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Evaluation of the MET and the STCW competence requirement standards (OEW)

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Abstract

Maritime training has sometimes been criticized for not being designed as it should be, and there is disharmony in its implementation. The different forms and methods applied to ship training also affect the achievement of the objectives.

The main objective was to highlight how the competency requirements for the STCW are defined and in which way those are connected to training methods and learning at work. The question could be, how the onboard training should be understood as part of an approved training programme and how should it therefore be realized?

For the preparation of the thesis, it was necessary to carry out a comprehensive study of the past. A literature review for previous studies and research projects was done for this. Some of the references to the thesis are from the Author's own work experience in the field of subject matter, material accumulated in the field and the connections to the execution of the work tasks.

The MET-methods and results (i.e. quality for seafarers) is a broadly discussed topic. To develop the international standards for maritime training and education have been mainly done by the amending the 1978 STCW Convention. Even this, the quality of provision for learning environment and the teaching provided is far from homogenous.

The international regulations such as the STCW should be received with a high priority in national education system. Also, when any of less developed countries have a real commitment and an effort to maritime educational activities it is reasonable to a support by the developed MET-countries.

Training for the acquisition and use of practical skills should addresses a degree of new methods for to fulfill the 'spirit' of the STCW Convention.

Key words

maritime education and training, marine engineer, onboard training

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Definitions and abbreviations

Administration	the Government of the Party whose flag the ship is entitled to fly
Approved	approved by the Party in accordance with the regulations
Certificated	properly holding a certificate
Certificate of competency (CoC)	a certificate issued and endorsed in accordance with the provisions of the STCW regulation and entitling the lawful holder thereof to serve in the capacity and perform the functions involved at the level of responsibility specified therein
Certificate of proficiency (CoP)	a certificate, other than a CoC issued to a seafarer, stating that the relevant requirements of training, competencies or seagoing service in the Convention have been met
Function	a group of tasks, duties and responsibilities, as specified in the STCW Code, necessary for ship operation, safety of life at sea or protection of the marine environment
MET	Maritime Education and Training
OBT	Onboard Training
OEW	Officer in charge of an Engineering Watch
Officer	a member of the crew, other than the master, designated as such by national law or regulations or, in the absence of such designation, by collective agreement or custom
Organization	the International Maritime Organization (IMO)
Party	a State for which the Convention has entered into force
TRB	Training Record Book

Definitions for a certain specific terms are also presented in the associated chapters through the thesis.

1 INTRODUCTION

To promote safety of life and property at sea and the protection of the marine environment…

The above was the main purpose when the International Standards of Training, Certification and Watchkeeping for seafarers was established in 1978 (Website of the International Maritime Organization 2021). Naturally, safety and security on board ships, but indeed also effective and economical operation very much depends on well trained crews. That is why all training and exercising procedures as well as efficiency in reliable management are crucial elements in this context.

Training process is vital for creating a permanent high level skills for crew on board to guard against human complacency on duty and to better motivate ships' crews. And on long term, this should also reduce unnecessary financial costs that could be avoided with better knowledge and understanding of crewmember. For watchkeeping engineer for example whose task is to control over of all functions within the engine department and maintain its performance the area of responsibility with proper procedures is very wide.

The best way to attain experience and to gain the necessary skills are practices how specific training needs are covered during learning process. To ensure that education and training objectives are clearly notified very much depends on design of different courses and training programs in which all necessary methods for demonstrating competence and criteria of evaluation can be specified on the way which ensure that quality standards are better achieved. Training onboard has a vital role on this.

This thesis is a part of the Master's Programme studies in Maritime Management, Master of Engineering at Satakunta University of Applied Sciences. The student's own initiative has resulted in an idea of a topic to examine a maritime training and education (MET) specific for leading to issue a certain certificate of competency as adopted by

the International Convention on Standards of Training, Certification and Watchkeeping for Seafarers (hereafter called the STCW Convention, or shortly the Convention or the 1978 STCW).

In Finland, the chapter 12 of the Act on Transport Services (320/2017) entered into force in 2018 and includes new obligations for the competent authority where on application to assess and approve training that meets the requirements of the STCW Convention and, for specific reasons, other maritime training leading to a certificate of proficiency, additional qualification certificate or documentary evidence. This obligation sets the requirements imposed by the Convention a new way on under review and thus is also a new issue both for the authority and for educational institutions as well.

In addition, the International Maritime Organization's six years strategic plan (2018 – 2023) recognize that the competence and professionalism of the personnel employed or engaged in the maritime sector, like seafarers, is essential when ensure and improve maritime safety (IMO 2017b, 4). Apparently, the competence level control and control by the IMO Member States may become a subject of international scrutiny shortly. In this respect and in the light of the above, thesis can considered be topical.

The STCW convention covers the levels for certification on deck and engine but because the examination of all the different proficiency requirement levels for certifications could prove to be too large for the Author's resources, the study is focusing one level of training only and onboard training of that. Limitation is set to the training requirements for officer in charge of an engineering watch (OEW), level STCW A-III/1. Limiting the topic like this, the study is a narrower but more comprehensive review. Any of analysis, comments or any references made to in the thesis shall include aspects of 'engine department' even that it may be relevant also for functions on 'deck'. Meaning that limitation does not directly exclude wider application of the thesis results. Deliberately, the directive (EU) 2008/106/EC has been excluded from the scope of the study. Mainly because its intention very much is in line with the Convention and would not bring more value to the study as intended to. The writing style has been trying to make clearly and by using generic sentence structures and words. However, because the of the unique nature of the topic, the reader may need to have some basic knowledge so to achieve fully effectiveness.

2 BACKGROUND

Influences on global economy and technical development. The modern international transport system consists of roads, railways, inland waterways, shipping lines and air freight services, each using different vehicles (i.e. ship/ferry, barge, train, lorry and plain). Since the first cargoes were moved by sea more than 5,000 years ago, it can be said, shipping is the oldest mode of transport in this transport system. Because shipping is such an old industry, with a history of continuous change, it has played a central part in trade and economic over thousands of years – the airline industry, shipping's closest counterpart, has barely 50 years of economic history to study. The shipping has the essential role in the global economy. At every stage in its development, sea transport has displayed prominently, and the shipping industry, with its distinctive international flavor, has played a central role (Stopford 2009, 44).

Because shipping is such an old industry, it has been at the forefront of global development. Most probably this is the reason why the maritime transport is also termed as the backbone of globalization, like nominated 2019 by Bal Besikci et all (2019, 1). Nowadays with the rapid emergence of the new technologies, the ships – main instruments of the maritime industry – are becoming more advanced and sophisticated. These ships may be manned by lesser number of crew but obviously demands better educated and trained personnel. The wheel of technological development on the maritime sector will not stop and the shipping is in many ways, due to the long history, nature of its activities and the extent of its globalization, unique. Indeed, that is what I have learnt also in my own career being the engineer on this industry.

National and international regulatory influence. The shipping is regulated, owned, managed, financed and supplied with labour on an international basis. That is why, for example, the industry is widely cited as an example of one of the most globalized of all contemporary industries (Sampson 2004, 245). A vessel may be owned in one country, technically managed in another, have its crew supplied by several others, trade internationally and be registered in any one of a number of nations operating open registers. This multilateral industry provides us with a fascinating example of how a global industry operates.

In the post-war period the shipping industry changed from the largely unregulated form it took in the nineteenth century to one that was increasingly regulated by nation States. The situation altered once again in the late 1940s when registries, popularly termed 'flags of convenience' were established 'off-shore' or in countries with no significant maritime history or tradition, and in some cases without so much as a coastline (Sampson 2004, 245). Such flags allowed ship owners to evade their home-based national legislation and to capitalize on a ready supply of cheap international labour by registering their ships overseas, and taking advantage of the relatively lax approach of many such registers and their lack of requirements regarding wages and nationality of employees.

The importance of educational resources for accidents. Traditional maritime nations such as Germany, Norway, the United Kingdom, and Japan had, over time, built up a knowledge and skills base in maritime training (Sampson 2004, 246). Maybe Finland could be included in the list because the maritime education being the oldest vocational education and training sector in Finland (Salmela, Apajalahti, Korpi 2017, 7). The Maritime Education and Training (MET) have a long history in Finland when first schools started 1813. First in Swedish and later in Finnish 1868. Generally speaking, Finnish sailors are well known to being high skilled seafarers.

Well developed countries have had the economic resources at state level to devote to the provision of quality vocational training for seafarers. However, the under-developed nature of some other states with no significant maritime history or similar traditions of education practices came into maritime labour market in the late 1940s. They could deliver cheap labour and this has been attractive to employers (Sampson 2004, 247).

Reciprocally. Marine accidents and casualties at sea quite often are resulting into loss of human life and significant damage towards the marine environment. Analyses of those accidents have shown that a great majority of the incidents are a direct result of operational mistakes and errors as well as lack of knowledge of the crew. Also, it is argued that safety of ships, quality of the crew and companies and environmental protection can be sustained only through training. (Bal Besikci, et al. 2019, 2031)

The proactive IMO instrument. The numbers of high profile shipping accidents involving pollution and related economic deprivation in the late twentieth and early twenty first centuries have ensured a sustained political concern with standards of maritime education and training that ship owners and managers have been forced to respond to. Third parties, such as insurance companies, have also been instrumental in placing pressure on the industry to improve its accident and incident rates and take greater steps to reduce the part of the 'human element' in causing disasters and mishaps. (Sampson 2004, 247)

This concern has been voiced by, and through, the International Maritime Organisation (IMO) which has responded with the development of a series of measures. The typical reaction to an accident has been a combination of regulations (mainly technical), changing of procedures and training. Systemic evaluations and changes have rarely been done (Schröder-Hinrichs, Hollnagel, Baldauf, Hofmann & Kataria 2013, 243). Traditionally decisions are accident driven (meaning reactive). However, could the amended STCW Convention be understood as a proactive IMO instrument?

This thesis deals with the implementation of the STCW Convention, focusing on training onboard. And evaluate the effectiveness of standards of competence, education and training in this perspective. A part of thesis work is based on the Author's past professional experience as a marine engineer, and as a surveyor of flag state of Finland. In the beginning I served in Finnish Navy 1996 being a navigation officer. Then I completed studies in maritime education and training from 1997 to 2001 and graduated as an Engineer of Energy Technology (B.Sc.). This included also a period of onboard training with keeping of training record book (TRB) as required by the STCW Convention. Years of employed an engineer officer in various levels and on various ships have given a lot of wide understanding of the skills needed in engine department. Especially starting a chief engineer position very first time early in 2007 the different tasks and responsibilities on board game more clearly personally under review.

Tasks and duties for the maritime inspector during years 2007 – 2012 and again since 2019 until 2021 have been important to learn the opposite point of the maritime industry and have given an understanding global maritime infrastructures and maritime

training activities. Since 2018 the Finnish Transport and Communications Agency (Traficom) has been responsibility to assess and approve maritime training provider and maritime training provided by it. Being a part of Traficom's evaluation group that assessed two MET-providers and theirs training programmes in Namibia (2019) and one in Greece (2020) has been extremely fascinating task and opportunity to learn a wider view of the MET. In fact, those trips were a kickoff for the topic of this thesis. Furthermore, it has been interesting to be involved IMO's meeting and to work one and half years in a correspondence group of its.

New perspective to this unique industry sector came true, when joined June 2021 with site team in China to perform the supervisor work for the newbuilding vessels under construction for Finnish shipping company. Duty is to undertake and exercise personal best efforts, endeavors and skills on behalf of the Employer in soliciting and securing that the terms and conditions of the contracts and the specifications are duly fulfilled and performed. Thus, to protect and promote the interests of the Employer. To live in a foreign country and being daily in contact with a different level of professionals when building 'a green technology' vessels will give a significant experience and enables to achieve knowledge on one essential element in the maritime industry.

Figure 1. November 22. 2021 the Supervision Site Team celebrates launching ceremony for the hybrid ro-ro vessel Finneco III at Jingling shipyard, Yizheng, China (Photo: Tanja Heinonen)

3 LITERATURE REVIEW

In this chapter, a literature for review around the topic was collected by select publications that together gives a good understanding from the past and ending to latest ones covering together the terms MET and marine engineer. Also, onboard training was the one that affected for selection.

A rapid increase of number and tonnage of the certain type of the merchant vessels causes the remarkable problem for maritime safety because of the lack of experienced seafarers, and especially officers for such types of the vessels. Latest now, when even stricter emission regimes and a stronger focus on energy efficiency, shipping operations are facing new challenges. Those kinds of aspects are contributed where shipping industry is widely examined for a long term since.

There have been numerous previous studies and theses where *marine engineer* is on someway mentioned. This was verified when searched reference materials on World Maritime University's (WMU) web sites, for example. However, if disciplines searching criteria with key words *marine engineering educations* or *MET engineer*, a much minor number of results, which are also pretty old ones, can be found. Could be mentioned that this study is somewhat different perspective and the thesis offers a new approach precisely targeting the learning objectives of training to a specific qualification.

In 1989, Menelieto Alano Olanda and Seng Chuan Lau introduced dissertations of their own related to maritime education and training. Both dissertations point out the education for maritime engineer and that was the reason why those were selected to studied for reference.

Olanda was studying marine engineering curriculum in the Philippines that is one of the major suppliers of manpowering the maritime field. The Philippines is tried to give proper training to the existing human resources who have elected to pursue a career as seafarers. The concept of training is directly affected by the needs of the international maritime community which are expressed in the different international conventions,

above all the STCW, produced by international organizations. For this reason, dissertation pinpointed the needs of the international maritime community contained in the international conventions.

Olanda compared the requirements of those to the marine engineering curricula in the Philippines at that time. The comparison showed that the Marine Engineering curricula in the Philippines differs from the needs of the international maritime community to various levels of significance. After considering all the curricula that were looked into the study general conclusion was that the Marine Engineering curriculum meets the identified needs of the international maritime community in varying degree or level of significance. (Olanda 1989, 63)

Dissertation was made when the STCW 1978, the earliest version, was already in force and it present outcomes how to improve the gap between the needs and the curricula in the Philippines. It is obviously clear that since then have progress been made. However, it is necessary to point out the outcome for Olanda's, where the rapid change in the application of new technologies in the different industries, the Philippine educational system hardly cope with these changes (1989, 2). This is mostly seen in the engineering field. Additionally, this study did not deal with the 'onboard training' at all, which is however nowadays a vital part of education and certification process for every candidate.

The dissertation of Lau's looks at the extent of application of technological development of ships and impact to maritime training resources of Malaysia. The possible impact on the operations and manning of ships is also assessed. The extent to which maritime education and training institutions in the developed countries and Malaysia have adapted changes of developed technology is the central focus of the paper. The paper then discusses how Malaysia should go forth in meeting challenge by evolving a more coherent. adaptable and positive MET system in engineering.

