on how Maritime Education and Training (MET) across Europe can benefit from strategies of measurable evaluation designed to cater for two inter-related core objectives:

a. maximizing efficiency, as well as satisfaction, from educational provision by matching skills to requirements. This applies to major stakeholders, industry, and prospective maritime professionals alike.

b. reversing the waning presence of the continent's residents in the maritime workforce of both the world and the European-owned fleets[1] by supporting the evolution of maritime careers with appropriate training and upskilling.

Evaluation strategies by themselves cannot solve selection, employability[2] and visibility issues related to appropriate publicizing of maritime careers. However, they can be a powerful feedback tool, an instrument for change and also serve as proof that stakeholder opinions – including those of students – matter and are taken into account. This has both a practical and a significant symbolic value, as professional education is often also an induction process. The appropriate use of tools may provide early alerts for the need to change, increasing efficiency of all types of resources. In this respect, designing an appropriate evaluation strategy is intertwined with having appropriate measurement tools for evaluation to serve as a guide for change.

In terms of the human resource, sustaining the numbers of maritime professionals with future-proof skills is urgent at European Union/EEA level, as member states have traditionally constituted one of the leading groups of world fleet ownership. They currently account for just over 40% of the world fleet, while Asian countries currently control around half the world fleet[3].

[1] Cf. WP3 deliverables, SkillSea (2020). D3.4 *Internationalized Strategies in MET*. Report, WP1 deliverable D1.2 as well as the WP3 deliverable SkillSea (2020). *D3.1 Strategy Plan Framework* Report as well as EMSA (2017). Seafarer Statistics in the EU 2017. Available at http://FIGURE.emsa.europa.eu/infographics/item/3322-seafarer-statistics-in-the-eu-2017.html, last accessed June 11, 2020.

[2] Employability is the main subject of an upcoming report within WP3 which has evolving employability as a focal concept.

[3] Cf. the report delivered by WP3 in June 2020, SkillSea (2020). D3.4 *Internationalised* Strategie*s in MET*.

In the rapidly evolving context of the wider maritime environment, under emerging developments in sustainability requirements and technology described in the D3.1 SkillSea deliverable[4], the MET system – both in Europe and worldwide – is in the process of adapting a wide variety of aspects of content and delivery.

There are common areas – identified from different angles both by SkillSea deliverables D1.1.3 and D3.1[5] – where changes in the wider environment within which MET operates are directly impacting on knowledge content, on methods of delivery and on skills taught or honed further in METs. Such changes include:

- The continuous development of the educational background required by the industry from prospective and current maritime professionals.
- The need for promoting transversal skills for professionals onboard and ashore.
- An emerging trend towards mobility within the MET system beyond a strict national basis.

The first point is directly related to the self-assessment and to the stakeholder assessment of provision by MET institutions, with evaluation[6] (cf. INSET 1.A) being the central tool for both types of assessments and essential for strategic development.

INSET 1.A

‘Evaluation: the process of determining the merit or worth or value of something; or the product of that process’

Scriven (1991)

[4] Cf. Chapters 1 and 2 in the D3.1 project report by WP3, SkillSea (2020). D3.1 *Strategy plan framework*, *op.cit.*,Chapters 1 and 2.
[5] Cf. Future Skill and Competence Needs and SkillSea (2020), D3.1. Strategy *op.cit.*
[6] Cf. Scriven, M. (1991). *Evaluation Thesaurus*. Sage.

Strategies and related methods of internal evaluation can vary; however, their essential common element is related to:

1. The stakeholder perception of essential aspects of MET provision.
2. The self-assessment of the latter by METs.
3. The adjustments made by MET governing bodies and national administrations.

Evaluation is also the core of external assessments. However, in the context of this targeted report 'Measuring evaluation strategies in MET', the focus remains on the internal mechanisms which can enable and enhance the evaluation process to become a strategic mechanism for adaptation of most aspects of MET education. Nevertheless, internal strategic evaluation measurement tools can be both derived from – as elaborated further in Chapters 3 and 4 of the report – and also used by stakeholders, internal and external to MET provision, such as students and prospective students, faculty, and administrators.

Internationally, and in Europe, MET institutions regularly undergo internal evaluation exercises, including internal quality assurance evaluations of STCW-MET at various levels to ensure compliance with the STCW Convention.

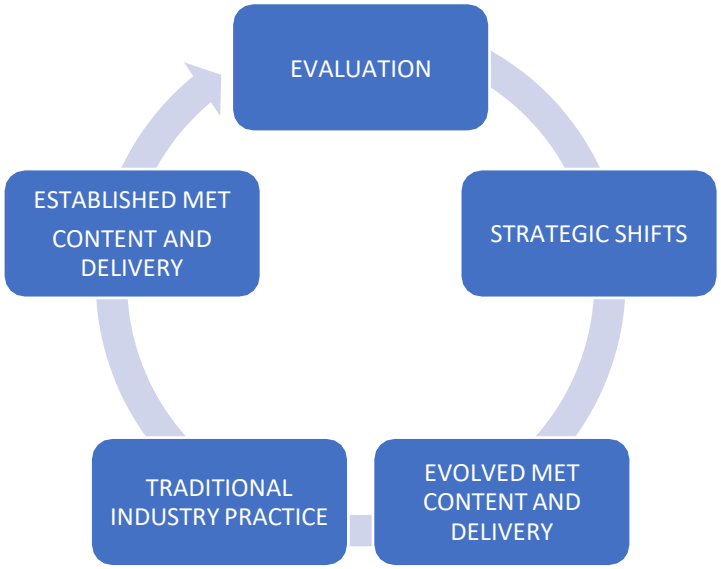
In a feedback relationship – incorporating response time lags for the full cycle as well – user evaluation results are fed to appropriate administrative bodies overseeing teaching quality to inform future educational provision of METs. This is currently the case with most types of METS at EQF 5/6 levels and beyond in Europe, whether of VET or HE type. As a rule, such evaluations remain within a specific – and often transposed – context and methodological frameworkborrowed from general education. To date, there is no special adaptation evaluation for VET-typeMETs or any typology of specific industry requirements and trends. Opting for an appropriate evaluation strategy is, however, a critical element of success in adapting faster and better to industry developments (cf. Figure 1.1) and possessing appropriate tools for measuring results and informing the relevant governance bodies is critical for and in the process.

This report aims to:

1. Highlight the need for a MET-specific strategic evaluation perspective in the context of new trends discussed at the strategic industry level through D3.1 and at the specific skills level through D1.1.2 and D1.1.3[7] deliverables of SkillSea.
2. Providing appropriate tools to enable the fit of degree/programme/module characteristics to be measured through strategic evaluation, to support emerging industry directions and to adapt skill requirements to trends such as the shift towards sustainable shipping and digitalization.

FIGURE 1.1

"INDUSTRY TO MET" CHAIN OF CHANGE



[7] Cf. D1.1.2 *Current and skills needs* and D1.1.3 *Future Skills and competence needs*

There are challenges in designing solutions suitable for the entire spectrum of MET diversity across Europe. However, there is also considerable experience of evaluation strategy implementation across all levels of European education. This accumulated experience renders the task less daunting and allows it to build on tested fundamentals of the European educational framework toolbox, extending strategic evaluation potential through the Strategic Evaluation MET Tool (ST.E.ME.T) – an innovative MET-adapted tool.

The structure of the report is as follows:

After the introductory chapter on the added value and potential of evaluation as a strategic guide, Chapter 2 reviews the results from the guiding surveys and summarizes ensuing conclusions. Chapter 3 analyses the direction that strategic evaluation is called to serve in terms of recent developments in shipping and of required skills for the current sustainability context of SDGs and of the Blue Economy. These not only relate to the maritime transport of the future but can be promoted through adequate adaptation of METs beyond what is imposed by technological progress. Chapter 4 proposes an evaluation tool, the Strategic Evaluation MET Tool (ST.E.ME.T.), suitable for measuring evaluation strategies supporting future shipping trends, and points to alternative scenarios. Conclusions in Chapter 5 summarize proposed policy initiatives to promote evaluation as a measurable strategy for change and future-proof MET according to alternative scenarios of the pace of change in technology in conjunction with sustainability trends.

1.2. The use of evaluation strategies as a guide for change

Assessing current gaps (WP1 deliverables and D3.3 within WP3) in MET provision is the first part of a re-evaluation exercise. Educational establishments involved in MET at any level could eventually[8] address these and benefit by highlighting such gaps through separate criteria and sub-criteria in the evaluation process. If designed appropriately, such a process can be valid across the present diversity of MET provision to active shipping professionals in the European maritime cluster[9]. European Union and European Economic Area countries follow largely similar

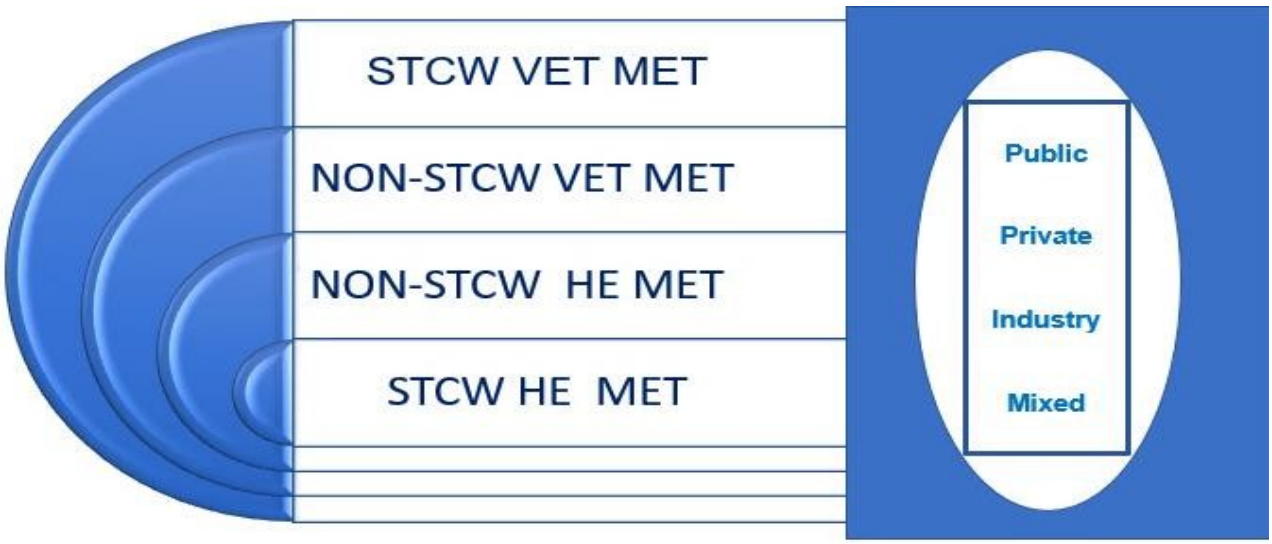
[8] As mentioned in SkillSea (2020). D3.4 *Internationalized Strategies in MET*, *op.cit,* this was the direction taken by the SkillSea project through thedeliverables across work packages WP1 and WP3.

[9] For the spectrum of maritime professionals cf. also Figure 1.8 in the deliverable of WP3, SkillSea (2020),D3.1 *Strategy Plan Framework*, *op.cit*. p.30.

evaluation across their educational activities falling within the EQF framework [10]. This is especially the case of HE MET[11] (cf. Figure 1.2) which adhere to EU Higher Education evaluation procedures on the basis of HE national evaluation authorities and to the specifications of accreditation institutions as per specific areas/disciplines.

FIGURE 1.2

PRINCIPAL CATEGORIZATIONS OF STCW - MET PROVISION



Source: Strategy Plan Framework, SkillSea deliverable D3.1, June 2020, Figure 1.2, Chapter 1.

[10] Cf. Chapter 4 also.

[11] As noted also across a number of SkillSea deliverables, STCW stands for the International Convention on Standards of Training, Certification and Watchkeeping for Seafarers (STCW) as amended, which sets minimum qualification standards for masters, officers and watchkeeping personnel on seagoing merchant ships and large yachts and contains regulations and their basic requirements. The requirements are dealt with in detail in the corresponding parts of the STCW Code. Part A of the Code is mandatory for all parties to the STCW Convention. Part B of the Code contains recommendations to facilitate the parties to the STCW Convention in its implementation. For a summary informative note on the STCW Convention, cf. https://www.imo.org/en/OurWork/HumanElement/Pages/STCW-Conv-LINK.aspx , last accessed 28 October 2020.

1.3. Evaluation strategies and MET measurable improvement

This issue of maritime education and training is by nature complex and intertwined with word wild shipping and educational policies. It not only involves objective aims and outcomes for maritime professionals determined by international conventions but also national regulatory provisions, national educational strategies, and priorities, as well as societal principles and values.

The evolution of marine technology and technological advances related to the operation of the shipping business model and variable – often hostile – natural conditions continuously alter requirements for maritime professionals, who have to comply with rules and regulations introduced to protect lives, the environment, and livelihoods. Such a combination creates challenges for MET providers at all levels. This is especially so as the focus on shipping sustainability through specific measures and directions aligning with the UN sustainability strategy – encapsulated in the 17 UN Sustainable Development Goals (SDGs) – and through the European sustainability and Blue Economy perspectives has become the prime direction for the future development of the sector, as reflected in the funding emphasis attributed to areas such as clean shipping[12].

At the same time, as underlined in key EU documents on education[13], (cf. INSET 1.A) strategic evaluation in the context of improving quality assurance is not disassociated from the issue of cross-border recognition of education (cf. INSET 1. B).[14]

INSET 1. B

> '…Improve provisions for quality assurance and cross-border recognition'
>
> European Commission (2013). European higher education in the world. COM/2013/0499 final.

[12] European Commission (2020), https://ec.europa.eu/commission/presscorner/detail/en/ip_20_986, last accessedOctober 18, 2020.
[13] Cf. European Commission (2013). European higher education in the world. COM/2013/0499 final. Available at https://eur-lex.europa.eu/legal-content/EN/TXT/HTML/?uri=CELEX:52013DC0499&from=EN, last accessed June 24,2020.
[14] In the SkillSea D3.4 report on internationalized strategies, a MET-adapted tool for cross-border recognition, Trans.I.T. (Transcript International Transfer) was created aimed at facilitating this, cf. SkillSea (2020). *Internationalized strategies in MET*. Report.

In a narrow perspective the task for MET providers is two-fold:

1. Provide the level of knowledge and the skills required for the efficient management of ships - as per STCW requirements for STCW METs of various levels - and of related maritime activities requiring specific competences.

2. Familiarize students with the idiosyncratic character of maritime professionals' career paths. The start point for such paths at sea is invariably STCW METs of all levels.

In a wider perspective, MET also has a third mission: to adjust and prepare future maritime professionals for a sustainable, fast-changing industry. In this process evaluation strategies and appropriate tools are key. This is a priority strategic direction for MET administrations, as the task of adapting the curricula to technological progress in the industry and to the STCW revisions is one dictated by de facto and de jure developments. Sustainability as a frame of mind and a framework of action is within the power of METs to nurture; this increases their responsibility and upgrades the role of strategic evaluation in this context.

This report provides both an analysis of the use of evaluation in this direction as well as an innovative tool for future-proof evaluation for which the dynamics of the SkillSea sectoral alliance have served. The wide range and capabilities of the SkillSea partnership enabled the dynamic interaction between the WP2 piloting results of the new educational toolbox and the creation of a measurement tool for strategic evaluation purposes[15] through appropriate feedback[16].

[15] Cf. Chapter 4 of the SkillSea (2020). D3.4 *Internationalized Strategies in MET*. Report.

[16] This was made possible through an interactive two-part workshop in October 2020 - jointly organised by WP2 andWP3 - as presented in the fourth chapter of this report. Such feedback had been planned at the submission stage cf.p.161(out of 190) of the SkillSea 2018 submission.

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2. GUIDING SURVEYS IN THE CONTEXT OF SkillSea

2.1. Survey and sample details

Ad hoc surveys addressing areas critical for evaluation in the current landscape of European MET have been used in the context of this report to highlight existing gaps in a fast evolving educational and industry environment. These surveys also explored how strategic evaluation of key areas where such gaps were indicated can eventually promote the role of MET in supporting not only required future-proof skills through education provision but also future shipping trends, nurturing these via a suitable knowledge and skills package.

The surveys were addressed to the three main categories of internal MET stakeholders: teaching staff; students; and higher academic administration. The level of administrators addressed was those usually responsible for introducing or improving evaluation strategies, administration bodies or individuals.

2.1.1. ID of the surveys

The surveys presented and analyzed in this second chapter of the deliverable were conducted from 15/03/2019 to 06/11/2020. However, data dated mainly from 2019 as supplementary data obtained in the year 2020 – in an effort to balance student and faculty survey data for comparison purposes – proved too few. Web-structured questionnaires were developed for the purpose of the surveys; these were addressed to students, faculty and academic administration of MET institutions through Survey Monkey platform e-mailed links.

2.1.2. Guiding survey Part I: ‘The students’ voice’

A total of 693 replies were received from students across 12 MET institutions. These were from a number of EU-EEA countries (Greece, Romania, Bulgaria, Poland, France, Norway, Denmark, and Estonia), and one MET facility outside EU/EEA (Turkey). The larger groups of replies were – in ascending order – from Norway (118), from Romania (121), from Poland (137) and with Greece recording the highest number (248). The rest of the replies received came fromthe remaining countries (in descending order): France (27); Bulgaria (24); Estonia (8); Turkey (8)and Denmark (2) (cf. Annex 1A for the Questionnaire and Annex 1B for sample demographics).

In the student part of the survey, the questionnaire was designed to gauge student satisfaction levels as well as to identify factors influencing it in relation to educational provision and the overall strategic directions of the establishment they were attending. The main questionnaire axes which follow reflected the main aspects related to student satisfaction, along with current shipping developments:

- Curricula and educational material used
- Knowledge and skills students obtain through their education
- MET infrastructure

Study content related to and/or promoting sustainability – an area identified with current trends and future needs in shipping[17].

2.1.3. Guiding survey Part II: Faculty members

The survey for faculty members was conducted from 08/07/2019 to 19/11/2019, distributed online as a web-structured questionnaire e-mailed link through the Survey Monkey platform. A total of 102 replies were received from MET institutions from 18 countries. The majority (82) came from EU/EEA countries, while 25 (including replies from non-European countries) were outside this group. On a country basis most replies were from Croatia (23) and Egypt (13) (cf. ANNEX 2A and 2B). As noted above, an additional five questionnaires were obtained through a round targeting Greek MET institutions in late October 2020[18] (cf. ANNEX 2C).

The aim of the faculty survey was to register the personal views of the academic staff regarding MET aspects closely related to evaluation in order to develop strategies for meeting the future needs of skills in the maritime sector while retaining and attracting more European residents to work as maritime professionals.

[17] WP1, WP2 and WP3 SkillSea deliverables, especially WP1 deliverables and WP3 deliverable D3.1.

[18] The limited total number of Greek MET faculties is due to the fact that they supplemented yearly by industry practitioners. In order to identify mismatches among perceptions of different categories, a second survey among faculty members in Greek MET institutions – to contrast with perceptions at the level of the student population - took place as there was limited interest during initial approaches in the first phase. Results of questionnaires obtained are presented separately in ANNEX 2C due to their small number.

The basic principles of the questionnaire reflected key aspects for the prospects of MET institutions:

- The relationship between MET institutions and the shipping industry
- The relationship between MET provision and the evaluation strategies followed
- The relationship between new technologies and educational provision
- The contribution of MET institutions to the promotion of future-proof skills and knowledge among students through appropriate content and methods of delivery

2.1.4 Guiding survey Part III: MET Administration

A third web-structured questionnaire was distributed online through an e-Survey Monkey platform link addressed to high-level MET academic administration members defined as rectors, heads of schools, etc. The survey was conducted from 01/11/2019 to 30/11/2019 and there were 32 replies from MET institutions across Europe (cf. ANNEX 3A and ANNEX 3B).

This specific survey focused especially on the relationship between maritime education and technological change, to identify strategies that MET institutions follow to meet the future needs of the maritime sector in terms of knowledge and skills related to the digital transformation of shipping[19].

2.2. Analysis of results

In the next sections, survey results are analyzed as per category of respondents. Sub-section 2.2.1 presents student perceptions, sub-section 2.2.2 analyzes faculty survey results, while academic administration survey results are analyzed in 2.2.3. A cross-comparison of results reveals gaps and areas which could eventually constitute focal points of MET improvement. These areas can be targeted at the stages of future design and delivery of MET provision – whether VET or HE – through new educational toolboxes/packages, such as those elaborated under SkillSea[20].

[19] Cf. D1.1.3 *Future Skills and competence needs*, op.cit.

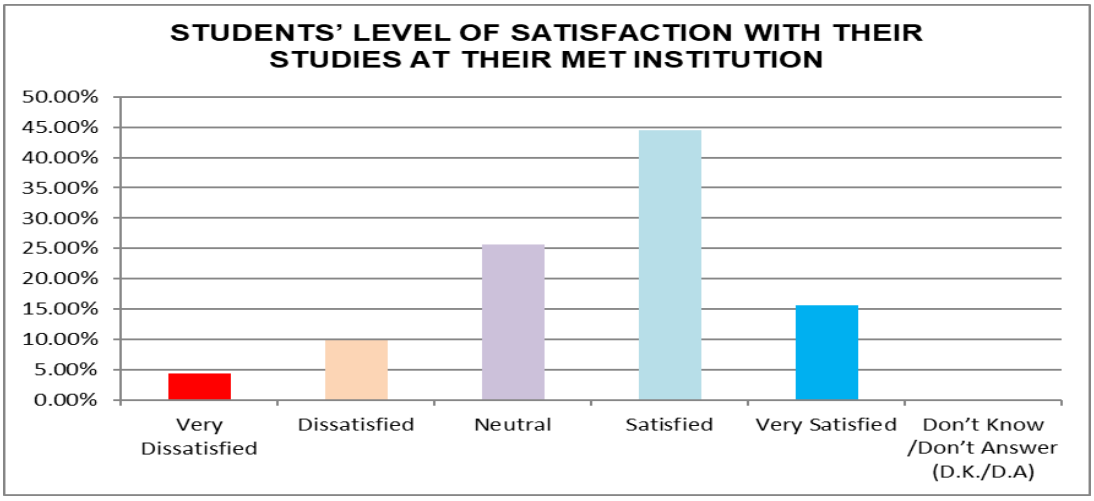
[20] The design of new toolboxes for specific Educational Packages is under WP2.

2.2.1. Perceptions of Students

Survey demographics are presented in detail in ANNEX 2B. It can be noted that almost all respondents were in the second (38.5%), third (25.4%), and fourth (24.4%) years of their studies, with only 9.2% being first year students. This was to be expected, as a result of the limited familiarization with and attendance of the curriculum. Most respondents were studying to become deck officers (53.3%) or engineer officers (42.4%), with 2.5% majoring in both subjects. The percentage of electrotechnical officers was only 1.9%, a result consistent with trends in that specialization and possibly with engineer officer course paths being standard for this category in some national education systems.

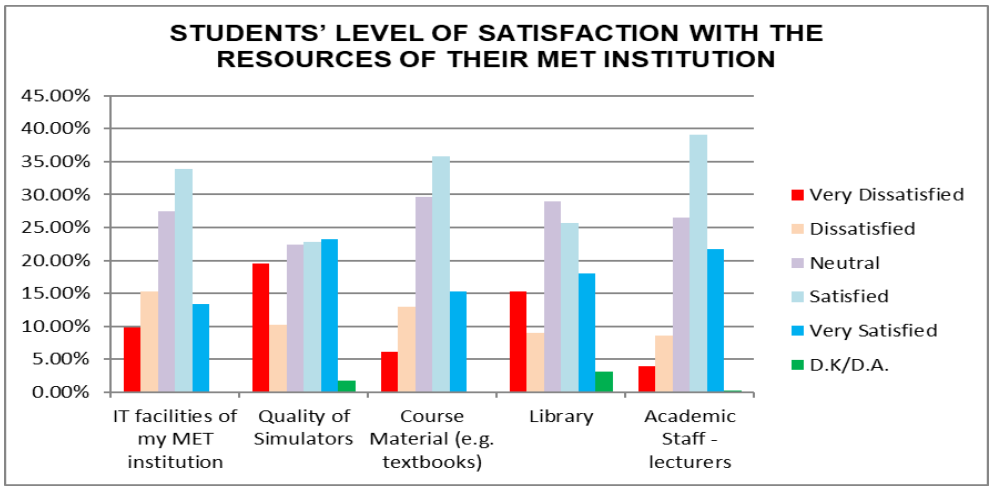
The first non-demographic question investigated the level of overall student satisfaction. As shown in Figure 2.1, the percentage of answers clearly indicating student satisfaction does include over half of all respondents, but the distribution of answers is not impressive – about 60%stated that they were either very satisfied or satisfied with their studies at their respective MET institutions. The cumulative percentage of these two respondent categories indicates the need forsome action when considering that fewer than one in six respondents expressed total satisfaction.Taking into account that a little over one quarter of the students (25.7%) were neutral and that 14.1% were dissatisfied or very dissatisfied with their programmes, it emerges that there is clearroom for improvements in either content or delivery, or both, across international and – in the context of the largest part of the respondents – EU/EEA METs.

FIGURE 2.1



Answers to the next question, shown in Figure 2.2, point to the causes of this gap between expectations and actual educational provision – an important point in terms of evaluation strategies[21] for matching expectations with actual experience. Across all specific categories of resources included in the corresponding question – such as IT facilities, simulators, course material, and library – the cumulative percentage of responses in the satisfactory or highly satisfactory area remains lower or just around the result for the entire provision, with the notable exception of the appreciation of educators.

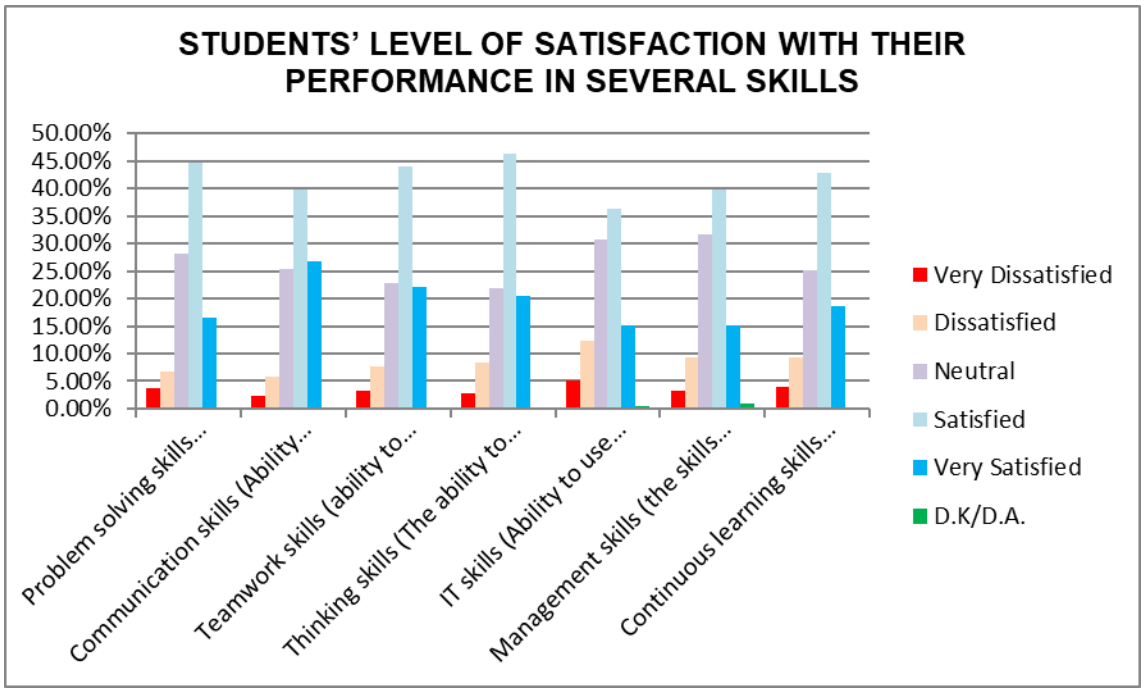
FIGURE 2.2



The highest levels of student satisfaction were recorded for the quality of simulators (23.2%) and for teaching staff (21.7%), while a non-negligible number of students reported being either dissatisfied or very dissatisfied with resources such as course materials and IT facilities.

[21] Cf. Chapter 3 of this report.

FIGURE 2.3

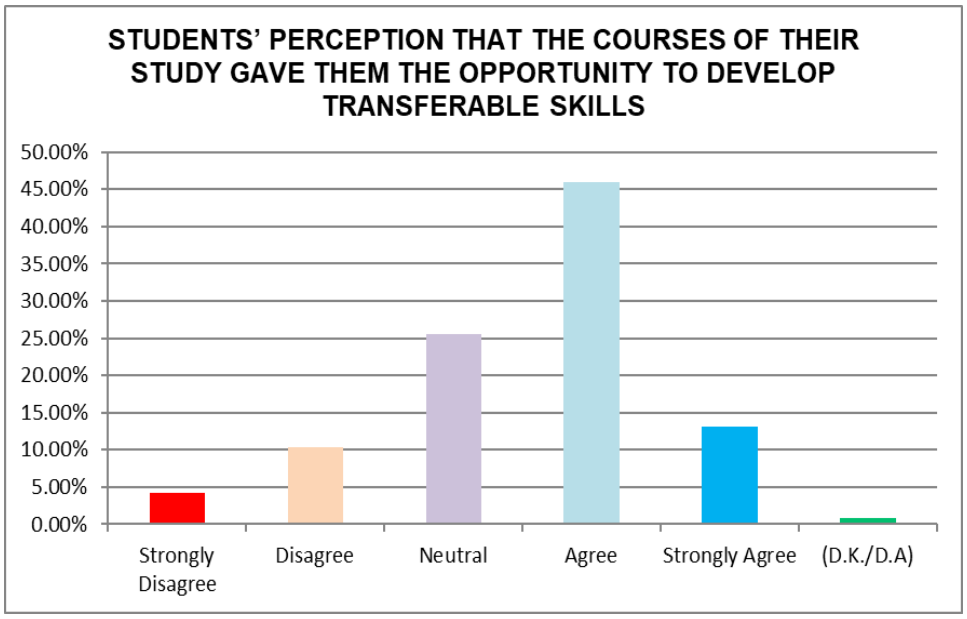


However, student satisfaction from skills developed during their education (cf. FIGURE 2.3), was registered as higher, reaching or exceeding 60% for most categories. The highest percentages of very satisfied were recorded for communication (26.7%), teamwork (22.0%) and thinking skills (20.4%). At the other end of the spectrum, the highest percentages of very dissatisfied and dissatisfied students were recorded for IT skills, with 5.2% and 12.3% respectively. This finding is consistent with the results in the previous question on IT and both results may be related to thefast pace of technological change over recent years.

Some clustering of low student satisfaction was also recorded around management skills (12.5%) and continuous learning (13.2%); this could be attributed to the emphasis of some MET curricula on addressing practical knowledge. While a more practically oriented educational strategy prepares graduates for the correct execution of demanding tasks onboard, it falls behind in terms of developing useful soft skills, such as critical thinking and lifelong learning skills. This survey finding is in line with the findings of WP1 reports.[22]

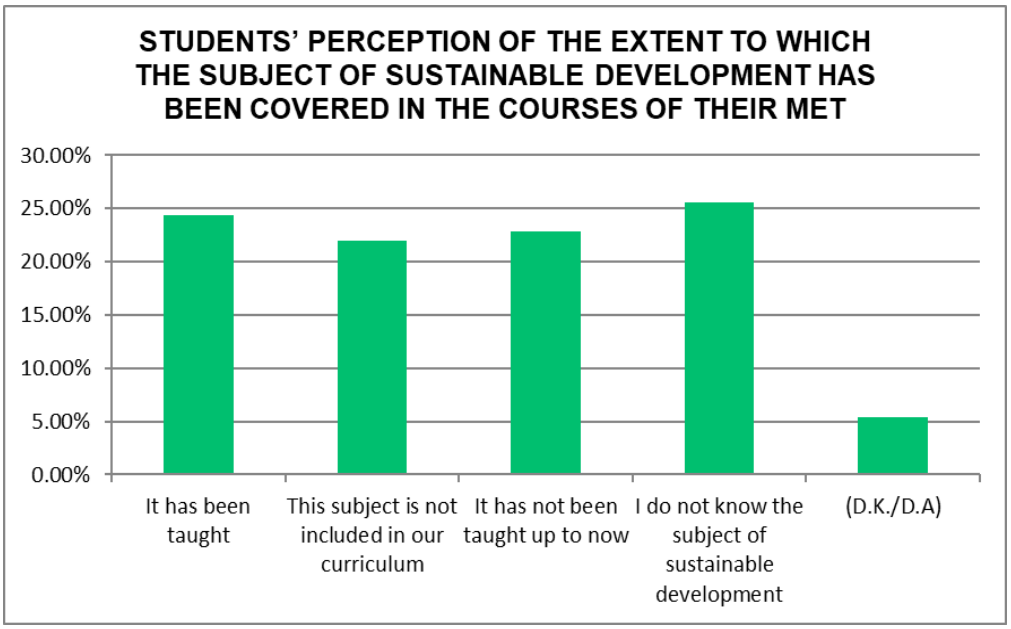
[22] D1.1.2 *Current and skills needs (Reality & Mapping)*, D1.1.3 *Future Skills and competence needs (Possible future development).*

FIGURE 2.4



Interestingly, students seemed to generally believe that the courses they attended gave them the opportunity to develop transferable skills: 59.0% of respondents agreed or strongly agreed with that statement (see Figure 2.4) and only 14.6% expressed disagreement with it, although it cannot be inferred whether responders factored present trends such as sustainability or digitalization in their answers.

FIGURE 2.5

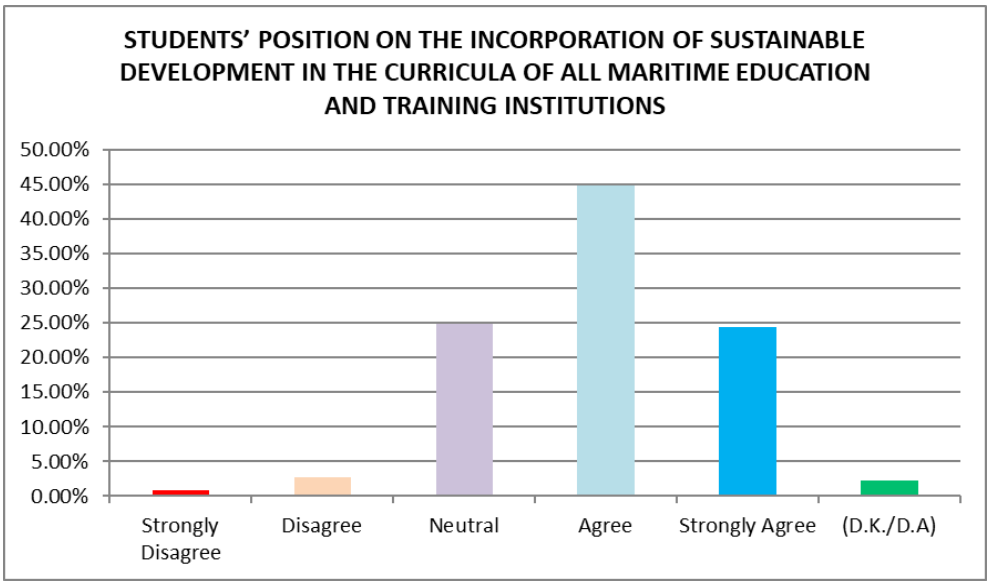


Responses on the subject of sustainable development are most interesting in this regard, as for over 20% there was no provision for teaching the subject in their programme. An even higher percentage stated that they were not familiar with the concept despite sustainability being a major direction on the maritime scene in recent years and requiring a more in-depth and extensive coverage in future MET provision[23]. Student perception of the need for emphasis on sustainability is a key finding of the survey, as shown in Figure 2.6, with the large majority of students (69.3%) agreeing or strongly agreeing that sustainable development should be incorporated in thecurricula of MET institutions.

However, in view of the recorded absence of the subject from many MET curricula, it is unlikely that even students who are quite familiar with the concept are also sufficiently aware of the many facets of sustainability or of the full number and the range of the United Nations 17 Sustainable Development Goals and of their adoption and related steps taken by the International Maritime Organization (IMO).

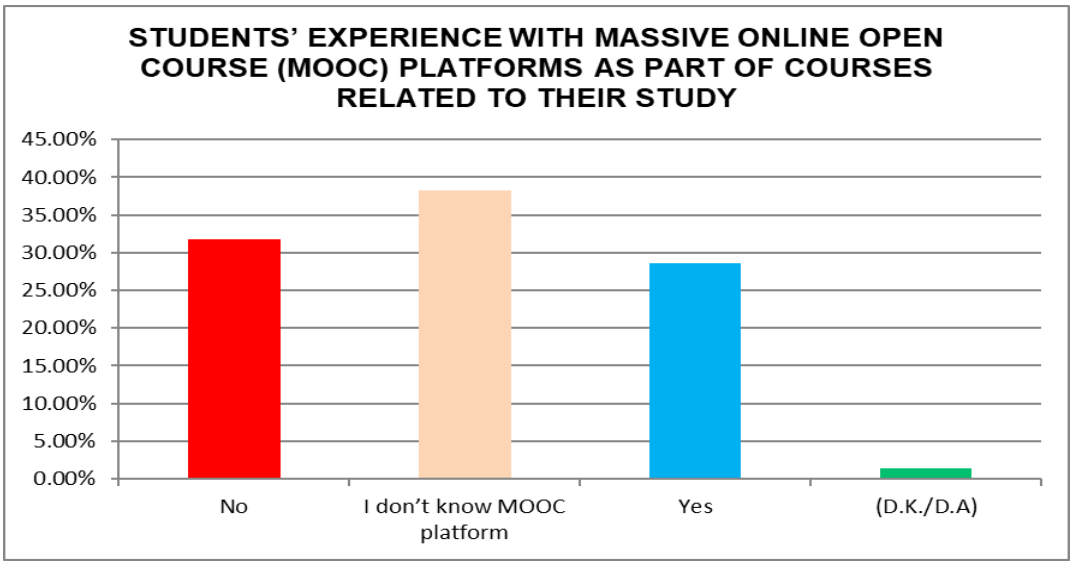
[23] As underlined in the delivered reports under WP1 and WP3.

FIGURE 2.6



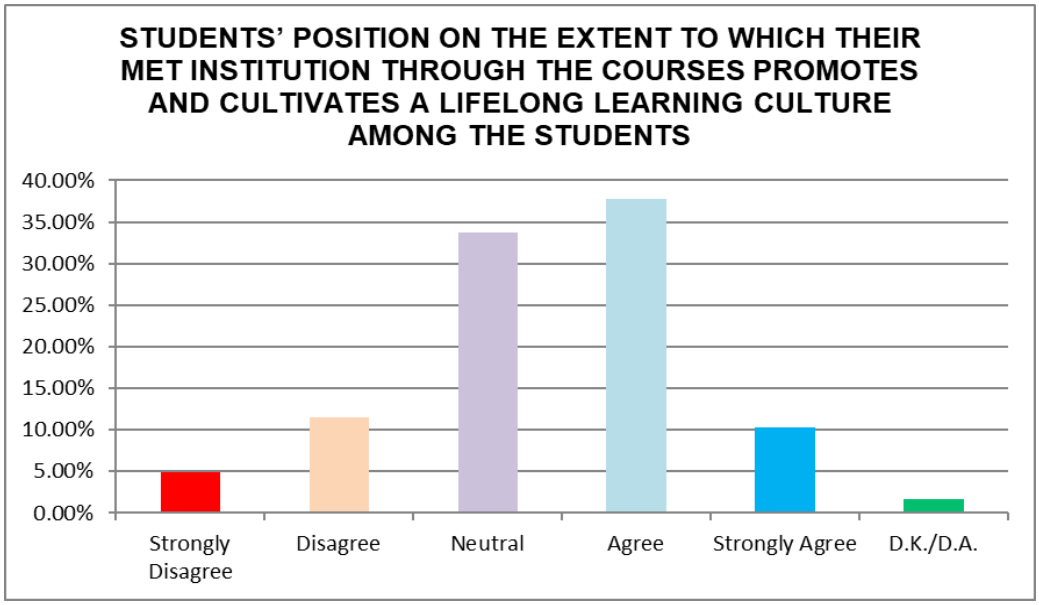
The next survey question (see Figure 2.7) examined the use of new delivery concepts in relation to new technologies, exploring the familiarity of students with Massive Online Open Course (MOOC) platforms which have increased in visibility in recent years. Responses revealed that most students (70%) did not have any experience with MOOC, which METs could consider embracing more widely as the wider utilization of e-learning platforms could open up new avenues of maritime education beyond STCW. METs could also benefit from their use to share course material and introduce students into a lifelong learning culture which could drive their future professional development.

FIGURE 2.7



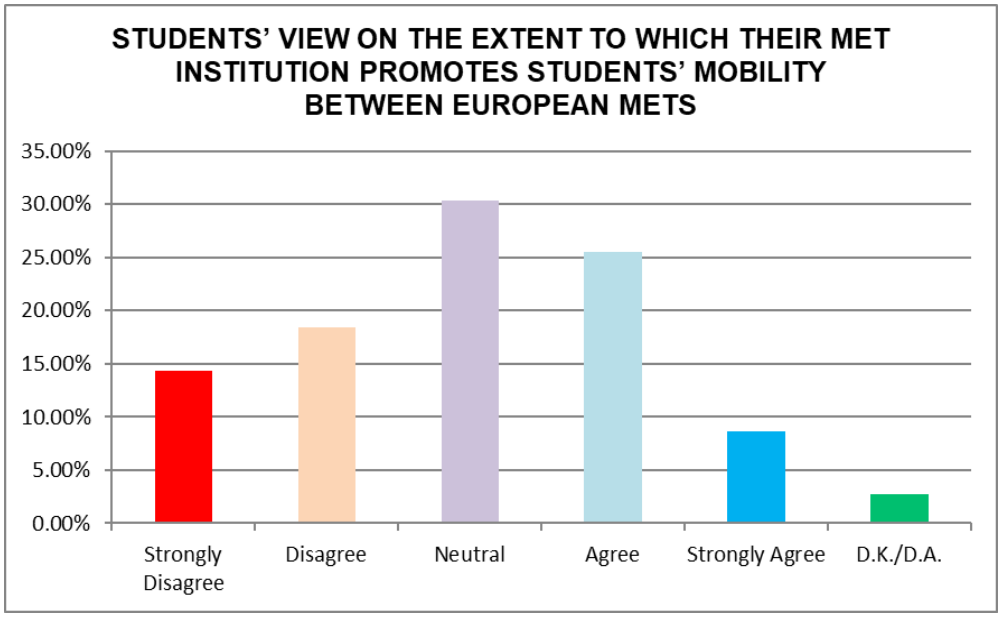
Moreover, a very large percentage of students believe that their MET institution does instill a lifelong learning culture in them through the courses offered (cf. Figure 2.8), with 48.1% agreeing or strongly agreeing that this is the case, despite a non-negligible 16.5% expressing disagreement or strong disagreement with the question statement – a percentage rather consistent with the proportion of students dissatisfied or very dissatisfied with their continuous learning skills (see Figure 2.3 *supra*).

FIGURE 2.8



In terms of mobility, while a relatively large percentage of students (34.2%) agreed or strongly agreed that their MET institution promotes student mobility between European METs, an equally substantial 32.8% disagreed or strongly disagreed with the statement (cf. Figure 9). The latter finding may stem primarily from legal barriers and differences in structures or from the lack of transferability of credits between different MET institutions across borders, as in order for the training to be recognized, the (foreign) MET institution needs to be approved by the certificate holder's home country[24]. These findings provide evidence of barriers in student exchanges between METs across the rather chequered MET system within Europe, although Directive 2019/1159 underscores the importance of student mobility for skills development. As a result, METs may be missing out on some of the opportunities provided by the Erasmus+ programme.

FIGURE 2.9



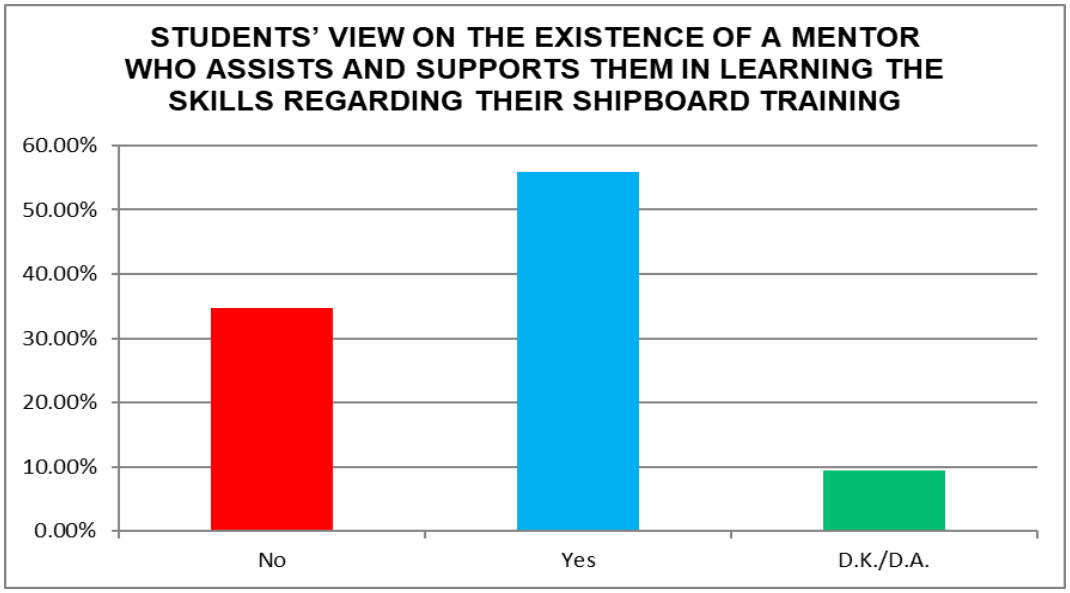
Finally, students' opinions about the existence of a mentor during their training were divided (cf. Figure 2.10). More than half (55.9%) considered that current provision allows effective support by a mentor as stipulated by the STCW[25]; however, 34.8% disagreed. MET institutions need a more

[24] The D3.4 report SkillSea (2020). *Internationalized Strategies in MET, op.cit.,* offers a specific MET adapted and EU framework-based tool to facilitate internationalization strategies Transcript International Transfer (Trans.I.T)

[25] Mentoring helps students with the education and training necessary to control the operation of a ship and to manage and care for - persons on board at the operational level by the application of resource management, leadership and Team working skills. More info is included in the STCW (Operational Level), Table A-II/1 (Officer in charge of a navigational watch), Table A-III/1 (Officer in charge of an engineering watch) and Table A-III/6 (Electro-technical officer).

student-centred training approach to ensure that trainers also act as mentors when offering shipboard training. Such a direction does not dictate or preclude modes of delivery or any specific content but requires a shift towards the possibility of more customized guidance and student support on the basis of the needs and specific circumstances of individual cases.

FIGURE 2.10



2.2.2. Perceptions of Academic Staff

The majority of faculty responding to this specific survey had at least 10 years' experience (cf. FIGURE ANNEX 2B.4, ANNEX 2B) which is a substantial period of service to allow perceptions to form over evolving aspects of the provision critical for strategic evaluation.