Although the dissertation was presented already in 1989, it is still valid on the view how technological development have its wide impacts to maritime training on national level. The competitiveness of overseas fleets affects performances in the world market. International freight rates affect to competitiveness and hence state's own profitability.

According to Seng Chuan Lau, the developed world, with vast resources, expertise and experience, could give many developing countries beneficial guidelines on the approach (Lau 1989, 17). Mainly because the application of new technology on ships has been relentlessly tried by these countries.

As we have sawn, the implementation of even modern technology will not stop. The drive for enhanced optimization of ship operation, mainly because of highly increased needs to restrict all kind of energy waste to stop the climate warming, will ensure continuous research and development. The present advanced technology is certain to be very common in the future. Already many ships have been built incorporating many features of the 'ship of the future' project. Lau has been right when he states:

"Ships. however, are unlikely to get less automated and the hard reality is that ships are likely to incorporate more and more modern technology" (Lau 1989, 16).

Even today his question remains valid:

"Are we ready to make our MET graduates ready?"

In 2004, the Journal of Vocational Education and Training published Ms. Sampson's article where she presents the findings of a small-scale study considering standards of maritime education and training, focusing on three nations, the United Kingdom, Singapore and the Philippines. Article offers an insight into the regulation and conduct of training and education in a globalized industry, and across an international labour market. It considers the provision of training and education for merchant officers within the context of an international regulatory framework. Ms. Sampson focuses on the 1978 STCW, and analysis the effectiveness of the international standards in maritime education and training, and asks whether efforts to implement such standards amount to anything more than romantic rhetoric on the part of governmental and non-governmental organizations and agencies (Sampson 2004, 248)?

The study on which the article is based encompassed a number of ethnographic site visits to maritime colleges and training centers, given thus a good understanding what kind of discrepancies, caused mainly by economic reasons, the maritime education and training have between countries. Ms. Sampson concluded that employers in the sector are generally reluctant to invest in training, where profit margins and fear of poaching

by other companies are the reason for their unwillingness (2004, 263). An employer may feel that the costs used for training are their own loss if another company manages to recruit someone who has just been trained for their own needs. The risk of free movement of labour is probably considered too high in this situation. They would prefer vocational training to be funded and supplied by state, or private colleges as far as possible. She alleges, since the proliferation of flags of convenience, and the expansion of labour sourcing from new and less developed countries, many of today's labour supply states, and thus METs, do not have the resources to provide that same level of education for new seafarers as in more developed countries (2004, 263). Still, in 2019, this was evidently sawn when the Author itself had a possibility to visit in Namibia where maritime education and training is mainly focused in local fishery sector and partly for mining vessels that operates on coastal waters of Namibia.

Apparently, enforced self-regulation of labour supply, as it is intended by the international standards in MET, countries cannot resolve this problem, and is currently failing in its intention to raise international standards of training and seafarer competence. She also made a conclusion, based on the evidence of the study, that efforts to regulate international standards of education and training using a form of enforced self-regulation on the part of party states have largely failed and at worst may even be seen as dragging standards down. (2004, 264)

In her study, Ms. Sampson presented a solution available to employers to adopt stable crewing practices and allow continuity of labour supply. This would, as she descripted, allow for the benefits of infrastructural investment in new labour supply countries, such as the Philippines, to be reaped with the expectation that in time they would attain the standards in training that the industry requires. Staff would gain experience, a stock of good equipment and facilities would be built up, and local regulators might become more effective (2004, 264). Without knowledge if this kind of practices have been built up and with which results, something similar could be sawn in countries like Namibia, who seems to have willingness to develop their MET-sector.

Constantza Maritime University of Romania (hereafter also CMU) has developed a project that aims for an increase in the quality of training and the practical skills of the students that will be working in the maritime industry, by organizing and undergoing

on board training stages at higher standards. This PRACNAV project, as it was named, took place during 2008 and was introduced in the article written by Barsan and Muntean in September 2010.

In the years prior to 2006 the students of CMU had great difficulties to acquire the 12/6 months period of sea training. Romanian and foreign ship owners were unwilling to accept cadets on board their ships resulting that only 60-65% of students found placement. However, situation changed in 2006 when crewing and shipping companies came to university asking for cadets. Change in their attitude was a direct consequence of a prognosis confirming the shortage of well-trained officers for the merchant fleet during the next 10 years. (Barsan, Muntean 2010, 351)

The PRACNAV project was established to reorganize the onboard training stages of the cadets in order to optimize their professional achievements. In order to do so, CMU collected data from students of their on board training period by a questionnaire. Because the University has not the possibility to monitor the student's activity on board ships, this was selected to be method to improve the quality of professional training and skills level acquired by students (Barsan, Muntean 2010, 351). The enquiry revealed, amongst other, the great differences between the quality and complexity of the on board training programs performed on board different ships. Students also felt that they were not usually guided and monitored by a dedicated STO (i.e. Ship Training Officer) (Barsan, Muntean 2010, 352).

As understood by the Author itself, there are not necessary to be a specifically hired single STO on board ship. STCW requires that every candidate for certification shall follow an approved programme of onboard training, which is closely supervised and monitored by a qualified and certificated engineer officer aboard the ships, in which the approved seagoing service is performed (Barsan, Muntean 2010, 352; STCW A-III/1.2). It is truly acceptable when they receive guidance from any of the watch officers, including First Engineer, who can be a qualified assessor and could be accepted to this task. Also, accepted to sign and declare the subjects mentioned in the TRB.

More severe finding was where the cadets have to learn by themselves by looking and copying the actions and work style of the ship's officers. Actually, this kind of is

against the spirit of the STCW Convention and cast doubt on the quality violation. It shall be ensured that all training is continuously monitored through a quality standards system (QSS). Training and assessment of seafarers for certification shall be conducted, monitored, evaluated and, moreover, supported by qualified person (IMO 2017a, STCW A-I/6). This responsibility shall affect for any person conducting in-service training either onboard or ashore. The QSS shall cover the qualifications and experience required of instructors and assessors. Meaning, it is necessary to have a nominated persons on board, did by the company, who is responsibility to look over and monitor that the training fulfills the objectives. If the cadet does not receive a relevant training when (s)he is joined onboard and during this period are not supported by the ship's crew, it cannot be ensured achievement of the defined objectives.

From the beginning, accidents have affected for the development of maritime safety regulations. The Code of Hammurabi about the liability established in ancient Babylon almost 3800 years ago. Load line regulations were probably introduced even earlier in Crete in an attempt to reduce losses resulting from overloaded ships (Schröder-Hinrichs, Hollnagel, Baldauf, Hofmann & Kataria 2013, 243). Later, Samuel Plimsoll managed to raise up a public attention to the intolerable loss of life at sea due to missing effective controls of the maximal allowed cargo to be carried by ships. This was a kick-start that led to introduction of load line regulation on a 'new age' over a 150 years ago. In the beginning, this national approach applied in the United Kingdom only, but since 1966 these rules have been known as the International Load Line Convention. The disaster of the Titanic in 1912 marked ended the national attempts to govern maritime safety alone. The Safety of Life at Sea of 1914 (SOLAS) was the first international treaty related to maritime. This was the beginning of a new era in maritime safety regulations and evidently can be said, as did Schröder-Hinrichs et al., the history of maritime safety is characterized by maritime accidents followed by regulatory responses (2013, 243). In the modern world has the same context of characteristics. But does it still be on that way? Could development be taken forward more proactively?

The development of human factor- (HF) related regulations of the International Maritime Organization (IMO) has often been the result of responses to maritime accidents. The maritime sector has also considered HFs as a main contributing factor to accidents,

in common with other industrial sectors. Mr. Schröder-Hinrichs, et al. 2013, analyzed the maritime HF-related documents handed in to IMO and compare the content of these documents with the content published in two scientific journals focusing on maritime issues in the last 40 years. The objective of the analysis was to show if the HF-related decisions in IMO are still accident driven (i.e. reactive) or if they have become proactive. The conclusion they made were that decision-making, whether for regulations, safety, design, etc., must be based on a conceptualization of the system for which the decisions are made (Schröder-Hinrichs, Hollnagel, Baldauf, Hofmann & Kataria 2013, 257). This is a prerequisite to move from reactive to proactive regulation.

Humans are essential to make a system work, but not just as a factor among other factors. According to Mr. Schröder-Hinrichs et al., regulation and design instead require a perspective that emphasizes the intrinsic ability of joint systems and organizations to adjust their functioning prior to, during or following changes and disturbances, so that they can sustain required operations under both expected and unexpected conditions (2013, 258). Important is, the role of HF in maritime policy should go beyond the classical human factor and recognize that humans are necessary to ensure that systems work and that things go right. This way can we become genuinely proactive and think of wholes rather than of parts.

The analysis pointed that IMO may identify HF-related safety issues in a more proactive way. Actually, with the full spectrum of IMO instruments now at hand, it should be easier to be proactive. The day-to-day business is not characterized by loopholes in the legislative framework anymore (Schröder-Hinrichs, Hollnagel, Baldauf, Hofmann & Kataria 2013, 258). Time-consuming treaty negotiations could be less and less an issue. Instead, there should be time to identify proactively issues that require action from IMO member states.

The global trend in maritime education and training is increasingly to link an essentially vocational education with more general or deeper academic components leading to an academic qualification. This trend has led to some dilemmas for curriculum development, for training legislation in a global industry, and for achieving desired learning outcomes in a professional setting (in the shipping industry). In 2016, Dr. Manuel has addressed some of the challenges arising from this trend and the opportunities the

trend offers. His article was published online 2017 by World Maritime University and is interesting when looking at the vocational and academic relationship from the point of view of future MET development.

According to Dr. Michael Ekow Manuel, traditional seafarer training has always focused on the acquisition and use of practical skills (2017, 473). This have been reasonable way to learn when considers all those needs what the marine engineers should have. Meaning that in almost all countries and cultures of the world, operational education and training for transportation on water has origins in an on-the-job training paradigm.

In this context, it is not necessary to take a deeper look at the history of this prevailing trend, which may conflict with traditional learning methods. However, could be that vocational and academic approaches in the university context are only an issue of semantics. And indeed, many universities offer vocation-like courses even for the pure academics. But Mr. Manuel interprets that even if the existence of noticeable merits in the new academic paradigm it does not negate the challenges that it presents (2017, 479).

Although shipping has come rather ‘late to the party’, Dr Manuel notes that there are challenges related to facets of curriculum design and implementation. Such as including qualifications of instructors, content and the time available, relevant learning activities/teaching methods, availability of capital resources, assessment approaches, and synergies between quality standards systems (Manuel 2017, 479). The world is a very diverse place and there are still many parties involved who will attract individuals who are not in the least attracted to the evolving academic aspects of MET (Manuel 2017, 482).

The global trend towards a more highly academic education and the award of academic degrees is nevertheless real and needs the attention and interrogation of all who have a stake in global MET for the future. A rhetorical question could be, what will MET look like in the future with reference to the balance between the academic and vocational approaches and these associated challenges?

4 OFFICER IN CHARGE OF THE ENGINEERING WATCH (OEW)

Watchkeeping is the assignment of sailors to specific roles on a ship to operate it continuously. These assignments, also known as at sea '*watches'* are constantly active as they are considered essential to the safe operation of the vessel and also allow the ship to respond to emergencies and other situations quickly. *Watches* are divided into work periods to ensure that the roles are always occupied at all times, while those members of the crew who are assigned to work during a watch are known as *watchkeepers*. (Website of the free encyclopedia Wikipedia 2021)

Officer in charge of an engineering watch ensures that running machinery in the engine room, all related auxiliaries for propulsion and overall technical applications onboard continues to operate within tolerances. A watch system, watch schedule, or watch bill is a method of assigning regular periods of watchkeeping duty aboard ships and some other areas of employment. A watch system allows the ship's crew to operate the ship 24 hours a day while also allowing individual personnel adequate time for rest and other duties.

Watch durations may vary between vessels due to several reasons and restrictions. For example, the traditional watchkeeping system arose from sailing ships of the late 19th century and was used by the Royal Navy and many other Commonwealth navies (Website of the free encyclopedia Wikipedia 2021). Several other methods to arrange watch schedules are used since those days. Especially between navy vessels of the states may found different watch arrangements. Some watch systems aim to ensure that each team takes turns to work late at night, while other systems ensure the same team consistently works at the same hours every day. On merchant ships, watchkeepers on deck typically keep watch for six periods of four consecutive hours. Also so called six hours watch system is sometimes used. However, in engine department is commonly to use alternative arrangement.

Chief engineer may be free to keep of watch. This is typical when in case of bigger vessels and at least two engineers have been appointed as well. Engineers do not need to be physically present in the engine control room all the time when the machinery

alarm system is available to them. If anything abnormal appears in the machinery the watchkeeping engineer is informed of this by an alarm system and (s)he is able to react as needed. At least one engineer is always a duty engineer onboard who is responsible to follow the control of engines and be aware if the engine alarm occurs. Nominated engineers (2nd, 3rd and also 4th if nominated) divide this watchkeeping period. For ships flying the Finnish flag, the watch period is normally 24 hours, starting at noon each day (12 am).

During the period of watchkeeping the officer in charge of the engineering watch is the chief engineer's representative, in which case (s)he is responsible for the safe and efficient operation and upkeep of machinery items (STCW A-VIII/2, part 4-2 sub-section 53). Under the responsibility of the engineering watch, the OEW is responsible for the inspection, operation and testing of all machinery and equipment as required. This requirement is essential to take account as a general when in training and when acquire experience to achieve the necessary theoretical skills.

5 MARITIME EDUCATION AND TRAINING (MET) IN ENGINEERING

The engineer officer is a generic title for designated professional foreman of ships, power plants and repair workshops. Where the ship includes many different kinds of systems, purely with technical functions but also equipped with analog and digital electrical accessories, hydraulic and pneumatic functions and adjoined with different alarm systems, the marine engineer needs to have wide range of skills to perform his /her duties effectively and safely. His/her competence requires knowledge of heating and cooling systems, understanding of power supply circuits and much more.

In almost all countries and cultures of the world, operational education and training for transportation on water has origins in an on-the-job training paradigm (Manuel 2017, 1). Also, according to Dr. Manuel, traditional seafarer training has always focused on the acquisition and use of practical skills. This is reasonable way to learn when considers all those needs what the marine engineers should have.

The prevailing view is that, while this approach addresses a degree of cognitive skills, it focuses on and gives much more emphasis to the acquisition of hands-on practical skills for the performance of specific tasks. On the other hand, academic education has been seen to be much more focused on the development of in-depth analytical and critical thinking skills; cognitive skills that are less reliant on hands-on task-oriented training, but stress critical reading and discussion.

The global trend in maritime education and training is increasingly to link an essentially vocational education that provides specific and restricted competence outcomes with more general or deeper academic components leading to an academic qualification (Manuel 2017, 1). As Dr. Manuel writes, this trend has led to some dilemmas for curriculum development, for training legislation in a global industry, and for achieving desired learning outcomes in a professional setting (in the shipping industry). Therefore, the existence of noticeable merits in this academic paradigm does not negate the challenges that it presents (Manuel 2017, 479).

5.1 MET around continents and in some countries

5.1.1 Global view

For a long time, there has been a system in place that incorporate certificate of competency awards into national education systems. Almost all European countries, the United States of America and Australia have developed this kind of systems and graduates of these systems enjoy nationally recognized qualifications together with a basic watchkeeping certificate of competency complying with the 1978 STCW (Lau 1989, 18). Such systems of MET have a course structure of academic work and sea experience that covers the minimum requirements of the STCW for the award of a watchkeeping certificate of competency. This front-ended system enables all the theoretical work to be done at the beginning of one's career.

It is generally found that intensive study at an adult age tends to be difficult. Thus, according to Mr. Lau (1989, 18), this system enables some benefits just as:

- obviates the necessity of very time consuming and expensive leave for officers to upgrade to the next level of certification;
- mature senior engineers do not have to attempt many new subjects at a time when youth vigor is not a strong asset;
- the problem of family related pressures are often non-existent at the younger age; and
- it is generally in line with that of other professions ashore.

Such system basis on the principle where the theoretical knowledge is attained first. Then the competency experiences are acquired after graduation to fulfil the requirements of the profession. Many of the education systems are accredited by the professional bodies of the countries concerned. In 1989, Mr. Lau presented that this was because to make the courses much more attractive to potential entrants and it also helped to alleviate the problem of insufficient entrants as many was encouraged by the nationally recognized academic awards (19). Perhaps academic awards are no longer today used but some elements of that may still be in used somewhere.

The above presented basis on the principle is perhaps a good approach also in MET-system. However, because the operational training in the handling of marine machinery originates from methods of the on-the-job training and traditionally seafarer training has focused on the acquisition and use of practical skills, what the marine engineers must have, this system is sensitive and prone to fraudulently be mixed with the old-fashion methods. For example, when the education institute have some lack of recourses what is necessary to be learnt they use an alternative method where these gaps can be fulfilled. One solution is training periods onboard in which ship's facilities and machines offers to fulfill those gaps with real running equipment. This is allowed but is sensitive and prone for mistakes of quality, such as if methods used onboard fulfill all necessary objectives and if evaluation is done as should be. The fact that the training institute is responsible to do evaluation of the student's competency is pretty clear and thus should be clearly prescript in syllabus at kind of situations when they outsource teaching to achieve the learning objectives. In every course description this should be also in line with requirements with the STCW Convention.

When investigate the MET-system in different countries, there may exist significant differences. For example, the wide geographical and administrative separation between two complementary engineering wings in Malaysia were seen as a serious handicap (Lau 1989, 54). The excellent workshop and laboratory facilities at one location were beyond the effective utilization of those at the other. On that time there was too little centralized coordination. planning and organization as far as the marine engineering education and training are concerned. The two marine engineering wings, PUD (Polytechnic Ungku Omar) and ALAM (Malaysia Maritime Academy) were grown and developed relatively isolated from one another (Lau 1989, 54), which should not happen.

Whilst many changes are taking place in MET institutions, in 1989 Mr. Lau recognized a trend towards two well defined categories. On the one hand, some of the countries were of the view that the traditional interdepartmental disciplines on board ships (i.e. deck and engine) will be blurred and ultimately removed. For example, France and Netherlands were moving in this direction and have commenced courses to train bivalent officers (Lau 1989, 20). The more conservative countries were of the view that

ships will continue to be operated along existing lines. Even today, the interdepartmental disciplines are still in place in many way and this is reflected in the courses that are offering to their entrants.

It is fairly easy to agree with Mr. Lau, it is regrettable that when the objectives of the two marine engineering education institutions are identical, namely the education and training of manpower for the shipping industry, there is at present minimal cooperation and academic linkages between the two. When the objectives of the providers are the same and it is necessary to realize a control between the training providers, the international standard, just like the STCW regulations, are the reference point in the design, and implementation of education and training programmes for officers on a worldwide basis.

On the other hand, the design of course curricula is generally a matter for colleges in negotiation with and overseen by national ministerial departments or bodies specifically assigned with such responsibility (Sampson 2004, 252). For example, when Ms. Sampson did her small-scale study, in the Philippines the Commission on Higher Education (CHED) holds this function and heads an inter-agency committee the 'Technical Panel for Maritime Education' (TPME), which engages in curricula development for maritime schools. The same structure still applies 2018 when ten new members for TPME were sworn-in (Website of the Commission on Higher Education, Republic of the Philippines 2021). In the United Kingdom, as another example, the Merchant Navy Training Board (MNTB) works closely with both the Maritime Coastguard Agency (MCA) and METs in establishing standards and developing curricula for maritime education, whilst colleges formally come under the jurisdiction of the DfEE and the Scottish Executive. Furthermore, in Singapore, the Maritime Academy is part of the national Singapore Polytechnic and is formally governed by the Education department. However, maritime courses are moderated by the Shipping Division of the Maritime and Port Authority (MPA) of Singapore, which assumes responsibility for the enforcement of STCW.

5.1.2 Namibia, Africa

Mainly because where Africa is Europe's closest neighbor, the ties that bind Africa and the European Union (EU) are broad and deep as a result of history, proximity and shared interests (EU 2020, Questions and Answers, 1). Both, Africa and Europe face a growing number of shared challenges, including the effects of climate change and the digital transformation. So Europe needs to partner with Africa to tackle together the common challenges of the 21st century. This is why the need for a Comprehensive Strategy with Africa has been announced in 2020 by the EU.

The proposal for this new strategy is a starting point to take the partnership to a level based on a clear understanding of respective and mutual interests and responsibilities. Among others, boosting education, research, innovation and the creation of decent jobs through sustainable investments are areas of common interest where the interests and values of both sides are brought together to promote joint cooperation (EU 2020, Questions and Answers, 1).

Today Africa is a booming continent, with over recent years some of the quickest growing countries worldwide and is attracting the attention of several other players as well (EU 2020, Questions and Answers, 2). So it is also EU’s interest to adapt to these new realities and renew its partnership with Africa. With a young, innovative workforce and high levels of economic growth, Africa is a continent of growing opportunities. The EU is also Africa's largest trade and investment partner (EU 2020, Questions and Answers, 3). Thus it is relevant to cooperate with Africa for example to increase access to quality education, skills, research, innovation, health and social rights.

Generally in Africa, there is a potential need for readjustment of curriculum for METs’ in developing countries where it should not necessarily wait for international legislation to determine education standards. This was experienced by Songoro Yassin Magongo from field studies and presented in his dissertation in 2000. The new curriculum should absorb not only the STCW requirements, but also improve academic qualities and qualifications for marine engineers in order to provide flexibility in employment opportunities and give them the real competency to face the challenges of the future. (Songoro 2000, 4 and 84)

Africa has the potential of supplying qualified seafarers that may help reduce the shortage of seafarers in the world merchant fleet. However, some MET institutions have found the going very difficult because of lack of co-operation. Because of the economical constrains, has this been the reason for the decline of maritime education standards. According to Mr. Songoro, when be possible to share financial and technical resources more efficiently and in a more cost-effective manner it would be aid to maintaining maritime education standards (2000, 86). Co-operation among institutions at national and or regional level could be the platform to solve this.

Namibia, on the southwest coast of Africa, become independent in 1990. Since then, the Government of the Republic of Namibia (GRN) has been working closely together to ensure that all Namibians are educated and encouraged to develop their career in all possible ways. Later in 2004, 14 years after independence, Namibia adopted vision up to 2030 with the aim of transforming its people's lives through education. Therefore, Namibia is committed to fulfil its plans towards vision 2030 and that of the sustainable development goal (SDG) 4, which is to "ensure inclusive and equitable quality education and promote lifelong learning opportunities for all" (Kagola 2017, 12).

Ms. Leena Ndahafa Kagola has studied and assessed the benefits and challenges of lifelong learning in Namibia. Her dissertation is published 2017 by the World Maritime Unvirsety, Malmö, Sweden. She recognized, one of the biggest challenge Namibia is facing is not having a maritime institute that is accredited and recognized internationally to meet the needs of the industry (2017, 58). This has resulted a huge gap in terms of skills and a shortage of maritime experts in the country. The study shown that the only institute that exist mainly focuses on the fishing industry with very few companies focusing on merchant navy (Kagola 2017, 41). Also, the marine industry is narrow, and there is no career path that will allow them to grow professionally even if they have to advance their career. Further, there are limited instructors to run the training institute.

The first maritime schools started 1813 in Finland, being also the oldest vocational education and training sector in Finland. This was over 170 years before Namibia become independent country. To build up education facilities and certification system

for competent persons is a long path for any countries. It is clear to understand that as a globally the parties are not in the same level which must be taken account when develop international standards for maritime education and training, for example.

One a concrete example, how to improve education and people's skills, which develop also social rights, is the research to improve service and maintenance knowledge for ship electrical installations in Namibia. Mr. Jarmo Laine, Master´s Degree Programme in Engineering in Satakunta University of Applied Sciences, has done his thesis of this in 2020.

Research was a part of larger government funded MARIBILIS project during 2017-2020. The aim of the project was to develop maritime education and training systems in Namibia and to utilize and integrate the fish research vessel RV Mirabilis, built in Finland, into studies at the university of technology. With regard to training in the field of marine electricity, the project's sub-objective was to explore training opportunities in the marine electricity sector and to explore how the organisation of training in the field of marine electricity in Namibia could be organized (Laine 2020, 13).

The Maribilis project were funded through the Finnish HEI ICI system. The Higher Education Institutions Institutional Cooperation Instrument (HEI ICI) supports cooperation projects between higher education institutions in Finland and developing countries to strengthen higher education in less developed countries. The projects develop the field-of-study, methodological, pedagogical and administrative capacities of higher education institutions. As a result of this research and development project the Namibia has increased their MET-possibilities when the Namibian University of Science and Technology (NUST) was chosen to be the co-operator to produce technology oriented training in maritime sector. Together with NUST personnel the competence needs for ship electricians were evaluated and implemented to the electrical engineering studies as elective part. At same time the readjustment of curriculum was also done (Laine 2020, 3)

5.1.3 China

Based on the research by W.H Dong in 2014 on maritime education and training in China, the Chinese MET generally comprises three parts: typical MET which focus on seafarers' education and training, maritime services' education, and other education and training on rare subjects such as maritime archaeology (2014, 116).

The typical Chinese MET is responsible for educating people to be qualified seafarers and maritime managers in shipping companies, as well as some teaching and researching staffs in regarding maritime colleges and institutes. The Chinese shipping industry has been surging in the last three decades with the speedy developing of economy (Dong 2014, 116). Also the corresponding MET, providing a huge amount of human resources for shipping. Table 1 illustrates the huge number of recruitments of different Chinese METs during years 2008 – 2012. During the process of expanding, the typical Chinese MET has gradually developed to be a multi-level educational system which generally comprises the following three types.

Higher MET which integrates vocational MET with degree education. It is normally a four year's 'consistency' program compared to the 'sandwich' mode. Students are expected to develop an understanding of elements of maritime theory and the expertise of maritime practice by going through basic courses such as mathematics, computer skills, maritime English, etc. And included specialized courses, accompanied by STCW training for ship officers. During the process of cultivating, the school takes responsible for teaching, training, and courses examination, while MSA (China Maritime Safety Administration) for supervision and evaluation of STCW training. Only if those who finish with all courses and training, as well as onboard practicing which lasts for about one month provided by the school and MSA are eligible to take exams of Ship Officer's Certificates of Competency before graduation. People who pass the exam will not only get their diploma and bachelor's degree in maritime sector, but also a qualified testing score paper to indicate their qualifications to be a ship officer. By holding this paper, alongside with more than 12 months cadet experience on board ship after graduation, they will get the final Ship Officer's Certificates of Competency issued by China MSA. In 2014, there were 15 higher MET colleges and institutes in

China, providing hundreds of senior shipping professionals for shipping industry. (Dong 2014, 116)

Senior Vocational MET which concentrates on ship officer's training. Different from the Higher MET, Senior Vocational MET aims to train individuals to be ship officers who are going to rely on the expertise and professionalism of navigation, it will take 3 years to finish this program during which students are mainly focus on ship handling and management, as well as STCW training, but not too much basic theory learning. Likewise the Higher MET, China MSA is responsible for supervising and assessing the quality of education and training to make sure the future officers meet the demands of STCW. Individuals who finish with necessary courses, including STCW training, are able to apply for the examination of Ship Officer's Certificates of Competency before leaving school. Once passing the school and combined with above 12 months cadet's sea experiences will get them of real ship officer's certificates. Based on statistics by China MSA, the number of Senior Vocational MET colleges and institutes across China was 25 at 2010. These MET-providers are the main source of Chinese ship officers. (Dong 2014, 116)

Junior Vocational MET focus on training of ship ratings and is the main source of ratings in China. The entry qualification for this program constitutes two elements: one is physical requirements of STCW; the other is 9 years' compulsory education in which the 3 years high school studies are not included compared to the previous two types of MET. The 3 years program will equip individuals with detailed knowledge and activities of crews working on board ships. (Dong 2014, 117)
Mr. Dong's research did not mention how many Junior Vocational MET-providers exists in China. However, the amount of these increased with the number of 28 at 2010 (Dong 2014, 117).

Besides the three major MET modes mentioned above, there are still some other MET modes which includes: two-years' MET for becoming ship officers quickly without diploma, one-year's quick training to be officers for those graduates from universities and correspondence MET for promoting diploma in maritime fields (e.g. from junior college to undergraduate). In 2012, there were 40 schools across China to provide such form of MET (Dong 2014, 116).

Table 1. Number of recruitments in the Chinese METs from 2008 to 2012, based on data provided by China MSA (Dong 2014, 116 and 117)

Year / MET	2008	2009	2010	2011	2012
Higher MET	4604	4589	4475	5723	5271
Senior Vocational MET	9182	11026	12829	13050	9683
Junior Vocational MET	15472	18318	23324	15767	7349
others MET modes	15052	12245	13341	9373	5857
total	44310	46178	53969	43913	28160

When add up different training providers and number of recruitments, the overall volume is huge in China. And according to Mr. Dong, there are issues for concern in Chinese MET. The average enrollment of students is numerous, reaching 43334 singles annually in the past years 2008 - 2013, which is strongly contrary to the lack of funding, experimental facilities and teaching staffs, leading to a relatively lower quality of graduates (Dong 2014, 4). For another thing, the curriculums are apparently heavy on theory and light on practice especially for on board practicing procedures. Mr. Dong aims, the reason for this is because the school is only responsible for little proportion for that but leave over more to the company after graduation (2014, 4).