The dominant teaching direction of respondents was nautical sciences (53.9%), with 29.4% involving specialists in marine engineering and 9.8% in marine electromechanics and the remaining 27.5% teaching other subjects. Those findings are consistent with the study areas of most students, which involved engineer officers (52%) and deck officers (42%) (see FIGURE ANNEX1B.4, ANNEX 1B).

However, even though nautical sciences and marine engineering will remain for the foreseeable future the core subject areas of METs, new demands for transversal and soft skills – in view of the pace of change in shipping accelerated by the impact of the Covid-19 pandemic – may necessitate a greater diversity in the latter. Market-related disciplines such as maritime economics, management, quantitative analysis, maritime policy, and shipping law were indeed identified as gaps through WP1[26].

In terms of profile of faculty in the METs surveyed (see FIGURE ANNEX 2B.6), about half of the respondents among teaching staff held an MSc-level degree as highest academic qualification with another 42.2% also having earned the highest academic degree, a PhD, with only a small percentage (7.8%) holding just a bachelor's degree[27]. Moreover, more than half of the respondents held posts at a level of senior lecturer and above, which are normally included in tenured or tenure-track faculty (see FIGURE ANNEX 2B.7[28]).

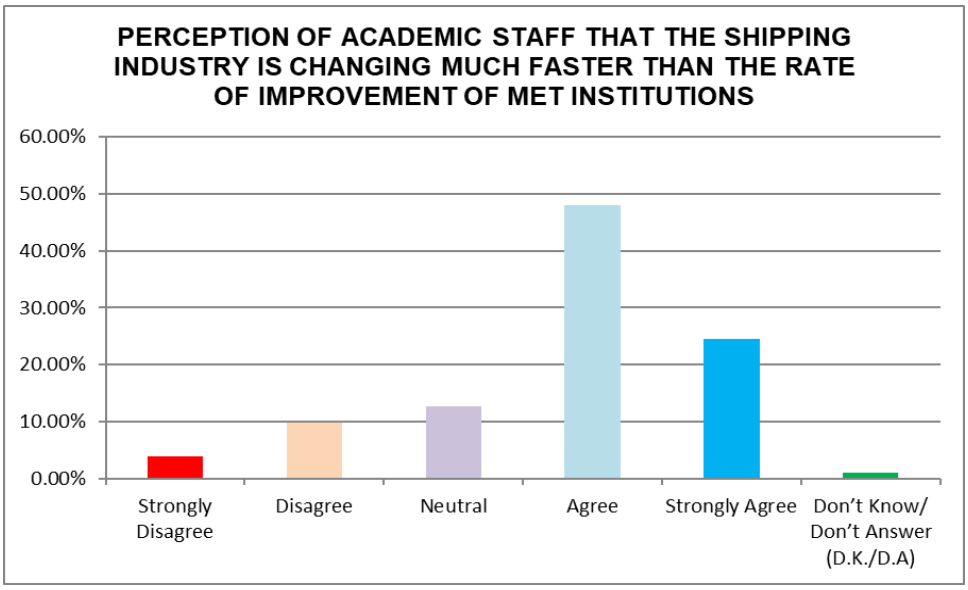
Figures 2.11A and 2.11B show the distribution of opinions of teaching staff on the prospects of MET responding adequately to current challenges. The two graphs illustrate responses in total and by region of METs surveyed. The prevailing perception recorded amongst faculty members (across both European and non-European institutions) is that METs cannot keep up with changes in the maritime industry: over 70% agreed or strongly agreed with the related survey statement. This reflects the dynamic character of the changes currently occurring in the industry and calls for the consideration of mechanisms to enable the more rapid adjustment of MET to those needs. The need to strengthen future-proof educational provision to promote career paths of maritime professionals is shown to be a shared perception among faculty members.

[26] Cf. Deliverables D1, under WP1.

[27] While the latter category participates little in total staff across academic institutions - by law in some European countries - in the case of METs there are cases of instructors who are selected on the basis precisely of their long practical experience, rather than on grounds of academic titles, something applying also for some special teaching positions related to professional qualifications or arts in some European countries. The contribution of such staff enhances the quality of practical training offered by METs, while staff in this category may be trained to cultivate the critical, analytical, and transversal skills of students as well.

[28] There was a small number of survey participants holding lower rank positions; a number among these could be practitioners although data were not requested to that detailed level in order to avoid leading to identification of faculty members surveyed. However, their share roughly corresponds to the BSc holders with possibly holders of higher academic degrees among them

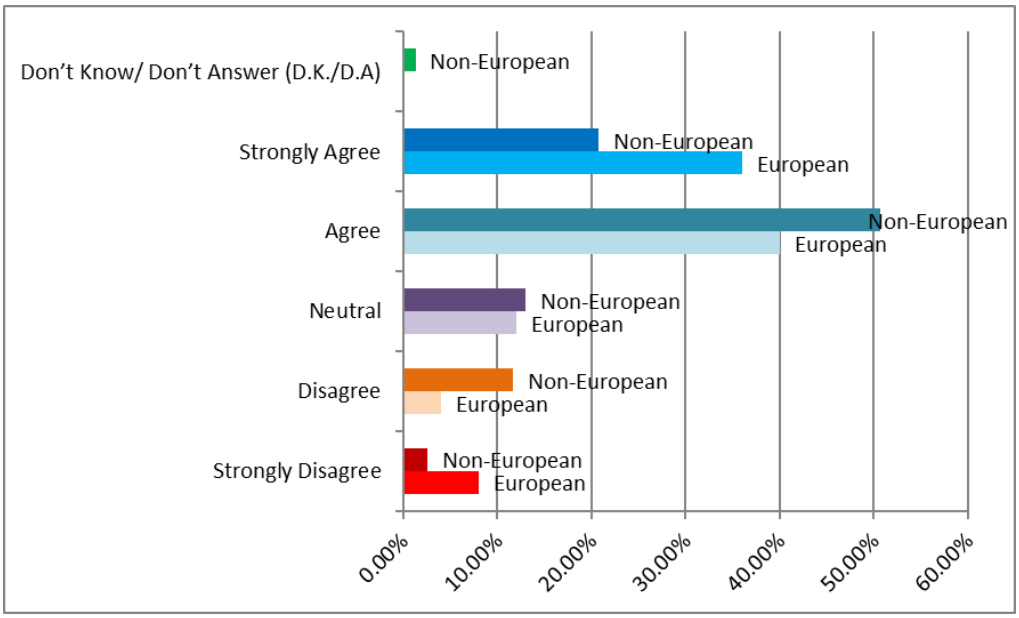
FIGURE 2.11A



When examining responses to this question by region (cf. Figure 2.11B) it transpires that faculty members across European METs surveyed are markedly more worried about the ability of MET to adjust as fast as required to provide maritime professionals with the necessary knowledge and skills.

FIGURE 2.11B

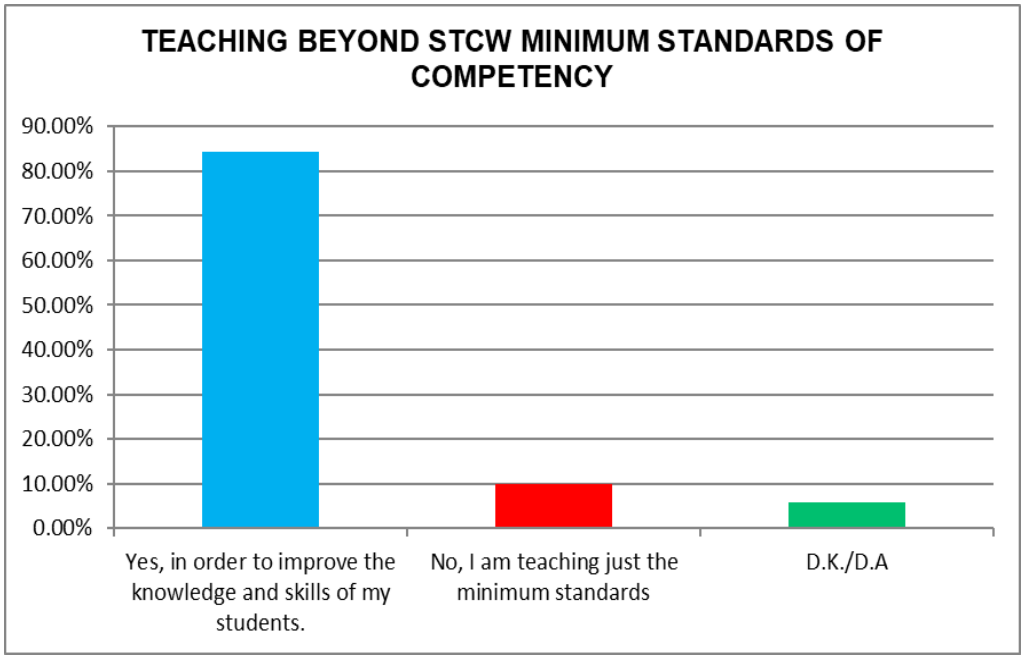
PERCEPTION OF FACULTY THAT SHIPPING IS CHANGING MUCH FASTER THAN THE RATE OF IMPROVEMENT OF MET INSTITUTIONS
(by MET country group)



It is worth noting that, in order to fill this gap, the Strategy Plan Framework SkillSea report[29] proposes a flexible strategic framework based on dynamic capabilities, adequate monitoring mechanisms, and sharing of best practices. Measurement tools for adapting through strategic evaluation may well have a significant role to play in the process, as discussed in the next two chapters of this report.

As shown in Figure 2.12A and Figure 2.12B, teaching staff in the METs surveyed are going beyond the minimum levels of professional qualification requirements by the STCW Convention standards of competency, with more than 80% going above and beyond these. The vast majority of instructors (84.3%) also enrich their teaching with material expanding on what is mandated by STCW.

FIGURE 2.12A



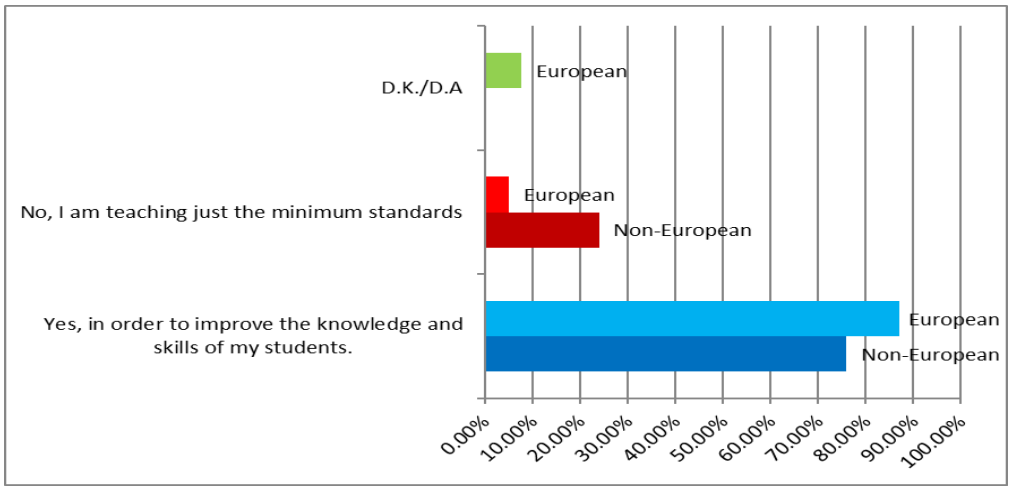
This particular trend seems even stronger among European METs, where 87.0% teach beyond STCW minimum standards, versus 76.0% in non-European METs. As only 5% of European METs stated that they teach only within STCW minima, it seems that almost all faculties across the European METs surveyed go above and beyond these minimum requirements.

[29] Cf. SkillSea (2020). D3.1 *Strategy Plan Framework*, op.cit., Chapter 4.

FIGURE 2.12B

TEACHING BEYOND STCW MINIMUM STANDARDS OF COMPETENCY

(by MET country group)



The perception of faculties regarding the rate of adaptability of METs (see Figure 2.11A) seems thus to be reflected largely in the effort by staff to adapt syllabi to current trends, even before any revision of the STCW Convention in the near future. This initiative signifies their realization that as technological evolution runs at a quick pace there a need to teach developments which policy-makers could not have taken into account at the time of creating and revising the STCW Convention.

These results are also in a way consistent with those shown in Figures 2.13A and 2.13B, as the scale of this practice by educators denotes the existence if not of an explicit plan, at least of a clear strategic perception of existing gaps and potential remedies to these.

FIGURE 2.13A

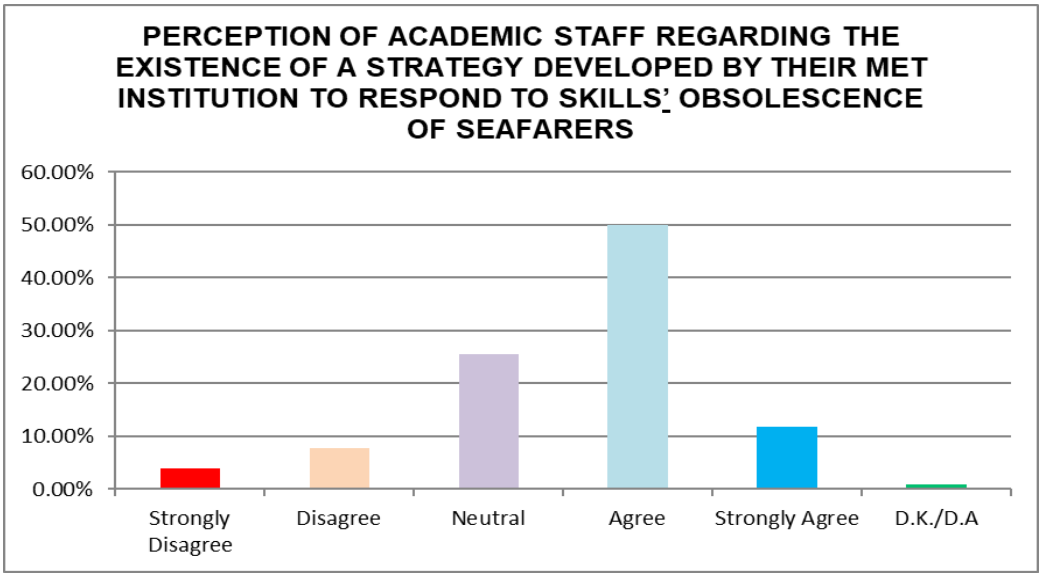
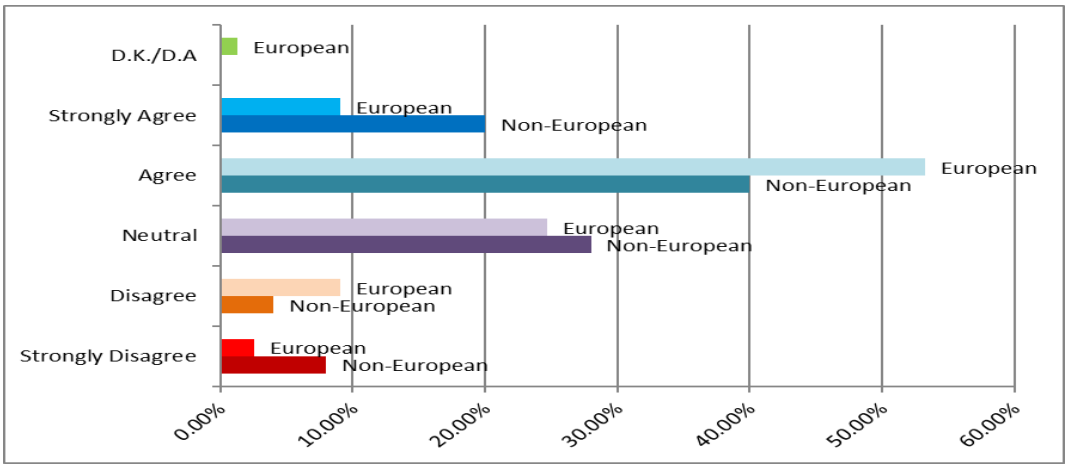


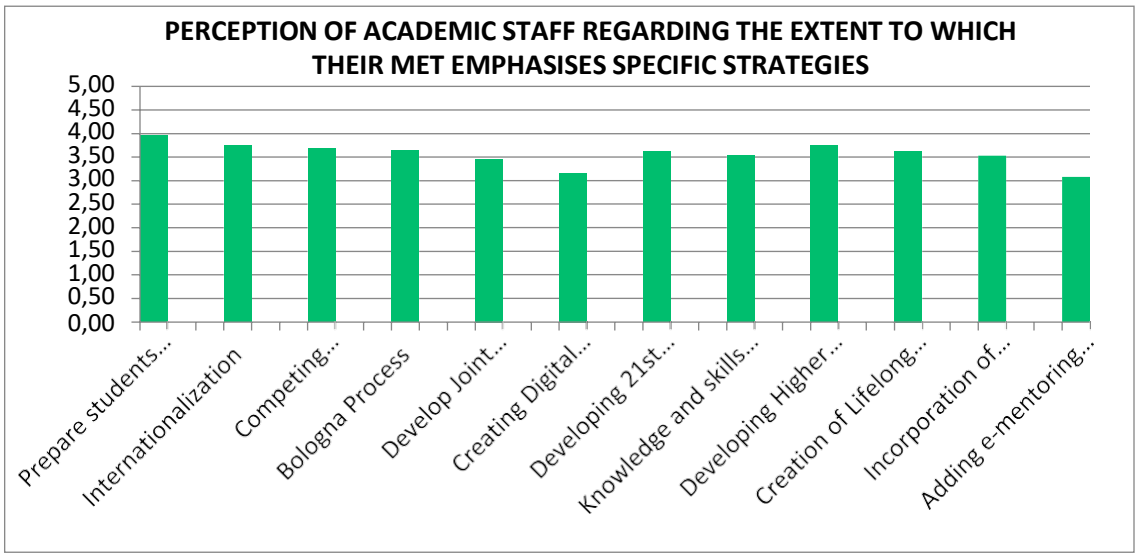
FIGURE 2.13B
PERCEPTION OF FACULTY ON STRATEGY DEVELOPED BY THEIR MET INSTITUTION TO RESPOND TO SKILLS' OBSOLESCENCE OF SEAFARES

(by MET country group)



More than 60% of respondents considered that their MET institution has developed a strategy to address the skills gap. Interestingly, a larger percentage of members of non-European METs (20.0% versus 9.1% for European METs) strongly agreed with the above statement. This may reflect the uncertainty around the existence of a comprehensive strategy at a European level. The realized need to craft such strategies stems from the perception of the slow adaptation of both STCW and METs to new trends, as revealed through these questions. However, there is no clear agreement about the type and goals of each of those strategies.

FIGURE 2.14A



Figures 2.14A and 2.14B (by country group) show the perceptions of academic staff measuredin average scores, with 5 indicating the highest emphasis of MET on the listed strategies and 1 corresponding to no emphasis.

FIGURE 2.14B

PERCEPTION OF SPECIFIC STRATEGY EMPHASIS BY ACADEMIC STAFF

(by MET country group)

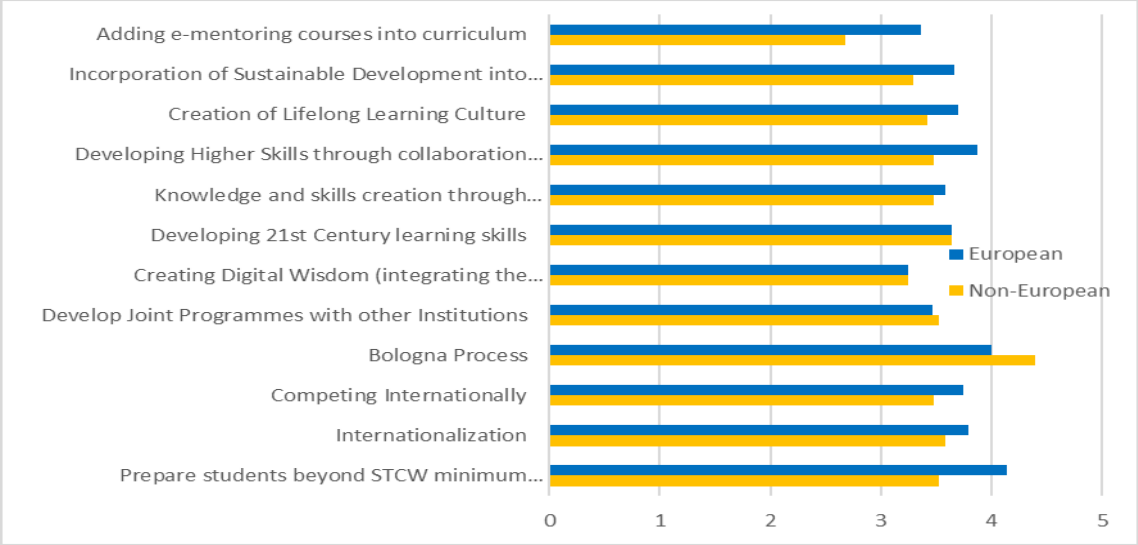


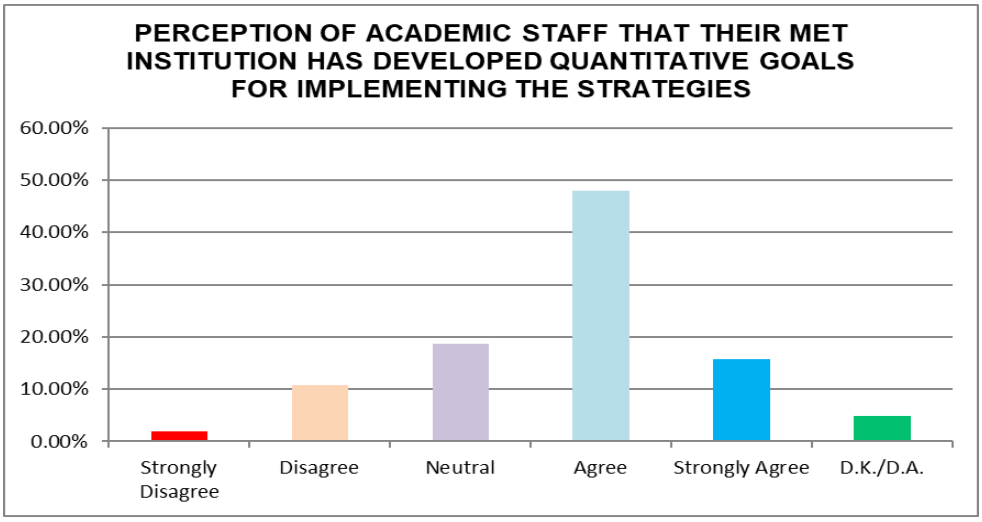
Figure 2.14A sheds some light on the unknown parameters of MET strategies. Consistent with responses to previous questions, the major areas of strategic focus are considered to be the preparation of students beyond STCW minimum requirements and the development of skills through collaboration between MET and employers. The respondents place the highest emphasis on those two strategic priorities (26.5% and 19.6%, respectively). Other strategic priorities highly emphasized by teaching staff include internationalization (53.0%), development of 21st century learning skills (52%), creation of lifelong learning culture (49.5%), development of joint programmes with other institutions (46.5%), international competition (44.1%), incorporation of sustainable development in the curriculum (43.6%), and knowledge and skills creation through interdisciplinarity and transdisciplinarity (40.6%). In terms of averages (Figure 2.14A), the top three areas of strategic focus are the preparation of students beyond STCW minimum requirements (3.95), skills development through collaboration between MET and employers (3.75), and internationalization (3.74).

In terms of any regional differences, the results among faculties in European MET are largely aligned with the aforementioned ranking of strategic priorities. However, in the case of non-European MET, there is some divergence. Their members place the highest emphasis on the

development of 21st century learning skills (3.64), internationalisation (3.58), development of joint programmes (3.52), and preparation of students beyond STCW minimum requirements (3.52).

The average of 2.64 for the Bologna Process – which includes crystallized procedures on evaluation – is not significant, since 52.2% of members of non-European METs did not respond as the process could be either irrelevant, unless adopted voluntarily, or unknown. In general, it could be argued that faculties in non-European METs are recorded as eager to promote international collaborations. Interestingly, the respondents did not evaluate very highly either the incorporation of the digital culture in their thinking and decision-making or e-mentorship, averaging respectively 3.00 for non-European MET members and 3.21 for European ones, and 2.68 and 3.21 in the second case respectively, registering the lowest scores in this survey for both regional groups (with the exception of the Bologna Process).

FIGURE 2.15A

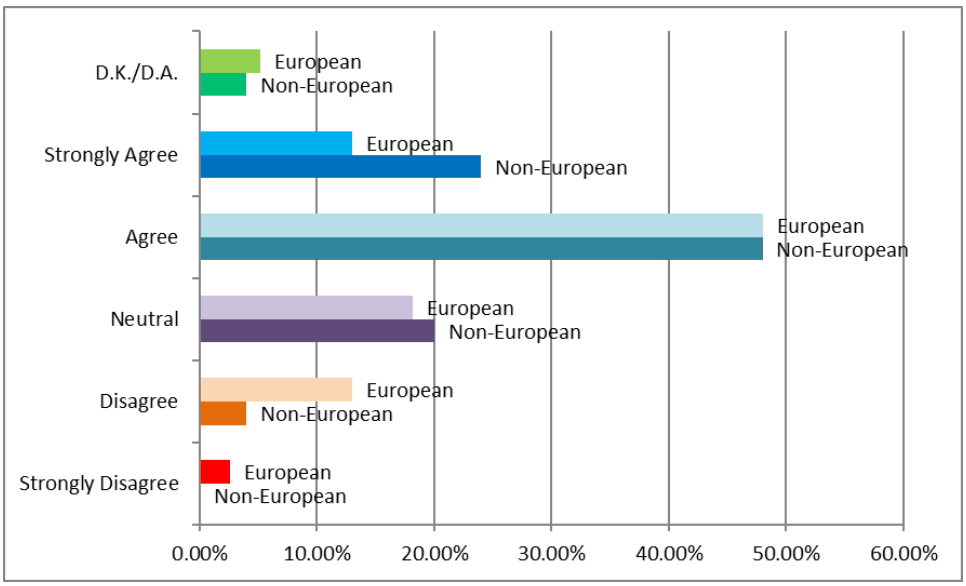


As shown in Figure 2.15A, about six out of 10 faculty respondents agree or strongly agree that their MET institution has set quantitative strategic goals. The faculties of non-European METs appear slightly more confident about the quantification of their institution's strategic goals, as the percentage of those who strongly agree (24.0%) is almost double the percentage of European (13.0%) as shown in Figure 2.15B.

FIGURE 2.15B

PERCEPTION OF ACADEMIC STAFF THAT THEIR MET INSTITUTION HAS DEVELOPED QUANTITATIVE GOALS FOR IMPLEMENTING THE STRATEGIES

(European METs/non-European METs)



As shown in Figures 2.16A and 2.16B, there is agreement with previous results on the pace of MET in response to change in the industry (cf. Figures 2.11A and 2.11B), with more than 85% of respondents agreeing or strongly agreeing that MET institutions need to revise their curriculum at regular intervals to keep abreast of new trends. This is much more pronounced in non-European METs, where 20.0% of respondents agreed and 72.0% strongly agreed. The respective percentages for European METs were 41.6% and 48.1%, although the five-year example could introduce a bias covering larger time differences.

FIGURE 2.16A

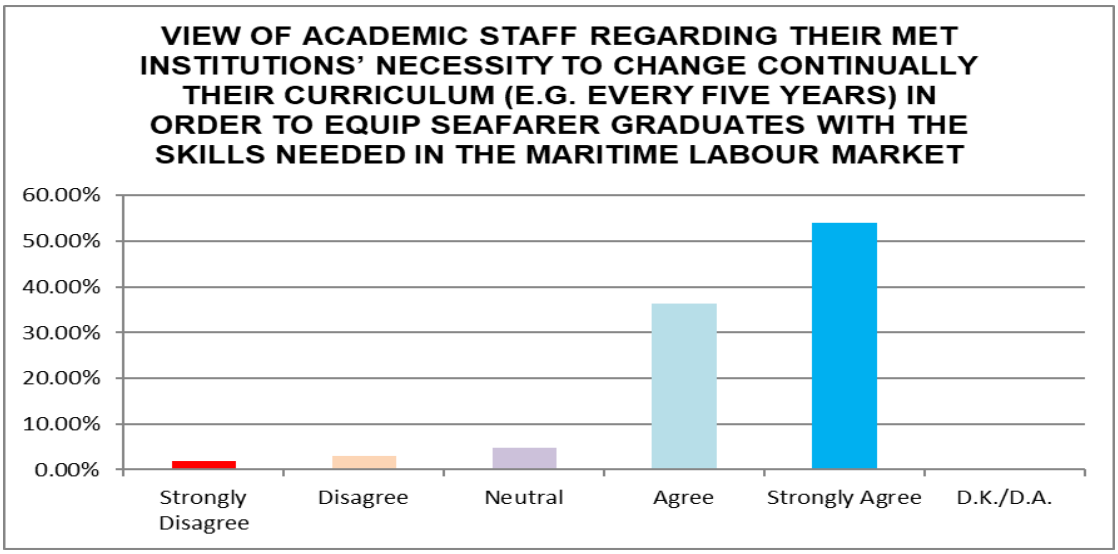
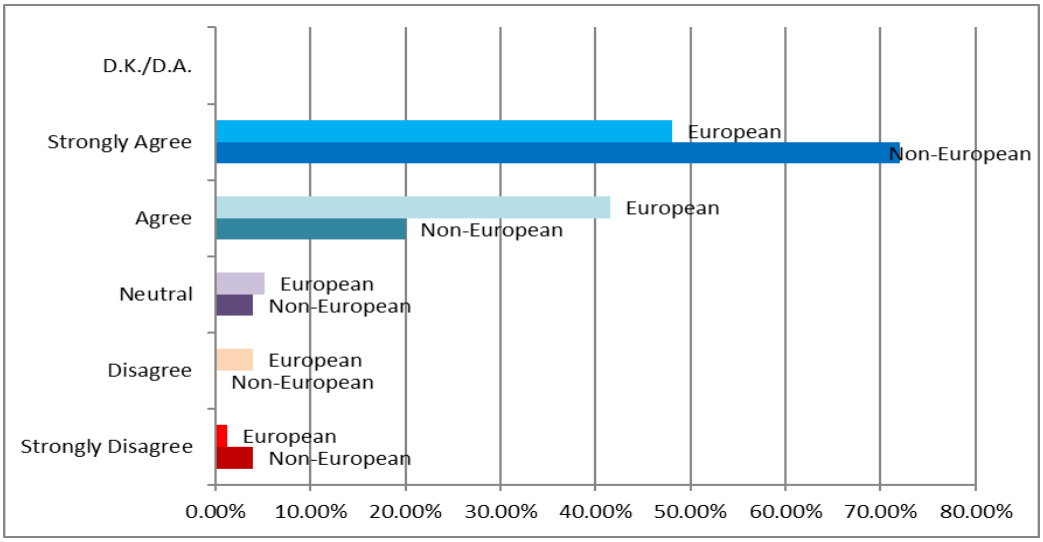


FIGURE 2.16B

VIEW OF ACADEMIC STAFF ON MET CURRICULUM UPDATE NEED

(by MET country group)



The results shown in Figures 2.17A and 2.17B illustrate that sustainable development should be one of the key strategic priorities for improvements across METs internationally, in accordancewith the findings of both SkillSea reports on future skills needs and with findings about current trends and strategic directions in shipping set out in the D3.1 Strategy Plan Framework deliverablereport by WP3.

FIGURE 2.17A

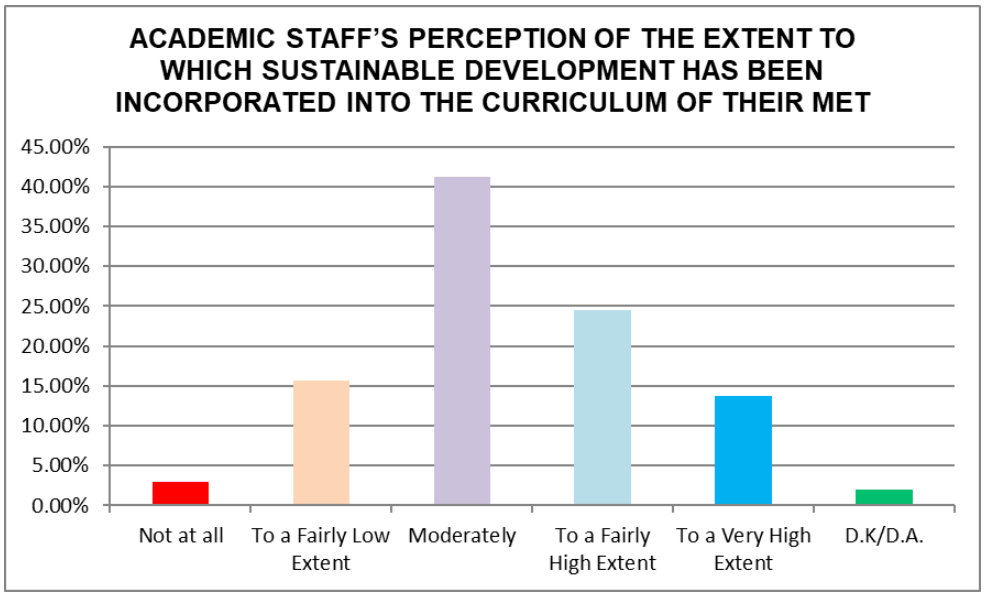
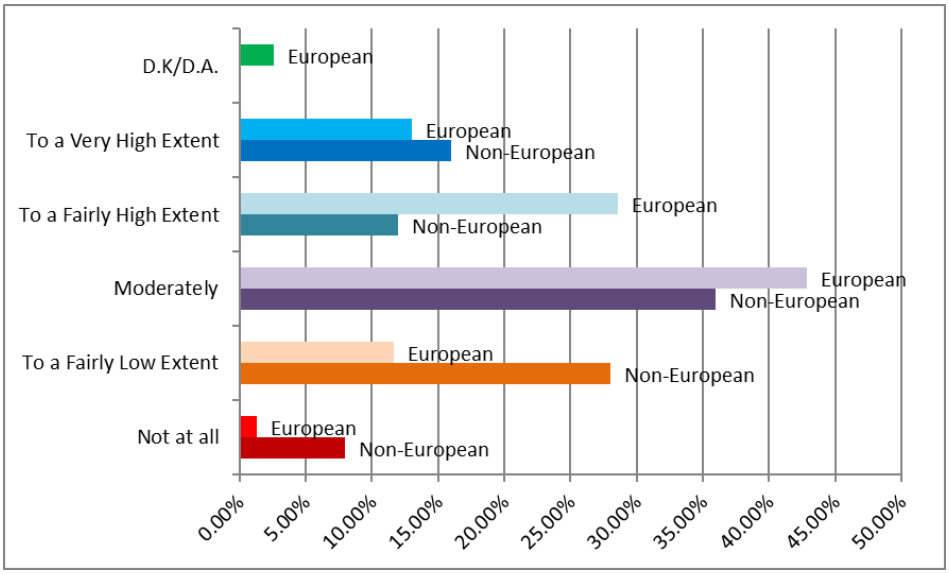


FIGURE 2.17B

ACADEMIC STAFF PERCEPTION OF THE EXTENT TO WHICH SUSTAINABLE DEVELOPMENT HAS BEEN INCORPORATED INTO THE CURRICULUM

(by MET country group)

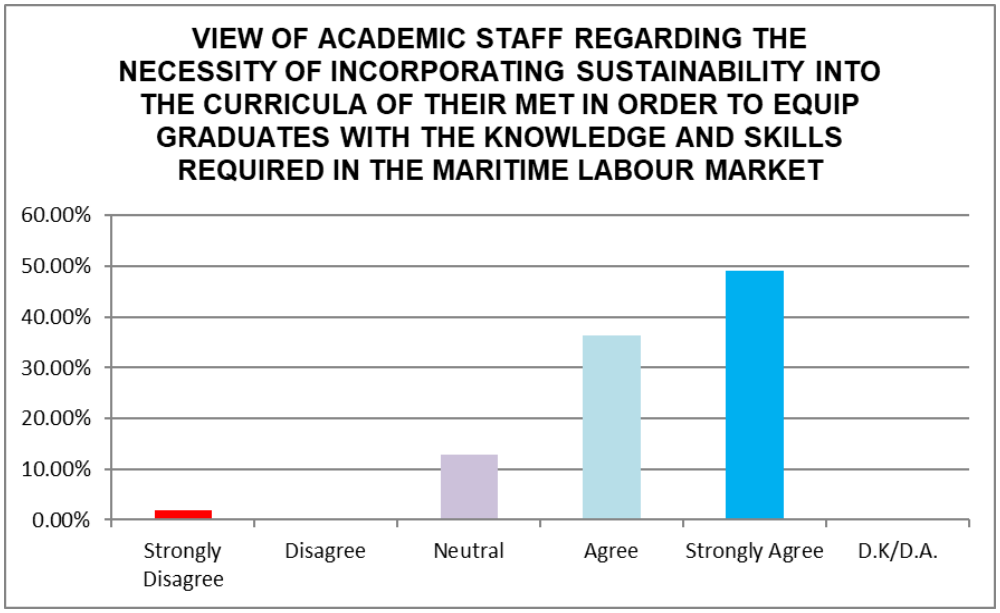


In particular, Figure 2.17A reveals that even though a large percentage of respondentsconsidered that sustainability has already been incorporated into their institution's curriculum, there is still

ample margin to improve. Four out of 10 faculty respondents feel that there has beena moderate integration, while 24.5% and 13.7% only see a fairly high or very high integration respectively, with another 15.6% believing that there is a low degree of integration, and 2.9% stating zero integration. European MET institutions are perceived by their teaching staff membersto have taken more steps to embrace sustainability than non-European METs, as 41.6% of members of European MET staff responding reported high or very high integration, as opposed to 28.0% for non-European METs.

Given that sustainability is one of the major trends for the shipping industry, as identified by other SkillSea reports[30], it is imperative for METs to adjust their curricula accordingly and thereby offer training of higher quality, which will in turn result in graduates possessing the knowledge and skills required by the shipping labour market. This view is also shared by the majority of academic staff, as presented in Figure 2.18A below, with more than 85% of respondents endorsing the necessity of incorporating sustainability into the curricula of their MET institutions and only 2% disagreeing. Despite the low degree of sustainability incorporation in their MET curricula, the vastmajority of non-European faculty members are in favour of this initiative, with 92.0% agreeing or strongly agreeing. Likewise, 83.1% of faculty working for European METs agree or strongly agreewith the incorporation of sustainability subjects into their institutions' curriculum, as shown in FIGURE 2.18B.

FIGURE 2.18A

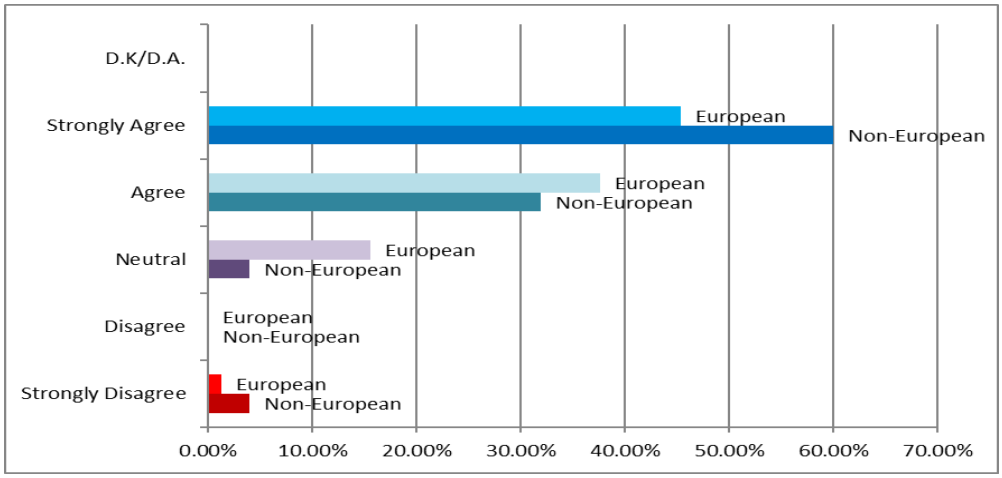


[30] WP1 and WP3 reports.

FIGURE 2.18B

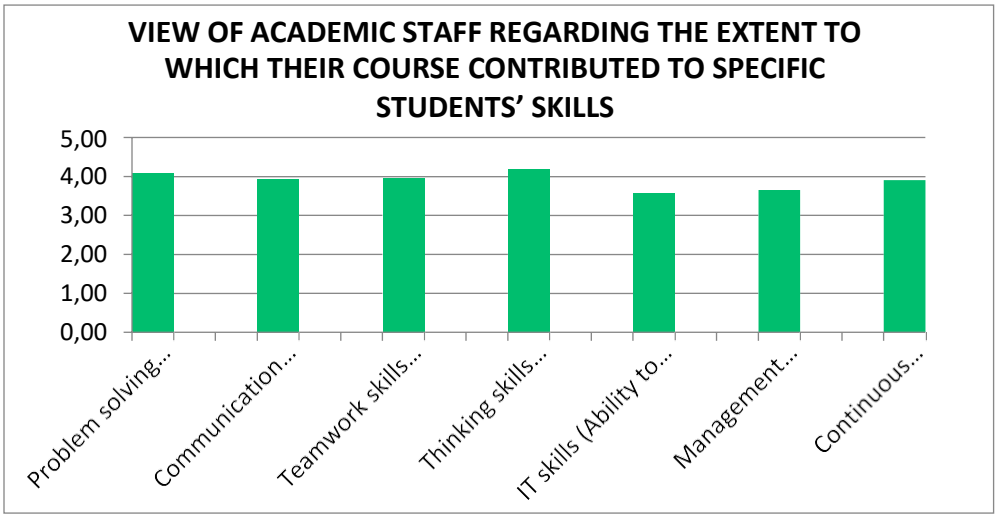
FACULTY VIEWS OF THE NECESSITY TO INCLUDE SUSTAINABILITY IN THE CURRICULUM

(by MET country group)



Turning to skills, Figure 2.19A presents the skills developed through existing courses at METs, based on the views of faculty. Having the lowest average scores (3.60 and 3.68), IT and management skills appear to be the most neglected skills. In both types, approximately 15% of respondents reported little or no contribution, with the averages being the lowest (3.60 and 3.68, respectively) with a substantial percentage of faculty believing that their courses primarily contribute to the development of problem-solving (4.13), critical thinking (4.21), and teamwork skills (3.99) with the corresponding average scores ranking the highest.

FIGURE 2.19A

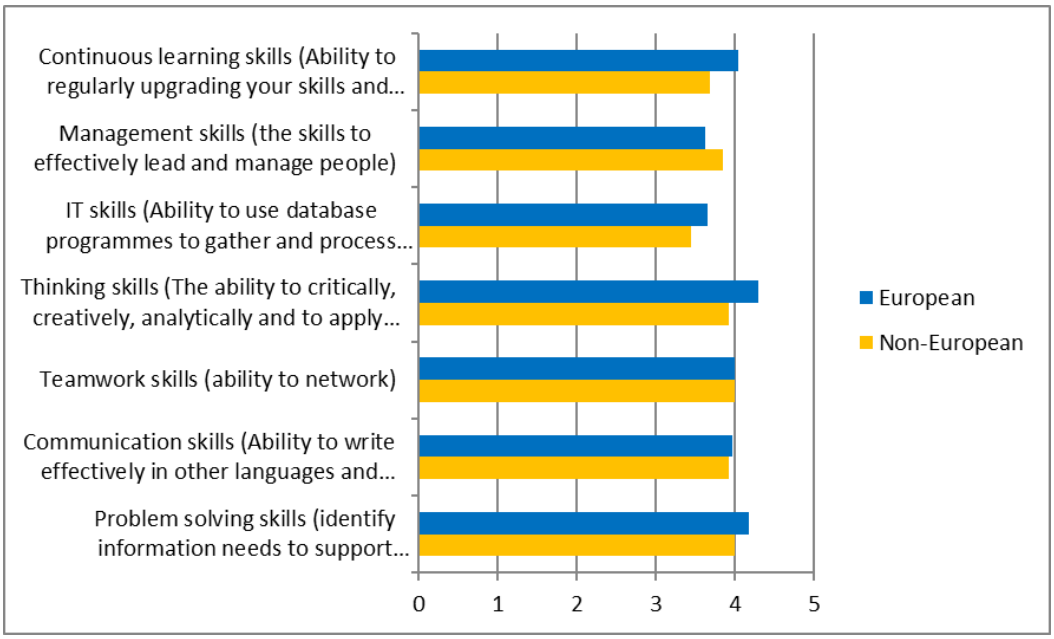


Faculty working for European METs reported that their courses primarily contribute to the development of critical thinking (4.30), problem solving (4.17), and continuous learning[31] (4.04). Academic staff in non-European METs considered that their courses have the most significant contribution to the following skills: problem solving (4.00); teamwork (4.00); communication (3.92); and critical thinking (3.92), as shown in FIGURE 2.19B.

FIGURE 2.19B

VIEW OF ACADEMIC STAFF REGARDING THE EXTENT TO WHICH THEIR COURSE CONTRIBUTED TO THE SPECIFIC STUDENTS' SKILLS

(by MET country group)



A lower contribution was reported in terms of continuous learning (3.95) and communication (3.95) skills. This was largely in line with students' perceptions, who generally considered lifelong learning to be an area for improvement in their METs.

As mentioned earlier, lifelong learning is one of the skills that need greater emphasis within the design of MET curricula. The value of this particular skill is further highlighted by the responses of MET academic staff. Almost all were of the opinion that lifelong learning is the main driver of seafarer employability, as shown in Figure 2.20A. Only 2% of respondents disagreed, while

[31] Lifelong Learning.

another 4.9% were neutral. Staff in European and non-European METs were somewhat aligned on the importance of lifelong learning, with the percentage of European MET members who strongly agreed being higher than members of non-European METs (42.9% versus 36.0%) as shown in Figure 2.20B.