Viewing from the maritime services' education dimension, the quality of maritime services' educational components including teachers, students and curriculums does not really meet the requirements of the speedy developing of shipping market (Dong 2014, 4). For teachers, the characteristics of maritime services require a globalized perspective and relevant field background which they don't really have more; and for students, English has become the biggest obstacle for their career development no matter how hard they are doing.

5.2 MET in Finland

In Finland, a total of 1,600 students study in the field of maritime (Salmela, Apajalahti, Korpi 2017, 8). Approximately 140 students complete the vocational studies in the maritime sector each year and approximately 140 students of bachelor degree (Sea Captain, Marine Engineering).

Watchkeeping engineer qualification is possible to achieve either by through vocational studies or through bachelor degree programmes for engineer (marine engineering). Training is provided at four vocational degree schools (undergraduate maritime qualifications) and at four University of Applied Sciences. One vocational education provider and one polytechnic are located in Åland. In addition, the field includes education leading to Master's degree. As well, continuing and safety training is offered by the maritime sector. In addition to vocational degree training and polytechnics degree institutions, complementary training is provided by two training organizations (Government proposal 145/2017, 133).

5.2.1 Vocational studies

Based on the eCurriculum service information, published by the Finnish National Agency for Education, of qualification requirements for the vocational qualifications the scope of the Vocational qualification in Seafaring is 180 competence points. The qualification is composed of vocational units (145 competence points) and 35 competence points consist of common units (Website of the eCurriculum 2021). Holders of a vocational qualification in seafaring may work as watchkeeping ratings in the deck or engine department. Based on their educational choices, qualification holders who have completed the competence area for engineer officers may additionally work as officers in charge of engine watches.

By completed the competence area for Watchkeeping Engineer Officer, holders of a qualification can act as officers in charge of engine watches. They know how to use and service the ship’s main and auxiliary machinery and associated equipment and other machinery on the ship. They know how to act in emergency situations like as of life raft and life boat. Furthermore, they can administer first aid and extinguish fires.

The qualification contains in-service training of at minimum 12 months required for the issue of a watchkeeping engineer officer's certificate.

Or, if the student meets the alternative requirements laid down in the decree concerning seagoing service of at minimum 36 months and training in mechanical workshop skills as well as duties relating to engine watchkeeping included in the seagoing service, he or she does not need to complete the combination of training in mechanical workshop skills and approved seagoing service referred to in the decree (Website of the eCurriculum 2021).

5.2.2 Bachelor degree programme

When studying bachelor degree programme, the scope of the training is 240 - 270 credits (ECTS), depending on the training unit and the planned duration of the studies is 4–4.5 years (Salmela, Apajalahti, Korpi 2017, 8). For example, structure of engineering studies in maritime consist of:

- basic studies 36 ECTS;
- professional studies 106 ECTS;
- elective studies 5 ECTS;
- supervised training 108 ECTS; and
- bachelor's thesis 15 ECTS.

Maritime engineering training is divided into three levels: basic, operational and management levels. After completing the management level, the student has the theoretical capability to perform the top officer's duties in international traffic. In addition, the qualifications of the power plant, which are carried out as optional, enable them to operate in ground power plants (Website of the South-Eastern Finland University of Applied Sciences 2021). When graduated and received necessary work experience onboard in specific tasks is possibly to achieve a full qualification of marine engineer in the maritime sector. This is a long path and are in three stages. The first stage is the watchkeeping engineer, the second stage is the 2nd engineer, in some countries called as the engineer (i.e. Finland), and the final stage is the chief engineer. After training,

the qualification of a watchkeeping engineer is achieved through 12 months of approved work experience. The competence of a engineer is achieved through training and 12 months of prescribed work experience as a watchkeeping engineer. The qualifications of the chief engineer are achieved through training and 24 months of work experience as a 2nd engineer. In the power plant industry, the specifications are slightly different.

In case of watchkeeping engineer. When completed defined studies or programmes, and completed seagoing service as needed, the candidate may achieve qualification to hold a A-III/1 -level competency certificate (CoC).

5.2.3 Implementation of MET in Finland

In Finland there are a certain coordination system in implementation of MET.

The Finnish Transport and Communications Agency, shortly Traficom, has overall responsibility for the implementation of the STCW Convention in Finland. Traficom's responsibilities include, inter alia, certificates of competence, alternative certificates of competence, certificates of additional qualifications, renewal of certificates of competence and recognition of certificates of proficiency and certificates of additional qualifications issued by other States in matters relating to the STCW Convention. (Salmela, Apajalahti, Korpi 2017, 9)

The Ministry of Education and Culture is responsible for granting training permits to education providers, which is a prerequisite for organizing vocational education and training with a degree objective (Salmela, Apajalahti, Korpi 2017, 9).

In turn, **the Finnish National Agency for Education** is responsible for providing the basics of vocational education and training degrees and the corresponding curricula at universities of applied sciences (Salmela, Apajalahti, Korpi 2017, 9).

MET-providers (i.e. training units) are responsible for the implementation of education and training itself, the assessment of competences and the award of diplomas.

In addition, the Ministry of Justice, the Ministry of Economic Affairs and Employment and the Ministry of Social Affairs and Health have certain STCW responsibilities.

5.2.4 Approval of maritime training providers and training

Website of the IMO 2021: *"The STCW Convention requires that training leading to the issue of a certificate is approved".*

Perhaps the above 'statement' is not explicit written in the Convention. However, regulations in chapter II to IV indicate that every candidate shall have completed approved education and/or training. And, in particular section A-I/2.6 of the Code defines how courses can be approved:
"In approving training courses and programmes, Parties should take into account that the relevant IMO Model Courses can assist in the preparation of such courses and programmes and ensure that the detailed learning objectives recommended therein are suitably covered".

The IMO does not approve any training courses or institutes. This is a privilege and responsibility of Member Governments who are Parties to the STCW Convention.

In Finland, the MET is mainly covered by the vocational qualifications system and related approvals (Government proposal 145/2017, 109). Formerly, there were a number of requirements in the maritime conventions which had not been implemented in Finland as such. Shortcomings in implementation were reflected, among other things, in the opportunities for education providers to export education. These shortcomings was removed when accepted the proposal containing new requirements for the adoption of training providers and the content of training.

The chapter 12 of the Act (320/2017) needs attention that includes these new obligations for the competent authority to assess and approve maritime training providers and training programmes leading to a maritime certificate of competency or certificate

of proficiency issued under the STCW Convention. Amendments came in force 1 July 2018. Meaning, evaluation and approval of maritime training providers and training by the Finnish Transport and Communications Agency (Traficom) is a new activity. In the past, an evaluation (the audit) for the maritime schools' quality standard system is periodically undertaken but to conduct of assessment and give a specific approval is thus a new issue, both for the authority and for educational institutions. Consequently, it was assumed the new procedure would to some extent increase the administrative burden on training providers and entail costs. The costs of the approval for secondary schools and universities of applied sciences were expected to be around EUR 3.000 – 8.000 (Government proposal 145/2017, 133). The approvals of individual courses in course centers were estimated less than EUR 1.000 per course.

As a general rule, the approval is valid for an indefinite period and therefore should be a one-off second cost. However, essential changes to training requires re-approval. In this respect costs are estimated to be lower. According to Government proposal, the assessment could often be carried out partly in the paper and the workload is thus lower than in the case of the first approval (proposal 145/2017, 133). At the moment, because mainly the first approvals are still under way, this is something that the future shows.

The fact that maritime training has been approved in accordance with the STCW Convention allow training providers to export training. With the approval of education, the MET-providers are able to market training leading to qualifications or additional qualifications separately from degree-based education in accordance with the Finnish education system. It is assumed, the assessment and approval of foreign training units of Finnish trainers also include the expansion of training activities and business provision of profitable training (Government proposal 145/2017, 133). Some educational institutions are already making educational exports. Satakunta University of Applied Sciences has a related project at least in Namibia leading to Bachelor degree and cooperation plans are underway also in South Africa. Furthermore, Aboa Mare Training Academy has maritime training co-operation in Greece with a local partner GMC.

The approval of foreign training units, and the provided training of them will enable shipowners to make use of these units in the recruitment and also training of their own workforce. Graduates of these units are able to apply for a certificate of competence

issued by the Traficom or for CoP when relevant (Government proposal 145/2017, 133). Meaning, the use of foreign training units can be used by shipowners as savings in training, accommodation and travel expenses, among other things. Maybe, some large shipping companies with a need for large numbers of people could benefit of this.

For the Traficom, the approval of training providers and training is mainly a new activity and is increased the Agency's workload during the start-up phase. Perhaps even more than one man-year, as were assumed in the Government proposal (145/2017, 146).

What comes to foreign training units. Based on author's experience, during a one year period (between 2019 and 2020) three officials had been involved to assess and approving of two foreign training units. Work was not a full time but still needed remarkable efforts and process was time consuming. May be suspected, assessment and approval of foreign training units have increased the Agency's workload fairly much more than 0.1 man-years as assumed (Government proposal 145/2017, 146).

Even if true that Traficom is involved in the preparation of amendments to the STCW maritime training requirements in the IMO and is familiar with those training requirements, the new approval activities have increased the need for a specific professionalism be involved to these matters in the Agency. Generally, a deeper practical marine engineer knowledge has not very largely be in present at this area of the operation in the organization. Meaning that a few officials have their background in practical marine engineering who have had time to focus also on assessment and approval matters.

6 LEGITIMATE BASIS OF SEAFARER'S COMPETENCY SCHEME

Why it is important to educate and train personnel, such as maritime engineers, under a supervision and according as agreed at international level?

As already stated in chapter 5. One may observe the general trend of vocational education and training, which traditionally is focuses on technical vocational skills rather than theoretical knowledge, a more emphasis is given on higher level of knowledge-based education. This is a transformation allowing for many vocational training institutions to be more attractive in the labour market and increase the employability of their students, which directly affect their reputations and financial sustainability.

In the post-war period the shipping industry changed from the largely unregulated form to one that was increasingly regulated by nation States and later also at international level. Maritime nations such as Germany, Norway, the United Kingdom, and Japan had, over time, have built up a knowledge and skills base in maritime training. This have been possible when the State have the economic resources at state level to devote to the provision of quality vocational training for seafarers (Sampson 2004, 247). Finland could be included in the list because the maritime education being the oldest vocational education and training sector in Finland. The first schools started 1813. First in Swedish and later in Finnish 1868 (Salmela, Apajalahti, Korpi 2017, 7).

In the late 1940s this situation altered when registries, popularly termed 'flags of convenience' were established and countries with no significant maritime history or tradition came into maritime labour market. The 'new' labour supply countries were attractive to employers precisely because they could deliver cheap labour. This ability was related to the under-developed nature of their economies (Sampson 2004, 247). Employers, in general, retained an expectation that seafarers would come to them, more or less, 'ready trained' and, as a result, colleges sprung up in vast numbers in countries with little spare resource to devote to them and, sometimes, with little general educational infrastructure.

A series of disasters have occurred causing grave ecological and economic damage, not only the *Torrey Canyon* (1967), the *Exxon Valdez* (1989) and the *Braer* (1993).

Based on investigations, inadequate skills were often a reason for these accidents and 'poor' skills a result of insufficient education system for seafarers. National states and international regulators were forced to respond to the criticism that these public events caused. In the face of a deteriorating public image, the maritime sector increased their efforts to regulate standards in the industry and the IMO focused attention to strengthening internationally recognized, but locally implemented and monitored, standards for the training and education of watch-keeping officers and ratings. Thus, following early disasters (i.e. the *Torrey Canyon*), standards in certification, training, and watch keeping (STCW78) were agreed and introduced by the IMO in 1978.

Figure 2. The supertanker SS Torrey Canyon ran aground on rocks off the south-west coast of the United Kingdom in 1967, spilling an estimated 94–164 million litres of crude oil, thus being one of the world's most serious oil spills (Website of the Treehugger 2021) (Photo: BBC)

These international regulations rapidly became the reference point in the design, and implementation of education and training programmes for officers on a worldwide basis (Helen 2004, 249). The process was assisted by the production by the IMO of a model courses that could be adopted and adapted by Maritime Education and Training colleges. Nowadays, as generally, seafarer needs to have specific competency for to be a certain position on board vessel. Of the IMO Member States, 166 countries are Parties to the 1978 STCW Convention. This number covers approximately 99% of the gross tonnage of the world merchant fleet (Website of the IMO 2021).

6.1 The 1978 STCW Convention and the Code

The International Convention on Standards of Training, Certification and Watchkeeping for Seafarers, 1978 (the 1978 STCW Convention).

6.1.1 General

In introducing STCW the IMO was introducing a system of enforced self-regulation. This was achieved by ensuring that states that were not party to the convention were bound by its regulations on entering any port within a party state. Article X of the 1978 STCW Convention contains this control measures and kind of aspect of the Convention ensured that it gained massive coverage in terms of its implementation across the world fleet. The process was assisted by the production by the IMO of 'model courses' that can be adopted and adapted by Maritime Education and Training colleges. The intention of the IMO's policy was to raise standards in nations that had previously provided poor education and training for maritime officers and ratings. (Sampson 2004, 250-251).

The 1978 STCW Convention was the first to establish basic requirements on training, certification and watchkeeping for seafarers on an international level. Before that the criteria of training, certification and watchkeeping of officers and ratings were established by individual governments. Unfortunately, usually without reference to practices in other countries. This non-harmonized training system led to result where standards and procedures varied widely, even though shipping is the most international of all industries. Nowadays, the Convention prescribes minimum standards relating to training, certification and watchkeeping for seafarers which countries are obliged to meet or exceed. (Website of the IMO 2021)

In this association it also important to note that the standards established by the STCW are vocational requirements. STCW does not establish criteria for general studies or what prerequisites students should have.

The Convention, in its accompanying Code, explicitly indicates expected standards of competence, the associated knowledge, understanding, and proficiency required, and

importantly the methods for demonstrating competence and criteria for evaluating such demonstration of competence. This is definitive of the STCW Convention - a paradigm heavily influenced by competence-based training and requiring specific practical and performance - based outcomes (Manuel 2017, 474).

6.1.2 Amended STCW and procedures of the IMO

The first version of the STCW Convention was adopted on 7 July 1978 and entered into force on 28 April 1984. Since then, several amendments have been done and below are presented only few of those.