FIGURE 2.20A

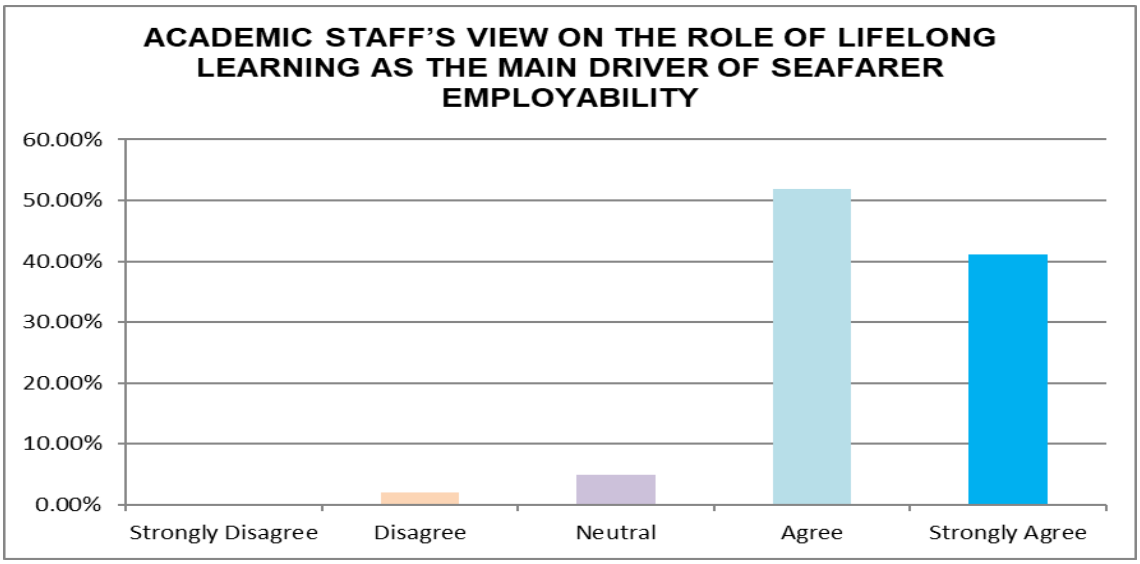


FIGURE 2.20B

ACADEMIC STAFFS' VIEW ON THE ROLE OF LIFELONG LEARNING AS THE MAIN DRIVER OF SEAFARER EMPLOYABILITY

(by MET country group)

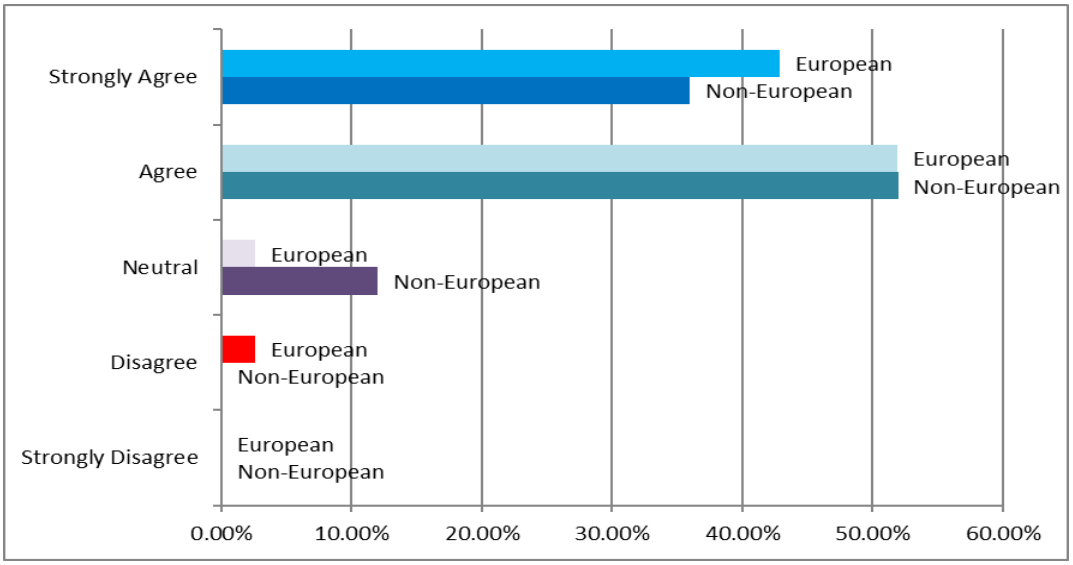
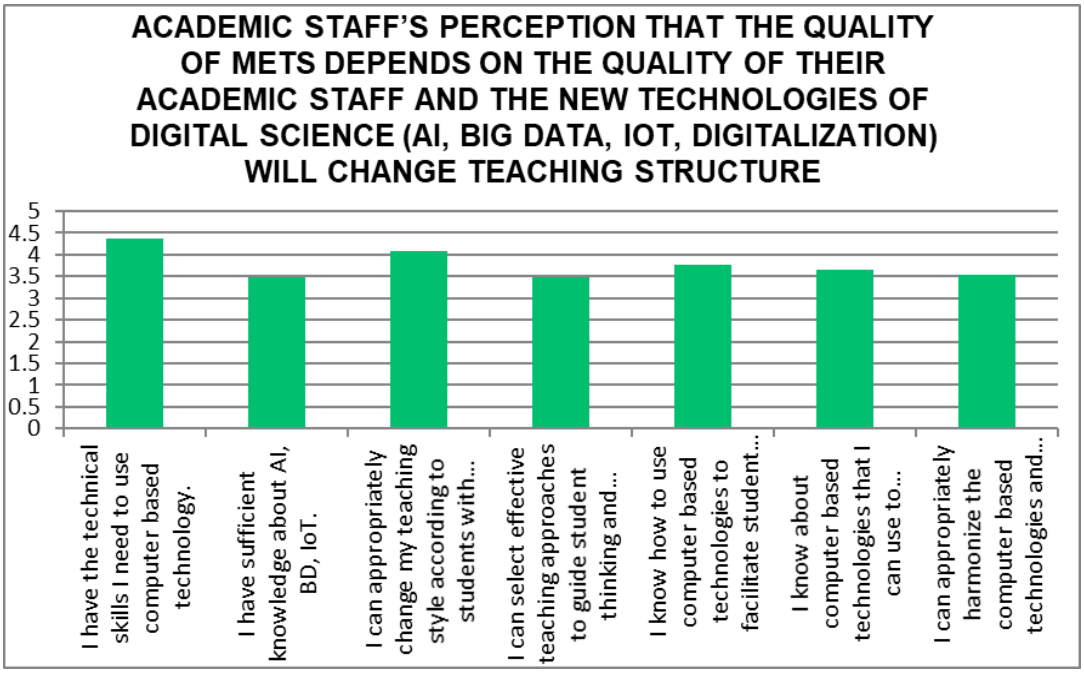


FIGURE 2.21A

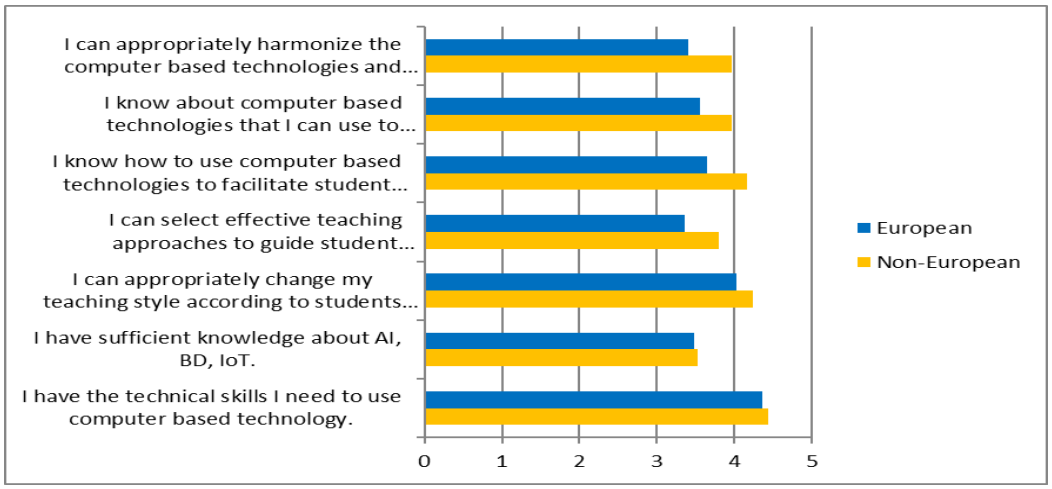


As much as 87.3% of survey participants (average of 4.08) said that they have the flexibility to adjust their teaching style to diverse student needs, but only half of the total respondents (average of 3.47) felt confident that they can adopt effective teaching approaches to guide student thinking and learning in AI, Big Data, and IoT. Finally, 56.9% (average of 3.54) felt capable of harmonizing computerized technologies with teaching methods for AI, Big Date, and IoT. The general conclusion that could be drawn is that the majority of academic staff are willing to embrace new technologies and use them as teaching tools, but even though they have the soft skills to understand these systems many appear reluctant to integrate them into their teaching practices straight away. Comprehensive faculty training may be one remedial path but a clear internal strategic management direction and support, along with the improvement of available related resources, may equally prove essential.

FIGURE 2.21B

ACADEMIC STAFFS' PERCEPTION OF THE IMPACT ON NEW TECHNOLOGIES ON TEACHING STRUCTURE

(by country group)



Responses to this question were consistent between European and non-European MET respondents, as shown in Figure 2.21B above. Therefore, the conclusions were uniform on this across METs.

The last survey question for this category of respondents was about the impact of specific technologies on courses over the next five years. Results showed (cf. Figure 2.22A) that the majority of academic staff expect that the most influential technological trends and applications in shipping will be virtual reality focused (simulators) with an average score of 4.5, greener ships (4.35), and automation (4.30). This is consistent with the findings of WP1, which identify automation and VR, including simulators, as major technological trends in the shipping industry. In parallel, green shipping – which is also related to the sustainability trend – is also highlighted in WP1.

According to faculty members surveyed, the technologies which are expected to have a less intense impact – but will still be influential – involve interactive teaching (4.27), e-mentoring (3.94), e-Textbooks (3.95), cybersecurity (4.17), and gamification (4.14). 3D printing was not perceived as equally influential, with 18.8% of academic staff not anticipating any significant impact on MET courses from this technology, resulting in a rather low average of 3.40 as shown in Figure 2.22A.

FIGURE 2.22A

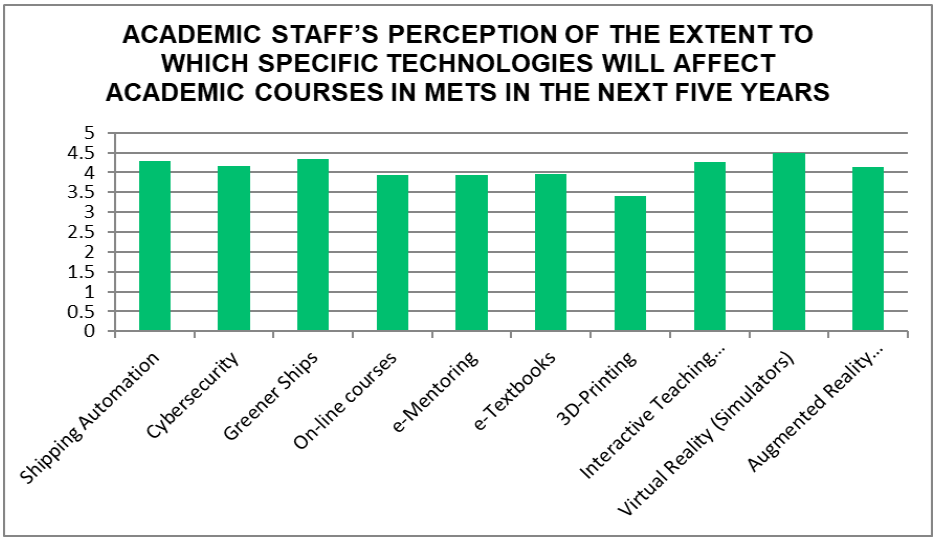
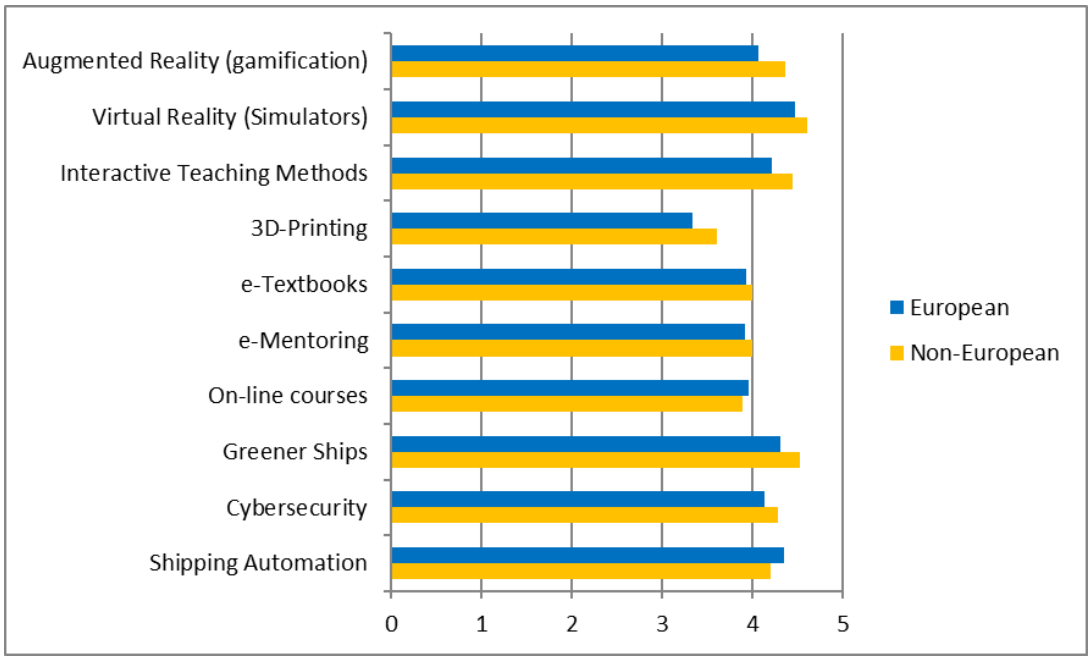


FIGURE 2.22B

FACULTY PERCEPTION OF THE EXTENT TO WHICH SPECIFIC TECHNOLOGIES WILL AFFECT MET ACADEMIC COURSES IN MET IN THE NEXT FIVE YEARS.

(by MET country group)



Differences in perceptions between members of European and non-Europeans METs are not significant, but they do affect the ranking of technological trends: according to the responses of

members of Europeans METs, the top three technological trends are virtual reality (4.47), shipping automation (4.34), and greener ships (4.30), whereas for non-European METs these are virtual reality (4.60), greener ships (4.52), and interactive teaching methods (4.44), as shown in Figure 2.22B.

2.2.3. Perceptions of high-level administrators

This third part of the survey explored the perceptions of high-level administrators. Most of the participants were department heads (43.7%), vice-deans (12.5%), and vice rectors (6.3%) (see FIGURE ANNEX 3B.2).

The survey results show the level of understanding by MET administration of the strategic importance of digitalisation for MET institutions, as 56.3% of participants agreed and 31.3% strongly agreed that digital transformation should be a key strategic priority for MET institutions. Only a minor percentage of administrators (3.1%) expressed disagreement.

FIGURE 2.23

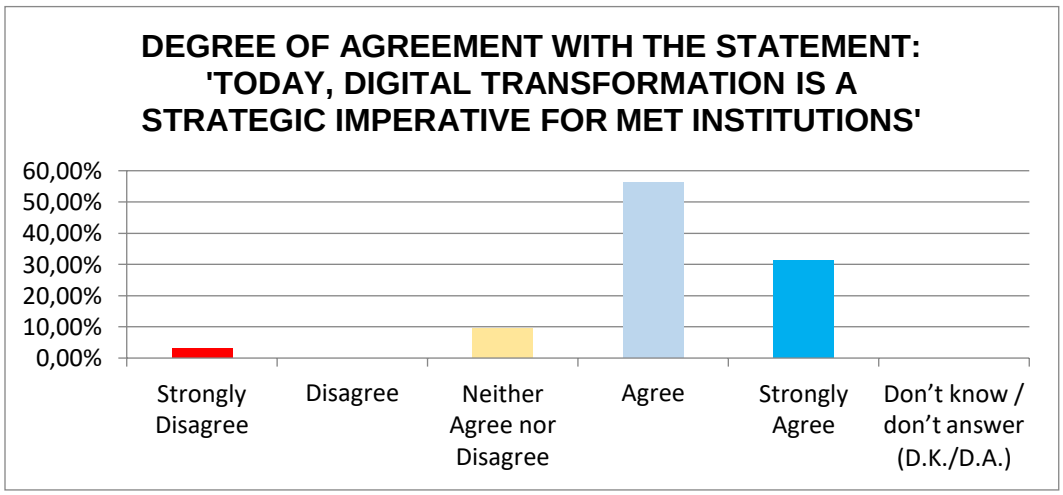
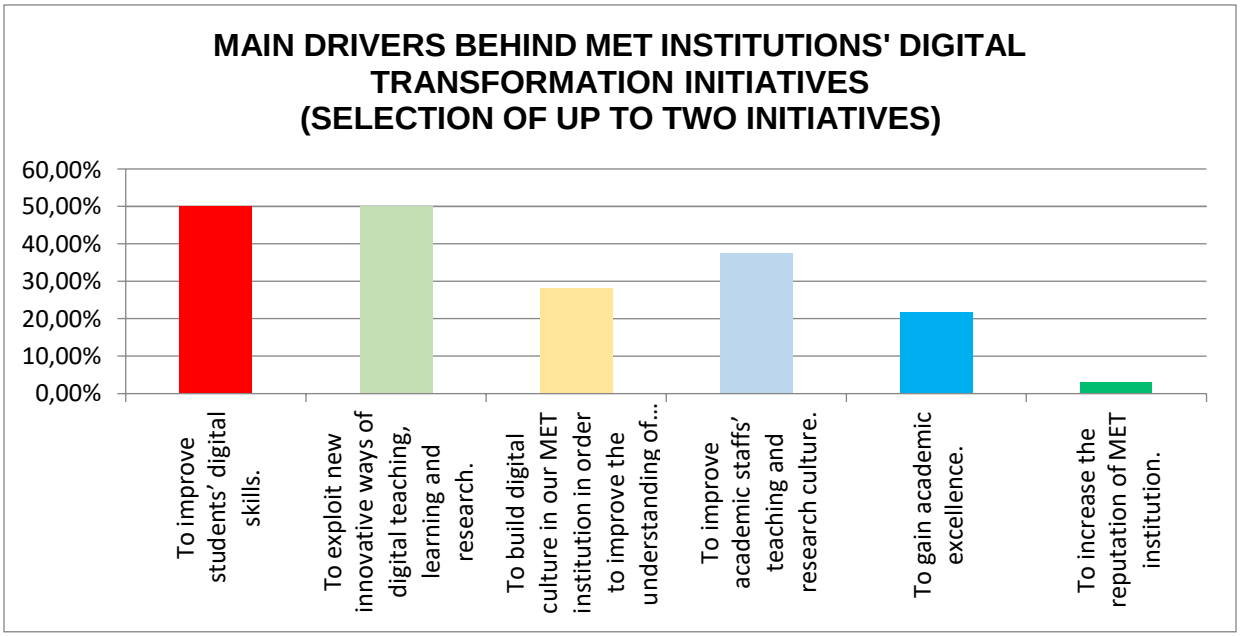


FIGURE 2.24 below presents the key drivers of the digital transformation of MET (it should be noted that respondents could select up to two choices). The results suggest that the two main drivers are the improvement of students' digital skills and the utilization of new innovative ways of digital teaching, learning and research. Each of these drivers was selected by half of the respondents. The selection of those two drivers by the majority of respondents highlights the emphasis of MET administrators on digital skills development and the need to incorporate innovation into teaching and research.

Other important drivers include the improvement of academic staffs' teaching and research culture (37.5%), the formation of a digital culture in their MET to improve the understanding of digital technologies (28.1%), the achievement of academic excellence[32] (21.9%), and the improvement of their MET's reputation (3.1%).

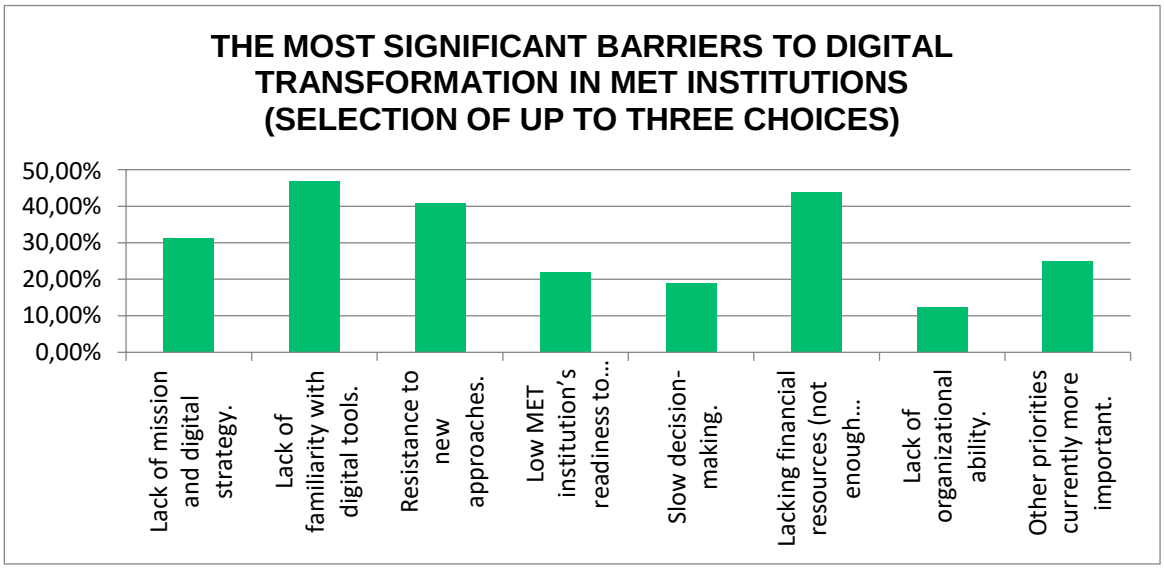
FIGURE 2.24



The next question (cf. Figure 2.25) explored what could possibly hold back digital transformationin METs. According to survey participants the most significant barriers are the lack of familiarity with digital tools (46.9%), the lack of funding (43.8%), and resistance to new approaches (40.6%).This suggests that successful digital transformation hinges on the need to increase familiarity withdigital tools and to overcome financial constraints as well as resistance to change. Other driversselected by administrators include the lack of mission and of digital strategy (31.3%), the lack of sufficient readiness to adopt and support digital transformation (21.9%), slow decision-making (18.8%), and the lack of organizational ability (12.5%).

[32] Although there may be differences in the perception or inclusion as goal the expression is commonly accepted to imply highest attainable result.

FIGURE 2.25



The existence of a digital strategy should not be taken for granted. In fact, the survey results reveal that 18.8% (cumulatively) of respondents did not identify a clear digital strategy in their MET. On the other hand, 43.8% agreed that their institution had developed a digital strategy, while 37.5% were neutral. Interestingly, none of the respondents was fully confident of the existence of a clear digital strategy, as shown in Figure 2.26.

FIGURE 2.26

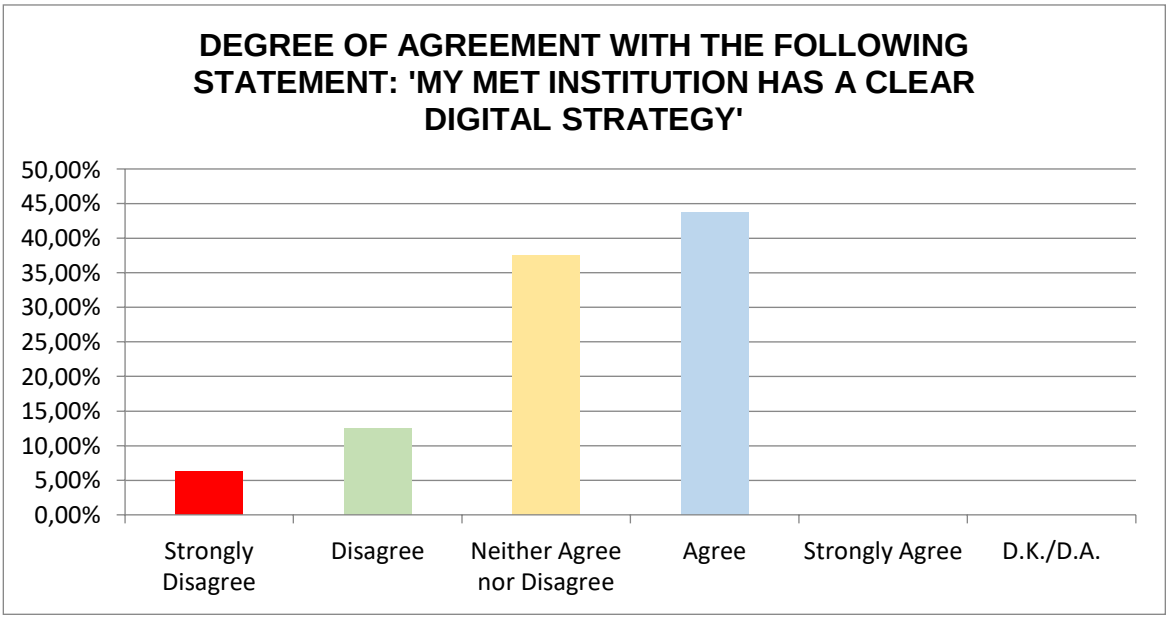
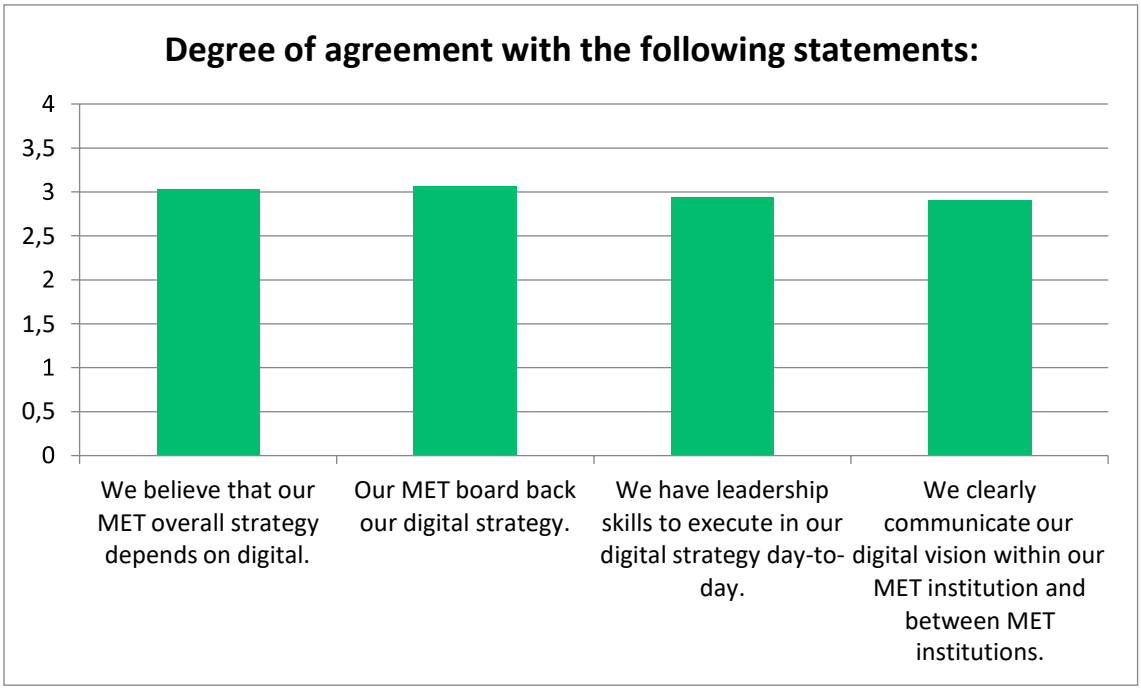


FIGURE 2.27



Respondent administrators evaluated the validity of several statements related to the ability of their MET management to adapt to digitalization trends. Figure 2.27 reports the results on an average scale of 1 to 4, with 1 corresponding to ‘completely disagree’, 2 to ‘somewhat disagree’, 3 to ‘somewhat agree’, and 4 to ‘completely agree’. The responses show that MET strategies are dependent on digitization to a moderately high degree (3.03/4.00) and that MET boards generally support the adoption of a digital strategy (3.06/4.00).

The possession of leadership skills to execute a digital strategy received a lower average score (2.94/4.00) and the ability to communicate the digital vision an even lower rating, (2.90/4.00). These may constitute areas for improvement on the path to a proficient execution of a digitalisation strategy.

Elaborating more on digital strategy execution, Figure 2.28 shows that administrators who participated in the survey were generally confident that their academic staff are knowledgeable enough to execute the digital strategy (40.6% agree), but not fully confident, as only 9.4% of respondents strongly agree. Notably, 9.4% of participating administrators disagreed that their academic staff has sufficient knowledge to execute their digital strategy.

FIGURE 2.28

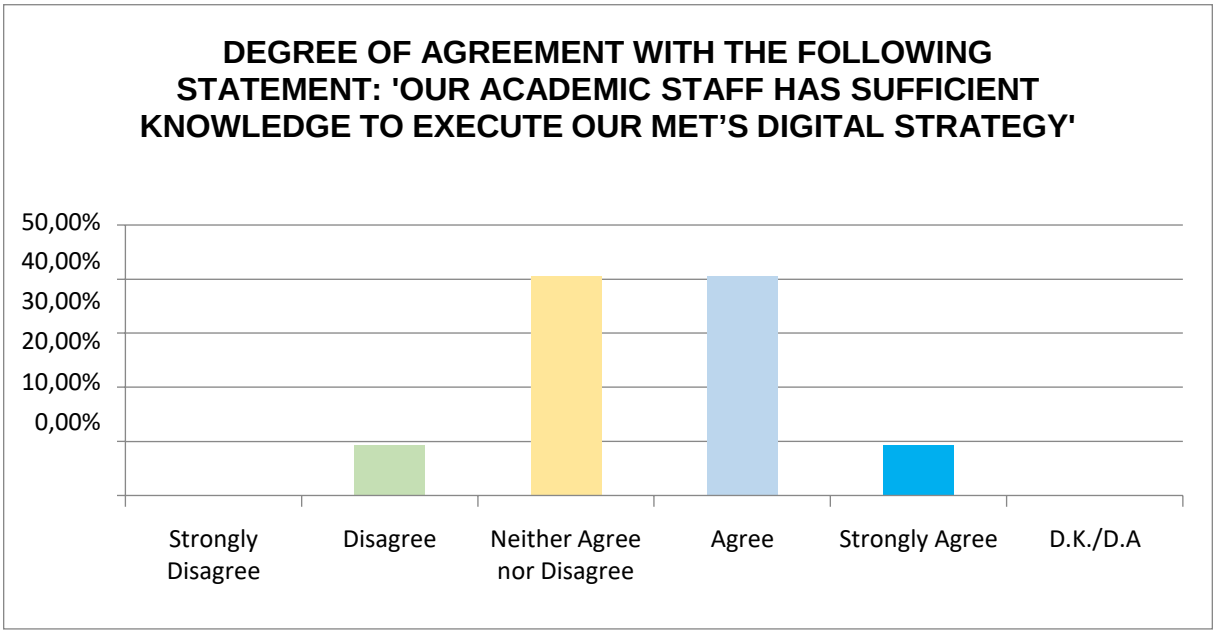
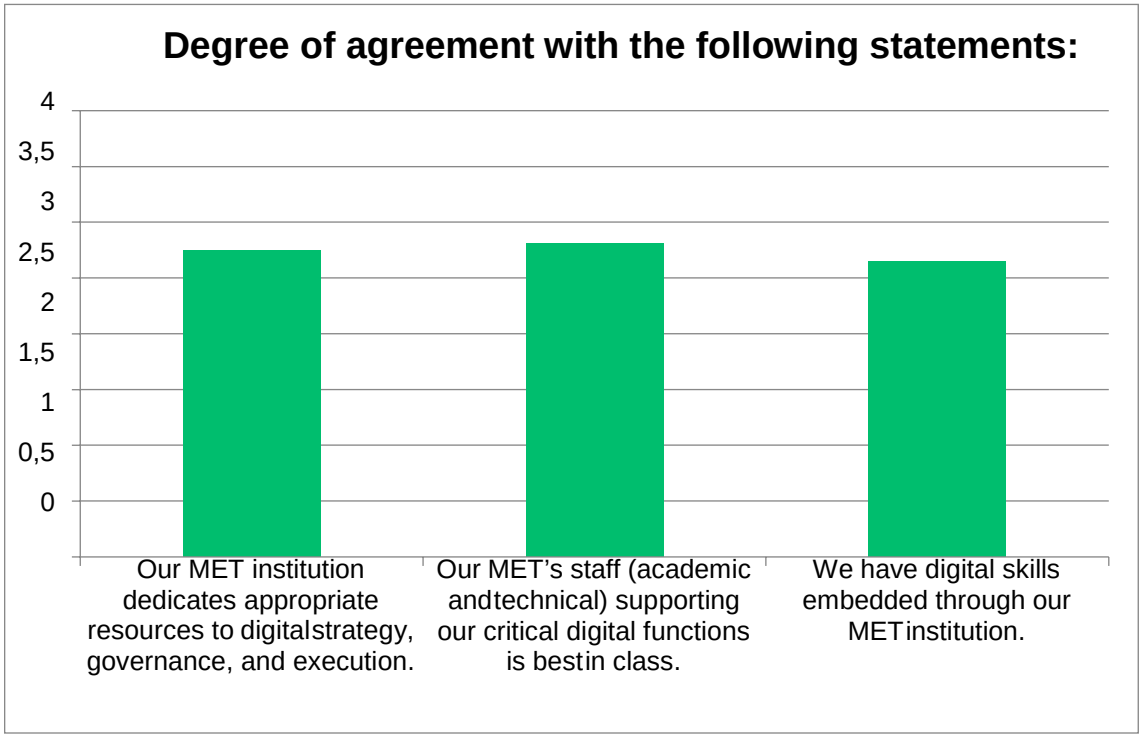


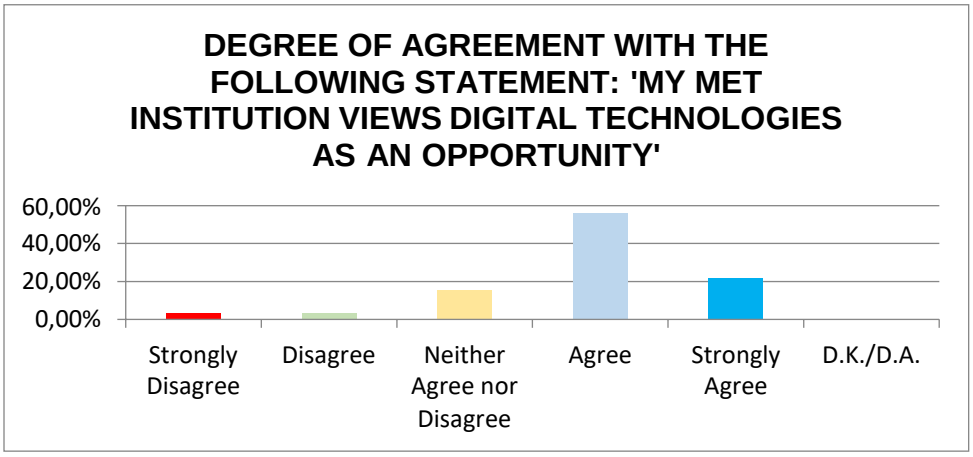
FIGURE 2.29



Next, the survey called for an assessment of MET resources and skills towards executing a digital strategy. FIGURE 2.29 presents the average scores (on a scale of 1 to 4) from the assessment performed by administrators. None of the statements received a satisfactorily high rating. This suggests that METs may need to acquire more resources and build more pertinent capabilities for the new digital era. Specifically, the view that the MET academic staff supporting the critical digital functions are of top quality received a score of 2.81/4.00. Also, the statement that their MET dedicates appropriate resources to digital strategy, governance, and execution received only2.75, while the possession of digital skills scored 2.65.

Figure 2.30 shows that a large percentage of administrators – 56.3% – agreed and 21.9% strongly agreed that their MET institutions view the utilization of digital tools as an opportunity forgrowth.

FIGURE 2.30



The next question explored the expected impact of digital technology on MET students and staff. Figure 2.31 presents the results on an average scale of 1 to 4. The expectations that the improvement of MET students' digital skills would follow digital progress received a fairly high rating (3.16), as did the expectation that digital technology will promote teaching staffs' innovation, collaboration, and mobility.

FIGURE 2.31

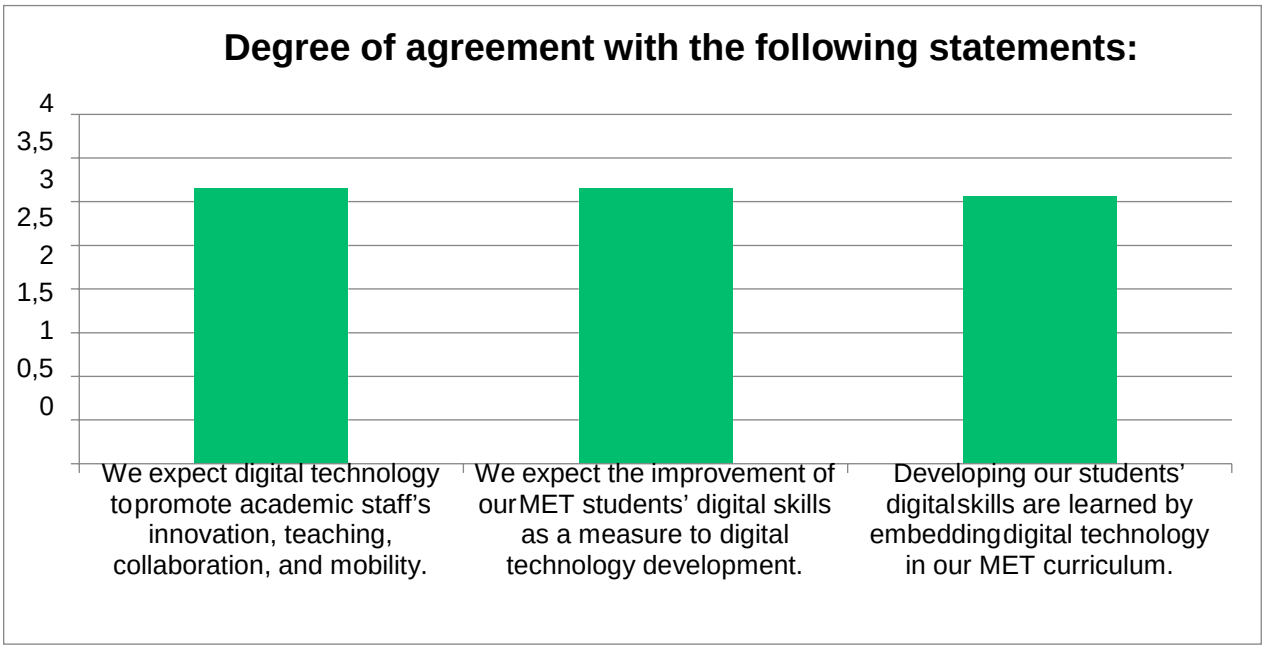
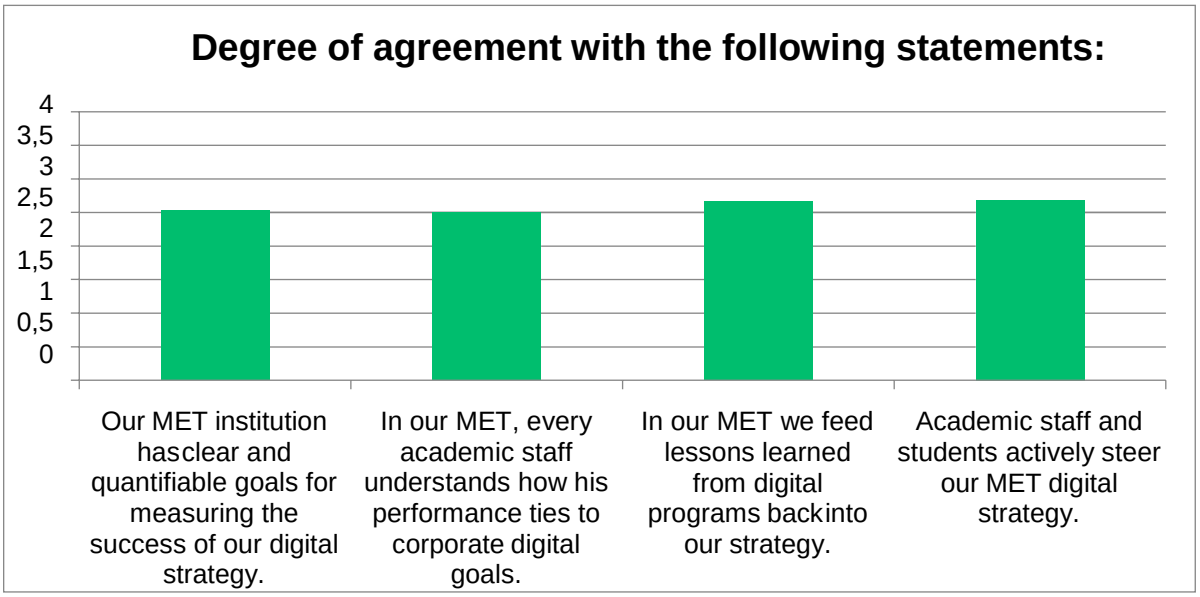


FIGURE 2.32

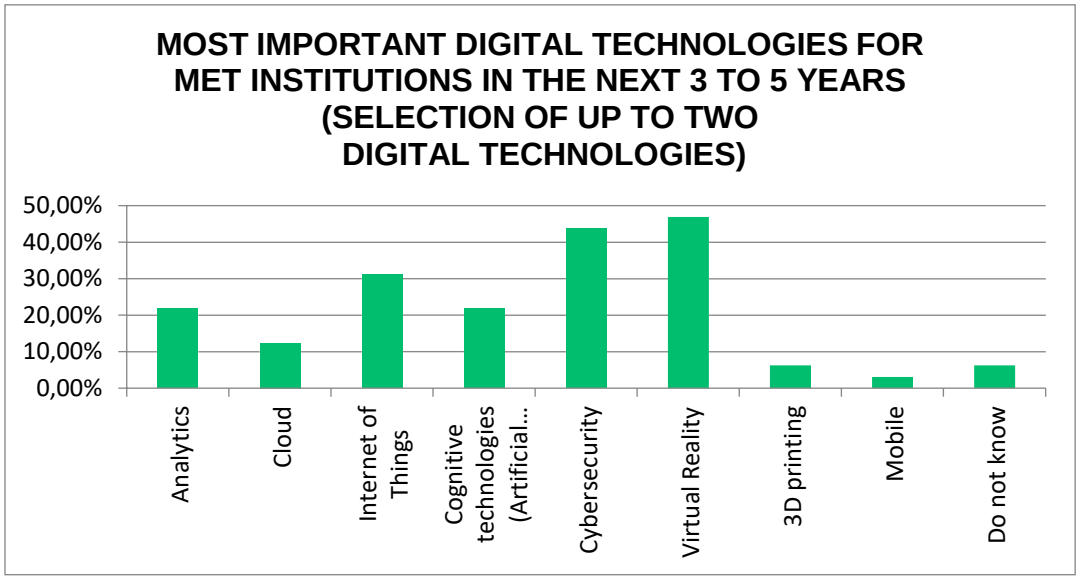
MET DIGITAL GOALS AND MONITORING



The perception of administrators on the existence of digital goals and the ability to monitor progress towards achieving them were investigated in the next questions. Figure 2.32 presents results on a scale of 1 to 4 and reveals that METs need to improve those processes. Participating

administrators gave a relatively low rating to the existence of clear and measurable digital goals (2.53/4.00) and to the clear connection between staff's performance and digital goals (2.50/4.00). A slightly higher rating (but still not satisfactory) was given to the adjustment of MET strategy in light on feedback (2.66/4.00) and to the active implementation of MET digital strategy by academic staff and students (2.69/4.00).

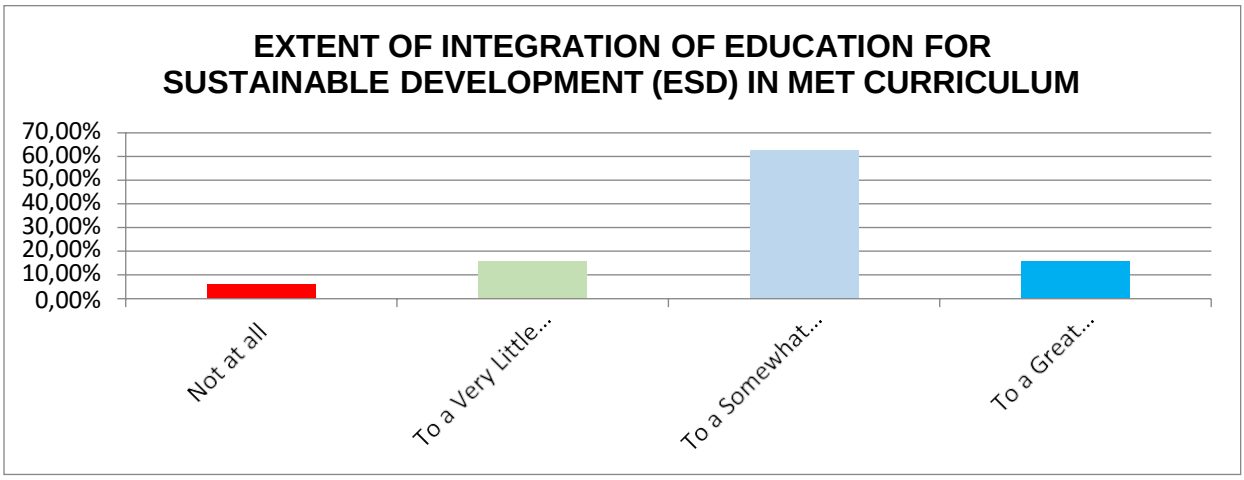
FIGURE 2.33



According to the responses of administrators, the three most important technologies for METs in the next three to five years are Virtual Reality (46.9%), Cybersecurity (43.8%), and the Internet of Things (31.3%). Artificial Intelligence and Data Analytics were also perceived as important technologies, with both having a percentage of 21.9%.

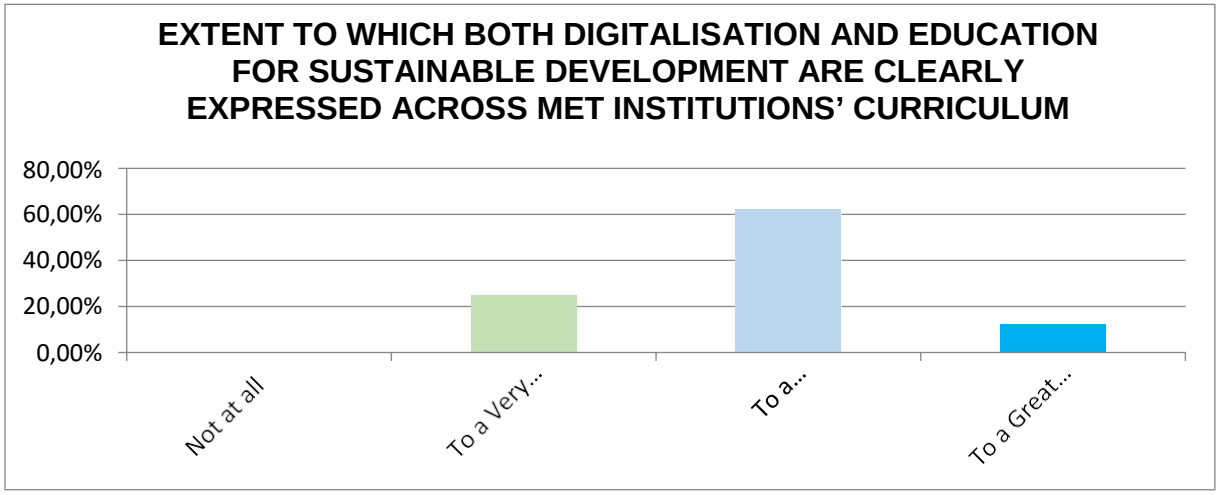
The majority of administrators participating in the survey stated that Education for Sustainable Development (ESD) is somewhat (but not fully) integrated in their MET's curriculum (62.5%), as shown in Figure 2.34. The alignment with sustainability trends in the maritime industry necessitates a greater degree of integration in the future.

FIGURE 2.34



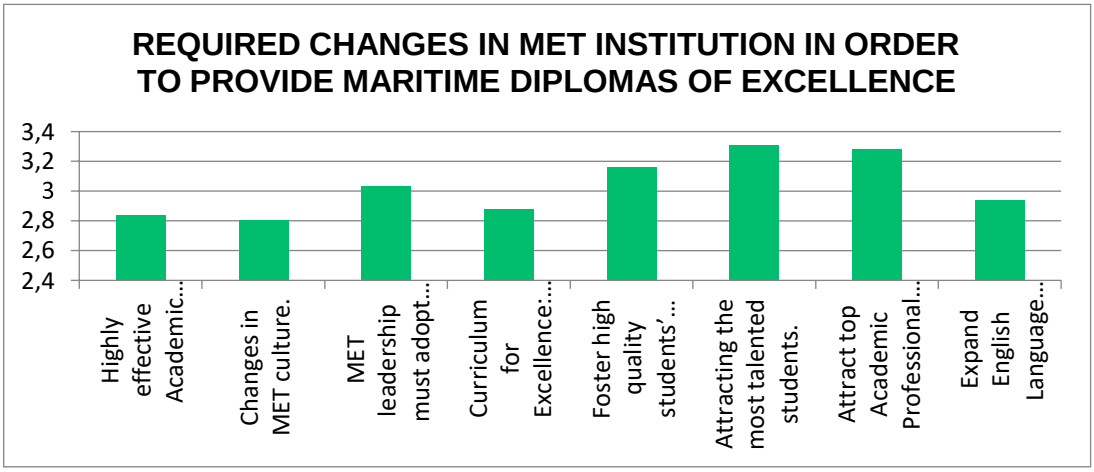
Further to the previous question, Figure 2.35 shows that ESD and digitalization are somewhat (but not fully) present across the curriculum (62.5%) of the respondents' MET institutions.

FIGURE 2.35



The last question investigated what should change in METs in order to be able to offer Maritime Diplomas of Excellence. Figure 2.36 presents the results on a scale of 1 to 5. According to the administrators who participated in the survey, the most crucial changes are the attraction of the most talented students (3.31/5.00), the attraction of top academic professionals from the maritime industry (3.28/5.00), the development of high-quality student skills (3.16/5.00), and the adoption of a transformational leadership style (3.03/5.00).

FIGURE 2.36



2.3. Survey key findings: conclusions

2.3.1. Faculty survey key findings

- Most teaching staff members are of the opinion that the curricula should be updated regularly to keep up with new trends. They also agree that future METs' strategic axes should include cooperativeness, internationalization, sustainable development, and lifelong learning.
- The majority noticed a slow adaptation of both the STCW Convention and of METs themselves to changes in the maritime industry. This reveals the need for new strategies based on flexible adaption of improved curricula, collaboration, and exchange of knowledge and academic practices amidst changes.
- Almost all of the faculties surveyed agree that lifelong learning is the main driver of seafarer employability.
- According to faculty members, the skills mainly developed through courses they teach involve problem-solving, critical thinking, and teamwork while also contributing to the development of continuous learning and communication skills. Weaknesses are ascertained in the area of IT and management skills. Most teaching staff are both willing and qualified to embrace new technologies; they use these as tools, but many of them are reluctant to integrate them into their teaching practices straight away. Training for faculty

potentially emerges as key to enable all to teach effectively using new technologies, but this may not necessarily be the prime reason – with availability of facilities and/or need for strategic leadership also potentially involved.

- Sustainable development is recognized by faculties as one of the key strategic priorities, while a large percentage report that it has already been incorporated into their institution's curriculum.

2.3.2. 'Student Voice' survey key findings

- For half of students responding, sustainable development remains an unknown concept or not a subject in their curriculum. This suggests that METs should place more emphasis on sustainability and clearly address this gap through learning outcomes of more related courses.
- From the students' standpoint, the courses they attended primarily helped them develop their communication, teamwork, thinking, and transferable skills. Students expressed dissatisfaction with IT, management, and continuous learning skills. There is consensus between students and faculty that the existing modules develop their teamwork and critical thinking skills, whereas IT and management skills are rather overlooked.
- Some ambiguity in terms of continuous learning skills remains: the faculty perception is that these are indeed developed, while student feedback seems to indicate that they do not perceive them to be as developed. However, the majority of students are still unfamiliar with Massive Online Open Course (MOOC) platforms.
- Students are satisfied with their instructors. However, four out of 10 students feel that they lack the support of a mentor. This may indicate that METs need to adopt a more student-centred approach and/or be strengthened with additional teaching resources for such a role to be played successfully by staff, while eventually also mobilizing social partners in this direction[33].
- Approximately half the students who participated in the survey were concerned about mobility limitations between European METs; this point is further discussed in the concluding Chapter 5 of this report.
- Students appear to be satisfied with their METs' IT facilities and the quality of simulators. However, a non-negligible percentage expressed dissatisfaction with some categories of MET resources and especially with course materials and IT facilities.

[33] The level of sophistication of organisation and cooperation may differ across countries, although seafaring, shipowning and affiliated associations can eventually participate in the mentoring process.

2.3.3. Academic administrators' survey key findings

- Administrators generally uphold the importance of digitalization for MET institutions. In the same vein, more than half of the respondents viewed the utilization of digital tools as an opportunity for growth. According to the survey results, MET digital transformation could be driven mainly by the improvement of students' digital skills and incorporation of innovation in teaching and research. Administrators view as the key barriers the lack of familiarity with digital tools, the lack of funding, and the resistance to new approaches.
- Less than half of the administrators identified a clear digital strategy in their MET, while current MET strategies were perceived as not highly dependent on digitalisation. Interestingly, MET boards generally support the adoption of a digital strategy.
- Administrators believe that their academic staff are generally knowledgeable enough to respond successfully to a digital strategy, but a significant percentage of respondents appeared sceptical about it.
- According to administrators, the most important technologies are virtual reality, cybersecurity, and the internet of things, and to a lesser extent artificial intelligence and data analytics. Also, ESD and digitalization are not fully integrated in MET curricula. Finally, administrators believe that MET could be able to offer Maritime Diplomas of Excellence, especially if attracting top students and instructors and developing high-quality students' skills.

2.3.4. Key findings in terms of mismatches and gaps

Overall, there were few mismatches, and not any notable ones among academic staff, students and administration regarding the key issues.

1. Areas where it emerged that strategic evaluation and measurement of coverage of targets may be required were mainly sustainability and digitalization.

2. With an overall perception that the MET system may be finding itself overwhelmed by the increasing pace of change in its external environment, strategic evaluation and tools to measure targets and progress towards them become essential.

2.4. The ID of the survey among employers

The survey presented and analyzed in this chapter of the deliverable was conducted from 02/07/2021 to 15/10/2021, with a total of 23 responses received. In the context of MET evaluation strategies, the purpose of this survey was to obtain a snapshot of the employers' perception of the effectiveness of MET education provided currently on the basis of current and desired future skills of maritime professionals in the light of sustainability and digitalization trends.

A special focus on strategic options for delivering key subjects which emerge as current significant gaps was also included in the web-structured questionnaire developed for the purpose of the survey. The final part involved respondents replying in an assumed role as potential MET evaluators.

The questionnaire was addressed to shipping industry executives via a Survey Monkey e-mail link and the link was sent for circulation to European shipping employer associations through the relevant SkillSea partner for further dissemination through its member associations[34].

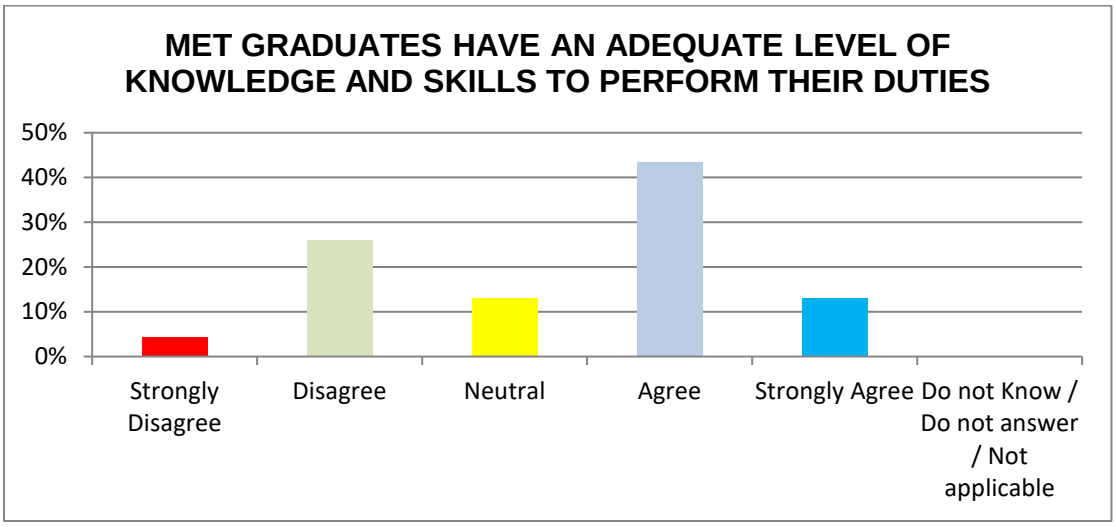
A wider range of European countries was thus included although the sample which responded was rather small. The full survey questionnaire is appended in Annex 5A while essential demographics of respondents and of their shipping companies are included in Annex 5B. The descriptive statistics of the survey are included in Annex 5C.

2.4.1. Industry survey results

As shown by the distribution of answers to the first question, respondents believe in their – not so overwhelming - majority that MET graduates are equipped with the necessary knowledge and skills to perform their tasks with 57% agreeing or strongly agreeing that this is the case. However, a non-negligible 30% disagrees or strongly disagrees, with the overall results from this part of the questionnaire revealing the need for improvements in maritime education and training (cf. Figure 2.37 next)

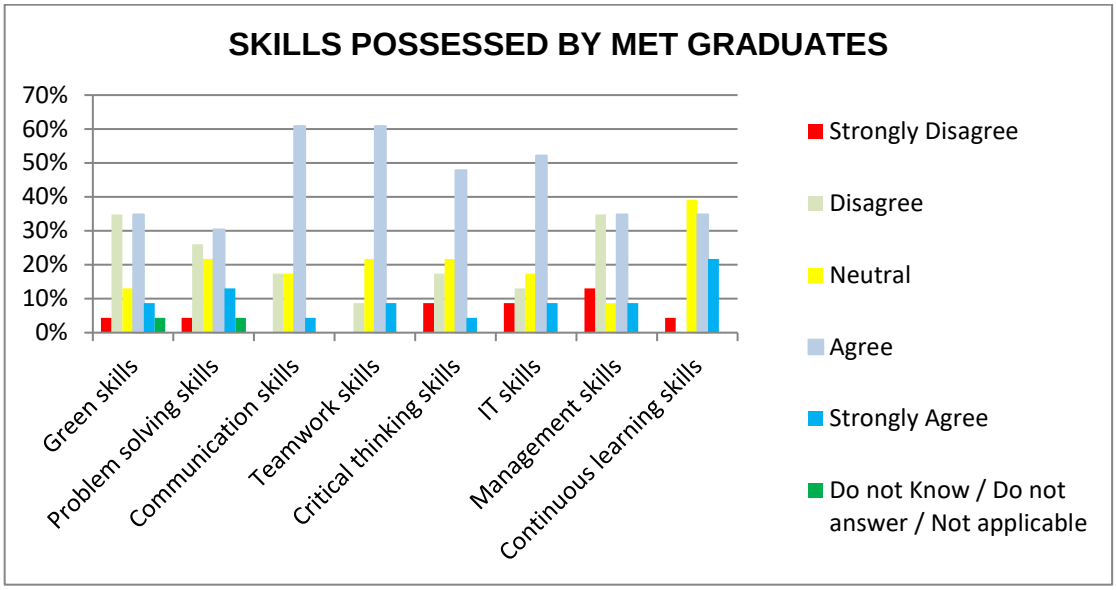
[34] European Community Shipowners' Associations, (ECSA).

FIGURE 2.37



In terms of evaluation of the degree that the skills and knowledge acquired by MET graduates following their training - as presented in Figure 2.38- there are assessed to be possessed by the following share of employers who responded (in descending order): teamwork (70%), communication (65%) and IT (61%). More evident gaps are recorded for continuous learning skills which are assessed to be possessed only by 57% graduates, in critical thinking (52%), green skills (44%), problem solving (44%), and management (44%) skills. These gaps underline, overall, the industry's perception of lack of sufficient familiarity of graduates with modern sustainability related concepts, such as green shipping.

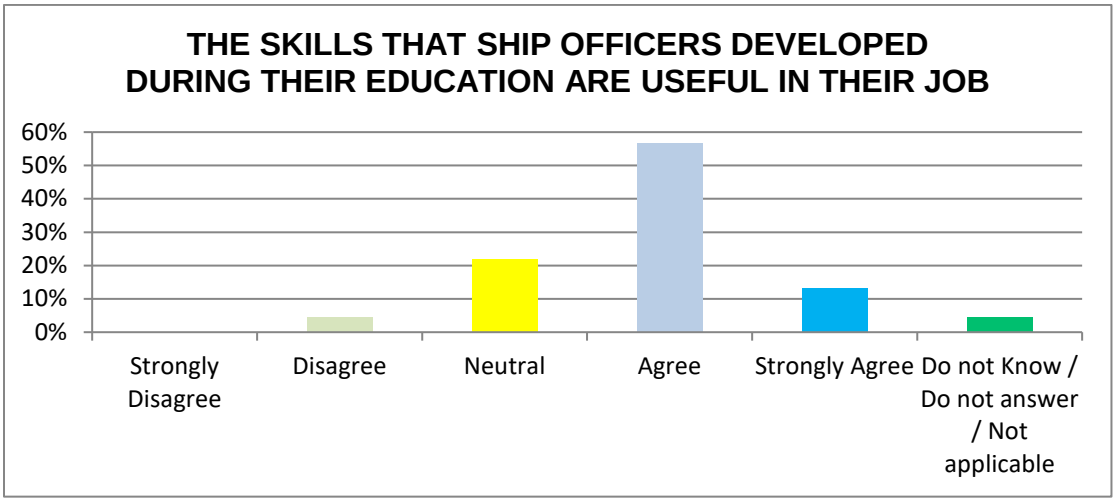
FIGURE 2.38



As it emerges from the analysis of results, there is a rather high degree of consensus among the respondents (69%) that the skills developed during maritime education are useful in practice (cf.

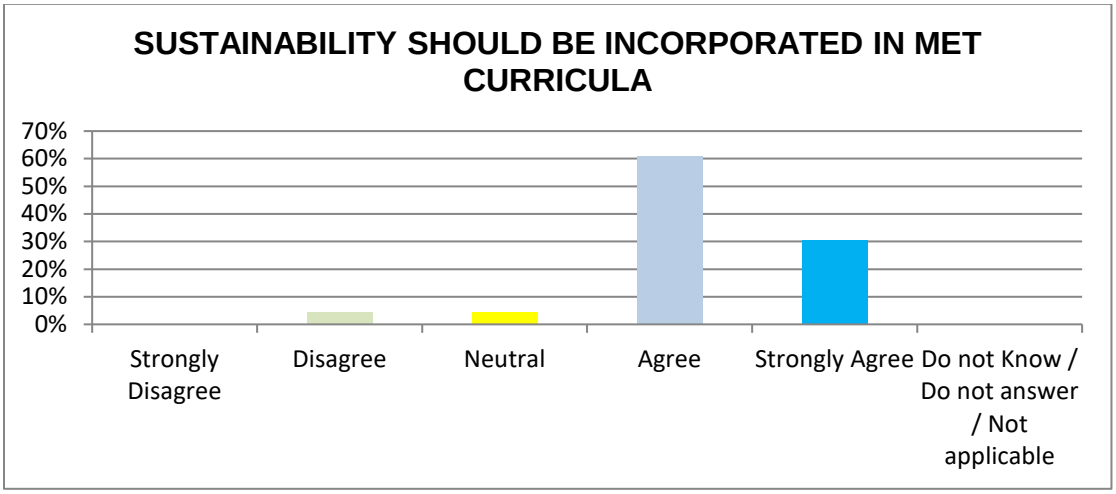
Figure 2.39) with less than 5% disagreeing. However, over a fifth of the respondents – and if including the ones not providing an answer, over a quarter – remain neutral; this may imply a "wait and see" attitude to the current changes of shipping of a non-negligible proportion of the industry[35].

FIGURE 2.39



The verdict on emerging educational needs is much stronger validating from the side of industry respondents the choice of direction made in this report. The high percentage of 91% agreement whether sustainability should be incorporated in MET curricula in order to equip graduates with the knowledge and skills required in the job market – as shown through Figure 2.40 below - clearly demonstrate a shared view among respondents; among the latter, about a third of the ones in favour of the inclusion of sustainability in the curricula feel strongly about it.

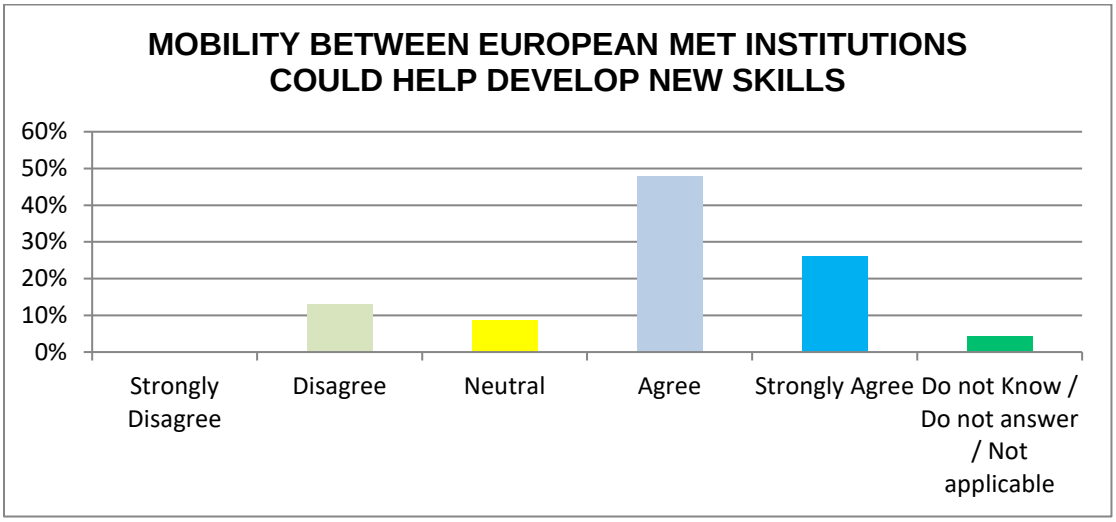
FIGURE 2.40



[35]The results of an early 2021 related survey - with a focus on employability - among industry are rather in line with the ones of this survey. Cf. SkillSea (2021). *D3.3*. Employability, anticipating skills needs and gaps measurement. Report.

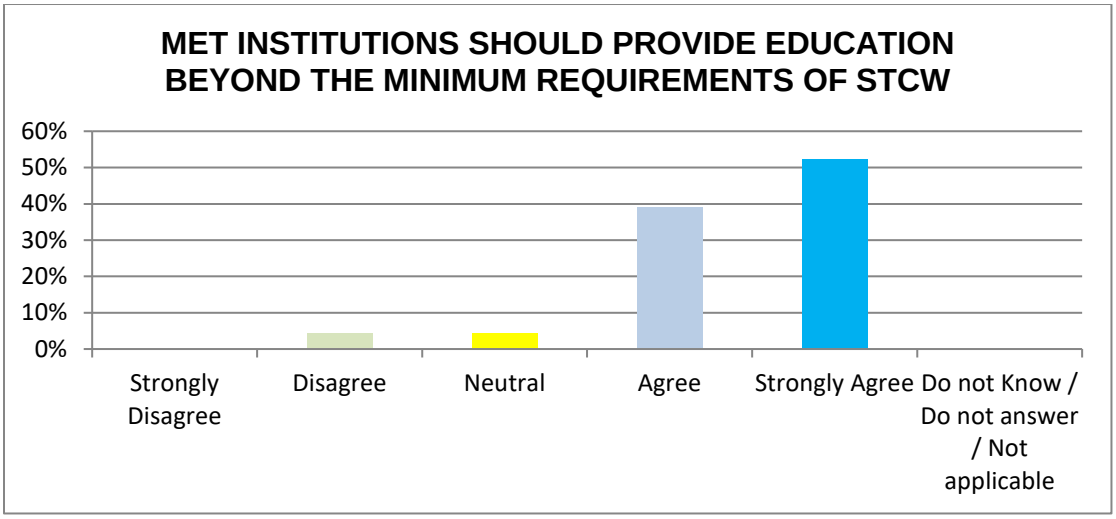
As suggested by the results in Figure 2.41 next, the mobility of students and professionals across European MET institutions is perceived by the majority of respondents (74%) as an important driver of new useful skills. This highlights the importance of internationalisation strategies as part of the effectiveness of the educational provision.[36]

FIGURE 2.41



In terms of desired content, most of the respondents (91%) advocate the view that MET education should be expanded beyond what is required by STCW which includes the necessary skills for current service needs (cf. Figure 2.42).

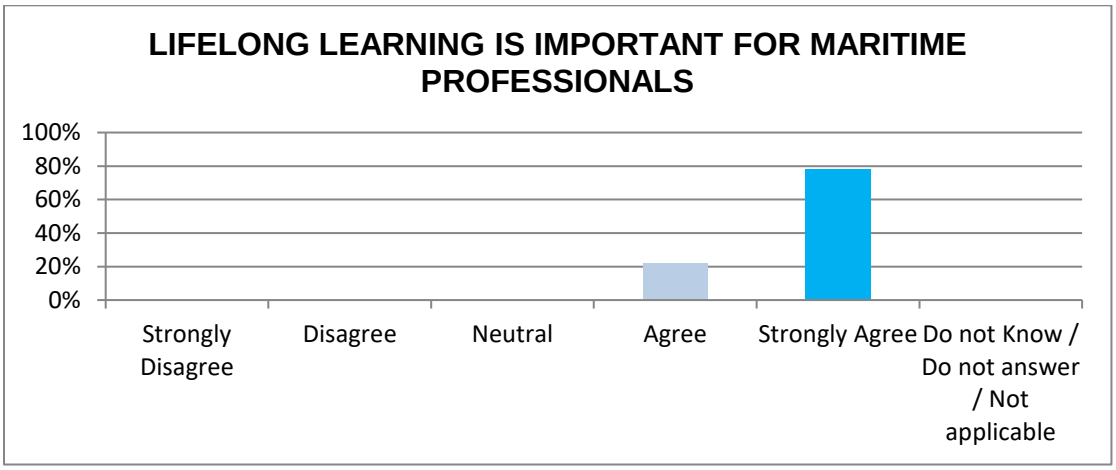
FIGURE 2.42



[36] The subject of MET internationalisation is extensively discussed in the D3.4 deliverable report of SkillSea, cf. SkillSea (2020). D3.4 *Internationalized Strategies* in MET. Report.

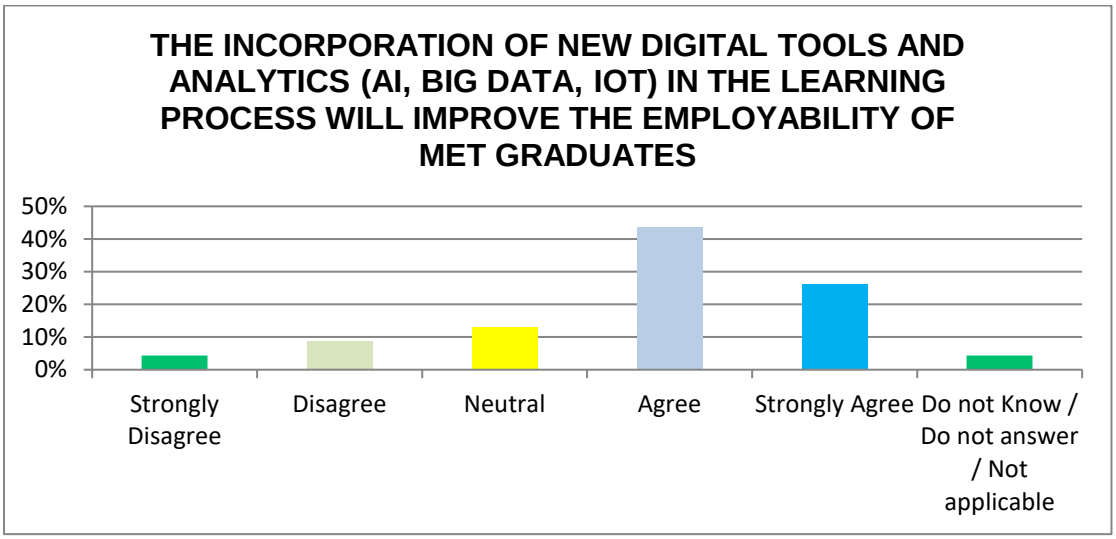
Figure 2.43, next, shows the great value respondents attribute to lifelong learning as all respondents agree that lifelong learning is important for maritime professionals, with over three quarters among them strongly supporting this view.

FIGURE 2.43



The employability of maritime professional in the new era of shipping is increasingly reliant on knowledge of digital tools and analytics as emphasised by the perceptions of respondents, who agree by 44% or strongly agree - by 26% - that the incorporation of such tools in the learning process will enhance employability as shown in Figure 2.43.

FIGURE 2.44



Results included in Figure 2.45 underline strongly that - according to the respondents - MET institutions should place emphasis on cybersecurity (96%), ship automation (91%), green shipping (91%) and virtual reality (91%). It is notable that green shipping skills was found to be one of the least possessed skills as previously commented on the basis of results shown in Figure 2.37.

FIGURE 2.45

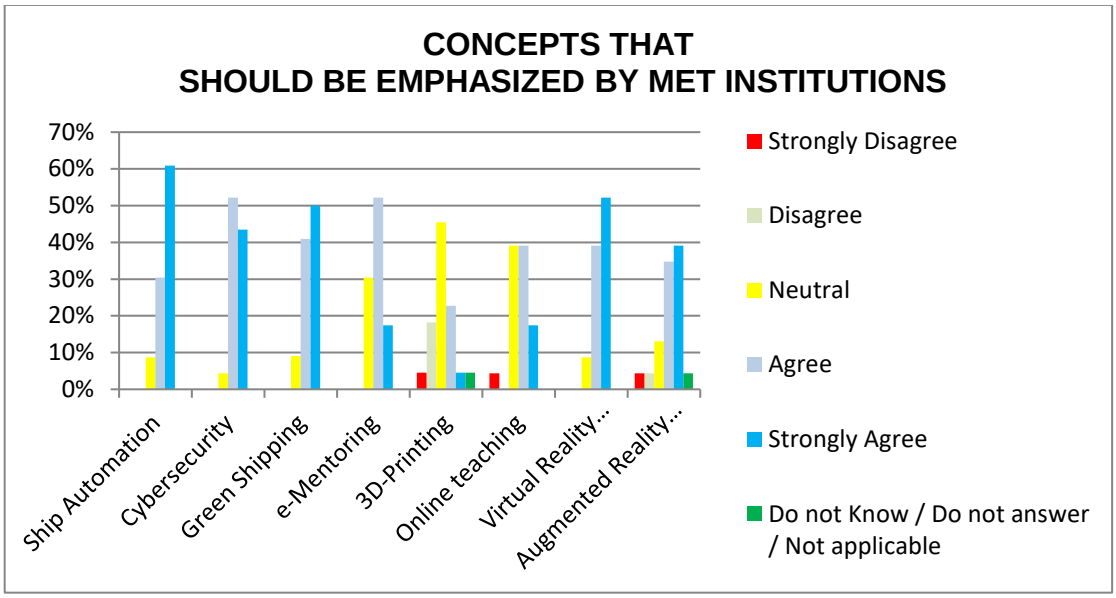
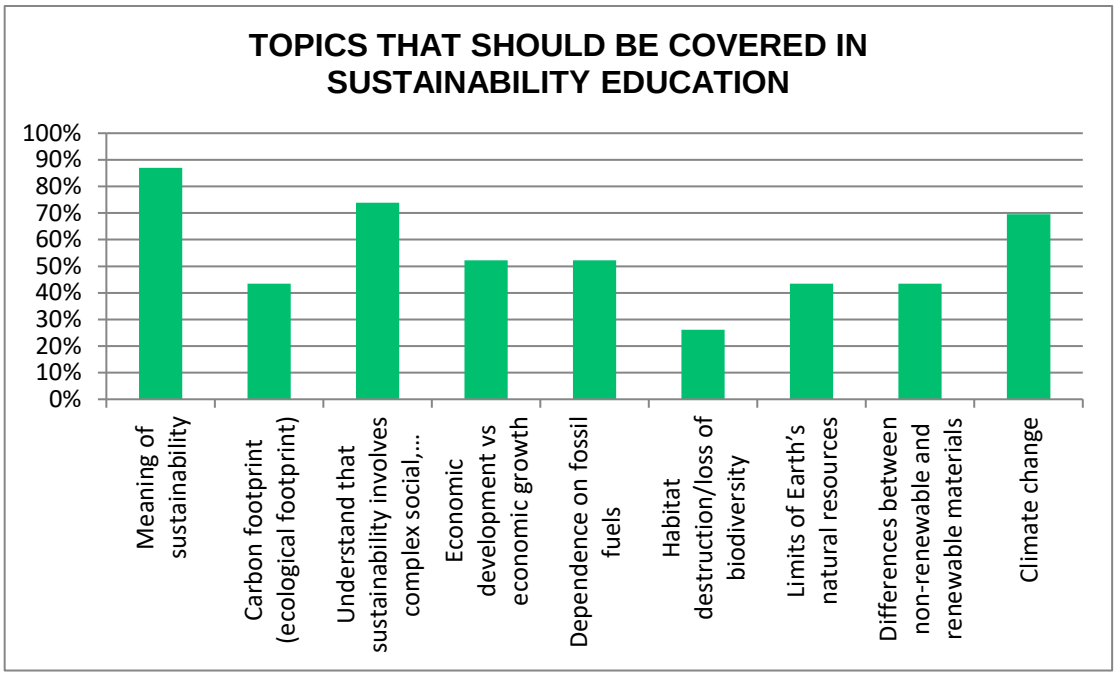


FIGURE 2.46

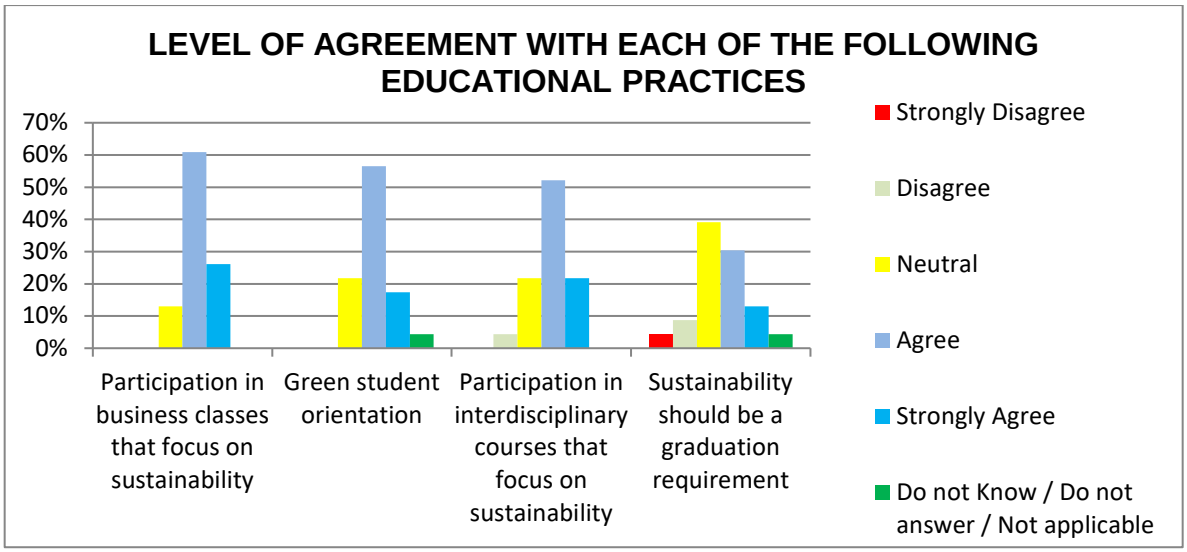


As shown in Figure 2.46, in the question regarding the specific topics that should be covered in this area which allowed multiple responses, the large majority of respondents (87%) felt that the meaning of sustainability itself must be the top priority. A significant percentage of respondents selected also "the understanding that sustainability involves complex social, cultural, political, economic, and scientific issues" (74%), with "climate change" (70%), and "economic development versus economic growth" (52%) following in popularity.

The next question investigates the perception of suitable approaches of sustainability education in MET again through the possibility of multiple responses.

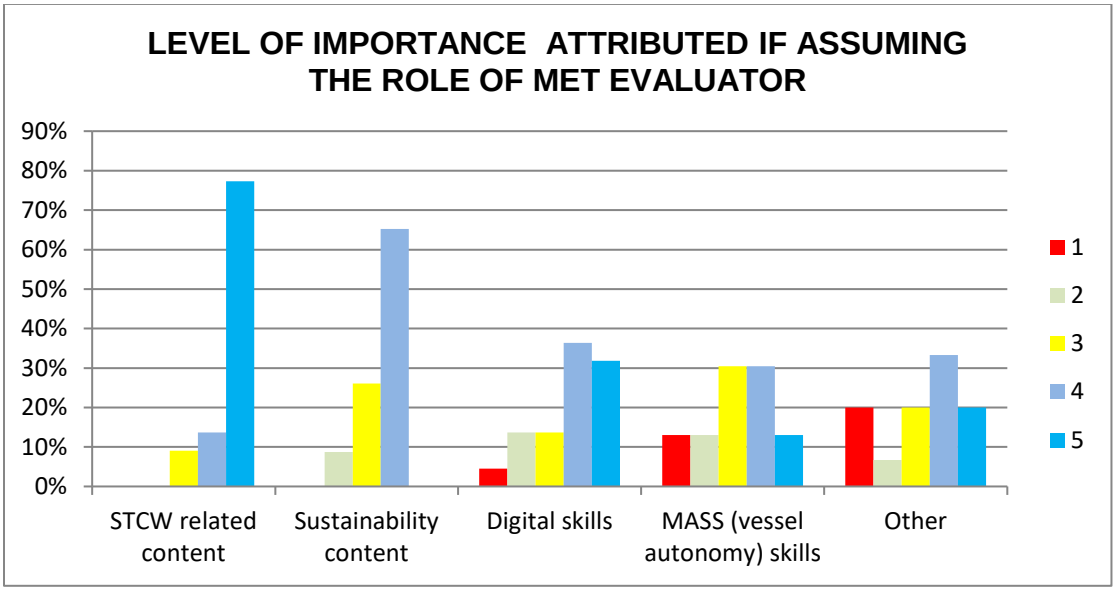
As shown in Figure 2.47 below, “Participation in business classes that focus on sustainability”, “green student orientation”, and “participation in interdisciplinary courses that focus on sustainability” are considered as valuable educational approaches by 87%, 74%, and 74% of respondents, respectively. Notably, only 13% of respondents do not believe that sustainability should be a graduation requirement.

FIGURE 2.47



Through the penultimate question of the questionnaire respondents were asked to assume the hypothetical role of a MET evaluator and attribute relative importance to a number of traditional and emerging areas of MET education.

FIGURE 2.48



Results presented in Figure 2.49 illustrate that almost all of the respondents (91%) would evaluate STCW related content as the most important item for MET institutions. Among the emerging subject areas sustainability was evaluated as important by 70% in the second overall place, followed by digital skills (68%) which may have a lower percentage than sustainability but with a marked element of strong agreement as well. The verdict on vessel autonomy seems to be still out among industry respondents as there is no consensus among them on the perceived importance of MASS (vessel autonomy) related skills with just 30% seeing it as important and less than 15% (13.04%) as most important.

On the issue of the opinion of the respondents about the future level of MASS in shipping, Figure 2.49 is very informative.

FIGURE 2.49

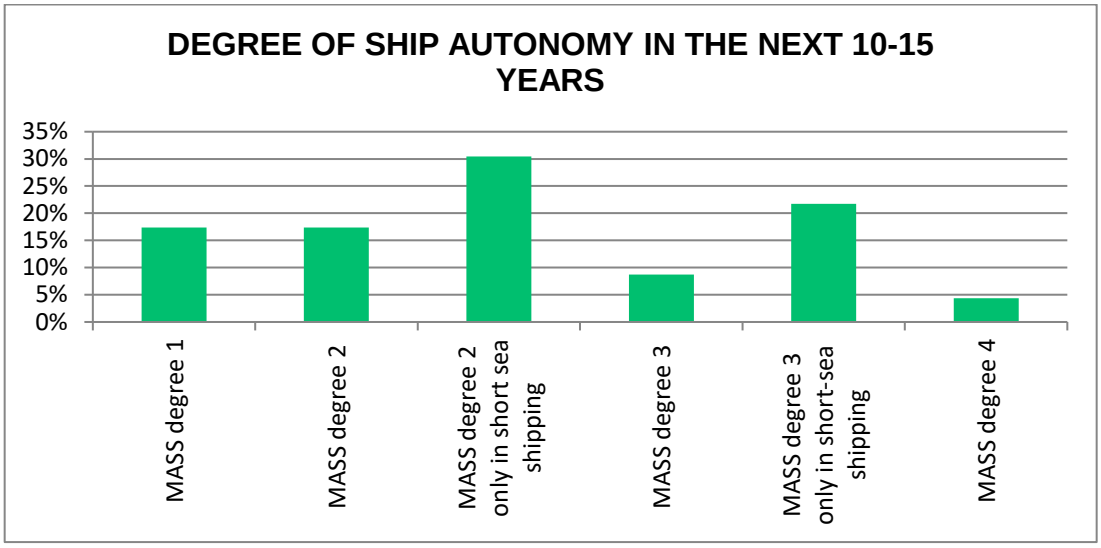


Figure 2.49 indicates diverse projections of respondents of the level of ship autonomy in the next 10-15 years (i.e. to around 35). A share of 30% of respondents foresee that vessel autonomy (MASS) will have progressed significantly to degree 2 as per IMO classification only in short sea shipping, whilst 22% of them favour degree 3 (again in short sea shipping). Interestingly, only 4% of respondents believe in the domination of full autonomy within the stated timeframe. It should be noted that limited autonomy (degrees 1 and 2) prevailing to that time horizon are supported by only 17% of respondents.

2.5. Conclusions from the industry survey and implications

- There is a significant gap between the skills presently acquired through MET and the needs of the industry especially in a forward-looking perspective of skills' anticipation.

- The mismatch observed between the assessed actual skills provided through MET education and desired ones suggests clearly that sustainability needs to be incorporated more comprehensively in maritime education with the result marking a significant gap in this area.

- The areas of sustainability and digital skills emerge as most important elements for a package of MET education in an evaluation perspective while STCW related knowledge retains still its most critical importance within MET educational provision.

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3. EVALUATING MET FOR FUTURE MARITIME TRANSPORT

3.1. MET in the sustainability era: future shipping and SDGs

The findings of the guiding surveys confirmed that the important aspects and perceived gaps which need to be addressed for future-proof MET provision are more shared than not among students, staff and administration surveyed. The review of responses corroborates the perception that the efficacy of any MET system, MET institution or individual course is proven through their ability to equip maritime professionals with the knowledge and skills needed to handle current and future processes in an industry which has traditionally and continuously evolved by adapting to the pace of technological and regulatory change.

One striking result from the guiding surveys (cf. Chapter 2) was that sustainability – underlined as a major maritime transport trend in the SkillSea WP1 and WP3 deliverables – remained an unknown concept across a significant number of student respondents, with another significant percentage declaring that no related educational element was included in their curricula. This, together with the student perception of gaps in important skills – such as IT and management-related ones – suggests a need for further adaptation and improvement across METs.

Evaluation strategies and appropriate tools for measuring critical aspects of the provision – in the context of current and prospective shipping developments requiring an appropriately educated cohort of maritime professionals – are therefore critical and especially so in keeping the MET system capable of providing future-proof skills to students.

In the process, the increasingly important for shipping aspects of:

a. sustainability and

b. technological change including digitalization

have emerged, along with the guiding survey results, as highly significant through the assessment of SkillSea reports hitherto[37] guiding to the need for an appropriately focused futureproof provision as proposed in the context of the project through WP2[38].

[37] Cf. SkillSea (2020). *D1.1.2 Current and skills needs*. Report, SkillSea (2020). D1.1.3 *Future Skills and competenceneeds.* Report and SkillSea (2020), D3.1 *Strategy Plan Framework*, *op,cit.*

[38] Cf. for a concise description of SkillSea (2020)*. D3.1 Strategy Plan Framework*, *op.cit*., Chapter 4, Figure 4.4.

3.1.1. MET for a competitive EU presence in future sustainable transport

By the time that the International Safety Management Code (ISM) was introduced into shipping practice, in the late 1990s[39], the overriding clause of operational safety which had been prevailing[40] had evolved into 'safety plus quality', while the title 'Safety & Quality' had begun to be widely adopted by related shipping company divisions worldwide as they started to operate through company ISM-compliant management systems, meticulously described in constantly reviewed manuals. Then, by the second decade of the new century, the sustainability agenda became increasingly dominant globally, being encapsulated in the 2015 adoption by the United Nations of the 17 Sustainable Development Goals in the context of the 2030 Agenda for Sustainable Development[41] (cf. Figure 3.1).

FIGURE 3.1

UN SUSTAINABLE DEVELOPMENT GOALS

Source: United Nations. Sustainable Development Goals. Communications Materials. https://www.un.org/sustainabledevelopment/news/communications-material/, last accessed November 8, 2020. NOTE: Any further reproduction/dissemination should be guided by the UN guidelines available in https://www.un.org/sustainabledevelopment/wp-content/uploads/2019/01/SDG_Guidelines_AUG_2019_Final.pdf, last accessed November 3, 2020.

[39] The Code became mandatory – by stages – on 1 July 1998. Cf. IMO (1997). Resolution A.848(20) adopted on 27 November 1997. Available at https://wwwcdn.imo.org/localresources/en/KnowledgeCentre/IndexofIMOResolutions/AssemblyDocuments/A.848(20).pdf, last accessed 15 November 2020.

[40] Not an automatic process but the result of (reactive to accidents) self-regulatory and also regulatory interventions and proactive pioneering efforts for many decades in the past cf. also Chapter 1, of SkillSea (2020). *D3.1 Strategy* ...,*op.cit.*

[41] Cf. UN (2015). Resolution adopted by the General Assembly of 25 September 2015, (without reference to a Main Committee (A/70/L.1), available at https://www.un.org/ga/search/view_doc.asp?symbol=A/RES/70/1&Lang=E, last accessed November 8, 2020.

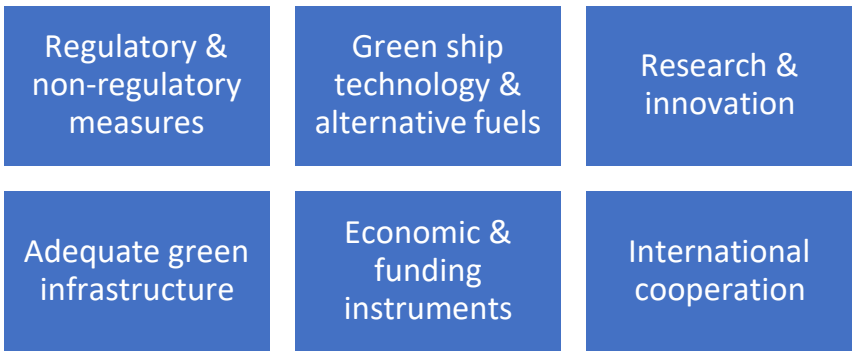
By that time, the focus of not only maritime regulators but also of the industry itself had started shifting to shipping operations being sustainable and not just competitive, safe and of quality.

Sustainability had entered the European Union agenda quite early; by the first part of the 2010s the EU had taken concrete institutionalized steps to promote sustainable shipping, forming – by the Commission Decision of 24 September 2013, with relevance to the EEA as well – the group of experts on maritime transport sustainability, the European Sustainable Shipping Forum (ESSF)[42]. This followed the creation of a sustainable EU shipping and international maritime transport team within the Directorate General for Mobility and Transport (DG MOVE) and the decision to formulate the Sustainable Waterborne Transport Toolbox approach (cf. Figure 3.2). Thus, a clear sustainability framework, together with appropriate mechanisms, had been created

in the context of the EU by early 2013. This was a direction that had been taken up in previous decades, with maritime transport environmental policy accelerated after the accidents involving the tankers Erika (1999) and Prestige (2002) in European waters.

FIGURE 3.2

EU SUSTAINABLE WATERBORNE TRANSPORT TOOLBOX MAIN DIRECTIONS



Source: On the basis of European Commission (2011).

[42] Cf. European Commission (2013). Commission Decision of 24.9.2013 on setting- up the group of experts on maritime transport sustainability - The European Sustainable Shipping Forum (ESSF). Available at https://ec.europa.eu/transport/sites/transport/files/themes/sustainable/news/doc/2013-09-25-essf-call-for-applications/c%282013%295984_en.pdf. Cf. also for a concise account on Europe and sustainability, EMSA (2020). Sustainable shipping. http://www.emsa.europa.eu/implementation-tasks/environment/sustainable-toolbox.html and on ESSF division and areas of activity http://91.231.216.7/main/sustainable-toolbox/relevant-eu-projects.html.