The 1995 amendments, adopted by a Conference, represented a major revision of the Convention. This was needed to bring the Convention up to level of those days and to respond to critics who pointed out the many vague phrases, such as "to the satisfaction of the Administration" (Baldauf, Dalaklis & Kataria 2016, 8520). These phrases resulted in different interpretations being made. Could be also said that the Convention changed from knowledge based requirements to competence based requirements (EMSA 2016a). The amendments entered into force on 1 February 1997 and one of the major features of the revision was the division of the technical annex into regulations. And implementation of a new STCW Code, to which many technical regulations were transferred. Part A of the Code became mandatory while Part B is a recommended section. This kind of division for the regulations reduce administrative burden and it also makes the task of revising and updating them to be simpler. For example, for procedural and legal reasons there is no need to call a full conference to make changes to Codes. (Baldauf, Dalaklis & Kataria 2016, 8520)

Another major change under the 1995 amendments was the requirement for Parties to the Convention to provide detailed information to IMO concerning administrative measures taken to ensure compliance with the Convention (Website of the IMO 2021). Generally, implementation is down to the flag States, while port State control also acts to ensure compliance. Meaning, this was the first time that IMO had been called upon to act in relation to compliance and implementation. Chapter I, regulation I/7 of the Convention requires to provide detailed information to IMO concerning administrative

measures. This information shall be relevant to ensure compliance with the Convention and its implementation. Like as education and training courses, certification procedures and other relevant factors. The information submitted by the Party to the Convention is reviewed by panels of competent persons that are nominated by these Parties (to the STCW Convention). Conclusions and findings are reported to the IMO Secretary-General, who, in turn, reports to the Maritime Safety Committee (MSC) on the Parties which fully comply. Role for the MSC is to produce a list of "confirmed Parties" in compliance with the STCW Convention. (Website of the IMO 2021)

6.1.3 Current consolidated version in force

In 2010 the Manila amendments to the STCW Convention and Code were adopted. This was second major revision of the STCW Convention, and the Code (Website of the IMO 2021). Under the tacit acceptance procedure for all Parties to the Convention, these amendments entered into force on 1 January 2012. Except Finland, which due to national procedural requirements was obliged to object to the amendments on that time (IMO 2021, 421). As usually, the purpose was to bring the Convention and Code up to date with developments since they were initially adopted. But also to enable them to address issues that are anticipated to emerge in the foreseeable future (Website of the IMO 2021). Additionally, the Manilla amendments brought a number of important changes to each chapter, including ones mentioned at this association:

- “Improved measures to prevent fraudulent practices associated with certificates of competency and strengthen the evaluation process (monitoring of Parties' compliance with the Convention);
- New requirements for marine environment awareness training and training in leadership and teamwork; and
- Introduction of modern training methodology including distance learning and web-based learning”. (Website of the IMO 2021)

Around one year later (1st of March 2013) the amendments came force also in Finland (Website of the Finnish Parliament 2021). Furthermore, to improve measures to prevent fraudulent practices (MET institutions) and strengthen the Parties’ control to monitor and evaluate was one reason for to improve the national regulation presented

in chapter 5.2.4. Subsequent amendments are adopted 2014, 2015, 2016 and latest May 2021 by the IMO Maritime Safety Committee at its 103rd session (Website of the IMO 2021).

6.1.4 Structure of the Convention and Code

Figure below illustrates the concept of the Convention and Code. The whole 1978 STCW Convention, as amended consist of the Convention and the annex thereto, which shall constitute an integral part of the Convention. Furthermore, every reference to the Convention constitutes at the same time a reference to the annex. (IMO 2017a, STCW Article I)

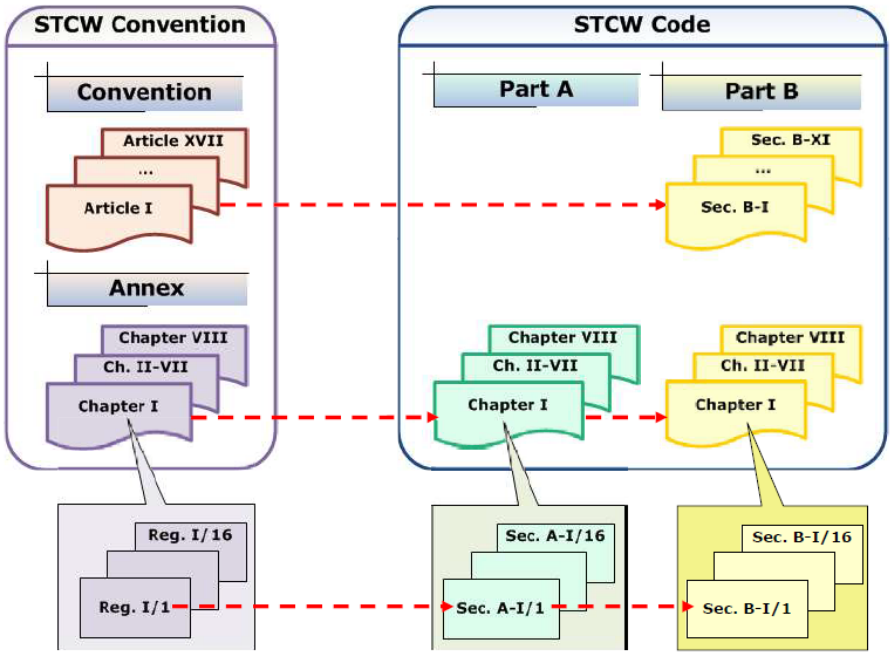

Figure 3. Structure of the Convention and Code (EMSA 2016b)

The Convention includes requirements for certification of seafarer and these regulations are divided to eight chapters as presented in table 2. In this study the focus is kept on chapter III (Engine department). Regulations are supplemented by the mandatory provisions contained in part A of the STCW Code and any reference to a requirement in a regulation also constitutes a reference to the corresponding section of part A of

the Code (IMO 2017a, STCW Reg. I/1). Furthermore, the related guidance and explanatory material contained in part B of the Code is instructed to be taken into account.

Table 2. Eight chapters includes regulations of the Convention

Chapter I	General provisions
Chapter II	Master and deck department
Chapter III	Engine department
Chapter IV	Radiocommunication and radio personnel
Chapter V	Special training requirements for personnel on certain types of ships
Chapter VI	Emergency, occupational safety, medical care and survival functions
Chapter VII	Alternative certification
Chapter VIII	Watchkeeping

Because of the structure of the STCW (i.e. the Convention and the Code), where the regulations are supported by sections in the STCW Code, when any amendments are adopted by the IMO the below differences between to part A and B applies.

1) "Amendments to part A of the STCW Code shall be adopted, brought into force and take effect in accordance with the provisions of article XII of the Convention concerning the amendment procedure applicable to the annex; and
2) part B of the STCW Code shall be amended by the Maritime Safety Committee in accordance with its rules of procedure". (IMO 2017a, STCW Reg. I/1)

The definitions contained in article II of the Convention, and the definitions and clarifications contained in regulation I/1 of its annex, apply equally to the terms used in parts A and B of the Code (IMO 2017a, STCW A-I/1). However, supplementary definitions which apply only to the provisions of the Code are contained in section A-I/1. Meaning, the Convention contains basic requirements which are enlarged upon and explained in the Code (Website of the IMO 2021).

The certification provisions are based on the abilities specified in the part A of the Code. The standards of competence are grouped, as appropriate, under the seven functions and certain levels of responsibility as listed in the next table (table 3). *Function* means a group of tasks, duties and responsibilities, as specified in the STCW

Code, necessary for ship operation, safety of life at sea or protection of the marine environment (IMO 2017a, STCW Reg. I/1).

Table 3. Different functions and the followed levels of responsibility as specified for certification (IMO 2017a, STCW section A Introduction)

	Function:
1.	Navigation
2.	Cargo handling and stowage
3.	Controlling the operation of the ship and care for persons on board
4.	Marine engineering
5.	Electrical, electronic and control engineering
6.	Maintenance and repair
7.	Radiocommunications
	Levels of responsibility:
	Management level
	Operational level
	Support level

Based on definition by the STCW Convention, section A-I/1:
Management level is the highest possible grade as under the STCW representing for example the level of responsibility associated with serving as a chief engineer officer or second engineer officer on board a seagoing ship. The task on management level is to ensure that all functions within the designated area of responsibility are properly performed.

Operational level, focused in this study, means in the case of engine department the level of responsibility associated with engineering watch or as designated duty engineer for periodically unmanned machinery spaces. A person maintain direct control over the performance of all functions within the designated area of responsibility in accordance with proper procedures but under the direction of chief engineer and 2nd engineer whose serving in the management level for the area of responsibility.

Furthermore*, support level* defined by the Code means the level of responsibility associated with performing assigned tasks, duties or responsibilities on board a seagoing

ship under the direction of an individual serving in the operational or management level. Such as repairman, motorman and electrician.

6.1.5 The sections A and B

In the STCW Code. The first section, called Part A is mandatory and the minimum standards of competence required for seagoing personnel are given in detail in a series of tables thereto (IMO 2017a, STCW section A Introduction). Functions and levels of responsibility are identified by subtitle in these KUP-tables of standards of competence given in chapters II, III and IV. In this study, only functions 3 – 6 (see table 3) of seven at the operational level was in question.

Part A. Mandatory provisions give the minimum standards required to be maintained by Parties in order to give full and complete effect to the Convention. Also, this part contains standards of competence required to be demonstrated by candidates for the issue and revalidation of certificates of competency. The numbering of the sections of this part corresponds with the numbering of the regulations contained in the annex to the STCW Convention. (IMO 2017a, STCW section A Introduction)

Part B. This part B contains recommended guidance which is intended to help when implement the Convention. Meaning, the measures suggested in this part are not mandatory. The examples given are only intended to illustrate how certain Convention requirements may be complied with. However, the recommendations in general represent an approach that has been harmonized by discussions within IMO and consultation with other international organizations. Important is to detect, observance of the recommendations contained in the part B will assist the Organization in achieving its goal of maintaining the highest practicable standards of competence in respect of crews of all nationalities and ships of all flags. Because guidance is provided in the part B in respect of certain articles of the Convention, in addition to guidance on certain regulations in its annex. The numbering of the sections of the part B therefore corresponds with that of the articles and the regulations of the Convention. (IMO 2017a, STCW section B Introduction & Guidance regarding provisions of the Articles)

6.1.6 Structure of the KUP-tables

Minimum competence requirements for seagoing personnel are given in detail in a series of tables. These Knowledge, Understanding and Proficiency -tables are generally called as a KUP-table that actually is the scope of the functions at the level of responsibility as stated and required to be demonstrated and evaluated for certification. The KUP-table defines the abilities listed under column 1 and consist total of four columns, where the:

Column 1: consist competence requirements (functions) what are needed to fulfill (i.e. tasks, duties, and responsibilities);

Column 2: list of minimum level of knowledge, understanding and proficiency that is required and be sufficient for the OEW to carry out his/her duties;

Column 3: descripts the different and acceptable methods for demonstrating his/her competence; and

Column 4: acceptable evaluation criteria how to evaluate the required competence.

For an assessor, column 4 provide the means to judge whether or not a candidate can perform the related tasks, duties and responsibilities (IMO 2017a, STCW A-I/1.1).

Column 1	Column 2	Column 3	Column 4
Competence	**Knowledge, understanding and proficiency**	**Methods for demonstrating competence**	**Criteria for evaluating competence**

Figure 4. Example of KUP-table columns

According to the regulation I/1 of the convention the Engineer officer means "*an officer qualified in accordance with the provisions of regulation III/1, III/2 or III/3 of the Convention*". Meaning, for example, that the Engineer officer qualified as per III/1 meets the minimum requirements for certification of officers in charge of an engineering watch in a manned engine-room or designated duty engineers in a periodically unmanned engine-room on a seagoing ship powered by main propulsion machinery of 750 kW propulsion power or more. (IMO 2017a, STCW Reg. I/1)

Above descripted engineer officer is generally called as a *Watchkeeping engineer* and abbreviation OEW is also used to mean the same (Officer in charge of an engineering

watch). This position is categorized as a operational level onboard and it consist four functions (see figure 5).

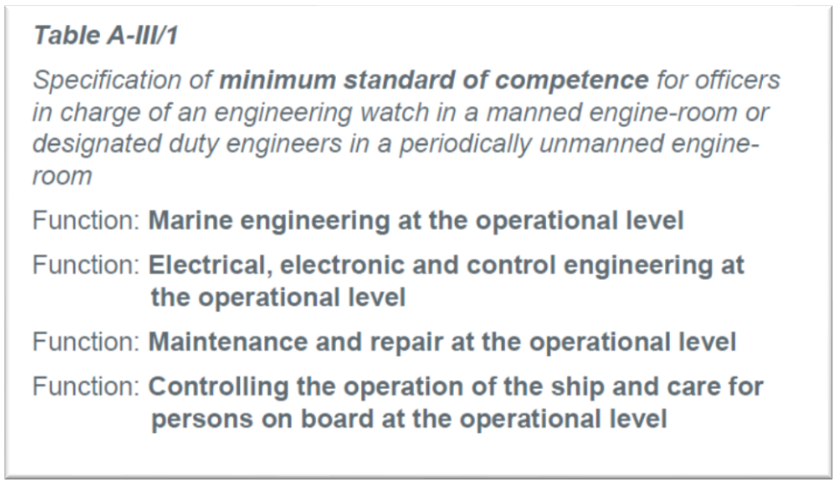

Table A-III/1

Specification of ***minimum standard of competence*** *for officers in charge of an engineering watch in a manned engine-room or designated duty engineers in a periodically unmanned engine-room*

Function: **Marine engineering at the operational level**

Function: **Electrical, electronic and control engineering at the operational level**

Function: **Maintenance and repair at the operational level**

Function: **Controlling the operation of the ship and care for persons on board at the operational level**

Figure 5. Operational level OEW's competence functions (EMSA 2016b)

In the case of OEW the KUP-table A-III/1 is the essential source of reference for to evaluate required standard of MET process for watchkeeping engineer under the provisions of the STCW Convention. The whole scope of the functions at this level of responsibility is in appendix.

6.1.7 Quality standards

For to educate, assess, approval and to control creates processes in teaching institution that contains several sub-areas. For to manage all of this shall have a quality system that took account all relevant aspects. Also, to perform monitoring and approval processes for such activities the governmental agencies or entities shall have a quality standards system.

In practice, regulation I/6 of the Convention also requires that the training and assessment of seafarers are administered, supervised and monitored. Subsequent regulation (I/8) establish that whole MET-process shall be continuously monitored through a quality standards system to ensure achievement of defined objectives, including those concerning the qualifications and experience of instructors and assessors (IMO 2017a, STCW). Meaning that not only the processes by the training institution but the whole

MET shall be administered through the quality systems. The EMSA has illustrated this combination with ‘an umbrella’ model as presented below.

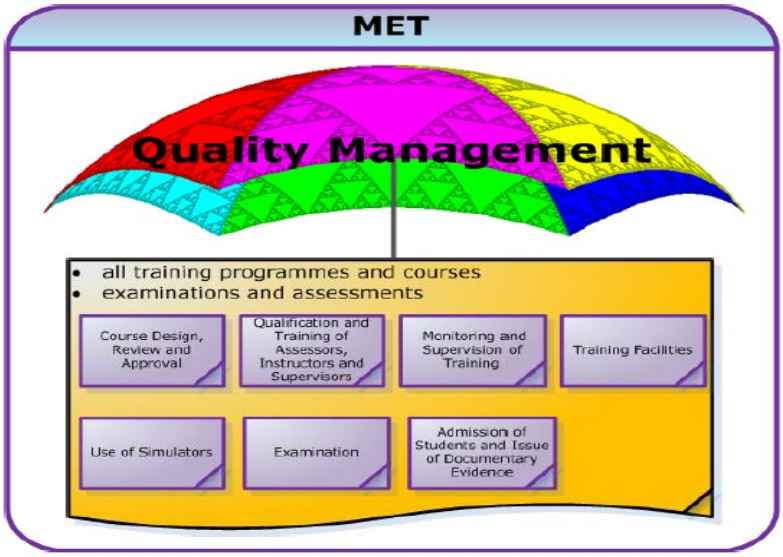

Figure 6. The quality of the MET shall be assured by manage it under the QM-umbrella (EMSA 2016a)

For to control quality of the MET an independent evaluation of the processes and assessment activities, and of the administration of the certification system, shall be conducted at intervals of not more than five years (IMO 2017a, STCW A-I/8). The evaluation shall verify, together with other issues, that applicable provisions of the Convention and STCW Code as amended, are covered by the quality standards system. It is responsibility of each country to ensure that these independent evaluations have been carried out (IMO 2017a, STCW A-I/8).

According to section A-I/8 shall be ensured: *“the education and training objectives and related standards of competence to be achieved have been clearly defined and that the levels of knowledge, understanding and skills appropriate to the examinations and assessments required under the Convention have identified”* (IMO 2017a, STCW). The scope of evaluation shall cover the administration of the certification system and training activities, in which the above are covered by the quality standard system. Because the objectives and related quality standards may be specified separately for different courses and training programmes also these can be included in the evaluation,

which should to provide a vision, whether the MET is accurately administered, supervised and monitored.

Part B of the Code explains different quality standards models for assessment, and includes several issues what the quality-standards model should incorporate. From the perspective of this study, could be highlighted following two ones:

- "quality system coverage, where appropriate, of the academic and administrative organizational structure, responsibilities, procedures, processes and the resources of staff and equipment; and
- the quality-control functions to be applied at all levels to the teaching, training, examination and assessment activities, and to their organization and implementation, in order to ensure their fitness for their purpose and the achievement of their defined objectives". (IMO 2017a, STCW B-I/8.3 and .4)

Each independent evaluation should include a systematic and independent examination of all quality activities. However, it should not evaluate the validity of the defined objectives (IMO 2017a, STCW B-I/8.6). It is advised, when applying quality standards, should take account of existing national or international models, and incorporate the following, among others, key elements:

(a) "the operational techniques and activities to ensure quality control;
(b) systematic monitoring arrangements, including internal quality-assurance evaluations, to ensure that all defined objectives are being achieved; and
(c) arrangements for periodic external quality evaluations as described in the following paragraphs below". (IMO 2017a, STCW B-I/8)

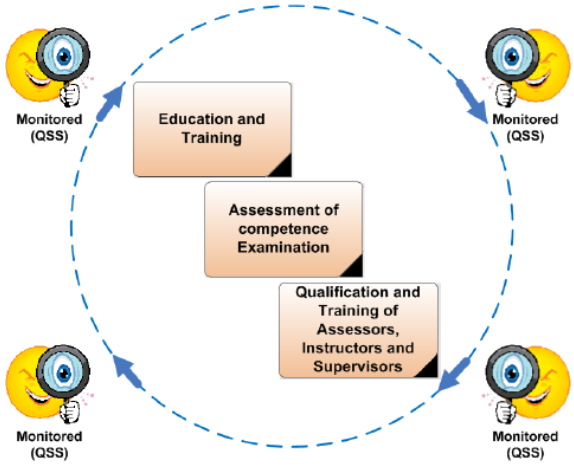

Figure 7. The quality of the MET shall be continuously monitored (EMSA 2016a)

6.2 Legislation for certification of seafarer in Finland

Finland is the Member State (MS) of the IMO, also a Party of the 1978 STCW Convention, and co-operates actively and widely for to promote its goals.

6.2.1 How the STCW Convention is affecting to the Member State?

Conventions, like the STCW are adopted by the IMO which is a specialized agency of the United Nations established on 17 March 1948 and is responsible for measures to improve the safety and security of international shipping and to prevent pollution from ships. Only a country can become a Member of IMO and it currently has 174 Member States. (Website of the International Maritime Organization 2021)

IMO, the early days only common denominator for the member states was the agreement that an international forum to discuss technical standards for ship construction and equipment was desirable. It was not until 1967 that the IMO was given a chance to develop a comprehensive profile. The foundering of the Torrey Canyon in that year highlighted loopholes in the international legislative framework, which prevented the IMO member states involved from reacting effectively to the accident. (Schröder-Hinrichs, Hollnagel, Baldauf, Hofmann & Kataria 2013, 245)

IMO's governing body is the Assembly which is made up of all the Member States. Its tasks are to adopt the budget together with technical resolutions and recommendations prepared by subsidiary bodies. The Council, of 40 Member States elected by the Assembly, acts as governing body in between Assembly sessions. The main technical work is carried out by the Maritime Safety, Marine Environment Protection, Legal, Technical Co-operation and Facilitation Committees and a number of sub-committees. By taking part to this technical work, example being joined in corresponding group established by the sub-committee, a member state has possibility to influence and pursue things in their interests. (Website of the International Maritime Organization 2021)

IMO's first chief concern was to develop international treaties and other legislation concerning safety and marine pollution prevention. However, this work had been largely completed already the late 1970s. Today IMO is concentrating on keeping legislation up to date and ensuring that it is ratified by as many countries as possible. As a result of its effort, many Conventions now apply to more than 98% of world merchant shipping tonnage. Currently the emphasis is on trying to ensure that these conventions and other treaties are properly implemented by the countries that have accepted them (Website of the International Maritime Organization 2021).

Important is to recognize. IMO does not implement any of legislation! This duty lies on a Member State. For example, as stated in the Article I of the 1978 STCW Convention:
"The Parties undertake to promulgate all laws, decrees, orders and regulations and to take all other steps which may be necessary to give the Convention full and complete effect, so as to ensure that, from the point of view of safety of life and property at sea and the protection of the marine environment, seafarers on board ships are qualified and fit for their duties".

IMO only adopt legislation and the Government of individual Member States is responsible for implementing it. When a Government of the State accepts an IMO Convention it agrees to make it part of its own national law and to enforce it just like any other law. With this government's responsibility, the flag State is responsible for certifying its ships and seafarers.

IMO also has an extensive technical co-operation programme which concentrates on improving the ability of developing countries to help themselves. It concentrates on developing human resources through maritime training and similar activities.

Furthermore, IMO has developed a Member State Audit Scheme and the audits became mandatory from 1 January 2016. The Audit Scheme is designed to help promote maritime safety and environmental protection by assessing how effectively Member States implement and enforce relevant IMO Convention standards, and by providing them with feedback and advice on their current performance.

6.2.2 The Act on Transport Services

The Act on Transport Services (320/2017) is part of national legislations in Finland. It includes two chapters 11 and 12 related to the study. Chapter 11 consist of qualifications of seafarers and apply to seafarers serving on board seagoing ships entitled to fly the flag of Finland. There are some exemptions on which cases the chapter does not apply, but are irrelevant in the scope.

Persons serving on board a vessel must have the qualifications set out in chapter 11 of the act. Furthermore, persons serving on board a vessel may, in addition to the qualifications for the capacity they hold on board, be required to have proficiency in accordance with the characteristics of the ship or the duties they have been assigned. Certificates of competency (hereafter also CoC) or certificates of proficiency (CoP) are issued to persons who have demonstrated qualifications. (A 320/2017, 98 §)

Regarding engine officers, he/she shall hold CoC for a motor vessel on board a motor vessel and a CoC for a steamship on board a steamship. (A 320/2017, 100 §)

Basically, the act descripts the documentary requirements how to demonstrate his/her qualification and does (s)he need to hold a certain proof for that. Even that the act is essential in general what comes to manning of seagoing ships, it mainly regulates a certain criteria for to the master and chief engineer in the view of this study. Example, the chief engineer officer of a vessel powered by main propulsion machinery of 3,000 kilowatts propulsion power or more shall hold a chief engineer officer certificate (A

320/2017, 101 §, subsection 7). Related to qualification requirements for the watch-keeping engineer, which is the scope of this study, the act does not give so much more.

However, the act is essential what comes to the relevance of a certain certificate. The Finnish Transport Safety Agency (Traficom) shall, on application, issue a certificate of competency and a certificate of proficiency and enter the related information in the transport register (A 320/2017, 107 §). For example, a condition for the issue of a certificate of competency is that the applicant satisfies, in respect of his or her knowledge, skills, training and experience, the qualification requirements for obtaining a certificate of competency. Certain minimum age and health criteria must also be fulfilled.

Also, in this context it is relevant to take into account section 110 of the Act (Recognition of certificates of competency or certificates of proficiency issued by competent authorities of other states under the STCW Convention).This section of the Act enables for Traficom to endorse the STCW certificate issued by the competent authority of another state. One criterion is, the person shall be familiar with Finnish maritime legislation to the extent that it is relevant to that position onboard in which (s)he will work. In this thesis a closer study was not made in which extent applicant shall be familiar about the Finnish maritime legislation in case of OEW. However, when another state, which shall be party of the IMO, has effectively implemented the international standards, for example MET-requirements, it is fairly simple to get learn legislation of foreign country. Structures of the legislation and the procedures of the implementations by state may vary. The context itself remains same as per agreed by international level. Like as requirements of the 1978 STCW Convention.

Like as the STCW requires, each party of the convention shall ensure that the education and training objectives and related standards of competence to be achieved are clearly defined (STCW, section A-I/8). Additionally, that the levels of knowledge, understanding and skills appropriate to the examinations and assessments required under the Convention are identified. For to this reason, a further requirement for obtaining a CoC and a CoP is that the Traficom has approved the training provider and the provided training in accordance with sections 114 and 116 (A 320/2017, 107 §, subsection 3). This amendment into the act is relatively new. In Finland, it came in force 1 July

2018 and is result from the new system for the approval of training providers and training provided by them. A requirement for approval of training is defined by section 116 of the act 320/2017. Subsection 2 defines that:

1) the training provider has a detailed written curriculum which includes teaching methods, procedures and teaching material necessary for meeting the qualification requirements;
2) the training provider has premises and equipment necessary for the training; and
3) training to be approved for a special reason under subsection 1 satisfies the requirements based on the guidelines and recommendations of the IMO or the International Labour Organization (ILO) or on other international obligations or the national requirements laid down under this Act or in the qualification requirements set by the Finnish National Agency for Education in order to ensure an adequate level of training.

This assessment is not a audit, which reflects objections to quality standards. A training provider shall apply for approval from the Traficom, which task is to assess whether the education and training complies with the requirements of the STCW Convention. The result for assessment, whether the MET-provider and any training programmes leading to a maritime CoC or CoP fulfills the requirements, may be also that some elements or functions are not enough, and thus cannot be accepted. Meaning, a negative decision is given on the application.

Approval shall be reapplied if substantial changes occur. An approved training provider shall inform the Finnish Transport Safety Agency if the information included in the application or other information given by the applicant changes. In practical terms, such a requirement should understand that, although the authority approves training, it is entirely the responsibility of the applicant for the context and validity of the information provided.

6.2.3 Other relevant national legislation

When the above legislation in the Act on Transport Services is fairly new and includes some new elements in the context of maritime training and education requirements,

perhaps a little better known are the traditional act of ship's crew and government decree of ship's crew that includes further provisions on the application for the certain act. Furthermore, the Finnish Transport Safety Agency, nowadays called Finnish Transport and Communications Agency (in this chapter hereafter the Agency) has issued further regulations of certification of seafarers. Perhaps in slightly different official terms, the legislation related to certification of seafarers have been in force for a long time. For certain reasons there have been necessary, time to time, to update this legislation for to fulfill prevailing needs. Currently in force are:

- the Act on Ships' Crews and the Safety Management of Ships, A 1687/2009;
- the Government Decree on the Manning of Ships and Certification of Seafarers, DG 508/2018; and
- the Finnish Transport Safety Agency's Regulation on the certification of seafarers, TRAFI/204498/2020.

The Act 1687/2009 lays down provisions on the manning of ships, watchkeeping, crew lists and the duty to submit information to the Transport Register. The Agency is responsible, for example, to store information on the seagoing service, training and qualifications of persons working on Finnish ships (section 26a). Act also lays down provisions on the national implementation of Regulation (EC) No 336/2006 of the European Parliament and of the Council on the implementation of the International Safety Management Code within the Community and repealing Council Regulation (EC) No 3051/95 (i.e. ISM Regulation).

As regards the subject matter of this thesis, the Government Decree 508/2018 is essential in many respects. Issued under the Act 1687/2009, the Government Decree establish provisions on the application for determination of minimum safe manning levels and on the validity of the minimum safe manning document (section 6, subsection 5). Additionally, issued under the Act 320/2017, provisions on the CoC, CoP and competence and proficiency requirements have been issued by the Government Decree in order to implement for example the STCW Convention and the SOLAS Convention. (107 §, subsection 4)

Under the provision of the Governments Decree (GD), instructors employed by a training provider or instructors, supervisors and assessors of training or supervised onboard training shall be appropriately qualified as provided by section 20 for training given either on board or ashore or for assessment of competence (GD 508/2018). The Decree necessitate:

“A person who conducts training qualifying for certification under the STCW Convention or a supervisor of supervised onboard training shall:

1) have an appreciation of the training programme and an understanding of the specific training objectives for the training being conducted;
2) be qualified in the task for which training is being conducted;
3) if conducting training using a simulator, have received appropriate guidance in instruction techniques involving the use of simulators and have gained practical operational experience on the type of simulator used ”.

Furthermore, any person responsible for training or the supervision of supervised onboard training of a seafarer intended to be used in qualifying for a CoC or a CoP shall have a full understanding of the training programme and the specific objectives for each type of training being conducted. Thirdly:

“Any person conducting assessment of training or onboard training of a seafarer in training or onboard training which is intended to be used in qualifying for a certificate of competency and certificate of proficiency covered by the STCW Convention shall:

1) have an appropriate level of knowledge and understanding of the competence to be assessed;
2) be qualified in the task for which the assessment is being made;
3) have received appropriate guidance in assessment methods and practice;
4) have gained practical assessment experience; and
5) if conducting assessment involving the use of simulators, have gained practical assessment experience on the type of simulator used under the supervision and to the satisfaction of an experienced assessor ”.

The above requirements are very clearly established and respectively shall be also followed. What is not specifically required, a person carrying out some of training tasks

descripted above shall not necessarily need to hold CoC or CoP by him-/herself. Practically means, his/her qualifications criteria shall be included in and descripted by the training provider's quality control system. This is required also by the decree (GD 508/2018, section 20, subsection 5).