In the current international and European context of shipping, with technology and sustainability leading changes[43], the answers to the need for MET provision equipping students with transferable skills were – until the more holistic approach of the SkillSea project – fragmented or mainly theoretical. Any answers given were partially answering a question that had not been posed fully: how to provide maritime professionals with skills that allow them to adapt to a changing industry and changing industry needs. The social emphasis on sustainability worldwide, together with the emphasis – especially at the level of EU/EEA countries – on the importance of the Blue Economy, has changed the scene for MET provision drastically, dictating those mechanisms for its adaptation – one being evaluation – acquire a strategic role. The directions of sustainability and technological change are also reflected in the strategic directions of the Educational Packages prepared in the context of SkillSea, which focus on green and digital skills, on science, technology, engineering, and mathematics (STEM), and on foundations of management skills such as entrepreneurship, leadership and innovation, along with the necessary training of trainers[44] in order to follow appropriately the changing elements of world maritime transport

3.1.2. Sustainability, Blue Economy and MET for a competitive EU

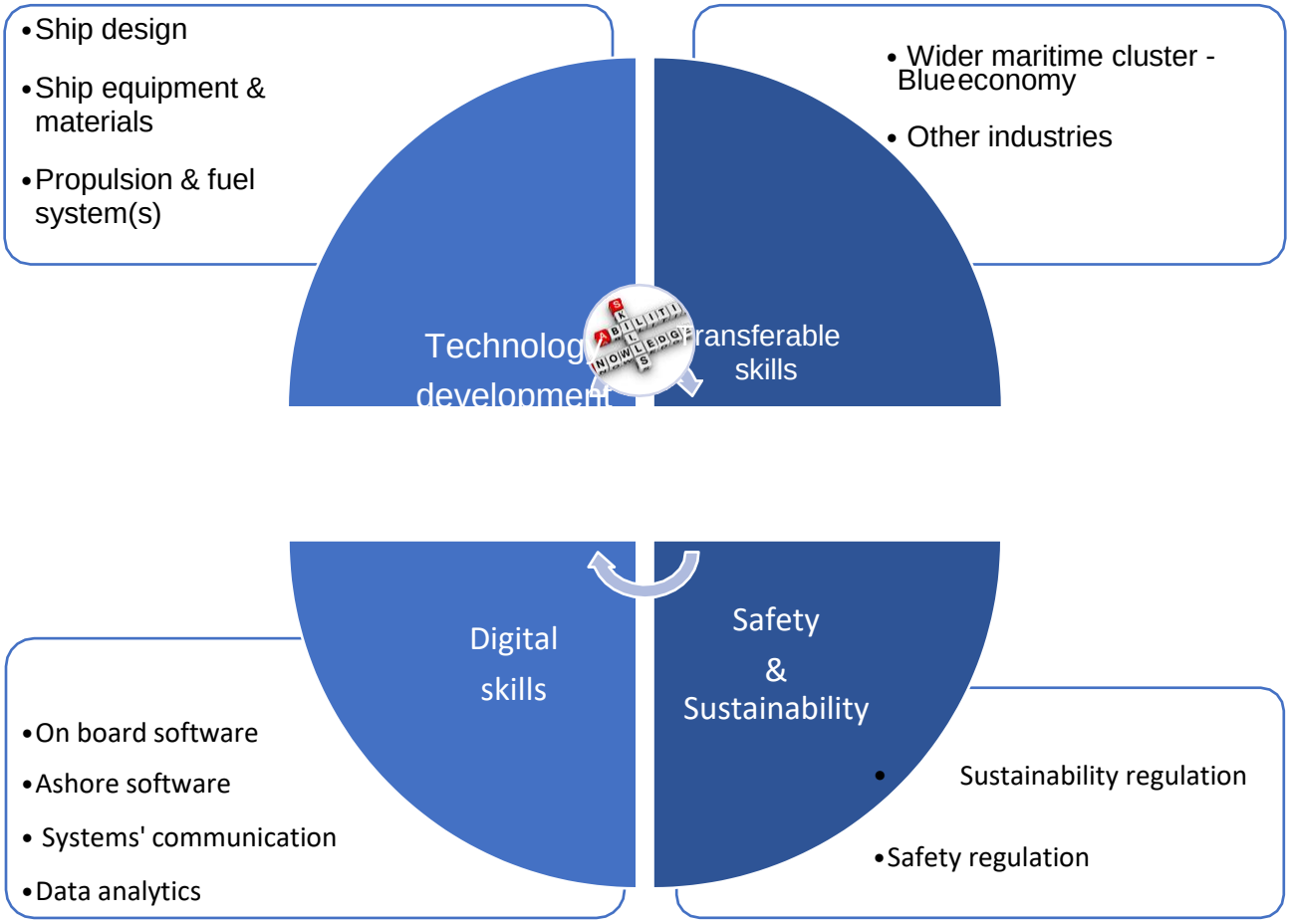
As highlighted in the D3.1 Strategy Plan Framework report of this project, the sustainability trend has long been identified as key – not only leading largely current changes across the maritime transport scene but, most importantly in the context of SkillSea, affecting maritime professionals 'skills-wise'[45]. Sustainability and compliance with the constantly updated regulatory framework have become central forces of the competitive profile of shipping, as has innovation[46] of which sustainable transport for clean, low-carbon operations has been a key direction.

Sustainability in shipping goes far beyond safety, which has been the main over-riding clause for the maritime transport industry until the recent past. Safety by itself is related more to safe navigation and safe handling of the elements in the upper left quadrant of Figure 3.3 below and extended today to those in the lower left quadrant through digitalization[47].

[43] Cf. SkillSea (2020). *D3.1 Strategy Plan Framework*, *op.cit*., Chapter 1.
[44] Cf. for a concise description of SkillSea (2020). *D3.1 Strategy Plan Framework*, *op.cit*., Chapter 4, Figure 4.4.
[45] Cf. SkillSea (2020). *D3.1 Strategy Plan Framework, op.cit.*
[46] Cf. Figure 2.1, Chapter 2 in SkillSea (2020). *D3.1 Strategy Plan Framework*, *op.cit*., p.46
[47] Cf. Chapter 2 of SkillSea (2020). *D3.1 Strategy Plan Framework, op.cit.,* p.44

FIGURE 3.3

MET PROVISION FOR SHIPPING IN CONSTANT CHANGE



Source: Adapted from Figure 1.4, SkillSea (2020), *Strategy Plan Framework,* op.cit p.21. withadditional input from D1.1.3 *Future Skills…*op.cit. p.36

However, the direct or indirect relations between sustainability, maritime transport and MET must be placed in context, firstly at the international level and secondly at the European level. In 2017, the International Maritime Organization, specifying the relation of its activities with Sustainable Development Goals[48] selected most SDGs as relevant.

[48] Cf. IMO (2017). Linkages between IMO's technical assistance work and the 2030 Agenda for sustainable development. Available at https://wwwcdn.imo.org/localresources/en/MediaCentre/HotTopics/Documents/TC.1-Circ.69.pdf, last accessed November 7, 2020. Cf. also ANNEX 5.

INSET 3.A

The safety and security of life at sea, the protection of the marine environment and the efficient movement of global trade depend on the professionalism and competence of seafarers.'

International Maritime Organization. *IMO and Sustainable Development*

Special emphasis has been given by IMO both in terms of general SDG relevance to shipping with goals such as poverty and hunger (SDGs 1 &2) highlighted in the brochure of the organization *IMO and Sustainable Goals* and in terms of direct relevance of another eight SDGs to the technical assistance work of the IMO encompassing safety, security, sustainability, and education[49].

TABLE 3.1
SDGs RELATED TO MARITIME TRANSPORT & MET
(direct ones in bold)

	SHIPPING	MET
Goal 1 (No Poverty)	**Facilitator of trade growth**	**Career skills/upskilling**
Goal 2 (No Hunger)	**Low-cost carriage of staples/processed foods**	**New technologies/quality**
Goal 4 (Quality Education)	**Sustainable quality operations**	**Quality education for sustainability**
Goal 12 (Responsible Production & Consumption)	**Sustainable ship design, materials, propulsion, shipbreaking**	**All training**
Goal 13 (Climate action)	**Sustainable shipping**	
Goal 14 (Life below water)	**Environmentally friendly operations**	**All training**
Goal 17 (Partnerships for the Goals)	**Partnering for sustainable shipping**	**Sustainability training**

Source: IMO (2017). Linkages…op.cit. and: IMO. *IMO and Sustainable Goals*, *op.cit.,* various and D3.2 authors.

[49] Cf. IMO (2017). Linkages between IMO's technical assistance work and the 2030 Agenda for sustainable development. Available at https://wwwcdn.imo.org/localresources/en/MediaCentre/HotTopics/Documents/TC.1-Circ.69.pdf and IMO (no date). *IMO and Sustainable Goals*. Available at https://wwwcdn.imo.org/localresources/en/MediaCentre/HotTopics/Documents/IMO%20SDG%20Brochure.pdf and D3.2 team.

Among the SDGs, Goal 14 is most relevant to this report and SkillSea, as maritime professionals – trained across various MET and MET-related courses – are destined to lead the next stages of the sustainability shift. They will also face the consequences in terms of upskilling and reskilling requirements, and these are analyzed in the relevant WP1 deliverables[50].

Matching the future directions of MET with future skills needs is especially critical in the context of Europe's enduring high dependence on maritime transport to sustain its open economy. An adequate number of maritime professionals attracted and retained in the sector – with their career prospects supported and enhanced by appropriate training – is essential in this perspective. MET institutions can have an impact upon sustainability, using appropriate strategic tools such as evaluation strategies and suitable measurement tools. This has been put forward for higher education in general (Findler *et al*, 2019) and can be implemented practically through shifting curricula appropriately (Qian, W. (2013), among other practical measures.

3.1.3. MET for EU Blue Economy: future needs

The World Bank defines the Blue Economy as the sustainable use of ocean resources for economic growth, improved livelihoods, and jobs, while preserving the health of ocean ecosystem (World Bank, 2017).[51] This definition is not unique or exclusive, as the EU definition considers all economic activities related to oceans, seas and coasts and covers a wide range of interlinked established and emerging sectors[52]. In the definition of the World Bank, maritime transport as activity is implied; in the definition of the EU, it is considered. The difference is subtle, yet it indicates the particular European perspective.

Overall, the term Blue Economy is not uniquely defined; brief – and definitely not complete – research on the term results in a variety of statements:

- '… comprises the economic activities that create sustainable wealth from the world's oceans and coasts' (Centre for the Blue Economy[53]).
- 'It is the overall contribution of the oceans to economies, the need to address the environmental and ecological sustainability of the oceans, and the ocean economyas a growth opportunity for both developed and developing countries' (Centre for the Blue Economy).

[50] Cf. for instance, SkillSea (2020*). D1.1.3 Future*…, *op.cit.*

[51] Available at https://www.worldbank.org/en/news/infographic/2017/06/06/blue-economy

[52] "The 2018 Annual Economic Report on EU Blue Economy". *European Union. 5/ 2018*

[53] Available at https://www.middlebury.edu/institute/academics/centers-initiatives/center-blue-economy, last accessed15 November 2020.

- '… is the sustainable use of ocean resources for economic growth, improved livelihoods, and jobs while preserving the health of ocean ecosystem' (World Bank Group)[54].
- '… comprises a range of economic sectors and related policies that together determine whether the use of ocean resources is sustainable' (UN[55]).

Notwithstanding their differences, the above statements underline the relationship between the oceans, the economy and sustainability.

In a targeted approach, the EU is determining the following related economic activities (see also Figure 3.4)[56]:

- Living resources
- Offshore oil and gas
- Port activities
- Shipbuilding and repair
- Maritime transport
- Coastal tourism

The current MET framework serves the needs of maritime transport, and indirectly the needs of other pillars, by providing, for example, the workforce for fishing vessels, vessels servicing platforms, port zone activities such as pilotage and mooring, and technician, yachts and pleasure boats.

In terms of maritime professionals, the current international framework related to education and the labour force – in particular the STCW Convention and the MLC 2006 – cannot fully address the needs of the EU's Blue Growth policies as well as the related requirements in the labour market. Whether the priorities of a new regulatory framework or market initiatives will focus on specific sectors remains an issue not dissimilar to others Europe has historically addressed

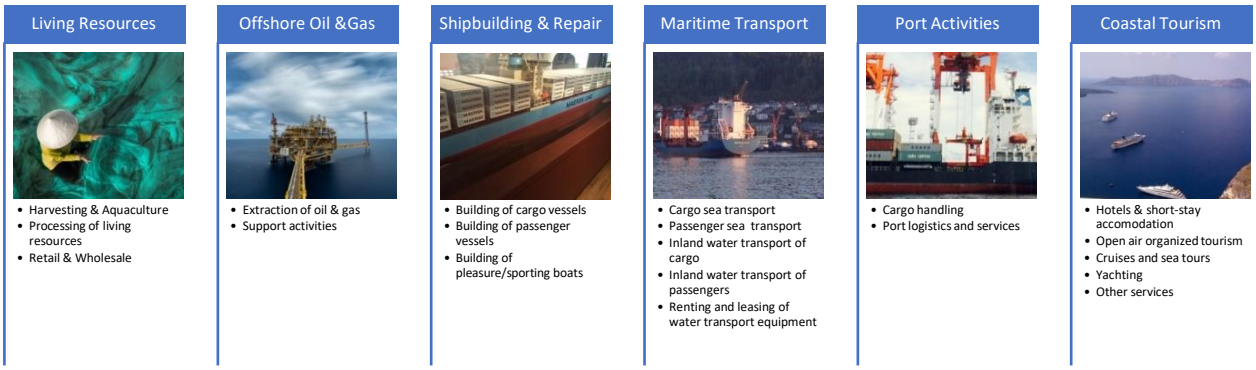
[54] World Bank (2017). What is the Blue Economy? (infographic). Available at https://www.worldbank.org/en/news/infographic/2017/06/06/blue-economy, last accessed 7 November 2020.
[55] UN (2019) Diving into the Blue Economy. Available at https://www.un.org/development/desa/en/news/sustainable/blue-economy.html, last accessed 7 November 2020.

[56] Cf. European Commission (2019) Blue Economy Report. Available at https://prod5.assets-cdn.io/event/3769/assets/8442090163-fc038d4d6f.pdf, last accessed November 2020.

effectively, as in the case of the common agricultural policy (CAP)[57]. In any case, the need for mobility among sectors and on- and off-board employment, needs to be considered, as many of the Blue Economy markets – related to sea tourism, for instance, on the right-hand side of Figure 3.4 – are seasonal or depend on exogenous factors that determine workforce demand and supply.

FIGURE 3.4

THE SECTORS OF THE EU BLUE GROWTH STRATEGY



Note: Pictures are Microsoft Word stock images or from EF team members.

Source: Informed and adapted from various EU documents especially from European Commission, Blue Growth Policy, COM(2014) 254/2 (13/05/2014)
and https://ec.europa.eu/maritimeaffairs/policy/blue_growth, last accessed 7 November 2020.

The Blue Economy and Blue Growth need to be promoted, supported and above all serviced by adequately qualified maritime professionals with a versatile portfolio of skills and knowledge. This portfolio should complement the current IMO framework, which provides a solid base but cannot support all the activities envisaged in the EU. Therefore, a range of new skillsets and competences[58] specially designed for EU business sectors could revive and expand current MET activities and generate jobs for EU nationals and graduates of European METs. At the same time, it could also safeguard European standards in the key areas of safety, environmental protection, and horizontal policies, such as gender equality and governance.

[57] See indicatively Papadopoulos AG. (2015), The Impact of the CAP on Agriculture and Rural Areas of EU MemberStates. *Agrarian South: Journal of Political Economy*, *4(1)*, 22-53.

[58] Generic or per profile as in ESCO profiles for instance.

3.2. MET adapting to new sustainable shipping directions

The current STCW[59] framework practically focuses on compliance with IMO instruments in place[60]. Therefore, requirements of the annexes of the MARPOL Convention – the IMO's main preventive pro-sustainability instrument in place – are incorporated in the STCW Convention and update it accordingly. In this regard, seafarers and MET facilities are often passive actors, who receive new input and should garner or provide educational content[61].

Ideally, IMO member states provide feedback and suggestions for updating the STCW Convention and the Code, with the latter consisting of part A (mandatory standards of training, certification and watchkeeping), and part B (recommended guidelines on training, certification and watchkeeping). The procedure seems to be rather efficient, as any update of the instruments is also considered in the IMO Instruments Implementation Code (III Code), hence member states update their requirements and procedures regularly and almost automatically. However, seafarers and METs are deemed passive and restricted to a top-down enforcement-oriented didactic approach, diminishing interest in 'over-and-above' performance as well as for proactiveness at a management level, either on- or off-board. This is an inherent characteristic of the system, which does not assist proactiveness at MET level.

Nevertheless, current environmental regulation and European instruments demand not only proactiveness that eventually will impact competitiveness, but also over-achievement. This is also a key driver for MET adaptation and generally for the adjustment of educational provision at VET and HE facilities within the MET ecosystem. Proactiveness promotes compliance by sensitizing students and trainers further. In summary, it may be not the lack of available educational content or expertise but of innovative educational approach that results mostly in employers and

[59] The International Convention on Standards of Training, Certification and Watchkeeping for Seafarers (STCW), 1978, was adopted by the International Conference on Training and Certification of Seafarers on 7 July 1978. The 1995 amendments were adopted by resolution 1 of a Conference of Parties to the International Convention on Standards of Training, Certification and Watchkeeping for Seafarers, which was convened by the IMO and met at the Headquarters of the Organization in the summer of 1995 (1995 STCW Conference). The 1995 STCW Conference adopted the Seafarers' Training, Certification and Watchkeeping (STCW) Code. The STCW Code contains, in Part A, mandatory provisions to which specific reference is made in the annex to the STCW Convention and which give, in detail, the minimum standards required to be maintained by Parties in order to give full and complete effect to the provisions of the STCW Convention; and, in Part B, recommended guidance to assist Parties to the STCW Convention and those involved in implementing, applying or enforcing its measures to give the STCW Convention full and complete effect ina uniform manner. Practically most Administrations (States) require compliance with both Parts.

[60] While IMO is not enforcing instruments directly but only through the states party to its conventions, within EU it is EMSA which enforces the adoption of the STCW convention through Directive 2008/106/EC as amended.

[61] This is not, however, an absolute top-down rule; a number of countries – one being Denmark for example - involve METs closely in the STCW process before the Sub-Committee on Human Element, Training and Watchkeeping (HTW meetings each year and include representatives from METs as national counsellors to IMO meetings in a more bottom-up approach.

employees not being as responsive to environmental challenges as they could, going above and beyond what is mandated by the international regulatory context.

In this context, educational approaches need to follow the spirit and needs of the Blue Economy and Growth objectives of the UN and of European policies, setting higher standards for both employers and employees while at the same time enhancing the competitiveness of European industries and of the European workforce in promoting sustainability. In the context of changes in the operating environment and in the operations of shipping itself, the timely adaptation of the systems of MET is critical.

3.3. The potential of MET evaluation strategies: 'complying beyond'

The adoption of any evaluation approach is a process that requires time and resources to be fully implemented by interested institutions[62]. Having an appropriate and measurable evaluation strategy is an even more complex task, especially in the context of emerging strategic shifts in the industry.

However, it is precisely at transitory times requiring a fast pace of suitable adaptation that strategic evaluation – going beyond the more standardised quality assurance procedures, of which a concise picture follows – can contribute more to MET development. Despite the rather chequered European MET scene in terms of types, levels and STCW relationship (cf. Figure 1.2, Chapter 1), 'complying beyond' regular quality assessment exercises and/or STCW prerequisites can support both the European maritime educational scene and the European industry's need for maritime professionals with skills supporting ongoing sustainability and technology shifts.

3.3.1. Evaluation in the context of European quality assurance in education

At Higher Education level, there are detailed European directions and instruments, increasingly standardised for the last 20 years (Chinta, 2016) regarding procedures of evaluations. These are both internal and external, covering educational provision at various levels and practically matching EQF levels 5 and above (Grek *et al*, 2009)[63]. There are various other aims (Chinta,

[62] A similar remark has been made in the context of SkillSea (2020). *D3.4 Internationalized…op.cit*.

[63] Cf. Grek, S., Lawn, M., Lingard, B., & Varjo, J. (2009). North by northwest: quality assurance and evaluationprocesses in European education. *Journal of Education policy*, *24*(2), 121-133.

2016) going beyond the standard European quality assurance framework in education, as the latter has been evolving since 1999 and now covers the European Higher Education Area mechanism and the entire continent, with 48 participant countries[64].

Vocational Education and especially MET – with the exclusion of MET integrated in Higher Education – has not enjoyed a similar level and speed of early progress[65] or a similar level of procedural uniformity. This reflects both the vocational character of MET and its diversity, although in some countries VET evaluation has already been a key priority for decades[66].

A key European initiative has been the European Quality Assurance Reference Framework for Vocational Education and Training (EQAVET)[67], progressively evolving since 2001 to produce the 2009 Reference Framework with an overall adoption of a toolbox approach[68] suitable for VET evaluation in relation to the industries VET serves. With the main focus of this report being industry adapted tools for strategic evaluation in a changing environment, innovative tools need to be explored to add to the arsenal of the METs across their diverse forms (cf. FIGURE 1.2, Ch. 1).

3.3.2. Strategic Evaluation Directions for MET in a measurement perspective

In terms of evaluation strategy basics, the first stage of a utilization-focused evaluation[69] relates to identifying the key areas for achieving the appropriate monitoring of adaptation. These form the basis for the evaluation proving useful in a strategic direction which is consistent with the definition. (Patton, 2013) *per se* of such evaluations (cf. INSET 3.B).

[64] Cf. For details and member countries since the Bologna declaration and the Bologna process set forth in 1999see http://www.ehea.info/page-bfug-partners.

[65] Cf. Fretwell, D. (2003). A Framework for Evaluating Vocational Education and Training (VET). *European Journal of Education, 38*(2), 177-190, p.177. Available at http://www.jstor.org/stable/1503536, last accessed 15 November 2020.

[66] For the case of Finland cf. Technopolis 2013, Evaluation of the European Quality Assurance Reference Frameworkfor Vocational Education and Training (EQAVET) https://www.eqavet.eu/Eqavet2017/media/publications/Annex-2- case-studies-finalised.pdf?ext=.pdf, last accessed October 15, 2020.

[67] For more on EQAVET cf. https://www.eqavet.eu

[68] For more cf. https://www.eqavet.eu/Materials-Resources/Evaluation-and-Quality-improvement-culture/Working-with-the-EQAVET-Cycle

[69] Cf. for an analysis, Patton, M. Q. (2013). The roots of utilization-focused evaluation. *Evaluation roots: a widerperspective of theorists*, 293-97.

INSET 3.B

'Utilization-focused evaluation begins with the premise that evaluations should be judged by theirutility and actual use'

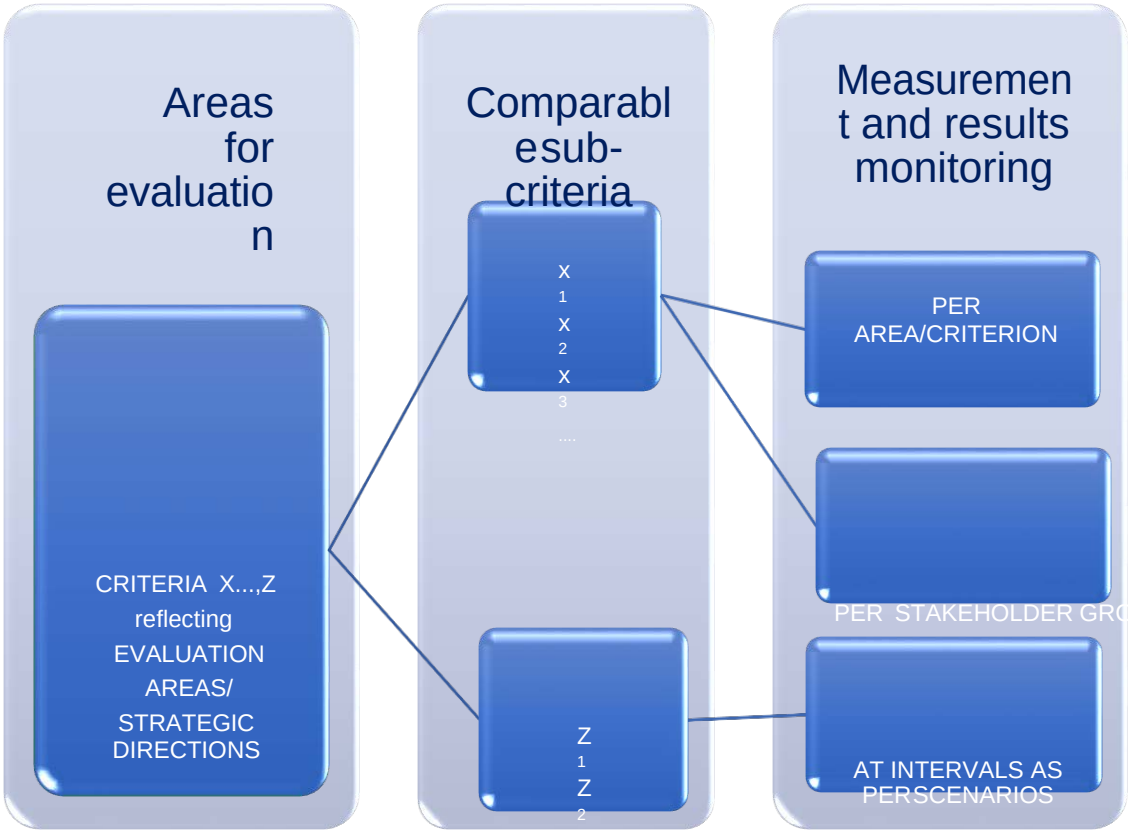
Patton (2013)

Although a more classic key performance indicator (KPI) based evaluation approach could be adopted[70], the dynamic and radical evolution currently of shipping trends - and as a result of educational content and terms of the provision - calls for flexibility. In the diverse environment of European METs this can be achieved identifying areas which can serve as indicator proxies in terms of degree of coverage and compliance of the educational provision to them. These key areas can constitute the main criteria of the evaluation (cf. FIGURE 3.5) and the basis for any measurement tool assisting the adaptation of METs to shifting industry requirements. It is equally key, therefore, for these to be validated for relevance by stakeholders as well.

Appropriate groups of stakeholders can participate in the evaluation process or evaluate METs themselves, as shown on the right-hand side of the Figure below, in terms of the strategic efficiency of MET provision.

[70] A key indicator approach is more compatible where standard measures and ratios can be applied as in the case of other SkillSea reports within WP3 allowing their use across diverse types and levels of the wide variety of types of European METs. The area of internationalisation is considered in the SkillSea perspective to be more compatible with the eventual use of such indicators in a roadmap perspective. Cf. SkillSea (2020). *D3.1 Strategy Plan Framework* and SkillSea (2020). *D3.4 Internationalised* Strategies *in MET*.

FIGURE 3.5
EVALUATION STRATEGY BASICS



Sustainability has a place in the left-hand side of areas of evaluation in FIGURE 3.5. Providing quality education is one of the major impacts that educational institutions can make to sustainable development, although definitely not the single one. Findler et. al (2017) point to a range of impacts; some are spread much more over time and space, while others are more localised or manifest themselves at a quicker pace. Quality education also now explicitly includes other more general social goals, as evident at the European level of Higher Education quality assurance[71].

3.3.3. Future-proof MET provision dynamics: developing scenarios

Potential future trends need to be taken into account when formulating evaluation strategies. Their consideration is necessary for assessing the success of the response of MET establishments to the dynamics of the industry as new trends put a new perspective on the skills and competences package that maritime professionals are – and may be more extensively in the medium and longer term – required to possess.

Environmental sustainability – including blue growth and circular economy – and automation, along with digital transformation, are areas for which new or updated competencies internationally demanded by the maritime sector[72] in the context of sweeping new trends in the world economy which have led to new approaches to the skillsets required in the future across industries[73]. Uncertainty complicates the process of adaptation. On the one hand, the content and the pace of such changes cannot be predicted with definite accuracy. On the other hand, any definition of quality education and any evaluation strategy cannot overlook the degree of correspondence of the content and of the strategic direction of the educational provision to the nature, range, and speed of developments in key areas.

In view of the degree of uncertainty accompanying future developments, the creation of scenarios can be a guide for reassessing industry trends and for accordingly adapting educational

[71] Cf. for the specific working group of the European Higher Education Area http://www.ehea.info/page-new-goals

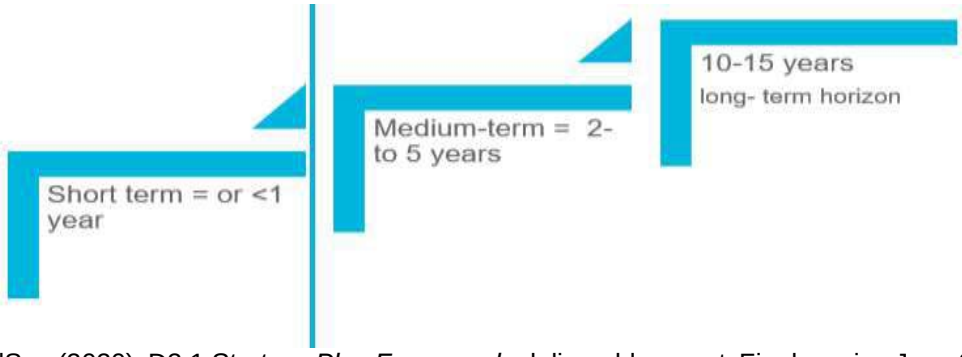
[72] Damvad Analytics (2019). The Blue Denmark´s requirement of competences. Agency for Science and Higher Education

[73] Cf. Dondi, M., Klier, J., Panier, F., & Schubert, J. (2021). Defining the skills citizens will need in the future world of work. McKinsey and Co. Available at https://www.mckinsey.com/~/media/mckinsey/industries/public%20and%20social%20sector/our%20insights/defining%20the%20skills%20citizens%20will%20need%20in%20the%20future%20world%20of%20work/defining-the-skills-citizens-will-need-in-the-future-world-of-work.pdf?shouldIndex=false, last accessed October 16, 2021.

directions. [74]The creation of basic scenarios is also useful for forward-looking design of curricula and can, while it is not incompatible with strategic evaluation tools used, assist the application of strategies and the measurement of their success such as the Strategic Evaluation MET Tool (ST.E.ME.T). These are used for the evaluation of the degree to which strategic MET goals have been met which is presented in detail in the next chapter of the report.

For scenario creation it is essential to distinguish the areas where change is emerging or predicted and assign a related probability. In terms of time-horizons (see Figure 3.6) scenarios incorporate a higher degree of certainty when referring to the medium term as the longer term is – by definition – more unpredictable; structuring the elements involved and defining the range of related probabilities is thus essential for estimating the likelihood of any of them.

FIGURE 3.6
TIME-HORIZON IN A STRATEGIC CHANGE PERSPECTIVE



Source: SkillSea (2020). D3.1 *Strategy Plan Framework,* deliverable report. Final version June 2020, Figure 1.10, Chapter 1.

In the context of shipping - and in practical terms of specific training challenges - there is more than one scenario for the potential impact of current trends on educational content required; this is especially so as there is a high number of combinations of the prevalence of successful candidates among competing alternatives in the various aspects of maritime operations – such as fuels or ship designs - and of the probability of their faster or slower application. In parallel, exogenous factors - which have impacted periodically on shipping - can suddenly, and at very short notice, alter any fundamental hypotheses on which scenario creation is based. The effect of the recent COVID-19 pandemic has been such a factor, accelerating the introduction of new trends and emphasising further the degree of uncertainty[75] which was already significant and

[74] The update of these scenarios through a future SkillSea Knowledge Hub is also a possibility in this direction as has been noted internally to the project and is currently explored.
[75] Cf. Notteboom, T., Pallis, T., & Rodrigue, J. P. (2021). Disruptions and resilience in global container shipping and ports: the COVID-19 pandemic versus the 2008–2009 financial crisis. *Maritime Economics & Logistics*, *23*(2), 179-210.

increasing in the maritime environment well before the emergence of COVID-19[76]. The following section focuses on these trends which are at work in parallel across world shipping and to which, proceeding to an estimate of their potential for widespread application and of their probable speed of introduction, the MET overall system will need to adapt its provision.

Some of these trends, such as the move towards aligning shipping with the Sustainable Development Goals and the 2030 UN Agenda, seem without competition from alternatives; for other aspects, such as whether fully autonomous ships will become the norm and in which time-horizon, the shipping market verdict may still be out for a longer period.

3.3.4 Emerging trends to be addressed by MET establishments

There is a long list of areas in which alternatives related to a aspects of shipping operations continue to compete with each other. The current period is reminiscent of those in the past where more than one alternative were battling to prevail[77].

For the current period, at least four areas can be distinguished where competing alternatives - or a high degree of uncertainty of future developments - have emerged. These areas relate to fuels which will prevail in the future, to the human/machine interaction, and to the cyber/physical interaction as well as to the need for a holistic approach to marine pollution in the spirit of Sustainable Development Goals (SDGs) and of the circular economy. They can be categorised as follows:

- Regulatory developments regarding environmental sustainability
- Application of - and regulation on - new fuels such as LNG, ammonia, hydrogen, rechargeable batteries etc.
- Degrees of vessel autonomy
- Digitalisation

[76] Cf. Thanopoulou, H., & Strandenes, S. P. (2017). A theoretical framework for analysing long-term uncertainty in shipping. *Case Studies on Transport Policy*, *5*(2), 325-331.

[77] One such case was in the area of ship propulsion, around the early 1800s, another for ship fuels and engine types around the time of the introduction of the Diesel engine in the early 1900s. Oil and Diesels were finally to prevail after a period of co-existence with older engines fuelled by coal. Cf. Thanopoulou, H., Theotokas, I., & Constantelou, A. (2010). Leading by Following: Innovation and the Postwar Strategies of Greek Shipowners. *International Journal of Maritime History*, 22(2).

The dynamic of the interface of each area must also be factored in for example, the choice and eventual prevalence of any new fuel(s) will be highly influenced by the need to increase future compliance with environmental sustainability regulation.

Regulation for environmental sustainability

In the area of maritime transport, *sustainability* has been a key driver since the first major sustainability – and not just safety – related worldwide changes in the design specifications of tankers in the early 1990s. The trend has continued to be the main one influencing technical solutions and directions, interacting with many elements of the system of shipping and resulting in a significant progressive transformation of its technical and operational aspects[78].

The International Maritime Organization (IMO) is a key driver in the effort to reduce the environmental impact of shipping, adopting the first set of international mandatory measures to improve ships' energy efficiency in 2011. In the past decade, IMO has taken further action, including more regulatory measures and the adoption of a Green House Gas (GHG) strategy. The IMO has reached an agreement on a strategy for the reduction of CO_2 emissions from shipping: the Marine Environment Protection Committee[79] (MEPC) has announced that flag states have agreed a target to cut the shipping sector's overall CO_2 output by 50% by 2050. In June 2021, IMO adopted short-term measures to reduce carbon intensity of all ships by 40% by 2030, compared with 2008[80]. For shipping to meet these GHG targets, new technologies and a high level of innovation requiring investment in R&D, infrastructure and trials will be necessary. A wide range of projects are addressing this already, with an emphasis currently on the related aspect of new fuels.

New fuels

In the case of *future fuels*, while the prerequisite and the general direction - i.e., compatibility with sustainability regulation - are relatively clear, the pace of the transformation remains unknown as

[78] Cf. SkillSea (2020). D3.1 *Strategy Plan Framework*, report.

[79] Cf. http://www.imo.org/en/KnowledgeCentre/IndexofIMOResolutions/Marine-Environment-Protection-Committee-%28MEPC%29/Pages/default.aspx

[80] See https://www.imo.org/en/MediaCentre/HotTopics/Pages/Cutting-GHG-emissions.aspx. Many Shipping companies are currently aiming higher as well as international shipping industry bodies such as the International Chamber of Shipping which submitted plans to the IMO detailing urgent measures which governments must take to help the industry achieve net zero CO2 emissions by 2050. Cf. ICS (2021). Press release (October 5, 2021). Available at https://www.ics-shipping.org/press-release/shipping-industry-sets-out-bold-plan-to-global-regulator-to-deliver-net-zero-by-2050/, last accessed November 8, 2021.

it is influenced by more than just technical factors. Developments in this area are fast and the success of directions taken also depends, as mentioned, on developments in the sustainability-related regulatory front. Already, one major technological solution for reducing emissions from conventional high-sulphur fuel is being driven out barely two years after its first widescale implementation: It has been proposed that open-loop scrubbers[81] be phased out through European legislation, while the possibility that this equipment would be banned outright emerged as an option in late 2020 (Corbett, 2020). During the early pandemic period, the then prevailing low oil prices also meant that scrubbers of all types became a non-paying extra investment (Bockman, 2020), showing how sustainability regulation can combine with economic developments to alter the picture at a dramatic pace. Presently, alternative future fuels such as methanol, ammonia and hydrogen attract a larger share of the attention that LNG had almost monopolised earlier, with a number of new fuel-related projects reaching fruition or readiness stage[82].

Digitalisation[83]

Digitalisation is not a very recent challenge. However, the emerging technological developments within the field of Information and Communication Technology (ICT) comprise connectivity whereby wireless communication, sensor technology and the Internet of Things (IoT) offer new possibilities in reducing paperwork, securing the supply chain, and offering a variety of data for analysis. Lambrou et al (2017)[84] distinguish three pillars in their discussion of digitalisation in shipping:

- digital technologies such as IoT, big data analytics, A.I., blockchain
- digital solutions (smart shipping systems and novel digital services)
- digital business concepts, models, and practices

In terms of its dynamics with the other areas under transformation singled out within the SkillSea

[81] This is the simpler and less expensive – yet of the order of seven figures in euros - type of large equipment intended to prevent sulphur pollution from exhaust emissions when operating with conventional fuel

[82] Cf. Chambers, S. (2021). Economics of ammonia-ready ships questioned, May 5, 2021. Available at https://splash247.com/economics-of-ammonia-ready-ships-questioned/, last accessed October 17, 2021.

[83] The review in this section has benefited from overviews of trends in SkillSea (2020*).* D1.1.3 *Future Skills and competence needs,* op.cit., in SkillSea (2020). D3.1 *Strategy Plan Framework*, op.cit. and in other SkillSea deliverables.

[84] Cf. Lambrou, M., Watanabe, D., & Iida, J. (2019). Shipping digitalization management: conceptualization, typology and antecedents. *Journal of Shipping and Trade*, *4*(1), 1-17.

context and the impact on training needs, it is noted that digitalisation is not only connected to ship economics and management but also to sustainability applications and closely related to the feasibility of higher levels of autonomy in the operation of ships.

Degrees of vessel autonomy: Maritime Autonomous Surface Ships (MASS)

The issue of the future degrees of vessel autonomy has attracted the interest of researchers, of the industry, and of policymakers, as has been the case with other sectors such as land transport[85]. The definition of the terms is still evolving as technology results become mature for commercialisation. The development of definitions as well as an outline of risk and challenges related to safety and the necessary skills and competences of their operators is still evolving. Autonomy is closely related to other trends such as digitalisation, with the latter being at the same time the catalyst for the former and the challenge for MET provision and direction since it impacts on the industry, on future navigational concepts at different levels and on skills of maritime professionals.

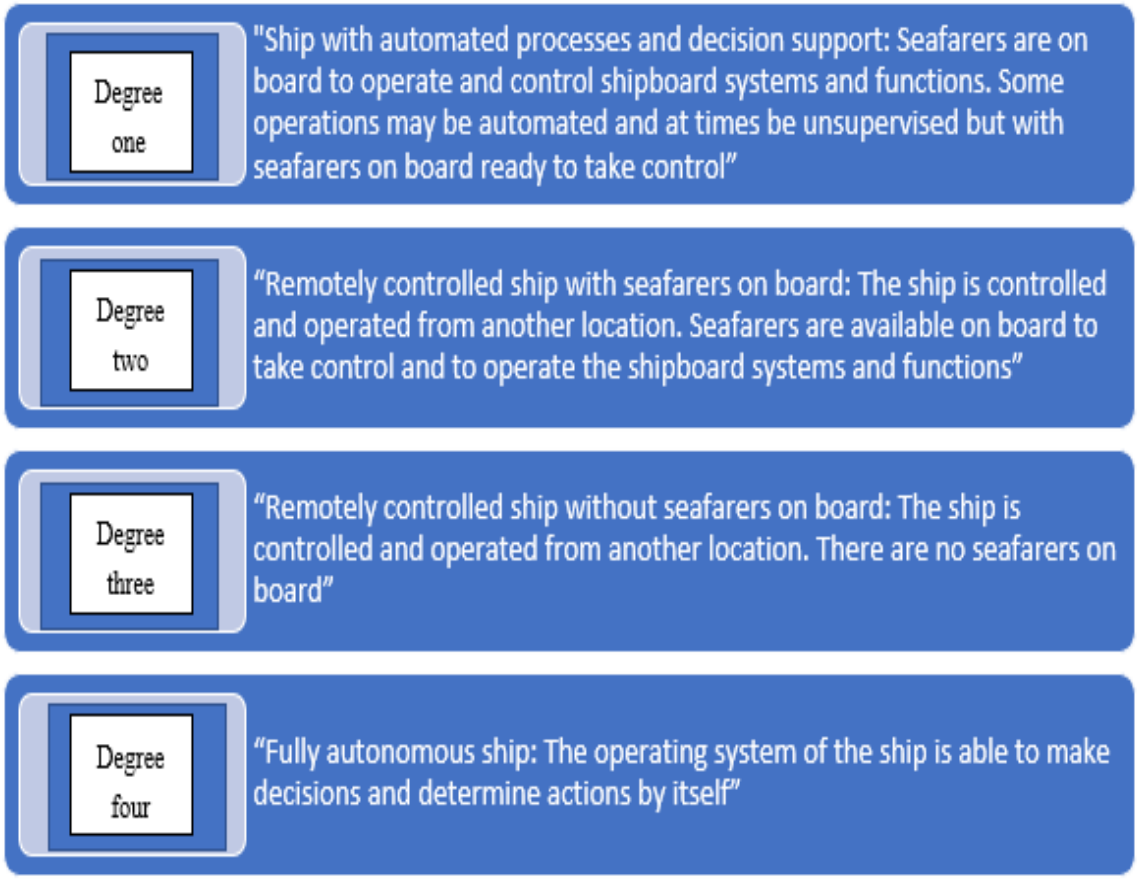
Whilst discussing educational requirements for autonomous vessels may appear contradictory, the operational responsibilities relating to these vessels remains with maritime professionals in the same way as a traditional crewed vessel. However, as the operation is very different and no training or education in the use of autonomous vessels is included within normal seafarer training to date, it becomes imperative that those expected to manage and be responsible for safe operations receive specific training covering the details of operating them.

Recognising the necessity to deal with the issue of MASS, the IMO concluded a regulatory scoping exercise in June 2021[86]. While no educational requirements are discussed there, it does set out operational scenarios, which for each degree will lead to the need for different skill sets. Currently the IMO distinguishes four levels of autonomy in the regulatory scoping exercise (cf. Figure 3.7) below.

[85] Lalli, M. (2020). Autonomes Fahren und Die Zukunft Der Mobilität. Springer. Berlin / Heidelberg.

[86] IMO (2021). MSC.1/Circ.1638: OUTCOME OF THE REGULATORY SCOPING EXERCISE FOR THE USE OF MARITIME AUTONOMOUS SURFACE SHIPS (MASS).

FIGURE 3.7
LEVELS OF SHIP AUTONOMY AS PER IMO CLASSIFICATION



Source: Adapted from IMO (2021).

In terms of MASS, as the industry and technology mature and operations progress towards the later stages, it is anticipated that there will be lesser involvement of seafarers on board ships. In the advanced stages greater autonomous functions will enable ships operating with no seafarers onboard.

3.3.5 The impact of new trends on the content of MET provision

On the basis of the analysis of emerging trends in the previous sections, it is evident that the long-term shift in job functions and the type of competencies required by seafarers in the longer term will be profound, requiring additional or upgraded skills to respond to new needs; for instance, sustainability developments will result in new training needs related to reducing fuel consumption and GHG emissions further.

Maritime professionals will thus have to acquire knowledge and competences to:

- Safely handle new fuels and operate new propulsion technologies beyond the current provisions of the STCW Convention
- Comply with sustainability regulation using new technologies
- Handle digitalisation developments as well as withstand cybersecurity threats
- In the longer term, be prepared to move more away from the vessel through the creation of Remote-Control Centres.
- In a transitional period of more sea/land mobility and of new training needs show leadership and strengthen their people skills such as language and communication.

As underlined in D1.1.3[87] close links between education institutions and industrial clusters can foster innovation through knowledge creation and strength of R&D, while- among others - transversal skills are needed to enable maritime professionals to move within the wider maritime value chain as its links change through the introduction of automation and autonomy[88].

The D1.1.3 SkillSea report also notes that lifelong learning programmes will be required to enable seafarers to work across industries and services in the maritime sector through knowledge update and the upscaling of their skills. New roles for maritime professionals will involve the greater adoption and use of cognitive skills combined with tacit knowledge for safe vessel operation as MASS progresses. Skills will include ever-increasing emphasis on the use of teamwork, leadership, decision-making, and problem-solving in addition to communication (cf.Table 3.2) below. This is not a process unique to shipping. The current transformation of entire sectors of the world economy has led to the introduction of new terminologies – such as the McKinsey DELTAs[89] - to describe the elements of the new assortment of foundational skills that will be required to survive and succeed in the future world which emerges under the impact of technology and a shift towards sustainability. Related shifts may be less or more gradual and should be done logically so that the workforce can migrate provided it possesses a suitable set of knowledge and skills.

[87] This section benefited from input from the WP1 authors of SkillSea (2020*). D1.1.3 Future Skills and competence needs,* op.cit.

[88] See also D2.2 Educational Packages for specified skills and D3.1 *Strategy Plan Framework.*

[89] Cf. Dondi, M., Klier, J., Panier, F., & Schubert, J. (2021). Defining the skills citizens will need in the future world of work. McKinsey and Co. Available at https://www.mckinsey.com/~/media/mckinsey/industries/public%20and%20social%20sector/our%20insights/defining%20the%20skills%20citizens%20will%20need%20in%20the%20future%20world%20of%20work/defining-the-skills-citizens-will-need-in-the-future-world-of-work.pdf?shouldIndex=false, last accessed October 16, 2021.

TABLE 3.2
SKILLSEA SYNOPSIS OF FUTURE SKILLS WITH AN IMPACT ON TRAINING NEEDS

Sustainability - Green shipping skills:

Emissions measurement and documentation of compliance
- Operation of complex hybrid and zero emission machineries
- Environmental economics, performance management systems
- Logistics and vessel utilization optimisation
- Advanced routeing knowledge (wind, currents, waves)
- Safe handling of the various new fuels

Digitalization related skills:

- Sensors, IoT
- Networks and connectivity
- Cyber security
- Ship 4.0/ Industry 4.0
- Advanced analytics and data-based fleet optimisation
- Updating, servicing and repairing digital systems

Autonomy related skills:

- Vessel monitoring
- Autonomous vessel maintenance

Operations in a digital world

- The fleet of the future 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.
- 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.

Innovation

- Understanding of business development taking advantage of digital technology (for example: cargo tracking, cargo and machinery condition monitoring, logistics in digital 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 develop 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

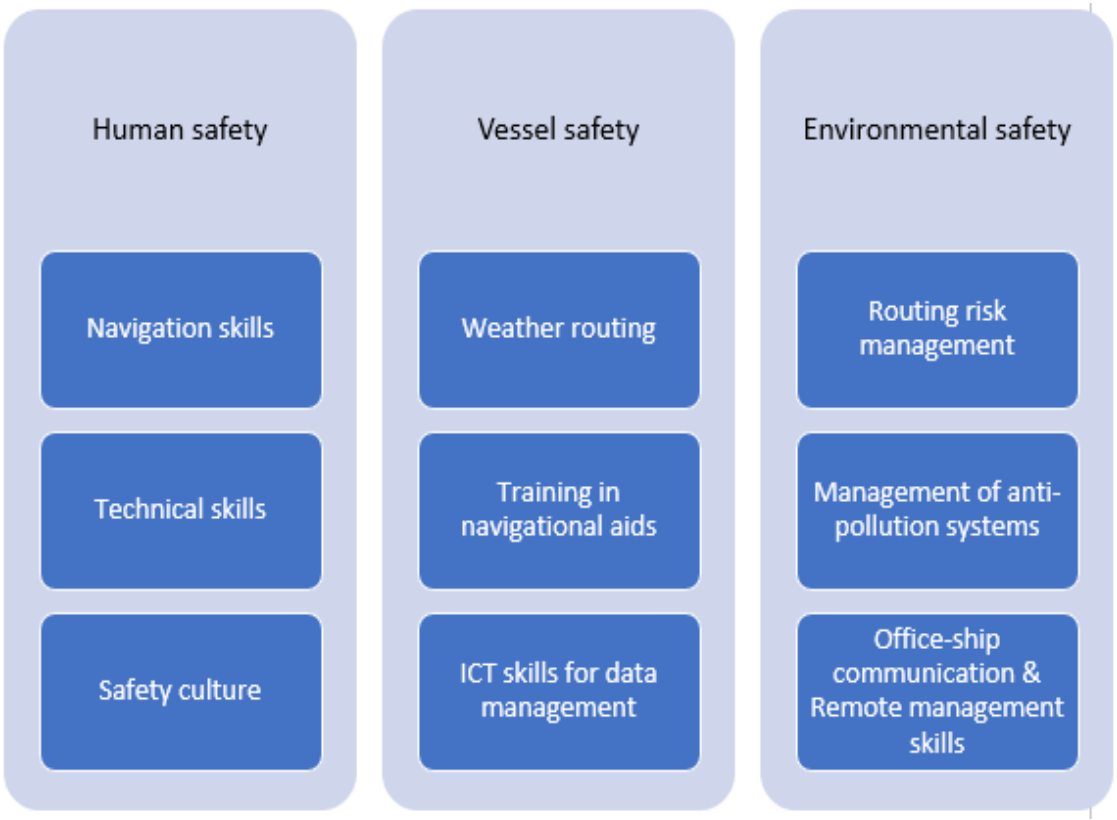
- Tranversal skills needed to to enable them to move from one value chain to another and thereby
- It is a need to establish suitable lifelong learning programmes that enable seafarers to work across industries and services in the maritime shipping sector
- Maritime clusters with a variety of job opportunities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

Source: Based on SkillSea (2021) D1.1.3 and elaboration by the WP3 team.

3.3.6 MET and scenarios of change in shipping

As a general context for scenario building, four pillars of the instruments of the IMO – safety, security, environmental protection, and the human element – have been adopted as the underlying guiding drivers for evolution. In this regard, building on the basis of Kramer (2009)[90] on active and passive safety, the following challenges for MET skills – as presented in Figure 3.8 – are considered to underpin the needs related to sustainability that METs will face in their evaluation process according to the scenarios classified in this section by extent and speed of change .

FIGURE 3.8
SAFETY CLASSIFICATION SYSTEM AND MET SKILLS



Source: Authors on the basis of Kramer (2009) and SkillSea D1.1.3 (2020) op.cit

[90] Kramer, F. (2009). Passive Sicherheit von Kraftfahrzeugen: Biomechanik - Simulation - Sicherheit im Entwicklungsprozess. 3., überarb. Aufl. ATZ-MTZ-Fachbuch. Wiesbaden: Vieweg + Teubner. Available at http://deposit.d-nb.de/cgi-bin/dokserv?id=3151273&prov=M&dok_var=1&dok_ext=htm, last accessed October 20, 2021.

The following extent of change scenarios to 2035-40 are encapsulated as:

Low extent of change "Reasonable" Evolution Scenario 1:

No radical technology transformation of ocean shipping. However, automation in Engine-Room Resource Management (ERM) and of Bridge Resource Management (BRM) as well as the introduction of digital resources lead to stagnation in the level of demand for crews and higher demand for new skills. The probability of this scenario is low.

Limited extent of change "Localised" Evolution Scenario 2:

In specialised trades – namely in coastal trades and close to territorial waters, yet not in international waters or in high seas – there is a gradual introduction of higher level of autonomous ships, eventually engaged in industrial shipping activities in an envisaged horizon to 2035. Impact on numbers employed is significant for these sectors and the level of skills demanded – mainly in MASS – increases steeply. The probability of this scenario is deemed high.

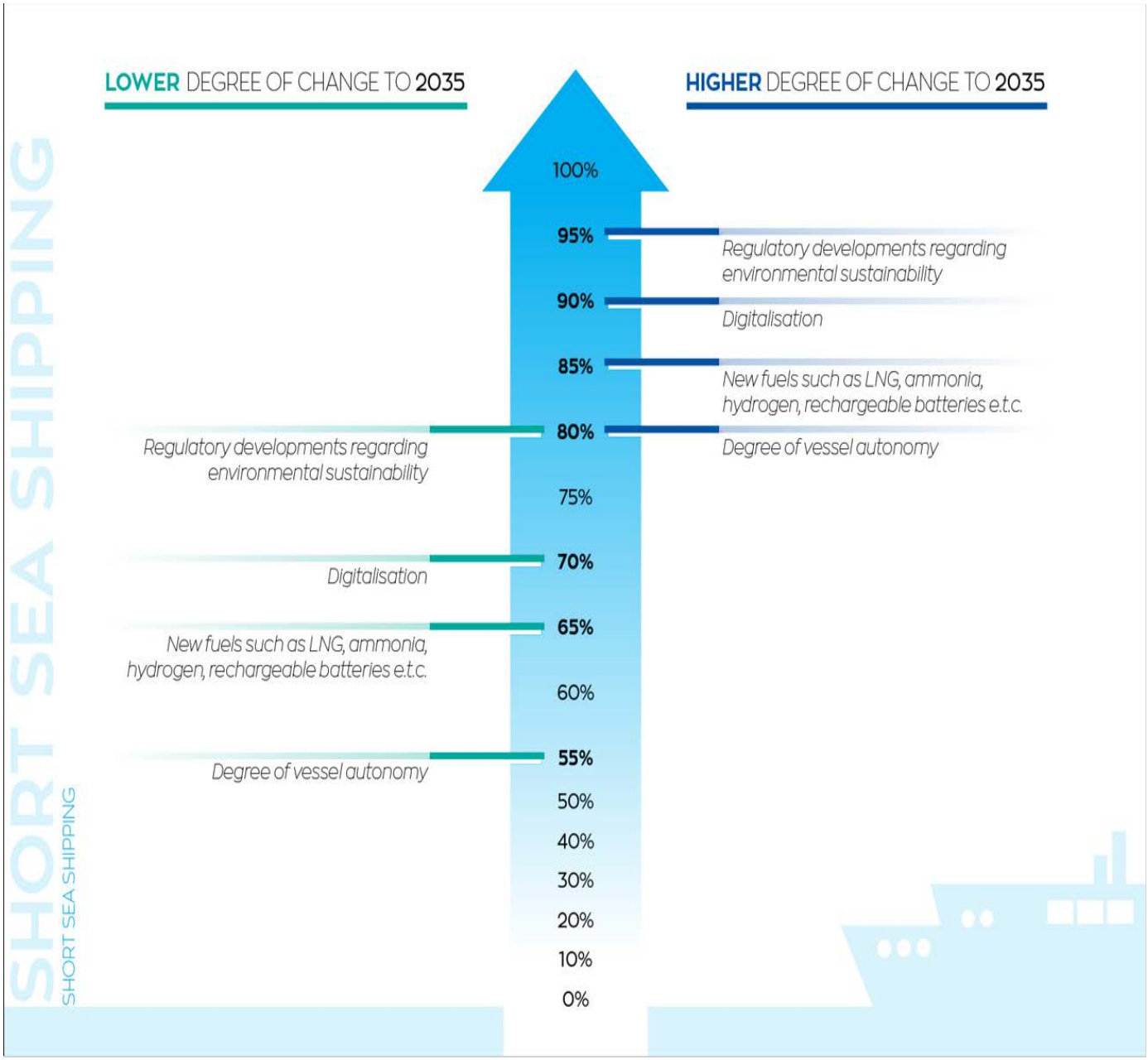
Higher extent of change "Transition" Evolution Scenario 3:

"Mixed" conventional and semi-autonomous operations, even in ocean-going ships such as those in liner services, are envisaged, with a time horizon towards 2040. In this case, ships might use traffic corridors to cross the high seas with little or no crew onboard, before stopping in off-port-limits (OPL) or pilot-station points, where pilots and crew will embark with the aim of safe mooring, port call and port-manoeuvring. The probability for such a scenario is deemed low.

High extent of change "Transformation" Evolution Scenario 4:

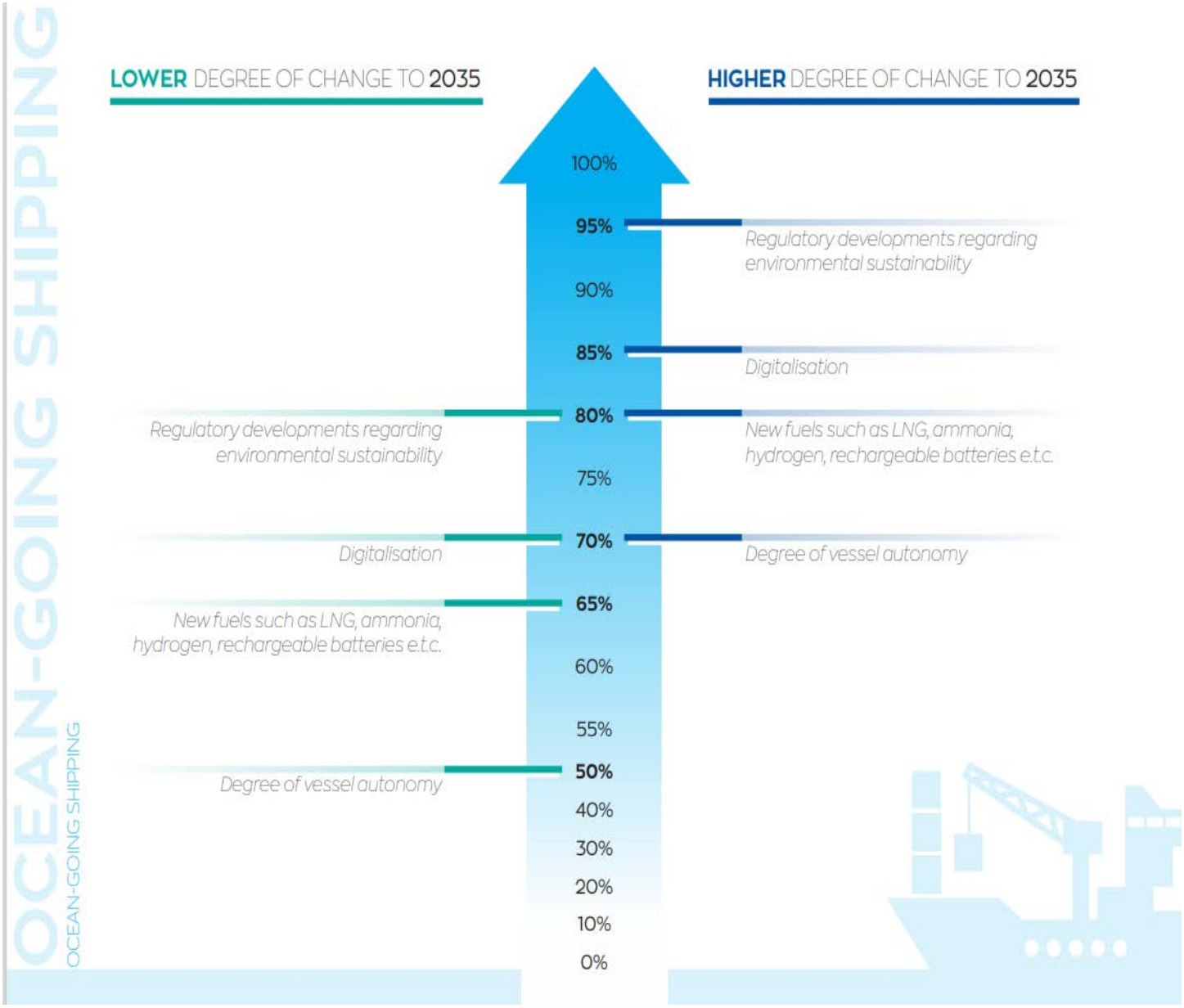
Embracing automated and digitalised operations, most ships engaged in international trades are autonomous or semi-autonomous (IMO levels 3 and 4). Exceptions, such as cruise ships and passenger ships, might persist due to the hospitality element of these activities. Conventional ships will be in the phasing out stage. The probability of such a scenario is deemed low. Figure 3.9A and Figure 3.9B, below, combine the evolution of the main elements of change in current trends assessed with the two sets of scenarios described earlier and the impact on short-sea and ocean-going shipping.

FIGURE 3.9A
SHORT-SEA SHIPPING



Source: Eugenides Foundation for SkillSea (2021).

FIGURE 3.9B
OCEAN-GOING SHIPPING



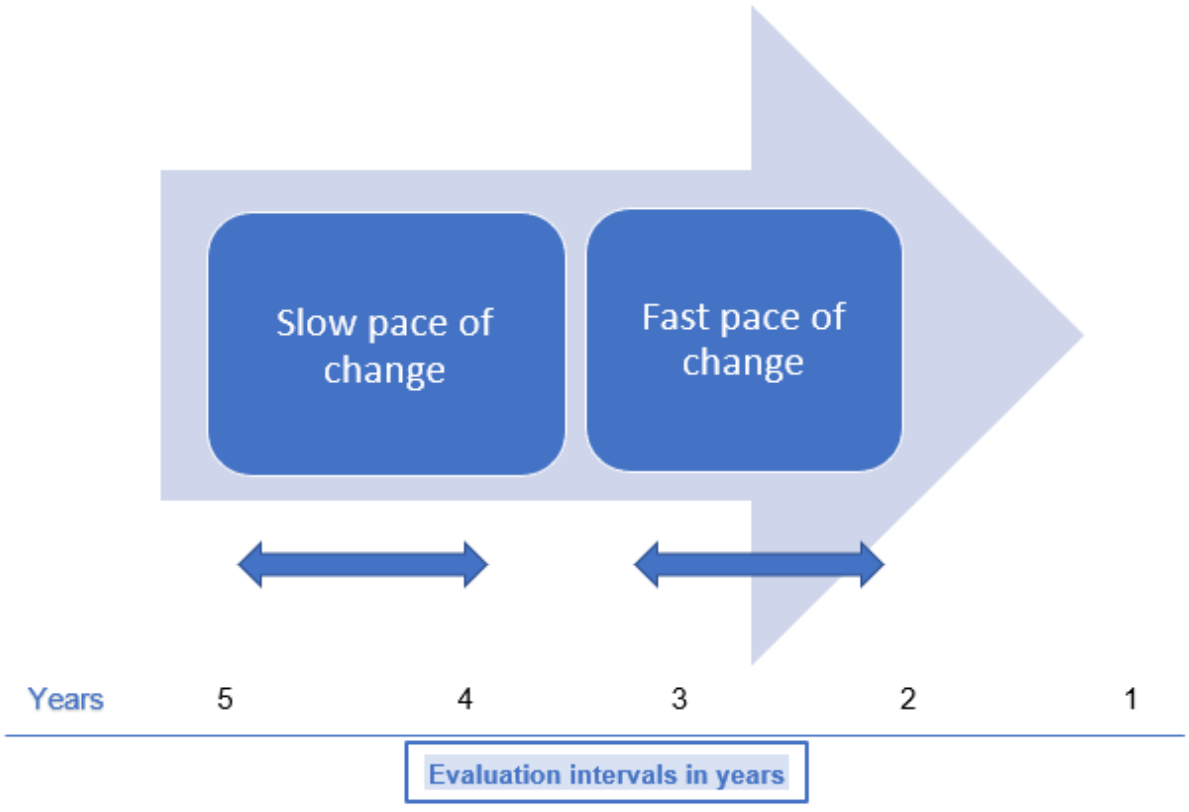
Source: Eugenides Foundation for SkillSea (2021).

3.3.7 “Shipping future” scenarios and MET evaluation modalities and intervals

What interests MET providers and stakeholders alike in terms of strategic evaluation intervals required to measure MET adaptation in the context of introducing new elements in the system of shipping is the speed of change; this also influences the end-state of MASS in the medium 5-year horizon and in a longer-term horizon of 10-15 years.

It follows that MET Evaluation could be in longer intervals in the case of the two lower impact on skills scenarios 1 and 2 above are assuming a slower pace of change; it would eventually take place in shorter intervals in the case an accelerating pace of change in the ‘hardware’ and ‘software’ elements of shipping consistent with scenarios 3 and 4 and of accelerated introduction of the new elements across all shipping sectors (cf. FIGURE 3.10).

FIGURE 3.10
EVALUATION INTERVALS OF MEASURING EFFECTIVENESS OF EVALUATION STRATEGIES PER SPEED OF CHANGE



As shown in the figure above, in the case of either slower or faster real application of expected changes, the Strategic Evaluation MET Tool (ST.E.ME.T.) tool proposed in the next Chapter can be applied at the appropriate interval; this lies within a wide range (for the medium-term horizon) of two to five years.

In the case of both scenarios 3 and 4 which assume more extensive /accelerated change, an interval of two to three years may be more appropriate. An interval of four to five years could be considered an alternative, in the case of the presently unlikely scenario in which the industry changes slowly or – for whatever reason – change is even halted, interrupted or slowed-down.

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4. DISTANCE TO SHIPPING FUTURE: A MET EVALUATION TOOL

4.1. A MET adapted AHP strategic evaluation tool: ST.E.ME.T[91]

The scope of this section is to develop a decision-support tool that assists METs to evaluate strategic options and alternatives for future-proof educational provision, to the best achievable degree. The proposed ST.E.ME.T tool considers criteria as well as alternatives on a relative basis and not on any set threshold or benchmark. The section also familiarizes readers and users of the report with the methodology used to design the ST.E.ME.T strategic evaluation tool, which can assist METs adapting and assessing the level of their adaptation to changing industry needs – any such process being the product of strategic decisions at MET level.

Strategic decisions involve human judgement on the basis of available data and information. Evaluation strategies need the latter, and evaluation as a procedure provides these types of input, if properly run. However, unstructured information – even if tabulated and analysed – has to be acted upon in a strategic direction. This involves judgement, which can be facilitated as an informed *choice* through structuring the problem. This is a process which logically passes from defining criteria enabling choice, with intuitive subjectivity ceding its place by a significant degree to more analytically objectified priorities. This is where Multiple Criteria Decision Making (MCDM) methodologies prove useful; among them, the Analytic Hierarchy Process (AHP) emerges as the most simple, efficient, and easy one (cf. ANNEX 7).

AHP is a MCDM method based on hierarchies and relative or absolute comparisons of the attributes of the alternatives. The structure of hierarchies permits the decomposition of decision-goals to criteria. This decomposition is a powerful way to help the human mind to cope with complexity and diversity. The decision factors are organized in steps and levels of importance. Further to the advantages of breaking down a decision problem into criteria and sub-criteria, hierarchies may take qualitative properties and factors into consideration (Saaty, 1977; Saaty, 1994; Saaty, 2001). Once the hierarchy of a problem is set, the decision-maker is concerned with weighting the criteria to evaluate alternatives (cf. ANNEX 7).

This particular methodology – hitherto applied to a large range of activities and sectors and to various types of problems involving choice – simulates the formation of decisions made by humans but in an analytical way, as its name denotes. AHP is based on relative comparisons, deploying user-friendly scales which are then translated to a specific scale of measurement widely applied in the literature and compatible with modern understanding of human decision-making.

[91] A full electronic operational version of the STE.ME.T tool will be available on the SkillSea website.

In summary:

1. AHP is a flexible approach, logically incorporating judgments and personal values – a most critical attribute when dealing with problems highly subjective by nature.
2. AHP provides a framework for group participation in decision-making, enabling the extraction of criteria and their weights through consensus and appropriate weighting.
3. AHP has been applied successfully to many problems of policymaking and impact assessment.

These AHP features fit to the needs identified for this specific problem. The decision model has to be simple to construct and natural to intuition and general thinking, and to encourage compromises and consensus whilst also not requiring specialized expertise. More on the method can be found in the books of Saaty (Saaty, 1977; Saaty, 1994; Saaty; 2001)[92].

4.2. Tools for Strategic MET Evaluation in a generic AHP context

As in any MCDM decision-making case, results are data-driven, and relevant issues are extensively discussed in the literature (for example, see Saaty, 2001, Appendix 2, pp 361-372).

Discrete problems are commonly analyzed in the following tabular format, where *m* is the number of alternatives and *n* is the number of criteria. It is interesting to note that in the MCDM terminology, an attribute may also be considered as a criterion. If A_i is an alternative, then:

[92] ANNEX 7 at the end of this report reviews the essential technicalities of the methodology.

TABLE 4.1:
THE TABULAR FORMAT OF THE GENERAL MCDM PROBLEM

		Criteria (Attributes)						
		C_1	C_2	C_3	…	C_j	…	C_n
	weights	w_1	w_2	w_3		w_i		w_n
Alternatives	A_1	a_{11}	a_{12}	a_{13}	…	a_{1j}	…	a_{1n}
	A_2	a_{21}	a_{22}	a_{23}	…	a_{2j}	…	a_{2n}
	A_3	a_{32}	a_{32}	a_{33}	…	a_{3j}	…	a_{3n}
	⋮					⋮		
	A_i	a_{i2}	a_{i2}	a_{i3}	…	a_{ij}	…	a_{in}
	⋮					⋮		
	A_m	a_{m2}	a_{m2}	a_{m3}	…	a_{mj}	…	a_{mn}

This tabular format implies a single hierarchy and is known as *decision matrix.* In this formulation:

let C_1, C_2, C_3, …, C_n be the decision criteria (attributes)

let A_1, A_2, A_3, …, A_m be the decision alternatives

let w_i (for i = 1, 2, 3, …, n) be the weight of criterion C_i

let a_{ij} be the performance of alternative A_i when it is examined in terms of criterion C_j

It should be noted that the criteria are considered as independent: there is no causal link among them, as per the cancellation principles of normative decision-making. Should the criteria be dependent, then different numerical treatment is necessary, besides any consideration of their physical meaning and impact. Generally, the examination of other alternatives or the analysis under other criteria is not the case in a given MCDM formulation and the decision-maker has to determine both alternatives and criteria before proceeding to further steps. Nevertheless, the suggested tools can easily accommodate as many alternatives as the decision-maker deems appropriate; the same applies for the selected criteria, although with rather careful numerical handling.

4.3. Interactive Workshop: results and direction guidance

An interactive workshop was organized to evaluate future-proof MET provision strategic directions. The workshop was coordinated with WP2's initial piloting evaluation of the proposed toolbox on which Educational Packages (EPs) are based and on early material readily available among the planned EPs.

For Part B of the joint interactive workshops, a group of maritime professionals who have had both STCW and non-STCW training assessed the proposed SkillSea evaluation directions in the context of MET provision aimed at refreshing the skillsets and competences of mariners in relation to current and expected developments.

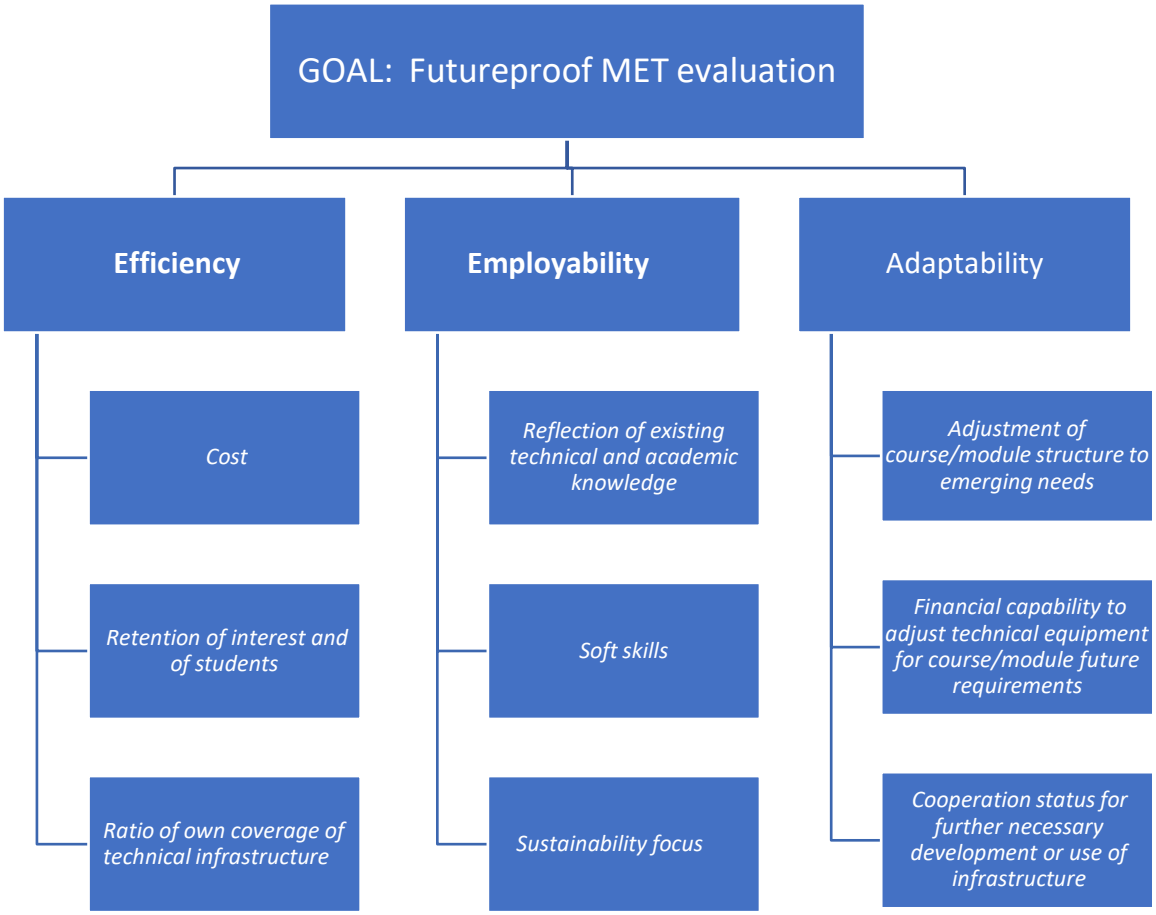
The combination of Part A and Part B workshops allowed the cross-distribution of questionnaires and some alignment in the style of questions and form of the questionnaires was used. The survey results were made available through Survey Monkey, allowing both WP2 and WP3 to exchange views and draw results from groups with a focus on different levels of evaluation and the assessment of any differences. The feedback between the two work packages, through initial piloting and tool validation results, enabled a more practical assessment of how complementary the levels of classic evaluation are and of strategic evaluation through the relevant tool.

The workshop in the second WP3 part also enabled the validation of the basic criteria and sub-criteria of the planned D3.2 adaptable and goal-oriented quantitative multicriteria (as per submission), the Strategic Evaluation MET Tool (ST.E.ME. T.) which is operable at a MET/course/module level. This tool seeks to assist in linking evaluation with MET strategic directions, which is the mission of this report. Moreover, this tool can be used in regular evaluations, allowing the evaluation of alternatives at a planning phase or the identification of internal strong and weak points of a programme, which is a critical element for an adaptive and dynamic strategy.

The S.T.E.ME.T tool is mostly intended for use by MET at administration (high level), with appropriate incorporation and combination with regular evaluation material. In this regard, the following hierarchy and criteria were given for validation by the participants in the interactive workshop part B (Leader WP3), as presented in FIGURE 4.1:

FIGURE 4.1

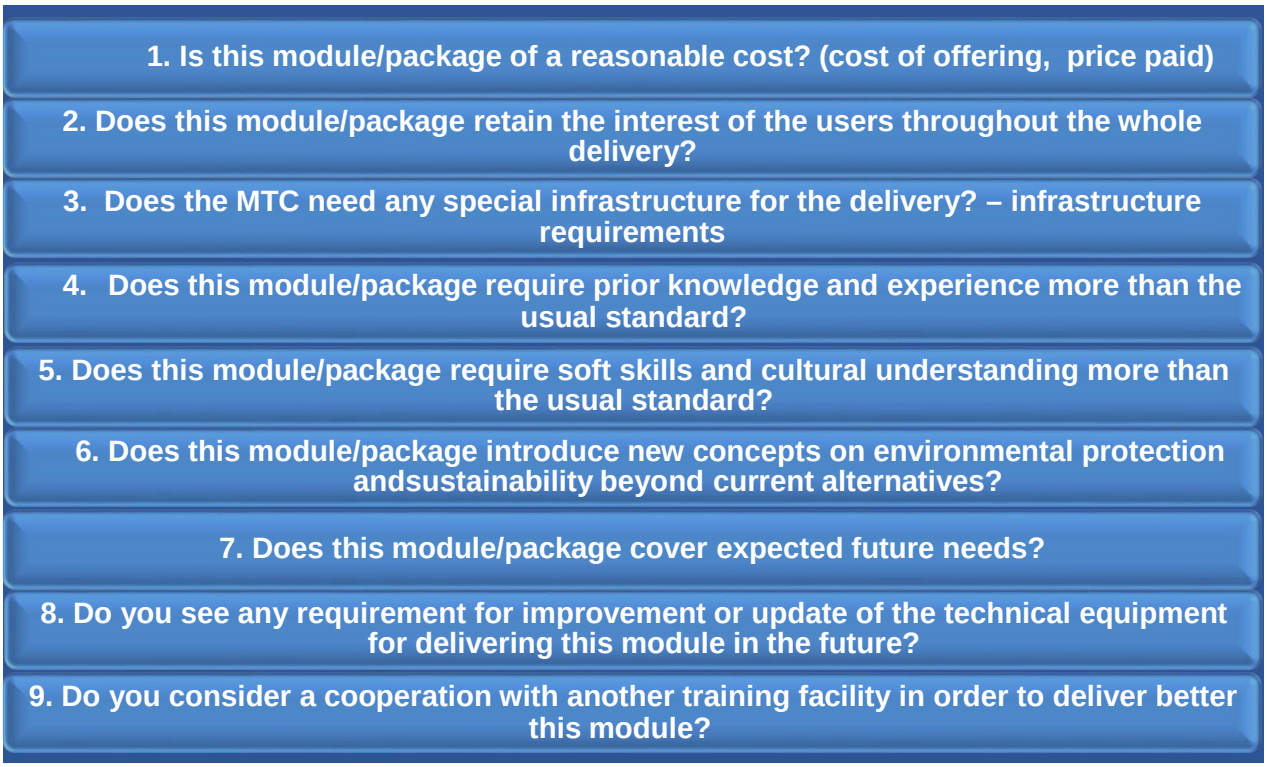
THE DECISION HIERARCHY BEHIND ST.E.ME.T



Input for the criteria in FIGURE 4.1 can be obtained by asking the questions in a human-friendly narrative way, as in FIGURE 4.2. Every sub-criterion is assessed per alternative in the AHP full approach; alternatives could be of different levels (the same each time) – for example, a new module or entire MET course packages – and could be graded with one of the following 'grades': high; somewhat high; indifferent; rather low; low. Apparently, every participant should only provide one 'grade' for every question within FIGURE 4.2.

FIGURE 4.2

QUESTIONS FOR CRITERIA INPUT



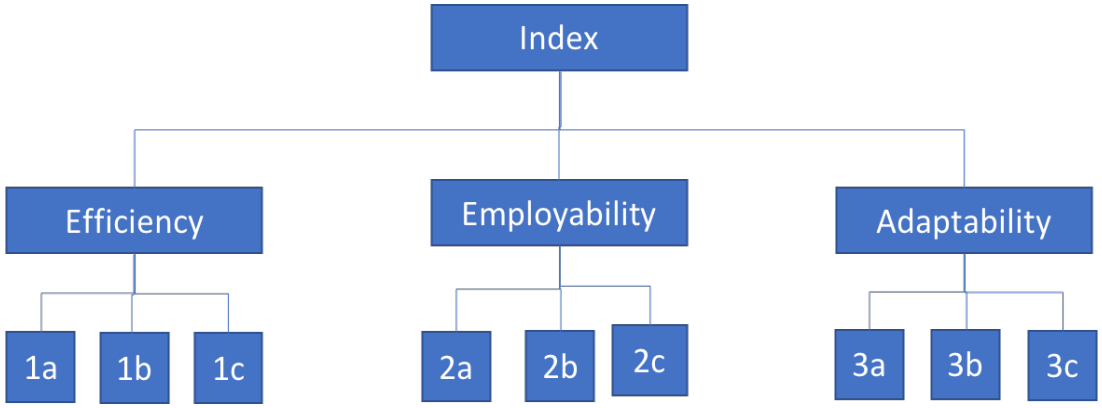
Considering the generic formulation of MCDM, the above criteria C1a, C1b, …, C3c consist of the Criteria group of C_n, while Alternatives are the various METs or Maritime Training Centers (MTCs denoted as m MTC). Input from the MTCs are the a_{ij} elements of the matrix. The criteria weights w_n are extracted by using the priority weights technique of AHP, as described in the literature.

Usual questions related to new content evaluation are as in FIGURE 4.2. A numerical example based on fictitious input demonstrates the usability and adaptability, which are the foundations for the effectiveness of this tool.

Thus, the following hierarchy depicted in Figure 4.3 is assumed as the basis of the relevant matrix calculations, with values gathered through typical AHP questionnaires and based on the criteria and sub-criteria detailed in FIGURE 4.1.

FIGURE 4.3

MODEL HIERARCHY BEHIND THE ST.E.ME.T TOOL



Assuming familiarity with the AHP[93] as well as the following indicative criteria relative evaluations:

1. Efficiency is of equal importance with employability
2. Efficiency is strongly more important than adaptability
3. Employability is more important than adaptability

Then the AHP matrix of preference yields:

TABLE 4.2

SCALED PREFERENCES

	Efficiency	**Employability**	**Adaptability**
Efficiency	1	1	5
Employability	1	1	5
Adaptability	1/5	1/5	1

[93] For a more detailed approach, the reader can consult ANNEX 7 to this report, or SkillSea (2020) *D3.4 op.cit*. and for a fuller description any book by Saaty in the list references.

Given:

TABLE 4.2, it is possible to estimate the weights of the criteria, usually called a preference vectorfor the weights, namely:

TABLE 4.3

PRIORITY WEIGHTS

Efficiency	0.45 5
Employability	0.45 5
Adaptability	0.09

Then we translate the selected grading system of *high – somewhat high – indifferent – rather low – low* into an AHP preference matrix:

TABLE 4.4

SCALED YET STANDARDIZED PREFERENCES

	High	somewhat high	Indifferent	Rather low	low	***priorities***
High	1	3	5	7	9	*51%*
somewhat high	1/3	1	3	5	7	*26%*
Indifferent	1/5	1/3	1	3	5	*13%*
Rather low	1/7	1/5	1/3	1	3	*6%*
low	1/9	1/7	1/5	1/3	1	*3%*

Given the above weights of TABLE 4.3 and TABLE 4.4, input from two MTC facilities is translated indicatively as follows:

TABLE 4.5

INDICATIVE RESULTS TABLE

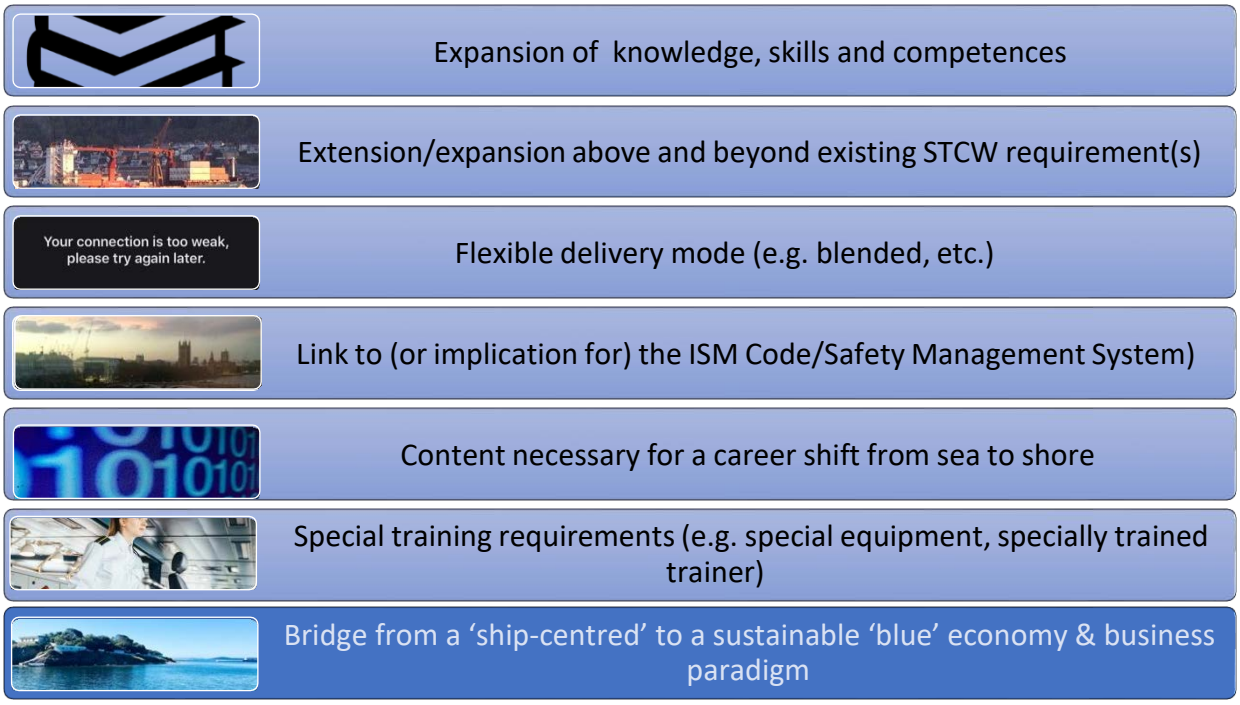
	C1a	C1b	C1c	C2a	C2b	C2c	C3a	C3b	C3c	
MTC1	High	Somewhat high	indifferent	Rather low	Somewhat high	low	High	Somewhat high	indifferent	
	23%	12%	6%	3%	12%	1%	5%	2%	1%	66%
MTC2	indifferent	Rather low	indifferent	Somewhat high	Somewhat high	Somewhat high	indifferent	Rather low	High	
	6%	1%	6%	12%	12%	12%	1%	1%	5%	56%

The results (TABLE 4.5) yield a final index – for example, 66% for MTC1 and 56% for MTC2 – as well as the relative importance of the criteria per MTC. Besides the final result that reflects a debatable closeness at large of overall evaluation measurement results, the analysis of results per criterion group reveals 'opinions of the same wavelength' which can definitely be more useful for the analysis. As an example, efficiency matters more for MTC1 than MTC2; MTC1 feedback suggest 41%/70%, i.e., 59% vis-a-vis 13%/70%=19% of MTC2. This result signals the need for further examination, potentially of qualitative nature, to explain the difference in the opinion of between MTC1 and MTC2. Similarly, employability seems to matter more when considering the feedback of MTC2, a trait that reflects policies and biases of MTC2.

However, differences between MTCs are a one-dimensional potential use of the ST.E.ME.T tool and in reality, secondary. Apart from potential use in external evaluation, such a tool can be at its most powerful for internal evaluation purposes and for evaluation by different stakeholder groups – including those internal and external to the provision. Over time, therefore, it can measure the degree of improvement in a future-proof direction. However, in any type of use of the tool, a strategic evaluation of proposed new content should ensure that it caters for critical aspects such as those in Figure 4.4 if ST.E.M.E.T is to be used appropriately and effectively.

FIGURE 4.4

IMPROVING STRATEGIC EVALUATION AND MET THROUGH ST.E.ME.T



Note: EF team pictures and Microsoft Word standard pictures/icons

The ST.E.ME.T. tool has been developed electronically and be accompanied by tutorial video explaining the use of it. The tool is available for further experimentation and familiarization in the SkillSea website here: [Strategic Evaluation MET Tool - SkillSea]

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5. CONCLUSIONS

5.1. General remarks

METs have to respond proactively to not only the quick and quickening pace of technology but also to the pace of regulatory change. As transpires from guiding surveys – and also from internal knowledge of large parts of the European MET system, a significant part of which is collaborating within SkillSea – the impact of new trends has become so immediate that it is not possible to rely solely on regulatory instruments for the training needs of seafarers. The trends of the new era need to be serviced proactively.

The extra training provided could be more systematized – for this purpose, METs need to develop synergies and exchange knowledge and academic practices, especially in view of a future revision of the STCW Convention. However, non-STCW MET institutions also need to keep up with the pace of change. Evaluation is a regular process for them, as they are typically Higher Education institutions and, as such, are covered in the European context by standardized evaluation and accreditation frameworks through the European Higher Education Area mechanisms. However, European METs of all types also need to use MET and industry-specificevaluation tools, to adapt in a targeted way to the rapid and significant changes in the industry –especially as part of regulatory changes in relation to and through the IMO system of legal instruments.

5.2. Summary of specific conclusions

- MET can promote and actively support sustainability and the Blue Economy at both global and European level, as current training and frameworks serve only maritime transport activities and sectors are only indirectly benefited.
- Standard evaluation procedures can benefit Higher Education non-STCW MET and elements of the European Higher Education Area. These can be borrowed by all typesof METS wishing to proceed with such a typical evaluation process; however, all typesof MET can benefit from MET and maritime transport adapted evaluation procedures,especially in a strategic direction.
- Sustainability and digital skills emerge through student and faculty canvassed perceptions as the most relevant areas if METs are to follow industry developments,

a task for which, even internally, there is acknowledgment of the difficulty the MET system may face.

- Sustainability-informed training, acquisition of skills and competences, could be a solution (if not a necessary prerequisite) for the enhancement of competitiveness of the European Blue Economy sector and implementation of Blue Growth, as well asfor strengthening the competitiveness of European maritime professionals or of mariners with EU-certified training.
- Adopting suitable criteria for strategic evaluation of the increasing sustainability and digitalization related developments can assist the European MET system to adapt to the needs of the industry it serves.
- The proposed Strategic Evaluation MET Tool (ST.E.ME.T.) is the second in a set of strategic decision-making tools advanced by SkillSea and can serve as a guide.
- STE.ME.T is easy to use, transparent, expandable and adaptable to evolving criteria and the periodicity of strategic evaluation can be adjusted according to varying scenarios of changes in the technological and regulatory context of international shipping and of societal priorities.

ANNEXES

ANNEX 1A: MET SURVEY QUESTIONNAIRE – "STUDENTS' VOICE"

SKILLSEA (Futureproof Skills for the Maritime Transport Sector)

Questionnaire "Student Voice"

Dear Student,

The SKILLSEA (Futureproof Skills for the Maritime Transport Sector) is a new EU-funded ERASMUS+ project (Sector Skills Alliance) with an aim to develop strategies to identify and meet the future skills needs of the maritime sector and attract greater numbers of Europeans.

The purpose of our survey is to understand students' satisfaction levels, and the knowledge of what factors influence satisfaction.

The survey should take between 8-10 minutes to complete. Your answers will be completely anonymous.

Your response is important and we deeply appreciate your valuable cooperation.

* 1. Please present your view truthfully regarding the following statement: "Overall I am satisfied with my study of my Maritime Education and Training (**MET**) institution".

- ◯ Very Dissatisfied
- ◯ Dissatisfied
- ◯ Neutral
- ◯ Satisfied
- ◯ Very Satisfied
- ◯ Don't Know /Don't Answer (D.K./D.A)

2. Please present your view truthfully regarding the following statements: I am satisfied with the…

	Very Dissatisfied	Dissatisfied	Neutral	Satisfied	Very Satisfied	D.K/D.A.
IT facilities of my MET institution	◯	◯	◯	◯	◯	◯
Quality of Simulators	◯	◯	◯	◯	◯	◯
Course Material (e.g. textbooks)	◯	◯	◯	◯	◯	◯
Library	◯	◯	◯	◯	◯	◯
Academic Staff - lecturers	◯	◯	◯	◯	◯	◯

3. How satisfied are you with your performance in…

	Very Dissatisfied	Dissatisfied	Neutral	Satisfied	Very Satisfied	D.K/D.A.
Problem solving skills (identify information needs to support problem solving)	○	○	○	○	○	○
Communication skills (Ability to write effectively in other languages and ability to speak fluently in English)	○	○	○	○	○	○
Teamwork skills (ability to network)	○	○	○	○	○	○
Thinking skills (The ability to critically, creatively, analytically and to apply knowledge in different contexts)	○	○	○	○	○	○
IT skills (Ability to use database programmes to gather and process information and use it in any organized way)	○	○	○	○	○	○
Management skills (the skills to effectively lead and manage people)	○	○	○	○	○	○
Continuous learning skills (Ability to regularly upgrading your skills and knowledge)	○	○	○	○	○	○

* 4. Please present your view truthfully regarding the following statement: "Overall, the courses of my study gave to me the opportunity to develop my transferable skills (that is skills developed within maritime education are also useful when transferred into maritime labour)."

- ○ Strongly Disagree
- ○ Disagree
- ○ Neutral
- ○ Agree
- ○ Strongly Agree
- ○ (D.K./D.A)

2

* 5. Taking a definition of sustainable development as: "Development that meets the needs of the present without compromising the ability of future generations to meet their own needs"
To what extent the subject of sustainable development has been covered in the courses of your **MET** institution?

- ◯ It has been taught
- ◯ This subject is not included in our curriculum
- ◯ It has not been taught up to now
- ◯ I do not know the subject of sustainable development
- ◯ (D.K./D.A)

* 6. In general, to what extent do you agree or disagree with the following statement: "Sustainable development is something which all maritime education and training institutions should incorporate in curricula."

- ◯ Strongly Disagree
- ◯ Disagree
- ◯ Neutral
- ◯ Agree
- ◯ Strongly Agree
- ◯ (D.K./D.A)

* 7. A Massive Online Open Course (MOOC, courses digitally) is a kind of online course that is open to everyone. Have you used MOOC platform in some courses related to your study?

- ◯ No
- ◯ I don't know MOOC platform
- ◯ Yes
- ◯ (D.K./D.A)

* 8. Taking a definition of Lifelong Learning as "Learning throughout life with the aim of improving knowledge, skills and competences..." In general, to what extent do you agree or disagree with the following statement: "My **MET** institution through the courses promotes and cultivates a lifelong learning culture between the students."

- ◯ Strongly Disagree
- ◯ Disagree
- ◯ Neutral
- ◯ Agree
- ◯ Strongly Agree
- ◯ D.K./D.A.

3

* 9. Please present your view truthfully regarding the following statement: "My **MET** institution strongly promotes student's mobility between European Maritime Education and Training institutions."

- ◯ Strongly Disagree
- ◯ Disagree
- ◯ Neutral
- ◯ Agree
- ◯ Strongly Agree
- ◯ D.K./D.A.

* 10. Please present your view truthfully regarding the following statement: "I have a mentor (=a person who has more knowledge and skills and transfers to them another who has lesser) who assists and supports me in learning the skills regarding my shipboard training."

- ◯ No
- ◯ Yes
- ◯ D.K./D.A.

11. What is your gender?

- ◯ Female
- ◯ Male

12. What is your age?

- ◯ Under 18
- ◯ 18 - 20
- ◯ 21 - 23
- ◯ 24 - 26
- ◯ 26+

13. What is your subject study?

- ◯ Deck Officer
- ◯ Engine Officer
- ◯ Electrotechnical Officer
- ◯ Dual Officer (both deck and engine officer)

14. What is your current year of study?

- ◯ 1st year
- ◯ 2nd year
- ◯ 3rd year
- ◯ 4th year
- ◯ Other

If you need any further clarification, please do not hesitate to contact us at skillsea@eef.edu.gr. We will gladly provide you with whatever support you need.

Thank you for your time and valuable input.