Applications for certification shall include documentary evidence of training and work experience. Requirements applying STCW A-III/1-level Watchkeeping engineer's certificate is under section 36 and are studied in chapter 7 of the thesis.

The Act on Transport Services enables also for the Agency to issue further regulations in order to implement the guidelines and recommendations of the IMO. The Agency may also issue further regulations on the procedures related to the application for certificates of competency and certificates of proficiency. (A 320/2017, 107 §, subsection 5)

7 TRAINING REQUIREMENTS FOR CERTIFICATION OF OEW

Where all the different proficiency requirement levels for certifications would have formed too large content for the Author's resources, the engineer level A-III/1 of the STCW was selected solely for closer review. Background reasons was:

- author's own intention for marine engineering;
- personal knowledge best supports this choice when author itself holds a management level CoC (A-III/2); and
- operational level A-III/1 can be the final but also mandatory intermediate step for individual person when aims to achieve management level competence.

As has already been said, every OEW (Officer in charge of an engineering watch) shall hold a CoC (Certificate of Competency) and for certification shall meet the specific standard of competence. *Standard of competence* means: "the level of proficiency to be achieved for the proper performance of functions on board ship in accordance with the internationally agreed criteria and incorporating prescribed standards or levels of knowledge, understanding and demonstrated skill" (IMO 2017a, STCW A-I/1.1).

In this chapter marine engineer operational level competence requirements are presented as regulated by the STCW in reg. III/1, that set mandatory minimum requirements for certification of OEW. For certification, (s)he shall:

1) "be not less than 18 years of age;
2) have completed combined workshop skills training and an approved seagoing service of not less than 12 months as part of an approved training programme which includes onboard training that meets the requirements of section A-III/1 of the STCW Code and is documented in an approved training record book,

   -

   or otherwise have completed combined workshop skills training and an approved seagoing service of not less than 36 months of which not less than 30 months shall be seagoing service in the engine department;
3) have performed, during the required seagoing service, engine-room watchkeeping duties under the supervision of the chief engineer officer or a qualified engineer officer for a period of not less than six months;

4) have completed approved education and training and meet the standard of competence specified in section A-III/1 of the STCW Code; and
5) meet the standard of competence specified in section A-VI/1, paragraph 2, section A-VI/2, paragraphs 1 to 4, section A-VI/3, paragraphs 1 to 4 and section A-VI/4, paragraphs 1 to 3 of the STCW Code".

Figure 8 below illustrate shortly the above requirements for certification. The requirement contains certain training needs for to meet competency of proficiencies (para 5 in the above list of requirements). Based on the STCW Code, these trainings are:

BT	basic training, formerly also called basic safety training, as per section A-VI/1, paragraph 2;
SCRB	survival craft and rescue boats other than fast rescue boats as per section A-VI/2, paragraphs 1 to 4;
AFF	advanced fire fighting as per section A-VI/3, paragraphs 1 to 4; and
MFA	medical first aid as per section A-VI/4, paragraphs 1 to 3.

The CoP requirements are more or less common for all officers in charge and are not included in this study. In the view of the thesis, the minimum age is the one that no need more attention as well. However, combined workshop skills training and an approved seagoing service as part of an approved training programme, performed engine-room watchkeeping duties during the required seagoing service and approved education and training are the topics what is covered more closely in this chapter.

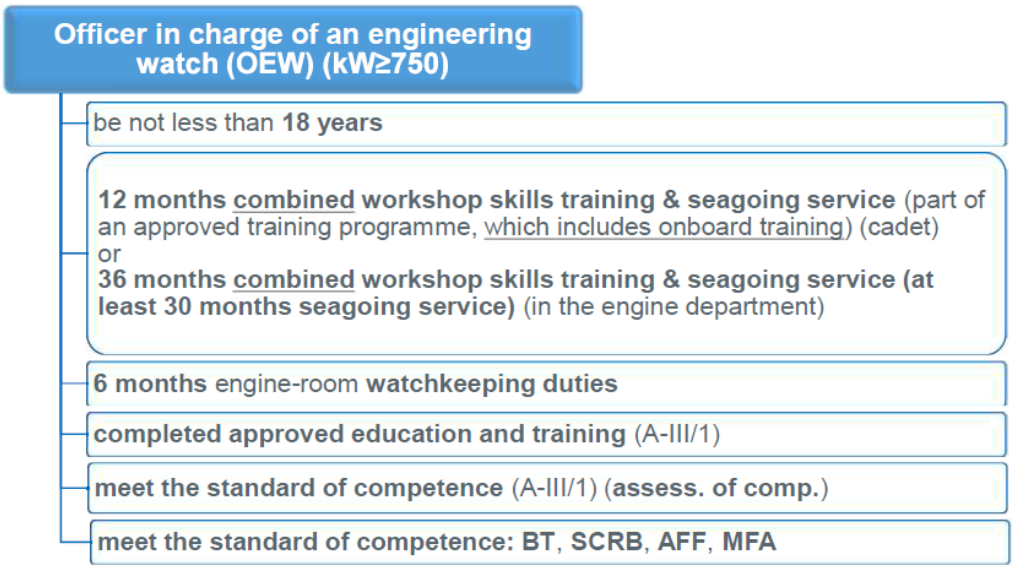

Figure 8: Criteria for certification of OEW (EMSA 2016b)

7.1 Standard of competence vs. observed experiences

Every person for certification shall be required to demonstrate ability to undertake the tasks, duties and responsibilities listed in column 1 of the KUP-table A-III/1, which are divided in four functions at the operational level:

- Marine engineering;
- Electrical, electronic and control engineering;
- Maintenance and repair; and
- Controlling the operation of the ship and care for persons on board.

The minimum knowledge, understanding and proficiency required for each function is listed in column 2 of the table and shall be sufficient for engineer officers to carry out their watchkeeping duties. The MET-provider may use the relevant IMO Model Course(s) of assistance in the preparation of courses but this is not mandatory requirement. Actually, training provider is free to prepare the needed courses and teaching materials, provided that all the contents of column 2 of the KUP-table are included in the teaching.

Section A-VIII/2, part 4-2 of the Code set up, the *officer in charge of the engineering watch* is the chief engineer officer's representative and is primarily responsible, at all times, for the safe and efficient operation and upkeep of machinery affecting the safety

of the ship (sub-section 53). Sub-section continues, (s)he is responsible for the inspection, operation and testing, as required, of all machinery and equipment under the responsibility of the engineering watch.

The above is essential to remember when education and training is provided to achieve the necessary skills. This shall be organized in a way that principles based on section A-VIII/2, part 4-2 can be fulfilled. Principles to be observed in keeping an engineering watch. This practically means that when (s)he carries out engine-room watchkeeping duties during the six months training period and under the supervision, shall supervisor be aware also about evaluation criteria as presented in the column 4 of the KUP-table. In fact, any person responsible for the supervision of in-service training of a seafarer intended to be used in qualifying for certification under the Convention shall have a full understanding of the training programme and the specific objectives for each type of training being conducted (IMO 2017a, STCW A-I/1.6.5). Overall, every trainee shall be required to provide evidence of having achieved the required standard of competence in accordance with the methods for demonstrating competence (column 3) and the criteria for evaluating competence tabulated in column 4 of the KUP-table. Practically, this evidence is the diploma provided by the MET-institution. Meaning, the school is responsible to follow the evaluation methods and criteria as descripted in the KUP-table.

To be able to manage the whole above, training providers must have the curriculums which includes teaching methods, procedures and teaching material necessary for meeting the qualification requirements. This documentation presents what courses are studied under each programmes for to achieve a certain competence. The written curriculum must include course descriptions and details of the context of the course, criteria for evaluation and how the student shall demonstrate his/her competence (methods for demonstrating).

Context of the course, in case of A-III/1 level studies, shall correspond with the competencies for all four functions listed in column 1. Each of competence includes one or more subjects from which there must receive knowledge, understanding and proficiency. This ensures the ability to undertake the tasks, duties and responsibilities. These subjects are listed in column 2. Overall, this means that courses altogether,

which are included in the curriculum that leads to complete the approved education and training and meet the standard of competence specified in section A-III/1, shall include all four functions with all competence subject areas as listed in column 2.

There are a couple of 'exemption' if some of learning objectives as required are omitted. For example, if serving solely in ships in which steam boilers do not form part of their machinery, (s)he may omit the relevant requirements of table A-III/1. Important is to note, only a national authority is a legitimate right to omit certain knowledge requirements for types of propulsion machinery. Furthermore, a certificate awarded on such a basis is not thus valid for certain category of machinery installation and any such limitation shall be stated on the certificate and in the endorsement. (IMO 2017a, STCW A-III/1.7 and 1.8)

Required competence (column 1) and included subjects may be studied during a single course but very often these subjects are divided and included with two or more courses. This is mainly because of structure of training providers courses differs with the structure of KUP-tables. This is not, however, a wrong in respect of the 1978 STCW but is challenging what comes to evaluation process and to achieve objective evidence if all necessary competencies and subject areas are included in the context. Generally, the training providers have a pretty good tools for to show that all needed competencies are included in the scope of the training programme and should not be a problem. This was studied when author was involved in two evaluation processes carried out by Traficom during 2019 and 2020. As noted, training provider is free to prepare the needed courses and teaching materials, provided that all the contents of column 2 of the KUP table are included in the teaching. And this requirement was well followed.

Where the column 2 contains relevant subject areas that shall be included in training. The column 3, in turn, presents the relevant methods for to demonstrate the competence. By other words, this column gives the approved assessment method how to obtain the evidence of each of subject for evaluation.

OEW studies contains 18 different listed competencies (see appendix, column 1). Furthermore, approximately 41 different subject areas is possible to calculate listed in column 2. These subject areas are not numbered in the official publications but are

shown in the appendix with figures /1/ - /41/ in the column 2. How the competence of these subjects be shall demonstrated according to column 3?

Column 3 contains ten different types of groups of methods for demonstrating competence. There are certain differences between these groups and can be allocated from A to J as illustrated in table 4 at next page.

During the evaluation processes carried out by Traficom in 2019 and 2020, was closely examined course descriptions that were necessary for to complete approved education and training and meet the standard of competence. Was noted that solely exam and some practical exercises was recorded into documented programmes as a method for to students to demonstrate his/her competency and these were also criteria how the evaluation is carried out. Of course, onboard training sessions and relevant in-service and practical experiences were noticed by the curriculum. But only by generic way and were not linked to evaluation processes. This was quite confusing. According to table A-III/1 only two of required competencies (i.e. *relevant skills to use English in written and oral forms* and *ability to monitor compliance with legislative requirements*) can be considered to being evaluated solely by the examination (see letters C and I in the table 4). These two subjects are less than 5% of all needed subjects that has to be fulfilled.

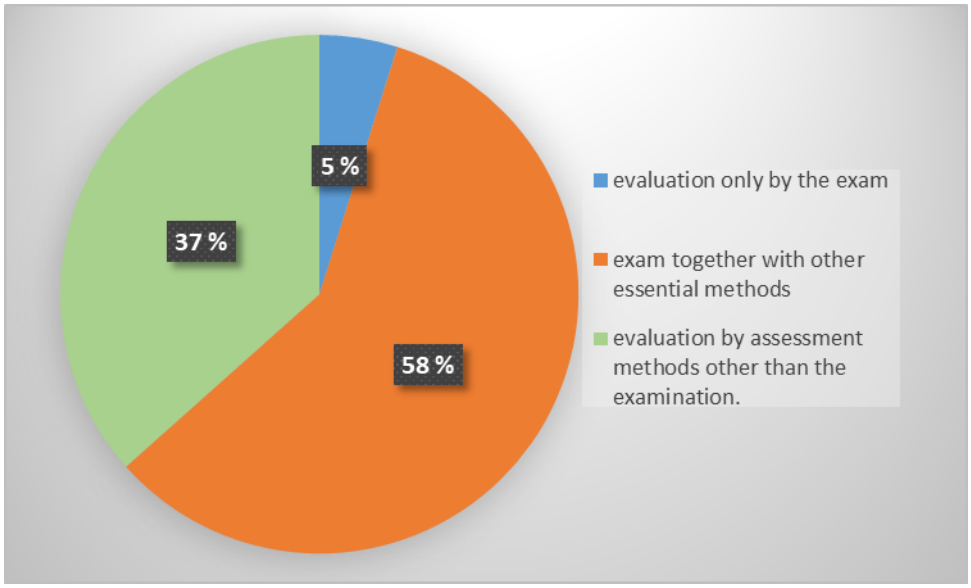

Figure 9. Breakdown of evaluation criteria for different learning subjects of Officer in charge of an engineering watch -studies

Table 4. Groups of methods for demonstrating competence (IMO 2017a, KUP-table A-III/1)

(A) Assessment of evidence obtained from one or more of the following: - approved in-service experience; - approved training ship experience; - approved simulator training, where appropriate; - approved laboratory equipment training.
(B) Assessment of evidence obtained from one or more of the following: - approved training; - approved in-service experience; - approved simulator training.
(C) Examination and assessment of evidence obtained from practical instruction
(D) Examination and assessment of evidence obtained from one or more of the following: - approved in-service experience; - approved training ship experience; - approved simulator training, where appropriate; - approved laboratory equipment training.
(E) Examination and assessment of evidence obtained from one or more of the following - approved in-service experience; - approved training ship experience; - approved laboratory equipment training.
(F) Examination and assessment of evidence obtained from one or more of the following - approved in-service experience; - approved training ship experience; - approved training.
(G) Examination and assessment of evidence obtained from one or more of the following: - approved workshop skills training; - approved practical experience and tests; - approved in-service experience; - approved training ship experience.
(H) Assessment of evidence obtained from approved certain training and experience as set out in certain section of the Code
(I) Assessment of evidence obtained from examination or approved training
(J) Assessment of evidence obtained from one or more of the following: - approved training; - approved in-service experience; and/or - practical demonstration.

In case of many, to use an exam for evaluation is one possible part of the whole evaluation concept and it is acceptable together with other essential methods in nearly 59% of all subjects. Depending of competency and subject included, additionally is required:

- approved in-service experience;
- approved training ship experience;
- approved simulator training, where appropriate;
- approved laboratory equipment training;
- approved training;
- approved workshop skills training; and/or
- approved practical experience and tests.

Meaning that by using an exam is possibility to do part of required evaluations but also some other criteria shall be included for to be able fulfill the requirements. The groups D, E, F and G in the table 4 represents these methods for demonstrating competence. Essential is also to note that about 37% of subjects that are listed into 18 different competencies needed for the OEW, evaluation and criteria for that must be carried out by relevant assessment methods other than the examination. The groups A, B, H and J represents these assessment of evidence cases with following methods:

- approved in-service experience;
- approved training ship experience;
- approved simulator training;
- approved laboratory equipment training;
- approved training; and/or
- practical demonstration.