Sincerely yours,

Epameinondas Panas
Professor of Athens University of Economics and Business
Head of Research on Maritime Education for
Eugenides Foundation

Co-funded by the
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of the European Union

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ANNEX 1B: MET SURVEY DEMOGRAPHICS – "STUDENTS' VOICE"

FIGURE ANNEX 1B.1

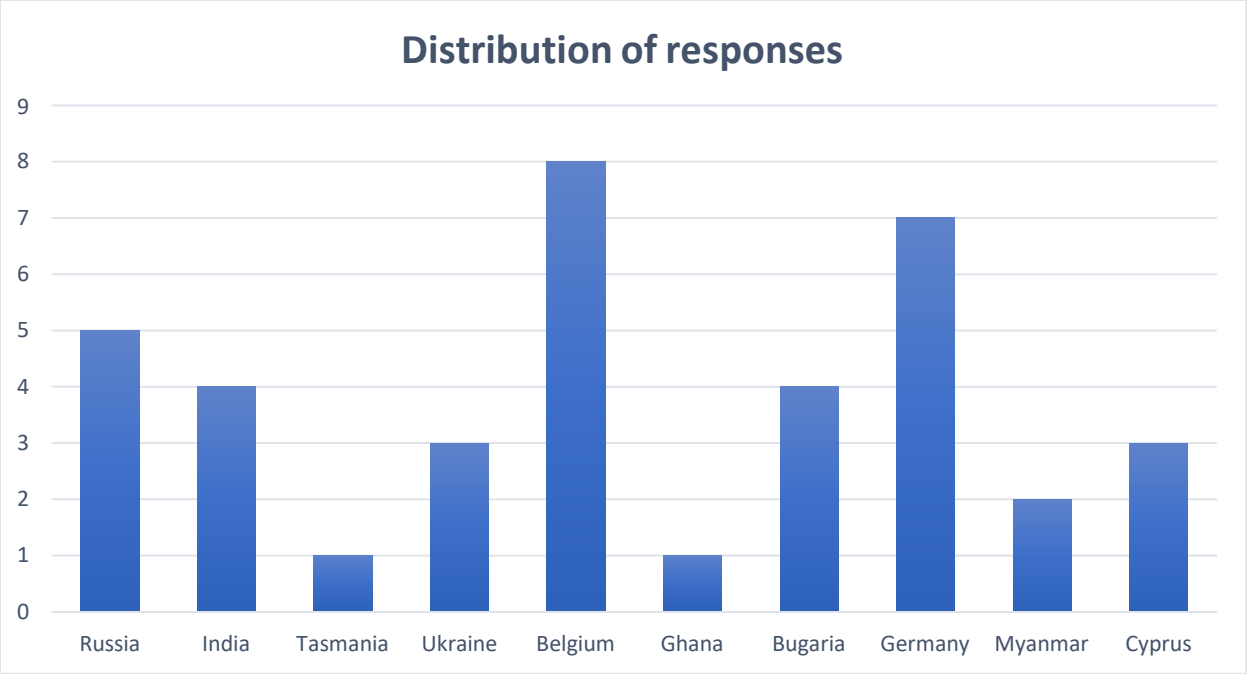


FIGURE ANNEX 1B.2

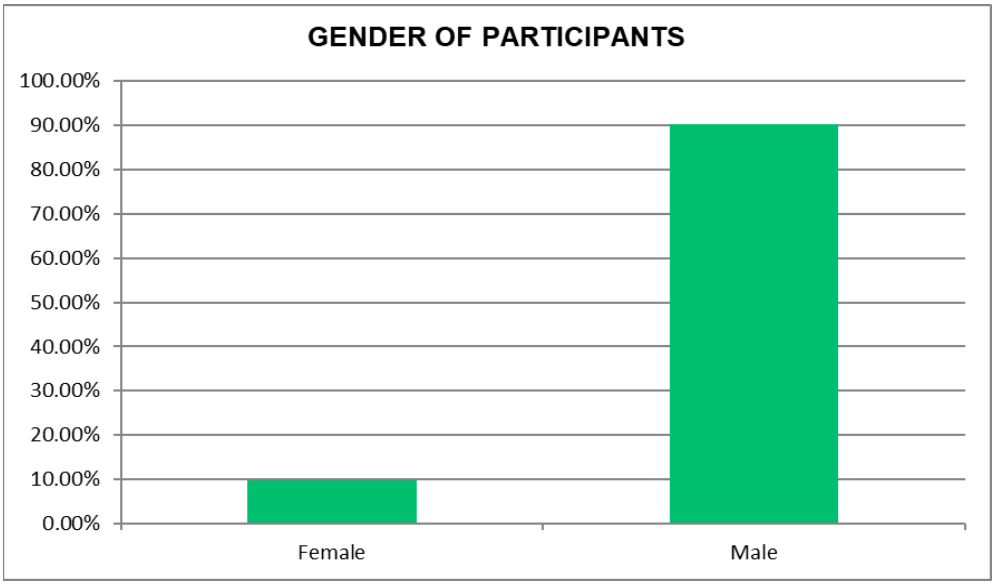


FIGURE ANNEX 1B.3

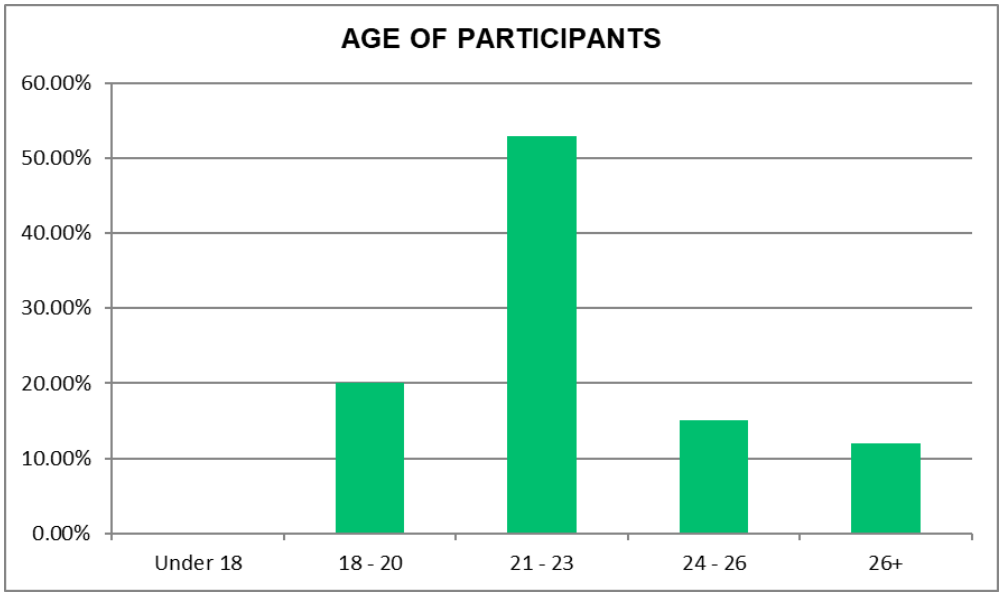


FIGURE ANNEX 1B.4

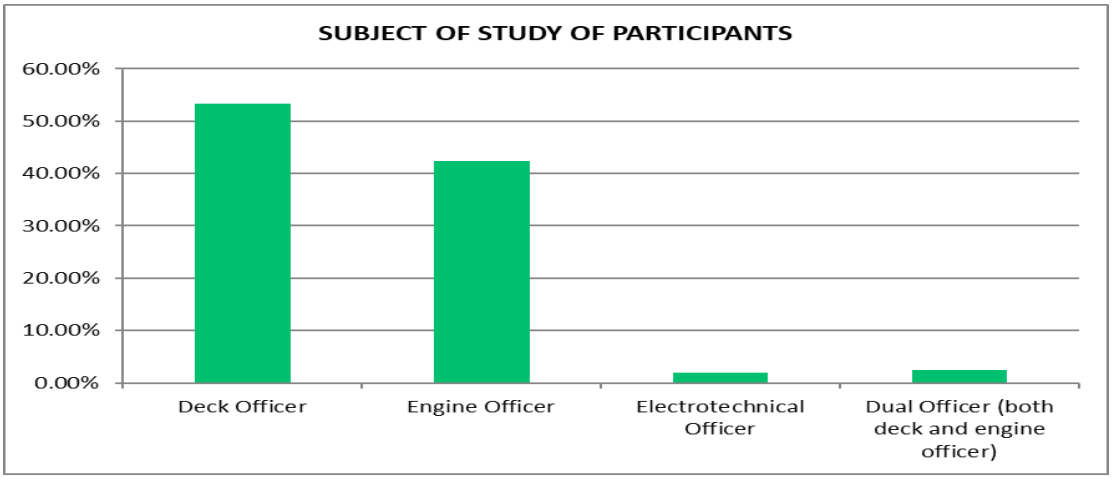
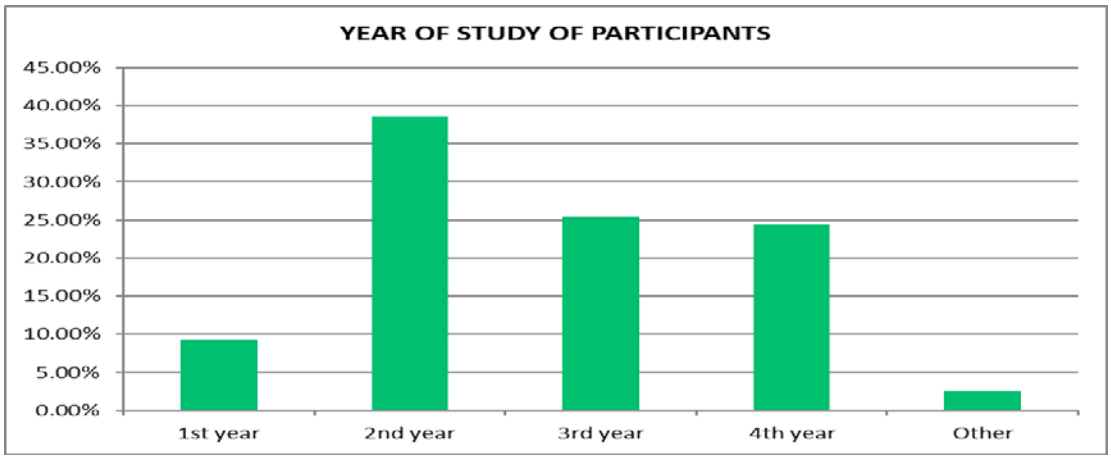


FIGURE ANNEX 1B.5



ANNEX 2A: MET SURVEY FACULTY QUESTIONNAIRE

EUGENIDES FOUNDATION

SKILLSEA (Futureproof Skills for the Maritime Transport Sector) - Academic Staff

Dear Colleagues,

I would like to inform you that I participate in the **European Project** with title: **"Futureproof Skills for the Maritime Transport Sector - SkillSea" (www.skillsea.eu)**. The project aims to develop strategies to identify and meet the **future skills** needs of the maritime sector and attract greater numbers of Europeans to work in maritime industries. On behalf of Greece, I am the scientific responsible of **Work Package 3 – STRATEGY**.

In the framework of implementing the aim of the project, I consider the **opinions of maritime academic staff as vital and indispensable.** In my capacity as University Professor **I** believe that academic staff comprises the pillars of maritime education. The results of the survey will enter the development of a looking-forward skills strategy of the European Commission on the Maritime sector. For this reason, my research team has created a questionnaire in order to gather and keep records of your significant views on maritime education.

I would be obliged if you could spend some of your time to complete this anonymous, short questionnaire. All data will be considered confidential.

Thanking you in advance for your kind cooperation,

Professor Epameinondas Panas,
Head of Research on Maritime Education for
Eugenides Foundation

* 1. Please present your view truthfully regarding the following statement: ***"Shipping industry is changing much faster than the Maritime Education and Training (M.E.T.) Institutions have improved"***.

- ◯ Strongly Disagree
- ◯ Disagree
- ◯ Neutral
- ◯ Agree
- ◯ Strongly Agree
- ◯ Don't Know/ Don't Answer (D.K./D.A)

* 2. Based on your teaching experience, are you teaching **beyond STCW minimum standards of competency?**

- ◯ Yes, in order to improve the knowledge and skills of my students.
- ◯ No, I am teaching just the minimum standards
- ◯ D.K./D.A

1

* 3. Please present your view regarding the following statement: "**My M.E.T. Institution has developed a Strategy to respond to complex job skills obsolescence issues of seafarers**".

- ◯ Strongly Disagree
- ◯ Neutral
- ◯ Strongly Agree
- ◯ Disagree
- ◯ Agree
- ◯ D.K./D.A

* 4. Please present your view truthfully regarding **to what extent does your M.E.T. Institution emphasize each of the following strategies:**

	No emphasis	Low emphasis	Neutral	High Emphasis	Highest Emphasis	D.K/D.A.
Prepare students **beyond STCW** minimum requirements	◯	◯	◯	◯	◯	◯
Internationalization	◯	◯	◯	◯	◯	◯
Competing Internationally	◯	◯	◯	◯	◯	◯
Bologna Process	◯	◯	◯	◯	◯	◯
Develop **Joint Programmes** with other Institutions	◯	◯	◯	◯	◯	◯
Creating Digital Wisdom (integrating the technology Artificial Intelligence (**AI**), Big Data (**BD**), Internet of Things (**IoT**), into our thinking and decision making)	◯	◯	◯	◯	◯	◯
Developing **21st Century learning skills**	◯	◯	◯	◯	◯	◯
Knowledge and skills creation through **interdisciplinary and Transdisciplinary**	◯	◯	◯	◯	◯	◯
Developing Higher Skills through collaboration between **M.E.T.** and **Employers**	◯	◯	◯	◯	◯	◯
Creation of **Lifelong Learning Culture**	◯	◯	◯	◯	◯	◯
Incorporation of **Sustainable Development** into curriculum	◯	◯	◯	◯	◯	◯
Adding **e-mentoring** courses into curriculum	◯	◯	◯	◯	◯	◯

2

* 5. Please present your view regarding the following statement: **"My MET institution has developed quantitative goals for implementing the strategies."**

- ◯ Strongly Disagree
- ◯ Neutral
- ◯ Strongly Agree
- ◯ Disagree
- ◯ Agree
- ◯ D.K./D.A.

* 6. Please Present your view regarding the following statement: **"In general, MET institutions should continually change their curriculum (for example every five years) in order to prepare seafarer graduates with the skills needed by maritime labour market."**

- ◯ Strongly Disagree
- ◯ Neutral
- ◯ Strongly Agree
- ◯ Disagree
- ◯ Agree
- ◯ D.K./D.A.

* 7. To what extent, **sustainable development**, has been incorporated into curriculum of MET institution at which you teach?

- ◯ Not at all
- ◯ Moderately
- ◯ To a Very High Extent
- ◯ To a Fairly Low Extent
- ◯ To a Fairly High Extent
- ◯ D.K/D.A.

* 8. Please present your view regarding the following statement: **"MET institutions should incorporate sustainability into their curricula in order to prepare seafarer graduates with the knowledge and skills required by maritime labour market."**

- ◯ Strongly Disagree
- ◯ Neutral
- ◯ Strongly Agree
- ◯ Disagree
- ◯ Agree
- ◯ D.K/D.A.

* 9. Please present your view truthfully regarding **to what extent your course contributed to the following students' skills:**

	Almost Nothing	Little	Neutral	Much	Very Much	D.K/D.A.
Problem solving skills (identify information needs to support problem solving)	◯	◯	◯	◯	◯	◯
Communication skills (Ability to write effectively in other languages and ability to spoke fluently in English)	◯	◯	◯	◯	◯	◯
Teamwork skills (ability to network)	◯	◯	◯	◯	◯	◯
Thinking skills (The ability to critically, creatively, analytically and to apply knowledge in different contexts)	◯	◯	◯	◯	◯	◯
IT skills (Ability to use database programmes to gather and process information and use it in any organized way)	◯	◯	◯	◯	◯	◯
Management skills (the skills to effectively lead and manage people)	◯	◯	◯	◯	◯	◯
Continuous learning skills (Ability to regularly upgrading your skills and knowledge)	◯	◯	◯	◯	◯	◯

* 10. In general, to what extent do you agree or disagree with the following statement: ***"Lifelong Learning is considered as the main element for seafarer employability."***

◯ Strongly Disagree ◯ Disagree ◯ Neutral ◯ Agree ◯ Strongly Agree

4

* 11. The quality of M.E.T. Institutions dependent on the quality of its Academic staff. The New Technologies of Digital Science **(AI, Big Data, IoT, Digitalization)** will change teaching structure. Please for each statement select one level of agreement or disagreement. If you are uncertain about your response select "Neutral".

	Strongly Disagree	Disagree	Neutral	Agree	Strongly Agree	D.K/D.A.
I have the technical skills I need to use **computer based technology**.	○	○	○	○	○	○
I have sufficient knowledge about **AI, BD, IoT**.	○	○	○	○	○	○
I can appropriately change my teaching style according to students with different learning styles.	○	○	○	○	○	○
I can select effective teaching approaches to guide student thinking and learning in **AI, BD, IoT**.	○	○	○	○	○	○
I know how to use **computer based technologies** to facilitate student learning in **AI, BD, IoT**.	○	○	○	○	○	○
I know about **computer based technologies** that I can use to students understanding of **AI, BD, IoT**.	○	○	○	○	○	○
I can appropriately harmonize the **computer based technologies** and teaching approaches for **AI, BD, IoT**.	○	○	○	○	○	○

5

* 12. To what extent do you believe that **the following technologies will affect academic courses in M.E.T. Institutions in the next five years**:

	Ineffective	Somewhat ineffective	Neutral	Effective	Very effective	D.K/D.A.
Shipping Automation	◯	◯	◯	◯	◯	◯
Cybersecurity	◯	◯	◯	◯	◯	◯
Greener Ships	◯	◯	◯	◯	◯	◯
On-line courses	◯	◯	◯	◯	◯	◯
e-Mentoring	◯	◯	◯	◯	◯	◯
e-Textbooks	◯	◯	◯	◯	◯	◯
3D-Printing	◯	◯	◯	◯	◯	◯
Interactive Teaching Methods	◯	◯	◯	◯	◯	◯
Virtual Reality (Simulators)	◯	◯	◯	◯	◯	◯
Augmented Reality (gamification)	◯	◯	◯	◯	◯	◯

* 13. What is your **gender**?

◯ Female

◯ Male

* 14. How many **years** have you been working (i.e. teaching experience) in **M.E.T. Institutions**?

◯ 1-4

◯ 5-9

◯ 10-14

◯ 15-19

◯ 20-24

◯ 25 or more

* 15. What is your **age**?

◯ 25-35 ◯ 36-45 ◯ 46-55 ◯ 56+

* 16. What is your **teaching direction**? (mark as many as appropriate).

☐ Nautical Science (Deck Officers)

☐ Marine Engineering (Engine Officers)

☐ Marine Electromechanics (Electrotechnical Officers)

☐ Other

* 17. What is your **highest degree earned**?

B.Sc. M.Sc. Ph.D.

* 18. What is your **Academic Ranking?**

- Professor
- Assistant Professor
- Associate Professor
- Senior Lecturer
- Lecturer
- Instructor
- Teaching Assistant
- Other

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ANNEX 2B: MET SURVEY DEMOGRAPHICS - FACULTY

FIGURE ANNEX 2B.1

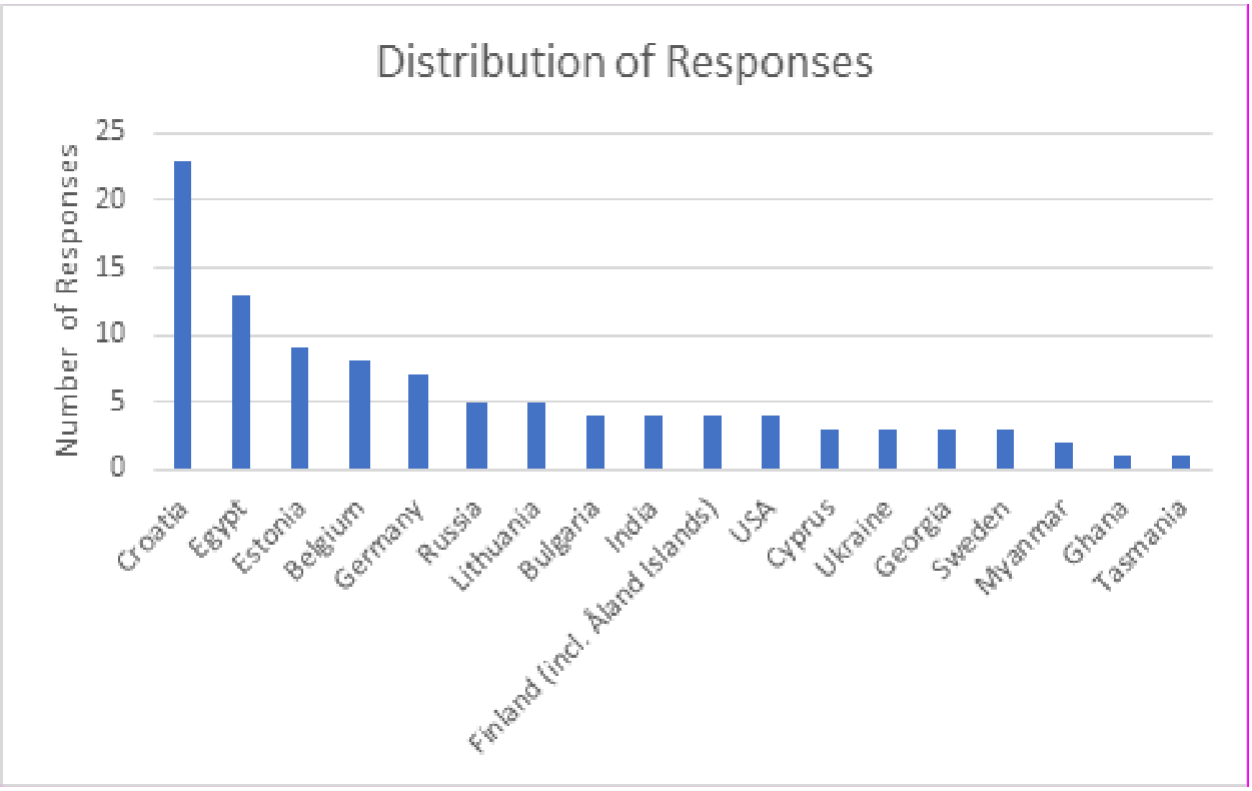


FIGURE ANNEX 2B.2

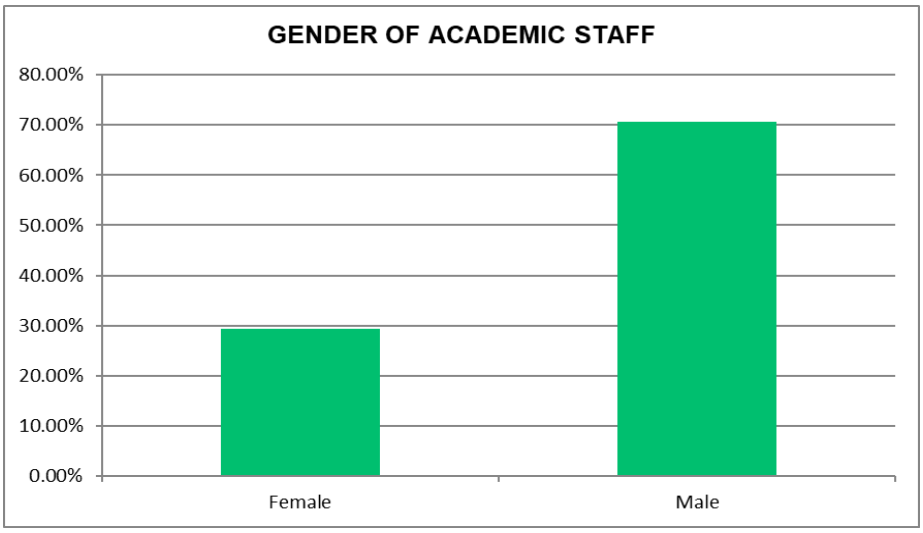


FIGURE ANNEX 2B.3

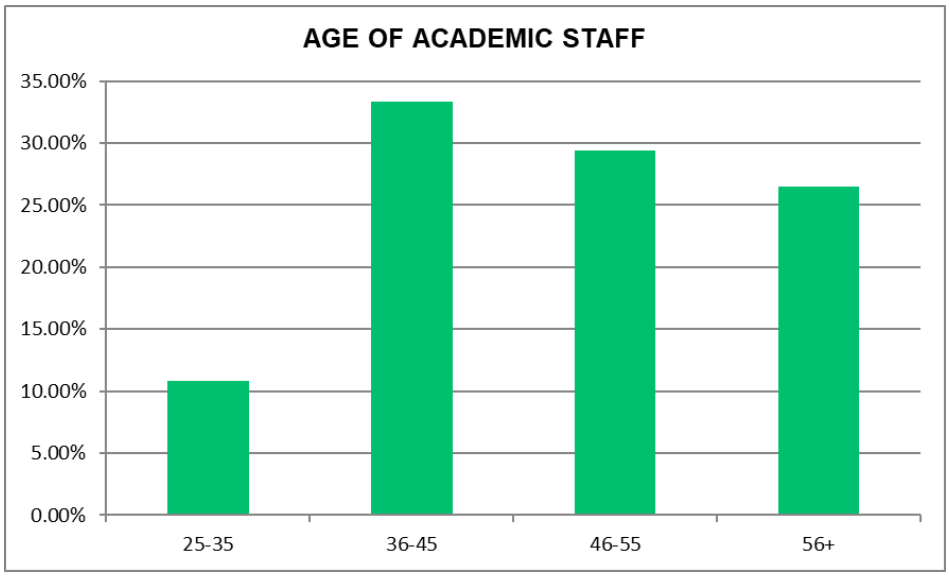


FIGURE ANNEX 2B.4

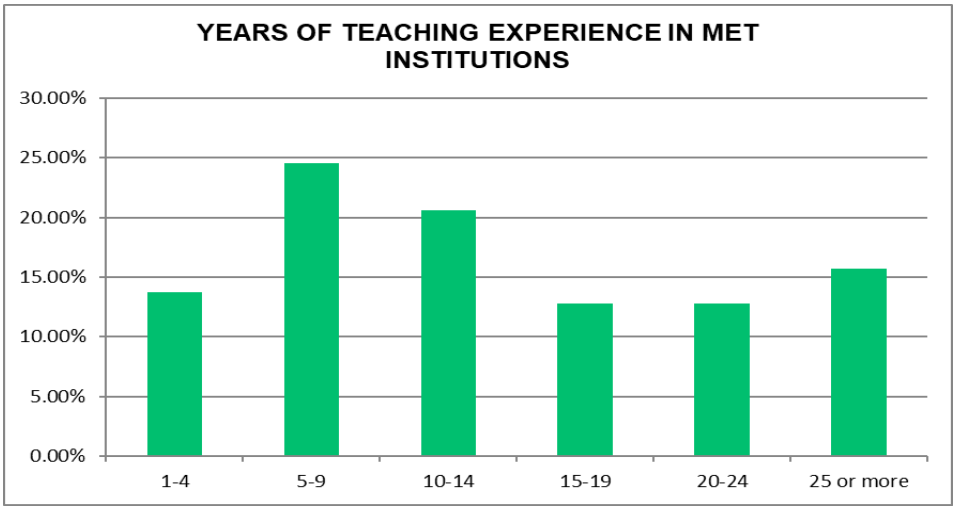


FIGURE ANNEX 2B.5

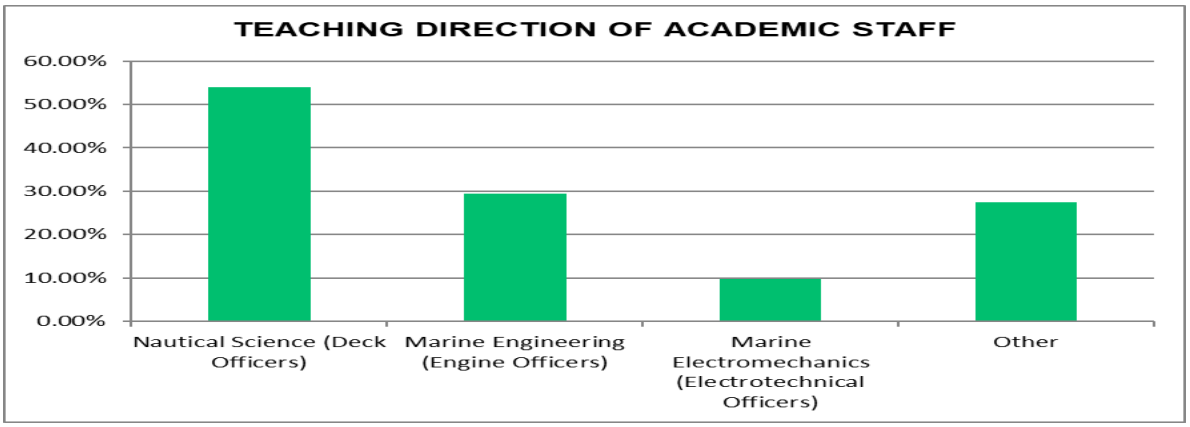


FIGURE ANNEX 2B.6

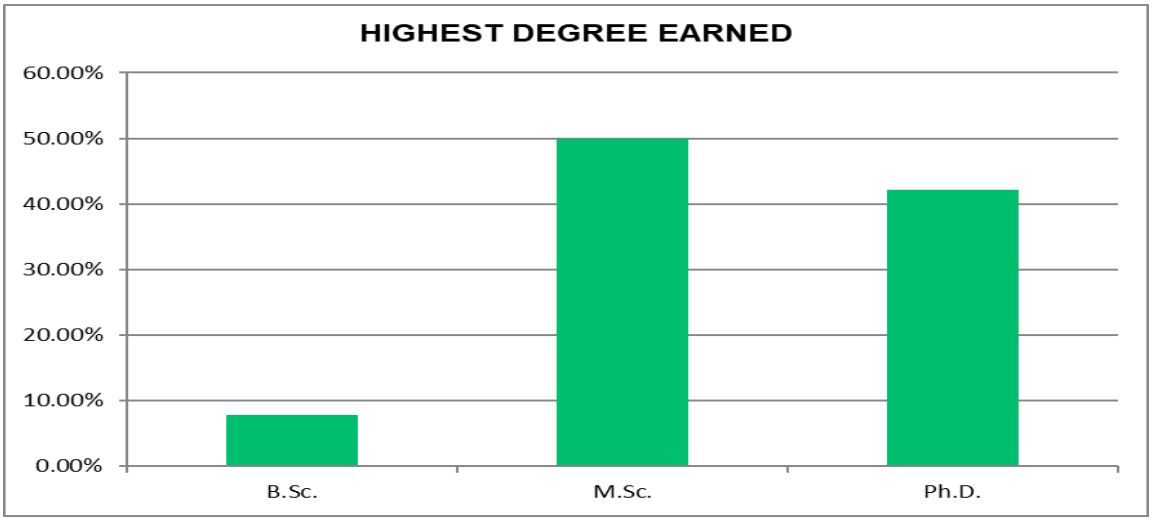
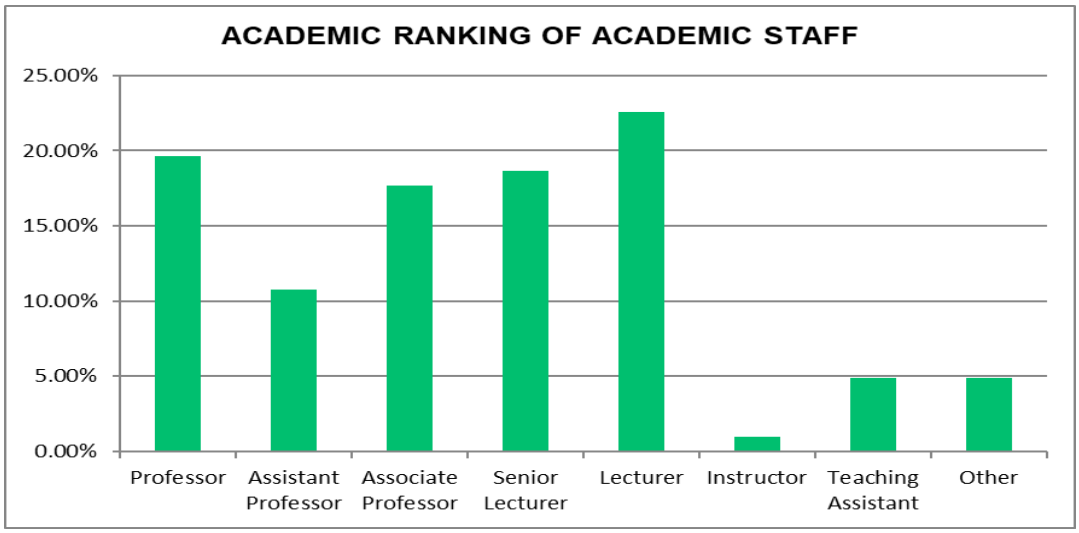


FIGURE ANNEX 2B.7



ANNEX 2C: MET SURVEY FACULTY COUNTRY DESCRIPTIVE STATISTICS (SD& AVG)

TABLE ANNEX 2C.1

MET 2019 SURVEY FACULTY 18 COU

	Croatia		Egypt		Estonia		Belgium		Germany		Russia		Lithuania		Bulgaria		India		Finland		USA		Cyprus		Ukraine		Georgia		Sweden		Myanmar		Ghana		Tasmania		Average per Question	SD per Question
Questions to MET Faculty	AVG	SD	AVG	SD	AVG	SD	AVG	SD	AVG	SD	AVG	SD	AVG	SD	AVG	SD	AVG	SD	AVG	SD	AVG	SD	AVG	SD	AVG	SD	AVG	SD	AVG	SD	AVG	SD	AVG	SD		
Q1. Shipping industry is changing much faster than METs have improved	3.91	0.83	4.23	0.89	4.22	0.92	2.38	1.22	4.57	0.49	4.40	0.49	3.40	1.02	3.00	0.71	4.25	0.43	3.50	0.50	2.75	1.79	2.67	0.94	4.00	0.00	4.33	0.47	3.00	1.41	4.00	1.00	3.00	0.00	4.00	0.00	3.76	1.10
Q3. My MET has developed a Strategy to respond to complex job skills obsolescence issues of seafarers	3.30	0.95	3.77	1.37	3.89	0.57	3.63	0.48	3.57	1.29	3.60	0.49	3.40	1.74	4.25	0.43	3.50	0.50	3.50	0.50	4.25	0.83	4.00	0.82	3.33	0.94	3.67	0.47	2.67	0.94	3.50	0.50	4.00	0.00	4.00	0.00	3.55	1.00
Q4. To what extent does your M.E.T. Institution emphasize each of the following strategies																																						
- Prepare students beyond STCW minimum requirements	4.13	0.68	3.38	1.21	4.38	0.48	4.50	0.50	4.00	0.93	4.20	0.98	4.00	0.00	4.00	0.71	4.00	1.22	4.25	0.43	3.25	1.09	3.67	0.47	3.67	0.47	4.00	1.41	2.50	0.50	3.50	0.50	4.00	0.00	4.00	0.00	3.95	0.91
- Internationalization	3.86	0.81	3.46	1.15	3.56	0.68	4.00	0.71	4.00	0.93	3.40	0.80	4.00	0.00	4.00	0.71	4.25	0.43	3.25	0.43	3.00	0.82	3.67	0.47	3.33	0.47	4.00	0.82	4.00	0.00	3.00	0.00	4.00	0.00	5.00	0.00	3.74	0.83
- Competing internationally	3.87	1.03	3.69	0.82	4.00	0.67	3.38	0.48	3.43	0.73	3.60	0.49	3.60	0.49	3.50	0.50	4.25	0.83	4.00	0.71	1.75	0.83	3.67	0.47	3.33	0.47	4.00	0.00	4.33	0.47	3.00	0.00	4.00	0.00	5.00	0.00	3.68	0.89
- Bologna Process	4.17	0.82	2.80	0.98	3.60	0.49	4.13	0.60	3.43	1.18	2.25	0.43	4.00	0.63	4.00	0.00	2.00	1.00	3.25	0.43	2.50	1.50	3.33	0.47	3.33	0.47	4.33	0.94	4.00	0.00	3.00	0.00	3.00	0.00	NA	NA	3.64	1.00
- Develop Joint Programmes with other Institutions	3.36	0.98	3.92	1.00	4.11	0.31	3.75	0.66	3.29	0.88	2.20	0.75	3.80	0.75	3.75	0.43	3.75	0.43	2.67	0.47	1.75	0.83	2.67	0.47	3.67	0.47	3.67	0.47	3.67	1.25	4.00	0.00	4.00	0.00	3.00	0.00	3.46	0.97
- Creating Digital Wisdom	2.77	0.90	3.17	1.14	3.67	0.82	2.88	1.05	3.43	1.50	3.40	1.02	3.60	0.49	3.25	0.43	4.00	0.71	2.75	0.43	1.33	0.47	3.33	1.25	3.67	0.47	3.33	0.94	4.33	0.94	2.50	0.50	3.00	0.00	3.00	0.00	3.16	1.07
- Developing 21st Century learning skills	3.36	0.93	3.69	0.99	4.11	0.87	3.38	0.99	3.40	1.62	3.80	0.40	3.80	0.40	4.00	0.00	4.25	0.43	3.00	0.00	2.75	0.83	3.67	0.47	4.00	0.82	4.33	0.47	3.33	0.94	4.00	0.00	3.00	0.00	4.00	0.00	3.62	0.93
- Knowledge and skills creation through interdisciplinary and Transdisciplinary	3.39	1.01	3.46	1.01	4.13	0.60	3.38	0.99	3.86	1.62	3.80	0.98	3.60	0.49	3.67	0.47	4.25	0.43	3.25	0.43	2.75	0.83	3.33	0.47	3.33	0.47	4.33	0.94	2.33	1.25	3.50	0.50	4.00	0.00	3.00	0.00	3.53	0.98
- Developing Higher Skills through collaboration between MET and Employers	3.65	0.96	3.23	0.89	4.00	0.67	3.75	1.20	3.43	1.18	4.40	1.20	4.20	0.40	4.50	0.50	3.75	0.43	4.00	0.00	3.33	0.94	3.00	0.82	3.67	0.47	4.67	0.47	4.33	0.47	3.50	0.50	4.00	0.00	3.00	0.00	3.75	0.95
- Creation of Lifelong Learning Culture	3.70	0.80	3.15	0.86	3.67	0.94	3.13	1.45	4.00	1.31	3.60	1.36	3.80	0.40	4.00	0.71	4.00	0.00	4.25	0.43	3.33	0.47	4.00	0.82	3.67	0.47	4.00	0.00	3.00	0.00	4.00	1.00	4.00	0.00	3.00	0.00	3.63	0.95

ENTRY DESCRIPTIVE STATISTICS (AVG & SD)

TABLE ANNEX 2C.2

GREEK METs' FACULTY DESCRIPTIVE STATISTICS vs. 18 COUNTRY AVERAGE (AVERAGE AND STANDARD DEVIATION)

	Greece		World	
Questions to MET Faculty	**AVG**	**SD**	**AVG**	**SD**
Q1. Shipping industry is changing much faster than METs have improved	3.80	0.75	3.76	1.10
Q3. My MET has developed a Strategy to respond to complex job skills obsolescence issues of seafarers	2.80	0.40	3.55	1.00
Q4. To what extent does your M.E.T. Institution emphasize each of the following strategies				
- Prepare students beyond STCW minimum requirements	3.40	0.80	3.95	0.91
- Internationalization	1.50	0.50	3.74	0.83
- Competing Internationally	2.25	1.30	3.68	0.89
- Bologna Process	1.00	0.00	3.64	1.00
- Develop Joint Programmes with other Institutions	1.40	0.80	3.46	0.97
- Creating Digital Wisdom	1.60	0.80	3.16	1.07
- Developing 21st Century learning skills	2.40	1.02	3.62	0.93
- Knowledge and skills creation through interdisciplinary and Transdisciplinary	3.40	1.20	3.53	0.98
- Developing Higher Skills through collaboration between MET and Employers	3.80	0.75	3.75	0.95
- Creation of Lifelong Learning Culture	4.00	0.71	3.63	0.95
- Incorporation of Sustainable Development into curriculum	3.25	0.83	3.53	0.99
- Adding e-mentoring courses into curriculum	1.00	0.71	3.08	1.08
Q5. My MET has developed quantitative goals for implementing the strategies	2.00	1.10	3.50	1.22
Q6. METs should continually change their curriculum	3.00	1.10	4.37	0.86
Q7. To what extent sustainable development has been incorporated into the curriculum of your MET	1.00	0.63	3.25	1.09
Q8. METs should incorporate sustainability into their curricula	3.00	0.63	4.30	0.84
Q9. To what extent your course contributed to the following students' skills:				
- Problem solving skills	3.20	0.98	4.09	0.83
- Communication skills	3.20	0.98	3.93	0.93

- Teamwork skills	3.80	0.98	3.97	0.87
- Thinking skills	4.00	0.63	4.19	0.81
- IT skills	4.40	0.49	3.57	1.08
- Management skills	3.75	0.43	3.65	1.04
- Continuous learning skills	2.20	0.75	3.91	0.88
Q10. Lifelong Learning is considered as the main element for seafarer employability	3.00	0.89	4.32	0.66
Q11. Select one level of agreement or disagreement				
- I have the technical skills I need to use computer-based technology	2.60	1.36	4.38	0.64
- I have sufficient knowledge about AI, BD, IoT.	2.00	0.63	3.49	0.98
- I can appropriately change my teaching style according to students with different learning styles	2.40	0.80	4.08	0.68
- I can select effective teaching approaches to guide student thinking and learning in AI, BD, IoT.	2.00	0.63	3.45	0.88
- I know how to use computer based technologies to facilitate student learning in AI, BD, IoT.	2.00	0.63	3.74	0.97
- I know about computer based technologies that I can use to students understanding of AI, BD, IoT.	2.25	1.09	3.63	0.97
- I can appropriately harmonize the computer based technologies and teaching approaches for AI, BD, IoT.	2.20	0.98	3.51	0.96
Q12. To what extent the following technologies will affect courses in METs in the next 5 years				
- Shipping Automation	4.60	0.49	4.30	0.76
- Cybersecurity	4.20	0.40	4.15	0.81
- Greener Ships	4.20	0.40	4.35	0.74
- On-line courses	3.80	1.17	3.93	0.98
- e-Mentoring	2.40	1.02	3.90	0.90
- e-Textbooks	2.60	1.02	3.93	0.86
- 3D-Printing	1.75	0.43	3.32	1.07
- Interactive Teaching Methods	4.40	0.49	4.25	0.70
- Virtual Reality (Simulators)	5.00	0.00	4.49	0.73
- Augmented Reality (Gamification)	5.00	0.00	4.10	0.82

Note: The Table is based on a very small number members of the academic staff of Greek MET The green cells correspond to higher scores than the 18-country average, the red to lower, and the blue to equal.

ANNEX 3A: MET SURVEY QUESTIONNAIRE – DEANS, RECTORS & HEADS OF DEPARTMENTS

EUGENIDES FOUNDATION

Questionnaire: "Rectors, Deans, Heads of Departments"

* 1. *Digital Transformation can be understood as a phenomenon that occurs with growing use of digital technologies (social media, cloud computing, big data and data analytics, Internet of Things, mobility, platform technologies, block-chain technology) but also having a clear and effective digital strategy with the purpose of improving MET institutions."*

To what extent do you agree with the following statement: **"Today, digital transformation is a strategic imperative for MET institutions."**

- ◯ Strongly Disagree
- ◯ Disagree
- ◯ Neither Agree nor Disagree
- ◯ Agree
- ◯ Strongly Agree
- ◯ Don't know / don't answer **(D.K./D.A.)**

* 2. **What are the main drivers behind your MET institution's digital transformation initiatives?**
(Please select up to **TWO** initiatives)

- ☐ To improve students' digital skills.
- ☐ To exploit new innovative ways of digital teaching, learning and research.
- ☐ To build digital culture in our MET institution in order to improve the understanding of digital technologies.
- ☐ To improve academic staffs' teaching and research culture.
- ☐ To gain academic excellence.
- ☐ To increase the reputation of MET institution.

* 3. **What are the most significant barriers to digital transformation in your MET institution?**
(Please select up to **THREE** choices)

- ☐ Lack of mission and digital strategy.
- ☐ Lack of familiarity with digital tools.
- ☐ Resistance to new approaches.
- ☐ Low MET institution's readiness to adopt and support digital transformation.
- ☐ Slow decision-making.
- ☐ Lacking financial resources (not enough funding).
- ☐ Lack of organizational ability.
- ☐ Other priorities currently more important.

* 4. ***Digital strategy*** *is formulated and executed in response to digital transformation which will align and support the overall MET strategy.*

To what extent do you agree with the following statement: **"My MET institution has a clear digital strategy."**

- ◯ Strongly Disagree
- ◯ Disagree
- ◯ Neither Agree nor Disagree
- ◯ Agree
- ◯ Strongly Agree
- ◯ D.K./D.A.

* 5. To what extent do you agree with the following statements:

	Completely Disagree	Somewhat Disagree	Somewhat Agree	Completely Agree
We believe that our MET overall strategy depends on digital.	◯	◯	◯	◯
Our MET board back our digital strategy.	◯	◯	◯	◯
We have leadership skills to execute in our digital strategy day-to-day.	◯	◯	◯	◯
We clearly communicate our digital vision within our MET institution and between MET institutions.	◯	◯	◯	◯

* 6. To what extent do you agree with the following statement: **"Our academic staff has sufficient knowledge to execute our MET's digital strategy."**

- ◯ Strongly Disagree
- ◯ Disagree
- ◯ Neither Agree nor Disagree
- ◯ Agree
- ◯ Strongly Agree
- ◯ D.K./D.A

* 7. To what extent do you agree with the following statements:

	Completely Disagree	Somewhat Disagree	Somewhat Agree	Completely Agree
Our MET institution dedicates appropriate resources to digital strategy, governance, and execution.	○	○	○	○
Our MET's staff (academic and technical) supporting our critical digital functions is best in class.	○	○	○	○
We have digital skills embedded through our MET institution.	○	○	○	○

* 8. To what extent do you agree with the following statement: **"My MET institution views digital technologies as an opportunity.**

- ○ Strongly Disagree
- ○ Disagree
- ○ Neither Agree nor Disagree
- ○ Agree
- ○ Strongly Agree
- ○ D.K./D.A.

* 9. To what extent do you agree with the following statements:

	Completely Disagree	Somewhat Disagree	Somewhat Agree	Completely Agree
We expect digital technology to promote academic staff's innovation, teaching, collaboration, and mobility.	○	○	○	○
We expect the improvement of our MET students' digital skills as a measure to digital technology development.	○	○	○	○
Developing our students' digital skills are learned by embedding digital technology in our MET curriculum.	○	○	○	○

* 10. To what extent do you agree with the following statements:

	Completely Disagree	Somewhat Disagree	Somewhat Agree	Completely Agree
Our MET institution has clear and quantifiable goals for measuring the success of our digital strategy.	○	○	○	○
In our MET, every academic staff understands how his performance ties to corporate digital goals.	○	○	○	○
In our MET we feed lessons learned from digital programs back into our strategy.	○	○	○	○
Academic staff and students actively steer our MET digital strategy.	○	○	○	○

* 11. Which of the following specific digital technologies will be the most important to your MET institution in the next 3 to 5 years?
(Please select up to **TWO** digital technologies)

- ☐ Analytics
- ☐ Cloud
- ☐ Internet of Things
- ☐ Cognitive technologies (Artificial Intelligence)
- ☐ Cybersecurity
- ☐ Virtual Reality
- ☐ 3D printing
- ☐ Mobile
- ☐ Do not know

* 12. According to UNESCO ***"Education for Sustainable Development (ESD) allows every human being to acquire the knowledge, skills, attitudes, and values necessary to shape a sustainable future"***.
To what extent you have integrated **ESD in your MET curriculum?**

- ○ Not at all
- ○ To a Very Little Extent
- ○ To a Somewhat Extent
- ○ To a Great Extent

* 13. To what extent, **both Digitalization and Education for Sustainable Development, are clearly expressed across your MET institution's curriculum?**

- ○ Not at all
- ○ To a Very Little Extent
- ○ To a Somewhat Extent
- ○ To a Great Extent

* 14. According to the **Directive (EU) 2019/1159 of the European Parliament and of the Council of 20 June 2019**, amending Directive 2008/106/EC on the minimum level of training of seafarers and repealing Directive 2005/45/EC on the mutual recognition of seafarers' certificates issued by the Member States:

*"The Commission should establish a dialogue with social partners and Member States to develop maritime training initiatives **additional to the internationally agreed minimum level of training** of seafarers, and which could be mutually recognised by Member States as European Maritime Diplomas of Excellence."*

To your best knowledge, **what are the required changes that should take place in your MET institution in order to provide Maritime Diplomas of Excellence?**

	Not at all	To a Very Little Extent	To a Somewhat Extent	To a Great Extent
Highly effective Academic Staff.	○	○	○	○
Changes in MET culture.	○	○	○	○
MET leadership must adopt the transformational leadership style.	○	○	○	○
Curriculum for Excellence: Relevant curriculum programs different from minimum STCW requirements.	○	○	○	○
Foster high quality students' skills.	○	○	○	○
Attracting the most talented students.	○	○	○	○
Attract top Academic Professionals from the Maritime Industry.	○	○	○	○
Expand English Language Courses.	○	○	○	○

* 15. What is your **gender?**

○ Female

○ Male

* 16. What is your **age?**

○ 25-35 ○ 36-45 ○ 46-55 ○ 56+

* 17. How many **years** have you been working (i.e. teaching experience) in **M.E.T. Institutions?**

○ 1-4 ○ 10-14 ○ 20-24

○ 5-9 ○ 15-19 ○ 25 or more

* 18. What is your **administrative rank**?

- ◯ Rector
- ◯ Vice Rector
- ◯ Dean
- ◯ Vice Dean
- ◯ Head of Department
- ◯ Director
- ◯ Other

* 19. What is your **highest degree earned**?

- ◯ B.Sc.
- ◯ M.Sc.
- ◯ Ph.D.

* 20. What is your **Academic Ranking**?

- ◯ Professor
- ◯ Associate Professor
- ◯ Assistant Professor
- ◯ Senior Lecturer
- ◯ Captain
- ◯ Other

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ANNEX 3B: SURVEY DEMOGRAPHICS – MET ADMINISTRATION

FIGURE ANNEX 3B.1

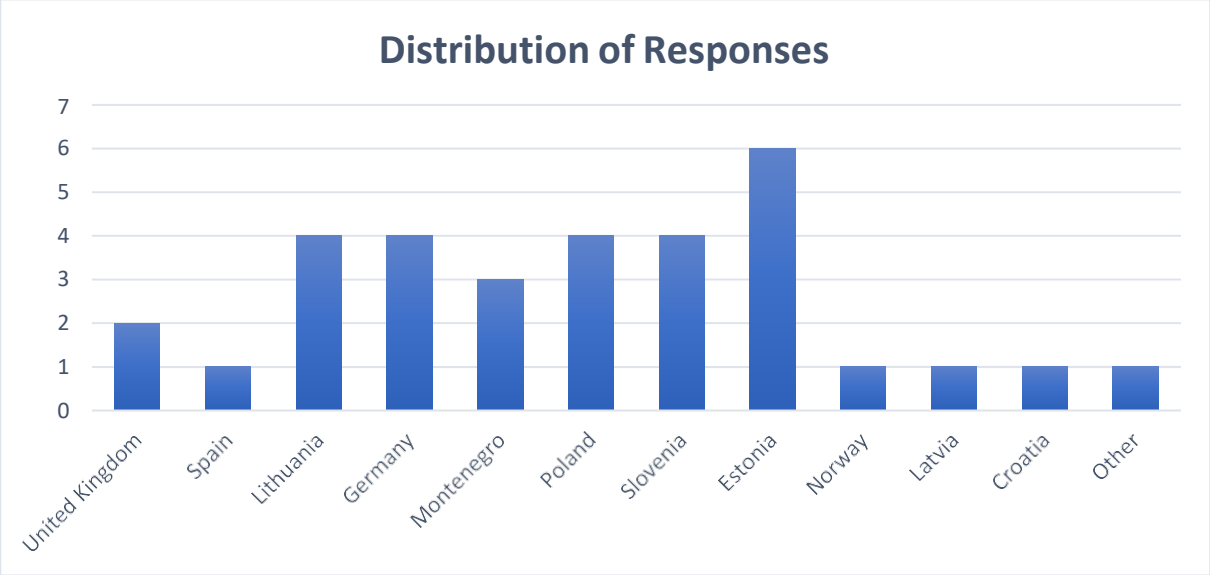
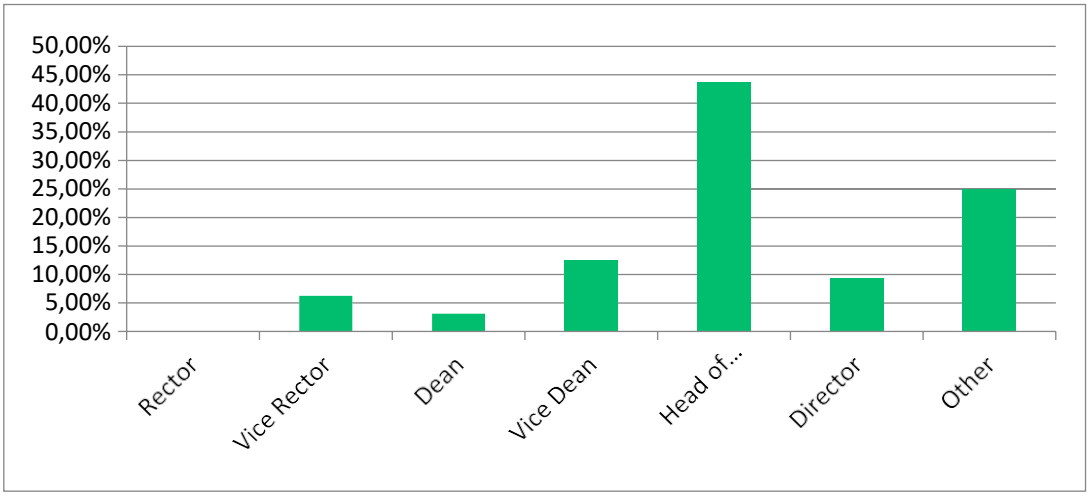


FIGURE ANNEX 3B.2

ADMINISTRATIVE RANK



ANNEX 4A: JOINT SkillSea WORKSHOP WP2 & WP3 (Part A) SHORT SURVEY

Joint SkillSea Workshop

WP2 and WP3 (Part A)

Short survey

Please answer the following questions and note the scale requirements!

* 1. Do you agree that Efficiency (of training) is more important than Employability?

- Strongly Agree
- Agree
- Indifferent
- Disagree
- Strongly Disagree

* 2. Do you agree that Efficiency (of training) is more important than Futureproof *Adaptability*?

Futureproof adaptability: the ability of the trained manners to learn new concepts and acquire new skills and competences

- Strongly Agree
- Agree
- Indifferent
- Disagree
- Strongly Disagree

* 3. Please rate the following aspects:

	Very Significant	Significan	Indifferent	Insignificant	Very Insignificant
Cost					
Retention of interest and of students					
Ratio of own coverage of technical infrastructure					
Reflection of existing technical and academic knowledge					
Soft skills					
Sustainability focus					
Adjustment of course/module structure to emerging needs					
Financial capability to adjust technical equipment for course/module future requirements					
Cooperation status for further necessary development or use of infrastructure					

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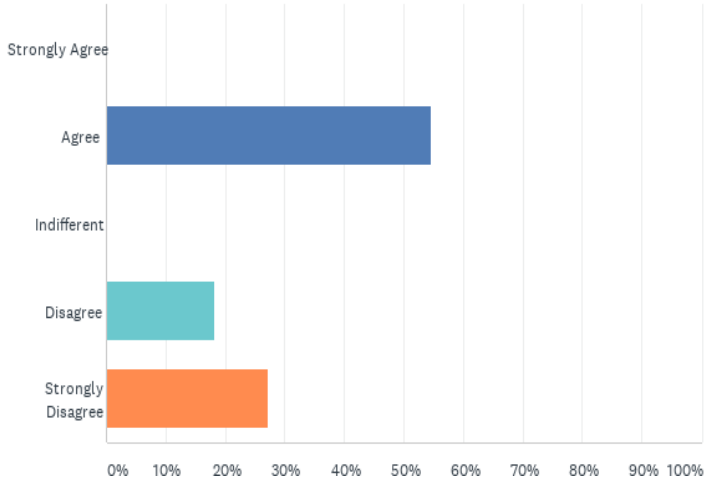
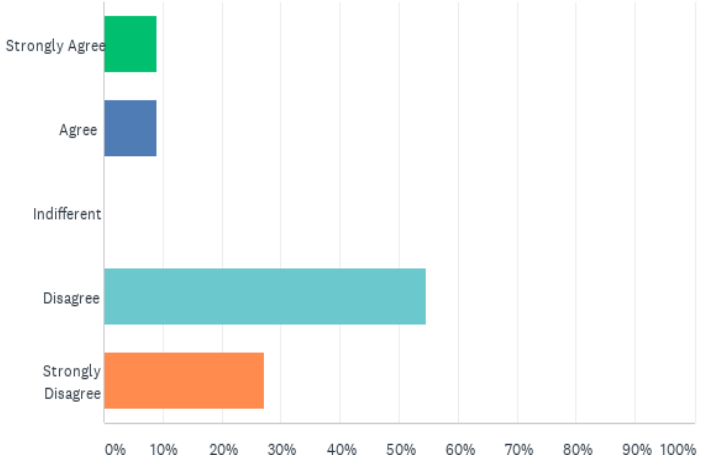
ANNEX 4B: JOINT SkillSea WORKSHOP WP2 & WP3 (Part A) RESULTS/CHARTS

Q1 Do you agree that Efficiency (of training) is more important than Employability?



Q2 Do you agree that Efficiency (of training) is more important than Futureproof Adaptability ?Futureproof adaptability: the ability of the trained mariners to learn new concepts and acquire new skills and competences



ANNEX 5A: SURVEY EMPLOYERS 2021

EUGENIDES FOUNDATION

SkillSea (FutureProof Skills for the Maritime Transport Sector) - Employers _ 2021

Dear Manager,

SkillSea (Futureproof Skills for the Maritime Transport Sector) is a new EU-funded ERASMUS+ Sector Alliance) project aiming at developing strategies, identifying and meeting the future skills' needs of the maritime sector. The work on the four-year project has started in January 2019.

This survey, serving the objectives of the project, seeks to evaluate the effectiveness of MET education on the basis of current skills and of desired future skills of maritime professionals in light of sustainability and digitalization trends. We would be grateful if you could share your views via this short questionnaire.
Your views are valuable for the future skills of the European Maritime Shipping sector and it will take just about 10 minutes to complete it. The information provided in the questionnaire will be used for research purposes to inform the project. Your responses will be completely anonymous and never analyzed or displayed individually.

Thank you for your time and for your valuable input.

*** 1. Do you believe that the students of Maritime Education and Training (MET) institutions have an adequate level of knowledge and skills to perform their duties when they graduate?**

- ○ Strongly Disagree
- ○ Disagree
- ○ Neutral
- ○ Agree
- ○ Strongly Agree
- ○ Do not Know / Do not answer / Not applicable

* 2. **Maritime Education and Training (MET) institution graduates possess the following skills:**

	Strongly Disagree	Disagree	Neutral	Agree	Strongly Agree	Do not Know / Do not answer / Not applicable
Green skills	○	○	○	○	○	○
Problem solving skills	○	○	○	○	○	○
Communication skills	○	○	○	○	○	○
Teamwork skills	○	○	○	○	○	○
Critical thinking skills	○	○	○	○	○	○
IT skills	○	○	○	○	○	○
Management skills	○	○	○	○	○	○
Continuous learning skills	○	○	○	○	○	○

* 3. **The skills that ship Officers developed during their education are useful in their job (transferable skills).**

○ Strongly Disagree ○ Neutral ○ Strongly Agree

○ Disagree ○ Agree ○ Do not Know / Do not answer / Not applicable

* 4. **In general, to what extent do you agree or disagree with the following statement: "Sustainability should be incorporated in the curricula of all Maritime Education and Training institutions in order to prepare graduates with the knowledge and skills required by maritime labour market".**

○ Strongly Disagree ○ Disagree ○ Neutral ○ Agree ○ Strongly Agree

○ Do not Know / Do not answer / Not applicable

* 5. **Encouraging mobility for students and professionals of the maritime sector between European Maritime Education and Training institutions could help them develop new useful skills.**

○ Strongly Disagree ○ Disagree ○ Neutral ○ Agree ○ Strongly Agree

○ Do not Know / Do not answer / Not applicable

* 6. **MET institutions should provide education beyond the minimum requirements of STCW.**

○ Strongly Disagree ○ Disagree ○ Neutral ○ Agree ○ Strongly Agree

○ Do not Know / Do not answer / Not applicable

* 7. **Defining Lifelong Learning as "Learning throughout life with the aim of improving knowledge, skills and competence", to what extent do you agree or disagree with the following statement: "Lifelong learning is important for maritime professionals".**

- ○ Strongly Disagree
- ○ Disagree
- ○ Neutral
- ○ Agree
- ○ Strongly Agree
- ○ Do not Know / Do not answer / Not applicable

* 8. **The incorporation of new digital tools and analytics (AI, Big Data, IoT) in the learning process will improve the employability of MET graduates.**

○ Strongly Disagree ○ Disagree ○ Neutral ○ Agree ○ Strongly Agree

○ Do not Know / Do not answer / Not applicable

* 9. **MET institutions should place emphasis on the following concepts:**

	Strongly Disagree	Disagree	Neutral	Agree	Strongly Agree	Do not Know / Do not answer / Not applicable
Ship Automation	○	○	○	○	○	○
Cybersecurity	○	○	○	○	○	○
Green Shipping	○	○	○	○	○	○
e-Mentoring	○	○	○	○	○	○
3D-Printing	○	○	○	○	○	○
Online teaching	○	○	○	○	○	○
Virtual Reality (Simulators)	○	○	○	○	○	○
Augmented Reality (gamification)	○	○	○	○	○	○

* 10. **Which of the following topics should be covered in sustainability education? (choose all applicable)**

- [ ] Meaning of sustainability
- [ ] Carbon footprint (ecological footprint)
- [ ] Understand that sustainability involves complex social, cultural, political, economic and scientific issues
- [ ] Economic development vs economic growth
- [ ] Dependence on fossil fuels
- [ ] Habitat destruction/loss of biodiversity
- [ ] Limits of Earth's natural resources
- [ ] Differences between non-renewable and renewable materials
- [ ] Climate change

* 11. **Indicate your level of agreement with each of the following educational practices**:

	Strongly Disagree	Disagree	Neutral	Agree	Strongly Agree	Do not Know / Do not answer / Not applicable
Participation in business classes that focus on sustainability	○	○	○	○	○	○
Green student orientation	○	○	○	○	○	○
Participation in interdisciplinary courses that focus on sustainability	○	○	○	○	○	○
Sustainability should be a graduation requirement	○	○	○	○	○	○

* 12. **If you were part of an external evaluation team for MET institutions what level of importance for your evaluation you would attribute to the following elements?**

1= least important 5= most important

	1	2	3	4	5
STCW related content	○	○	○	○	○
Sustainability content	○	○	○	○	○
Digital skills	○	○	○	○	○
MASS (vessel autonomy) skills	○	○	○	○	○
Other	○	○	○	○	○

* 13. **In the next 10-15 years (choose one answer):**

- ○ Vessel autonomy (MASS) will be limited to degree 1, as per IMO classification (operated by full crew with some autonomous systems, which can be run by crew, as well).
- ○ Vessel autonomy (MASS) in ocean-going shipping will have progressed considerably to degree 2 as per IMO classification (remotely controlled ship with seafarers on board).
- ○ Vessel autonomy (MASS) will have progressed significantly to degree 2 as per IMO classification only in short-sea shipping (remotely controlled ship with seafarers on board)
- ○ Vessel autonomy (MASS) in ocean-going shipping will have progressed significantly to degree 3 as per IMO classification (remotely controlled ship without seafarers on board)
- ○ Vessel autonomy (MASS) will have progressed significantly to degree 3 as per IMO classification only in short-sea shipping (remotely controlled ship without seafarers on board)
- ○ Vessel autonomy (MASS) will have progressed significantly into degree 4 (fully autonomous) as per IMO classification into some of the shipping markets

14. **Types of vessels owned/managed by your company:**

- [ ] Oil Tanker
- [ ] Chemical Tanker
- [ ] Other Tanker
- [ ] LNG Carrier
- [ ] LPG Carrier
- [ ] Barge Carrier
- [ ] Bulk Carrier
- [ ] Container Ship
- [ ] Vehicle Carrier
- [ ] Other Specialized Carrier
- [ ] Ro-Ro Container
- [ ] Ro-Ro Passenger
- [ ] Refrigerated Ship (Reefer)

15. **What is the number of seafarers employed in your company?**

- ○ 0-50
- ○ 51-99
- ○ 100-199
- ○ 200-299
- ○ 300-399
- ○ 400-499
- ○ 500-599
- ○ 600-699
- ○ 700-799
- ○ 800-899
- ○ 900-999
- ○ 1000+
- ○ N/A

16. **How many years of experience do you have in the maritime sector?**

- ○ 0-5
- ○ 6-10
- ○ 11-15
- ○ 16-20
- ○ 21+
- ○ N/A

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ANNEX 5B: SURVEY EMPLOYERS 2021_DEMOGRAPHICS

FIGURE ANNEX 5B. 1

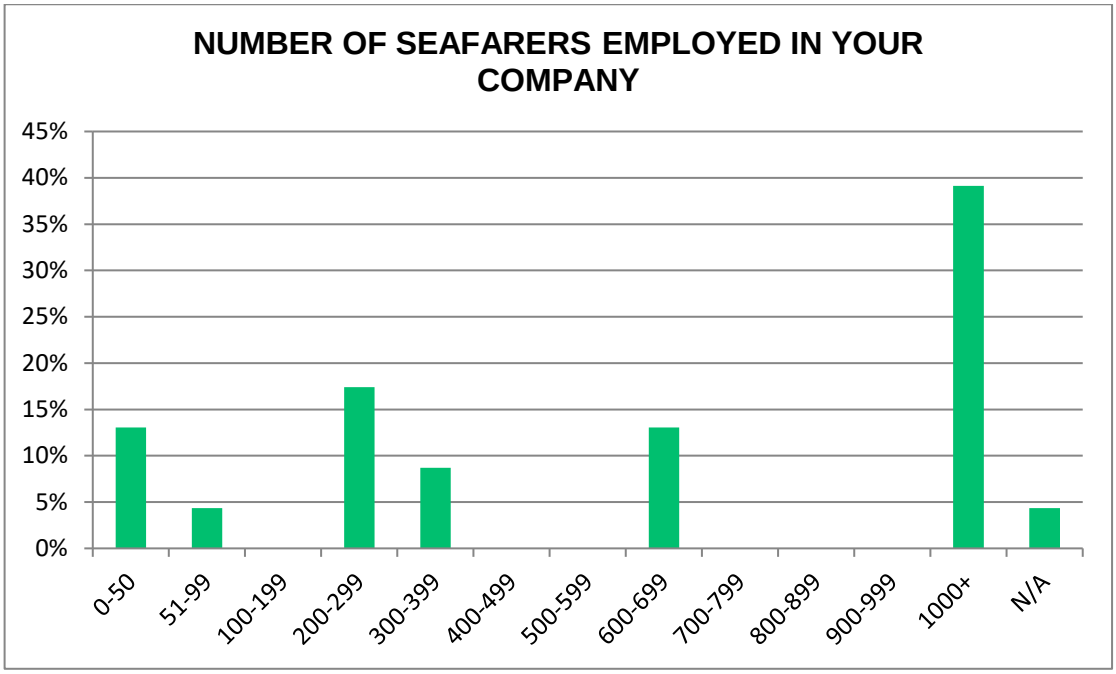


FIGURE ANNEX 5B. 2

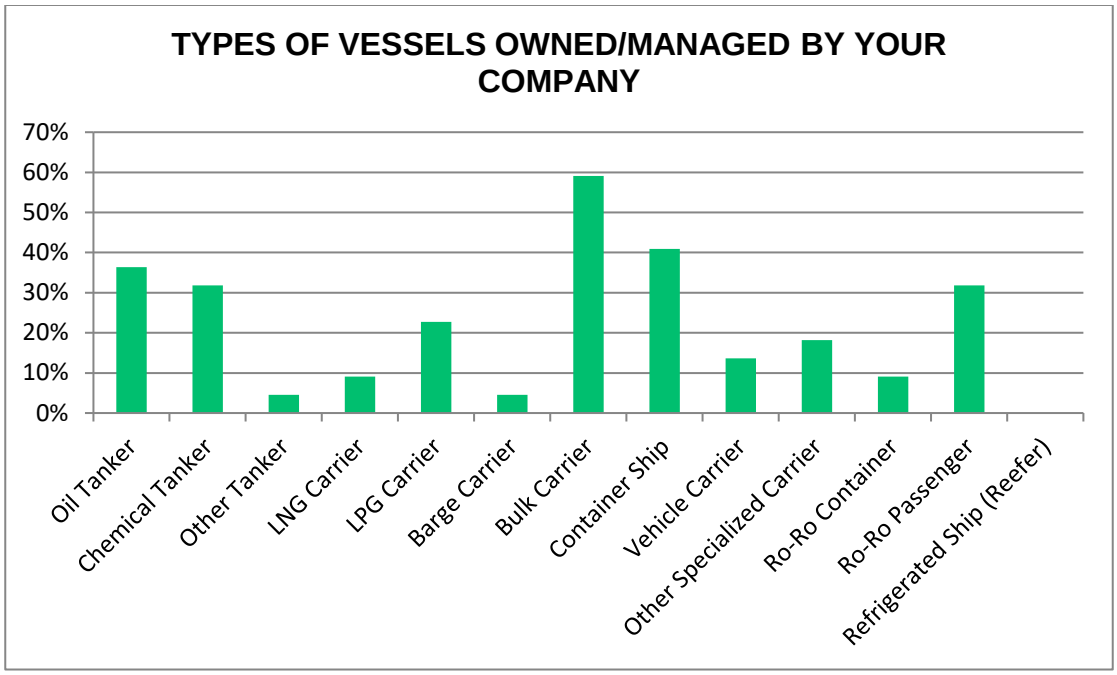
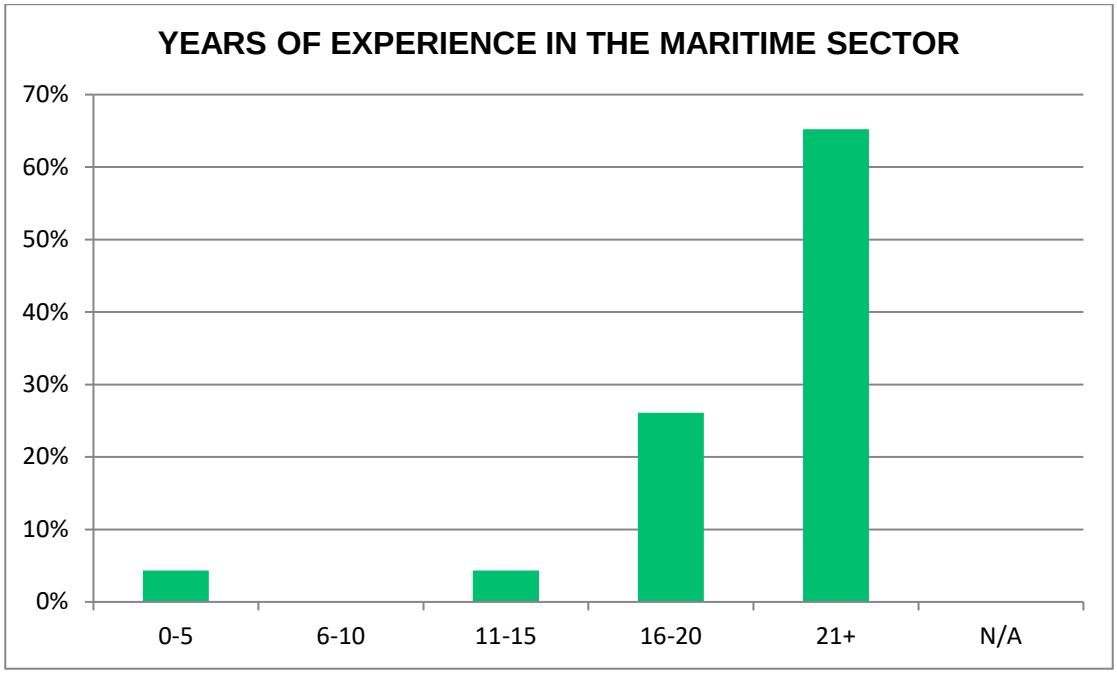


FIGURE ANNEX 5B. 3



ANNEX 5C: SURVEY EMPLOYERS 2021_DESCRIPTIVE STATISTICS

TABLE ANNEX 5C. 1

Descriptive Statistics									
	N	Minimum	Maximum	Mean	Std. Deviation	Skewness		Kurtosis	
	Statistic	Statistic	Statistic	Statistic	Statistic	Statistic	Std. Error	Statistic	Std. Error
Do you believe that the students of Maritime Education and Training (MET) institutions have an adequate level of knowledge and skills to perform their duties when they graduate?	23	1.00	5.00	3.3478	1.15242	-.373	.481	-.937	.935
Green skills	23	1.00	6.00	3.2174	1.27766	.271	.481	-.657	.935
Problem solving skills	23	1.00	6.00	3.3478	1.26522	.154	.481	-.581	.935
Communication skills	23	2.00	5.00	3.5217	.84582	-.815	.481	-.276	.935
Teamwork skills	23	2.00	5.00	3.6957	.76484	-.735	.481	.665	.935
Critical thinking skills	23	1.00	5.00	3.2174	1.08530	-.706	.481	-.384	.935
IT skills	23	1.00	5.00	3.3913	1.11759	-.879	.481	.057	.935
Management skills	23	1.00	5.00	2.9130	1.27611	.033	.481	-1.320	.935
Continuous learning skills	23	1.00	5.00	3.6957	.97397	-.609	.481	1.154	.935
The skills that ship Officers developed during their education are useful in their job (transferable skills).	23	2.00	6.00	3.9130	.84816	.175	.481	1.164	.935
In general, to what extent do you agree or disagree with the following	23	2.00	5.00	4.1739	.71682	-1.084	.481	2.767	.935

statement: "Sustainability should be incorporated in the curricula of all Maritime Education and Training institutions in order to prepare graduates with the knowledge and skills requirements									
Encouraging mobility for students and professionals of the maritime sector between European Maritime Education and Training institutions could help them develop new useful skills.	23	2.00	6.00	4.0000	1.04447	-.524	.481	.157	.935
MET institutions should provide education beyond the minimum requirements of STCW.	23	2.00	5.00	4.3913	.78272	-1.474	.481	2.640	.935
Defining Lifelong Learning as "Learning throughout life with the aim of improving knowledge, skills and competence", to what extent do you agree or disagree with the	23	4.00	5.00	4.7826	.42174	-1.468	.481	.161	.935

following statement: "Lifelong learning is important for maritime professionals".									
The incorporation of new digital tools and analytics (AI, Big Data, IoT) in the learning process will improve the employability of MET graduates.	23	1.00	6.00	3.9130	1.16436	-.763	.481	.711	.935
Ship Automation	23	3.00	5.00	4.5217	.66535	-1.100	.481	.194	.935
Cybersecurity	23	3.00	5.00	4.3913	.58303	-.291	.481	-.665	.935
Green Shipping	22	3.00	5.00	4.4091	.66613	-.699	.491	-.429	.953
e-Mentoring	23	3.00	5.00	3.8696	.69442	.179	.481	-.750	.935
3D-Printing	22	1.00	6.00	3.1818	1.09702	.559	.491	1.191	.953
Online teaching	23	1.00	5.00	3.6522	.93462	-.669	.481	1.588	.935
Virtual Reality (Simulators)	23	3.00	5.00	4.4348	.66237	-.767	.481	-.347	.935
Augmented Reality (gamification)	23	1.00	6.00	4.1304	1.14035	-1.083	.481	1.450	.935
Which of the following topics should be covered in sustainability education?(choose all applicable)	20	1.00	1.00	1.0000	.00000	.	.	.	.
Which of the following topics should be covered in sustainability education?(choose all applicable)	10	1.00	1.00	1.0000	.00000	.	.	.	.
Which of the following topics should be covered in sustainability	17	1.00	1.00	1.0000	.00000	.	.	.	.

education?(choose all applicable)									
Which of the following topics should be covered in sustainability education?(choose all applicable)	12	1.00	1.00	1.0000	.00000	.	.	.	.
Which of the following topics should be covered in sustainability education?(choose all applicable)	12	1.00	1.00	1.0000	.00000	.	.	.	.
Which of the following topics should be covered in sustainability education?(choose all applicable)	6	1.00	1.00	1.0000	.00000	.	.	.	.
Which of the following topics should be covered in sustainability education?(choose all applicable)	10	1.00	1.00	1.0000	.00000	.	.	.	.
Which of the following topics should be covered in sustainability education?(choose all applicable)	10	1.00	1.00	1.0000	.00000	.	.	.	.
Which of the following topics should be covered in sustainability education?(choose all applicable)	16	1.00	1.00	1.0000	.00000	.	.	.	.
Participation in business classes	23	3.00	5.00	4.1304	.62554	-.085	.481	-.206	.935

that focus on sustainability									
Green student orientation	23	3.00	6.00	4.0435	.76742	.585	.481	.665	.935
Participation in interdisciplinary courses that focus on sustainability	23	2.00	5.00	3.9130	.79275	-.437	.481	.150	.935
Sustainability should be a graduation requirement	23	1.00	6.00	3.5217	1.12288	.046	.481	.460	.935
STCW related content	22	3.00	5.00	4.6818	.64633	-1.924	.491	2.631	.953
Sustainability content	23	2.00	4.00	3.5652	.66237	-1.288	.481	.625	.935
Digital skills	22	1.00	5.00	3.7727	1.19251	-.815	.491	-.167	.953
MASS (vessel autonomy) skills	23	1.00	5.00	3.1739	1.23038	-.361	.481	-.607	.935
Other	15	1.00	5.00	3.2667	1.43759	-.539	.580	-.931	1.121
In the next 10-15 years (choose one answer):	23	1.00	6.00	3.1304	1.51671	.188	.481	-.985	.935

ANNEX 6: IMO TECHNICAL ASSISTANCE LINKAGES UN SDG GOALS

LINKAGES BETWEEN IMO'S TECHNICAL ASSISTANCE WORK AND THE 2030 AGENDA FOR SUSTAINABLE DEVELOPMENT

Examples of IMO's Technical Assistance Activities	Sustainable Development Goals (SDGs)	IMO's Strategic Directions
Strengthening institutional and human capacity of developing countries to implement IMO Conventions and to ensure the safe, secure and environmentally protective flow of maritime trade. Promoting the ratification and implementation of the Facilitation Convention. Assisting member states to implement the ISPS Code and the SUA Convention. Paying particular attention to the special needs of Small Island Developing States and Least Developed Countries.	SDG 1: *End poverty in all its forms everywhere* SDG 2: *End hunger, achieve food security and improved* *nutrition and promote sustainable agriculture* SDG 16: *Promote peaceful and inclusive societies for* *sustainable development, provide access to justice for all and* *build effective, accountable and inclusive institutions at all* *levels*	1 2 5 6
Promoting the ratification and enhancing effective implementation and enforcement of MARPOL, OPRC, SOLAS, OPRC-HNS and BWM Conventions. Strengthening national capacity to respond to marine pollution incidents and enhancing regional cooperation. Assisting countries in developing and adopting relevant aspects of the UNCLOS. Establishment of Special Areas under MARPOL and Particularly Sensitive Sea Areas (PSSAs). Paying particular attention to the special needs of Small Island Developing States and Least Developed Countries. Supporting ratification and implementation of the Cape Town Agreement.	SDG 14: *Conserve and sustainably use the oceans, seas and marine resources for sustainable development**	1 4
Promoting the ratification and implementation of the STCW and STCW-F Conventions. Cooperating with ILO in the Joint IMO/ILO Ad Hoc Working groups to address various issues concerning health and social protection of seafarers. Continue to promote and implement the programme on strengthening the role of women in the maritime sector. Continue to promote the award of scholarships for WMU, IMLI and other maritime training institutions.	SDG 4: *Ensure inclusive and equitable quality education* *and promote lifelong learning opportunities for all** SDG 5: *Achieve gender equality and empower all women* *and girls** SDG 8: *Promote sustained, inclusive and sustainable* *economic growth, full and productive employment and decent* *work for all*	1 2

Highlighted SDGs (4, 5, 6, 7, 9, 13, 14 and 17) denote those most directly relevant to IMO's technical assistance work.
I:\CIRC\TC\01\TC-CIRC-01-69.docx
SD1: Improve implementation
SD2: Integrate new and advancing technologies in the regulatory framework SD3: Respond to climate change
SD4: Engage in ocean governance
SD5: Enhance global facilitation and security of international trade SD6: Ensure regulatory effectiveness

Source: IMO (2017). Linkages between IMO's technical assistance work and the 2030 Agenda for sustainable development. Available at https://wwwcdn.imo.org/localresources/en/MediaCentre/HotTopics/Documents/TC.1-Circ.69.pdf, last accessed November 7, 2020.

ANNEX 7:

RECENT BIBLIOGRAPHY ON EVALUATION STRATEGY IN EDUCATION

(WITH RELEVANCE TO D3.2 CONTENT & METHODOLOGY)

TABLE ANNEX 7.1

RECENT BIBLIOGRAPHY ON EVALUATION ASPECTS

	Educational Packages / Structure	Training/Education Quality	Method	Students perceptions	Academic Staff perceptions
Evans, U. F., Mkpandiok, A., & Okonna, K. O. (2017). An evaluation of the level of awareness of the STCW-78 as amended in Manila 2010, using maritime education and training institutions as collective compliance mechanism. Australian Journal of Maritime & Ocean Affairs, 9(3), 168-181.	√		**Questionnaire - Coefficient of variation (CV) to assess the level of awareness of STCW**	√	√
Čampara, L., Frančić, V., & Bupić, M. (2017). Quality of maritime higher education from seafarers' perspective. Pomorstvo, 31(2), 137-150.		√	**Questionnaire**		
Samanlioglu, F., & Ayağ, Z. (2019). A fuzzy AHP-VIKOR	√		**Fuzzy AHP-VIKOR approach**		

approach for evaluation of educational use simulation software packages. Journal of Intelligent & Fuzzy Systems, 37(6), 7699-7710.					
Praetorius, G., Hult, C., & Snöberg, J. (2020, July). Maritime Resource Management in the Marine Engineering and Nautical Science Education–Attitudes and Implication for Training and Evaluation. In International Conference on Applied Human Factors and Ergonomics (pp. 461-467). Springer, Cham.		√	-	√	
Nazir, S., & Hjelmervik, K. (2017, July). Advance use of training simulator in maritime education and training: a questionnaire study. In International Conference on Applied Human Factors and Ergonomics (pp. 361-371). Springer, Cham.		√	-	√	
Stanca, C., Georgescu, S., Mina, S., & Olteanu, A. (2015). Measures of transforming the summative assessment in formative assessment in students activities evaluation at Constanta Maritime University. Karabük Üniversitesi Sosyal		√	**Discrimination index, Pearson's correlation, Z-score indicator**	√	

Bilimler Enstitüsü Dergisi, 5(1), 32-47.					
Aguado, C. L., Garcia, O. B., Laguador, J. M., & Deligero, J. C. L. (2015). Teaching performance and extent of work values among faculty members in One Asian Maritime Academy. International Journal of Management Sciences, 5(12), 805-816.		√	**Ranking and Mann-Whitney U test**		√
Ghosh, S. (2017). Can authentic assessment find its place in seafarer education and training?. Australian Journal of Maritime & Ocean Affairs, 9(4), 213-226.		√	**-**		
Hjelmervik, K., Nazir, S., & Myhrvold, A. (2018). Simulator training for maritime complex tasks: an experimental study. WMU Journal of Maritime Affairs, 17(1), 17-30.		√	**Cross-track error**	√	
Navarro, J. D., Garbin, Z. Z., Agena, E. M., & Garcia, O. B. (2015). Maritime students' English proficiency and their feedback on instructional materials. Asia Pacific Journal of Maritime Education, 1(1), 63-81.		√	**Percentage/Rank, Weighted Mean, Person r, t-test**	√	
Zhu, L., & Pan, W. (2017). Application of research-informed teaching in the taught-		√	**Research-informed teaching (RiT)**	√	

postgraduate education of maritime law. Innovations in education and teaching international, 54(5), 428-437.					
Ghosh, S., Bowles, M., Ranmuthugala, D., & Brooks, B. (2016). Authentic assessment in seafarer education: using literature review to investigate its validity and reliability through rubrics. WMU Journal of Maritime Affairs, 15(2), 317-336.		√	**Literature Review / Rubrics**		
Liu, Y., Lan, Z., Cui, J., Krishnan, G., Sourina, O., Konovessis, D., ... & Mueller-Wittig, W. (2020). Psychophysiological evaluation of seafarers to improve training in maritime virtual simulator. Advanced Engineering Informatics, 44, 101048.		√	**-**		
Ghosh, S., Bowles, M., Ranmuthugala, D., & Brooks, B. (2017). Improving the validity and reliability of authentic assessment in seafarer education and training: a conceptual and practical framework to enhance resulting assessment outcomes. WMU Journal of Maritime Affairs, 16(3), 455-472.		√	**Literature Review / Authentic Assessment**		

Mindykowski, J. (2017). Towards safety improvement: implementation and assessment of new standards of competence for Electro-Technical Officers on ships. Maritime Policy & Management, 44(3), 336-357.		√	-		
Skrzeszewska, K., & Beran, I. M. (2016, April). Maritime Governance-Differences Between Assumptions and Realizations. In International Conference on Management, Leadership & Governance (p. 312). Academic Conferences International Limited.		√	-	√	
Nause, N., Klimmek, E., John, P., & Greenwood, R. International Maritime Management: serving the seafarers of tomorrow and their educational needs.	√		-	√	
Sellberg, C. (2017). Simulators in bridge operations training and assessment: a systematic review and qualitative synthesis. WMU Journal of Maritime Affairs, 16(2), 247-263.		√	**Systematic Review**		
Venkadasalam, S. (2015). An analytic hierarchy process (AHP) approach to training typology selection based on student perspective. Asia-Pacific Journal	√		**AHP**	√	

of Business Administration.					
Kong, F., Liu, Y., Liu, X., & Sui, X. (2015, December). Research on System of Teaching Evaluation of the Maritime Teachers Based on AHP. In 2015 3rd International Conference on Education, Management, Arts, Economics and Social Science. Atlantis Press.		√	**AHP**		
Emad, G., Zare, H., & Rajaee, S. (2015). Identifying and ranking of fundamental factors affecting training systems of marine academic institutions in Boushehr Province utilizing AHP. In The 17th marine industries conference (MIC2015) (pp. 1-10).		√	**AHP**		
Anggrainingsih, R., Umam, M. Z., & Setiadi, H. (2018). Determining e-learning success factor in higher education based on user perspective using Fuzzy AHP. In MATEC web of conferences (Vol. 154, p. 03011). EDP Sciences.		√	**Fuzzy AHP**	√	√
Kalnina, R., & Priednieks, V. (2017). Proficiency improvement method in maritime education. WMU Journal of Maritime	√		**Modified Quality Function Deployment (QFD) method**		

Affairs, 16(1), 139-159.					
Tuljak-Suban, D. (2013). Quality standards implementation in maritime education and training institutions: fuzzy assessment. Transport Problems, 8.		√	**Common Assessment Framework (CAF) - Fuzzy multicriteria analysis (FMA)**		

ANNEX 8: SUMMARY OF AHP ESSENTIALS

AHP is based on gauging the weight specific criteria have in the process of decision-making where selection of alternatives is the issue in question. In some cases, the discovery of criteria weights is by itself the core point of the exercise without the evaluation of alternatives being a necessary concluding part of the process.

The weighting of AHP criteria and alternatives is a vigorous academic and multi-disciplinary issue. Humans have the ability to make two kinds of comparisons: absolute and relative. With relative measurements, items are measured and compared to each other while in absolute measurements items are compared to a standard. Saaty has presented the fundamental scale (see Table 4.2 below). Other researchers have presented other scales as well, but the one of Saaty is widely used in AHP applications. The fundamental scale permits pair-wise comparisons. One must first establish priorities for the main criteria judging them for their relative importance and proceed with the alternatives. The comparison matrices have specific mathematical characteristics, such as being reciprocal, and the diagonal elements are equal to unity.

TABLE ANNEX 8.1
THE FUNDAMENTAL SAATY AHP SCALE

Verbal Value	Numerical Values
Equally important, likely or preferred	1
Moderately more important, likely or preferred	3
Strongly more important, likely or preferred	5
Very strongly more important, likely or preferred	7
Extremely more important, likely or preferred	9
Intermediate values to reflect compromise	2,4,6,8

Source: Saaty (1994). Table also included for clarification in SkillSea (2020). *Internationalized …op.cit.*

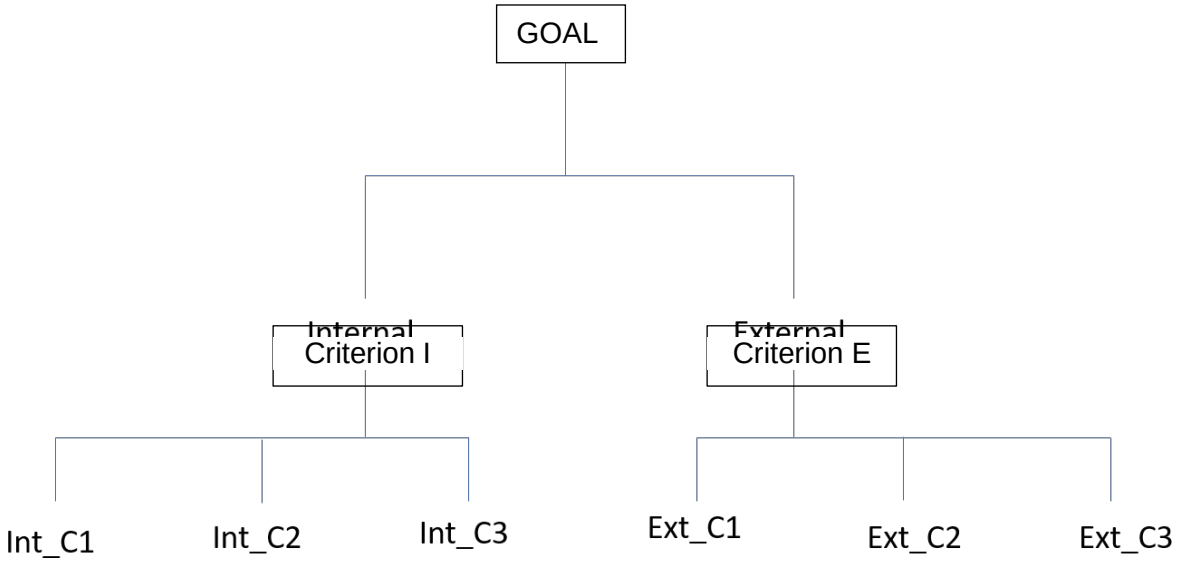
As an example, how the scale and pair-wise comparisons work, when comparing criterion A with criterion B and the decision maker finds that B is strongly more important, then the respective element in the comparison matrix gets the scale value 5 and the reciprocal element 1/5, as logically A is analogously not as important as B.

In the context of a concise presentation of an MCDM formulation and of the AHP method, two core points of concern are: firstly, the validity of the method, the judgments and the structure and, secondly, the sensitivity of the outcome. As it is very difficult, if not impossible, to calibrate a mechanism with so many qualitative and subjective elements and there are no given conditions for many MCDM problems, the method is self-controlled by the measurement of the consistency of the reciprocal decision matrices. The consistency ratios (CR) are calculated for every matrix, and as long as the CR of matrix is less than 10% the judgments are considered as valid. The notion of consistency is expanded to the hierarchies and the systems (Saaty, 1994, p. 126 and pp 246-7). If the CR of the hierarchy – overall consistency – is less than 10% the hierarchy is sound enough to support the decision. Furthermore, that means that the selected criteria describe the problem adequately and decisions can be made on this basis.

The sensitivity of the outcome is also critical. There are two basic questions involved in the sensitivity issue: (1) which is the most critical criterion, and (2) which is the most critical a_{ij} performance measure. Intuitively one may think that the most critical criterion is the one which corresponds to the highest weight w_j. It has been proven that this is misleading. There are various ways to extract the criticality of a criterion. The same applies for the criticality of the performance measurement. For the needs of this decision mechanism, the formulation and algorithms provided in the decision-science literature are used and specifically those of Triantaphyllou and Sánchez (Triantaphyllou and Sánchez, 1997). The methodology is better understood if the structuring of the hierarchy is fully comprehended.

The hierarchy constructed for a specific problem is presented in FIGURE 7.1 below. The goal itself, is typically called Level I. In the lower levels, criteria (attributes), sub-criteria are identified and the alternatives are provided separately.

FIGURE ANNEX 8.1
The Hierarchy of a Problem



Source: For illustration purposes of the generic applicability of the methodology sub-criteria initials have been borrowed from the SkillSea (2020. *Internationalized…op.cit.*

1st Step: The decision matrix D of input is established with *m* rows and *n* columns, representing the different alternatives and evaluation criteria, respectively.

$$D = \begin{bmatrix} x_{11} & x_{12} & \dots & x_{1n} \\ x_{21} & x_{22} & \dots & x_{2n} \\ \vdots & \vdots & \ddots & \vdots \\ x_{m1} & x_{m2} & \dots & x_{mn} \end{bmatrix}$$

Each variable x_{ij} in matrix D refers to the input given by facility i for the criterion j, and in the literature is understood as the performance of alternative O_i (i = 1,2, . . . , m) with respect to the criterion C_j (j = 1,2, . . . , n). Matrix D is provided as input, and x_{ij} can be scaled or non-scaled as per the theory.

2nd Step: The normalized decision matrix is calculated in order to transform the data into a dimensionless matrix. This allows for comparison of the criteria from different sources by creating a unified unit. For each variable x_{ij} a normalized value r_{ij} is calculated as follows:

$$r_{ij} = x_{ij} / \sqrt{\sum_{i=1}^{m} x^2_{ij}}, \quad j = 1,2, \ldots, n$$

3rd Step: The weighted normalized decision matrix is calculated by applying specific weights to the matrix generated in step 2.

$$v_{ij} = w_j * r_{ij}, \; i = 1,2, \ldots, m, \; j = 1,2, \ldots, n$$

Where, w_j is the weight of the j^{th} criterion; the vector w_j is provided as input and reveals the preferences of the decision-maker. In this application, the weights of the criteria are the outcome of the AHP procedure described in the previous section, therefore the criteria reflect the biases and priorities of the experts.

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