The education and training shall include also a relevant training in mechanical and electrical workshop for to learn practical skills as needed for an engineer officer. This training in workshop ashore can be carried out in a training institution or approved workshop (IMO 2017a, STCW B-III/1). Also, different simulator or laboratory equipment trainings can be acceptable to fulfill the standard training requirements.

A fascinating and multi functional simulators are available today. Those are a good aid in many ways. However, it is unprofessional and surreal to believe for yourself that these simulated facilities would fully replace the real-life learning environments. Especially marine engineer studies includes training subjects where real onboard environments are necessary for to offer qualified training.

For example, for to maintain a full scale engineer watch training is difficult to arrange if not in real environment. Also, full scale operation of main and auxiliary machineries together with all associated control systems necessitate real engine room facilities. Furthermore, different maintenance and repair skills for mechanical, electrical and electronic equipment requires the real understanding for engine room and onboard environments. Even the precautions to prevent pollution of the marine environment and important proactive measures to protect the marine environment shall be assessed by evidence obtained onboard (IMO 2017a, STCW table A-III/1). Ms. Miettinen, in her thesis in 2017 was noted as well that certain learning subjects shall be assessed through onboard training, previous work experience or practical demonstration (2017, 9).

In truth, recourses for the training providers are often limited. It is recognized by the training providers itself that often founds some lack of facilities for to perform some of learnings objectives under by professional and qualified teachers (author's experience). Thus, according to normal practice, the institutions rely on onboard training periods where the students should be able to have knowledge, understanding and proficiency for certain subjects and the gap can be fulfilled. Of course, this is acceptable, but only if correctly managed.

7.2 Onboard training

In almost all countries and cultures of the world, operational education and training for transportation on water has origins in an on-the-job training paradigm. According to Dr. Michael Ekow Manuel, traditional seafarer training has always focused on the acquisition and use of practical skills (2017, 1).

The 1978 STCW recognize this paradigm on multiple ways and makes references for training of practical skills. For example, marine engineer operational level competence requirements by paragraph 2.4 of regulation III/1 are acceptable only when also meet the standard of competence where the MET includes training in mechanical and electrical workshop skills relevant to the duties of an engineer officer (IMO 2017a, STCW A-III/1.1). Additionally section B of the Code gives guidelines for the training in workshop skills (IMO 2017a, STCW B-III/1).

The requirements includes also mandatory minimum criteria for on-the-job training onboard where necessary practical skills can be learnt. For certification, (s)he shall (IMO 2017a, STCW Reg. III/1.2.2):

a) "have completed combined workshop skills training and an approved seagoing service of not less than 12 months as part of an approved training programme which includes onboard training that meets the requirements of section A-III/1 of the STCW Code and is documented in an approved TRB (training record book)".

Alternatively (s)he may:

b) "have completed combined workshop skills training and an approved seagoing service of not less than 36 months of which not less than 30 months shall be seagoing service in the engine department".

No clear data have been evaluated, but may likely to believe that option *a)* is more common way to fulfill the requirement of an approved seagoing service. Additionally, (s)he must have performed, during the required seagoing service, engine-room watch-keeping duties for a period of not less than six months (IMO 2017a, STCW Reg. III/1.2.3). Practically, this six month period with learning subjects for engine-room watchkeeping duties can be included and conducted simultaneously together with 12 months OBT period.

Mr. Zhukov have written, one of the most important STCW Convention requirements for certification of the officers in charge of an engineering watch is onboard training. He also noted, when the TRB is objective evidence of the OBT for a officer, the quality of this OBT fully depends on the Company's Safety and Quality Management System procedure. (2015, 393)

When the students are onboard it is certainly vital that (s)he is able to act as an apprentice together with qualified assessors. The starting point for OBT is to ensures that the apprentice receives systematic practical training and experience in the tasks, duties and responsibilities of an officer in charge of an engine-room watch.

For to evaluate his/her competence at onboard environment is inconsistent unless been closely supervised and monitored by a qualified and certificated engineer officer aboard the ships. Moreover, all kind of quality standards requires that any kind of processes, which contains training and/or familiarizing and evaluations shall be adequately documented. In case of OBT, the training record book is the required method for documentation. The importance of this document cannot be disputed.

Onboard training is a period of seagoing service and used as a method to implement certain parts of the skill objectives required for qualification. It is a part of learning process where theoretical studies are implemented and applied in real environment. What comes to standard of competence required by the STCW, onboard training is indeed a vital part also because some learning objectives (or subjects areas) are difficult, or even impossible, to organize in a facility of maritime training provider and solely by the resources of them.

Whilst it is evident that the Convention requires the OBT, and stipulates the minimum amount of seagoing service which is required, it does not require parties or companies to employ officer trainees or provide the on board accommodation for officer trainees. It is axiomatic that if companies are not engaged in training or do not provide the onboard accommodation for officer trainees the provision of a well-skilled maritime workforce is endangered (Zhukov 2015, 394).

On the other hand, the onboard training can be also see as a ISM (International Safety Management) related issue. The Chapter 6 of the ISM Code(IMO Res. A.741(18)) requires that:
"The Company should establish and maintain procedures for identifying any training which may be required in support of the safety management system and ensure that such training is provided for all personnel concerned".

It might be common misunderstood that the chapter 6 of the ISM Code is intended to cover personnel employed on board only. When procedures for identifying required training is required to cover any training, also the training for apprentice should bee

understood to support the intention of the SMS. There is not any reference that procedures should cover solely company's employees bodies. Meaning that onboard training needs for the students as well should be ensured for to cover these objectives.

7.2.1 The Apprentice Mill in Finland

There are several models and habits how the OBT periods are organized and how it is ensured that the students are able to joint onboard and be part of real shipboard work environment. This study does not contain evaluation of different OBT models. Generally in Finland, the MET-providers are involved well to this and also the Finnish shipping companies are well collaborated. Thus, a short presentation of model of Finland is included for to give understanding for one possibility.

The Apprentice Mill (in Finnish: Merenkulun HarjoitteluMylly) was established in 2012 by the Finnish Shipowner's Association and the Finnish maritime academies. In 2015 the Apprentice Mill became its own association which lead the Finnish Shipowner's Association and the maritime academies to become members of the association. The purpose of the Apprentice Mill is to coordinate onboard training placements evenly between the Finnish maritime academies and their students. During the first year of activity Apprentice Mill distributed approximately 700 onboard training placements. In 2019 approximately 950 places were distributed and in 2020 around 800.
The "Mill" acts as a link between the maritime academies and the shipping companies in Finland. Apart from coordinating onboard placements, other important task for Apprentice Mill is to inform the maritime academies and shipping companies about the current onboard training situations. (Website of the Finnish Shipowner's Association 2021)

7.2.2 Global challenges

Generally, in the course of their college study, the students are required to spend time at sea undergoing structured on the job training for practical skills, under the supervision of senior officers on board. Usually, these onboard training opportunities are provided by fleet of merchant vessels owned by shipping companies.

However, students may also spend their ‘sea-time’ aboard a training vessel, owned and run by the institution in which they are enrolled. In Finland, the MET-providers’ have invested also to use own training vessels. One example is the motor vessel (MV) Merikarhu. In the past, the vessel serves as a patrol and oil recovery activities for the Finnish Boarder Guard. End of the 2020, she was transferred to the Joint Authority of Education of Kotka-Hamina Region Group (Ekami) in Finland and will be used for maritime education purposes. She replaces previous school’s owned training vessel MV Katarina, which was put up for sale. (Vartiolaiva Merikarhu… YLE 2020a)

Figure 10: The ex-patrol vessel Merikarhu is a new training ship of the Joint Authority of Education of Kotka-Hamina Region Group (Photo: Antti-Jussi Korhonen / Yle)

Inevitably, there are both advantages and disadvantages in such arrangements. For example, being aboard training ships may offer better access to computer-based training programmes, lectures and libraries (Sampson 2004, 252). On the other hand, students unlikely to experience same kind of maintenance and repair opportunities as aboard on merchant vessels and may not gain experience of prevailing current practices in engineering skills, learning rather outdated habits instead. Training vessel owned by the MET-institution are often quite old ones, thus not include modern techniques for machineries. For example, MV Merikarhu is 27 years old (built 1994). She was decommissioned by the Border Guard 2019 because no longer met the requirements of the Border Guard (Vartiolaiva Merikarhu… YLE 2020b). Similarly, MV Katarina was

built 1953 and serves as a MET-vessel since 1989 (Vartiolaiva Merikarhu… YLE 2020a), when she was already 36 years old lady.

Author's personal view. Even if the Merikarhu will offer better facilities for training for deck and navigational purposes than previous vessel Katarina, it is already old for marine engineer training needs. Specifically, when the environment requirements are continuously more strict, commercial ships are under constant pressure for development and shipping companies are forced to upgrade machinery equipment or order newbuilding vessels. The MET-providers do not similar pressure to do the same actions. Moreover, they seldom have finance resources for to upgrade the training vessel as much as should be necessary.

Looking for developing county perspective. Countries may suffer a lack of sufficient fleet that could offer suitable opportunities for training purposes. Some MET-provider do not have relevant chance to negotiate a contract with merchant companies whose vessels would fly the flag for it. Mr. Laine has stated, the training of practical work tasks on construction sites is quite limited in Namibia, as there are hardly any experts and equipment in the field or they are not ready to touch to those equipment (2020, 17).

The same was faced 2019 when the Traficom conducted the assessment applied for by a consortium of the Satakunta University of Applied Sciences (SAMK) and the Namibian University of Science and Technology (NUST). The application was a natural continuation of the MARIBILIS-project (2017-2020), which aim was to improve maritime education of Namibia with double degree program of maritime engineering. The NUST has premises in Windhoek, a city inland. The Namibia Maritime and Fisheries Institute (NAMFI) had been selected as a partner in the project, which already had training facilities where mainly personnel have been trained for fishing vessels. Thus, the NAMFI was involved into assessment as well.

For to tackle the lack of proper fleet for training purposes, the fisheries and multidisciplinary research vessel RV Mirabilis has been used for to train local students in Namibia. During the MARIBILIS-project one of the objectives were to integrate RV Mirabilis into training environments (Laine 2019, 13). The vessel is owned and operated

by the Ministry of Fisheries and Marine Resources of the Republic of Namibia that was not, as understood, directly and fully committed into this development project. Thus, was evidently able to saw difficulties of the MET-provider to generate a reliable syllabus for their purposes. Although the NUST and NAMFI are well placed to train on their own premises (i.e. workshops and laboratories), they have a major problem negotiating with shipowners on training needs that require a real ship environment. For the Author it is easy to agree with Laine's statement: “As a result, in the training of service and maintenance, it is difficult to get beyond the beginning with theoretical knowledge alone” (Laine 2019, 17). All simulated exercises are necessary. However, those position in teaching as a whole is more or less on the side of theoretical learning and cannot replace what has been learned in real environments.

Figure 11: RV Mirabilis at the pier of its home port, Walvis-Bay (Namibia), in October 2019 (Photo: Ari Heinonen)

For to fulfill obligation to offer an approved education and training for students, MET-provider is almost necessary to be able to trust shipping companies that they offer traineeship opportunities. Unfortunately, even if the fleet is existing, in the past are some shipping companies reported to be reluctant to invest in training offering cadets’ berths aboard their working vessels. This lack of berths have caused genuine problems

for training providers who could not organize appropriate sea-time for their students (Sampson 2004, 258).

A concrete example is from Romania where the students of Constantza Maritime University (CMU) surpassed great difficulties in order to acquire sufficient months of sea training. Prior 2006, Romanian and foreign ship owners were unwilling to accept CMU's or other cadets on board their ships resulting that only 60-65% of students found placement. A result of this dilemma, luckily, the crewing and shipping companies got familiar of a negative prognosis where the shortage of well-trained officers for the merchant fleet during the next 10 years would be true (Barsan, Muntean 2010, 351). However, according to collected data from the students of the CMU, the cadets were not usually guided and monitored. In most of the cases, the cadets had to learn by themselves, looking and copying the actions and work style of the ship's officers (Barsan, Muntean 2010, 352). This is a severe finding because it is clearly regulated that during the training period at sea must be ensured the cadets shall receive systematic practical training and experience in the scope of his/her studies. And this must be also supervised and monitored onboard in which the training period (seagoing service) is performed (IMO 2017a, STCW A-I/6).

When student does not receive appropriate onboard training, are consequences significant. Not only did it mean that some students are unable to qualify for their certificates of competence, regardless of their academic performance, but such poor actions also impact negatively on student motivation and could result in drop-out from diploma courses. Some METs have countered such problems by refusing to accept cadets unless they are already sponsored by a company, whilst others have attempted to supply sea-time themselves by investing in hugely expensive training ships aboard which cadets spend time engaged in practical training (Sampson 2004, 258). However, these kind of 'competition elements' does not offer equal study opportunities for the candidates.

Already in 1989, Mr. Lau wrote that the state of MET affairs can be summed as fluid, evolving and changing. Institutions have agreed that the world is in an age of vast and rapid change (Lau 1989, 20). Perhaps more than ever, today this agreement can be seen in climate issues. The advance in technology in the few decades has been rapid and

major new techniques have been implemented. MET-providers must be closely involved in this development. For students who become marine engineers this mean that they need adequate training onboard. This is not possible without a strong cooperation between industry and MET institutions. In this context, it seems to be clear that is vital in these countries, which has interest to maritime education, for to response to new demands of technology.

Based on Authors experience, when approving training courses and programmes, the curriculums and course contents for the MET-providers usually recognize the period of the onboard training. Course structures are also made in a way that the timing for period supports the learning process. Furthermore, at least in Finland, the system provided by the Apprentice Mill offers fairly equal opportunities for each to get joined onboard. However, concerns go beyond than simple involvement in work-based training periods. It is question of the quality and management of such periods. And moreover, how it is ensured that this period will fulfill all those possible gaps what the MET-provider have identified in their own recourses?

It is pointed out, it is not enough to have cadet placements. These placements must entail the delivery of quality training and not an excuse for the employment of cheap manual labour (Sampson 2004, 259). Quality of the learning environment is of critical importance. Equal importance is to ensure that detailed learning objectives are covered. Meaning, the minimum knowledge, understanding and proficiency required for certification as listed in column 2 of the KUP-table. In other words, all subjects indicated by the KUP-table, example table A-III/1, are covered and correctly indicated in the written curriculum (i.e. course description for onboard training periods). When any subject (column 2) is recognized to be covered by the onboard training, it is correct to do so if this is in line with the method for demonstrating the competence (column 3). This should also be possible to recognized when read the syllabus or course description. Clear information should be given which subject is planned to cover by aid of the onboard training period. Moreover, because has a full responsibility for to implement the education and training, the MET-provider should effectively monitor that education and training objectives and related standards of competence to be achieved are clearly defined (STCW A-I/8). Additionally, monitoring shall include that appropriate

assessment required under the Convention are identified (A-I/8) and also used. All this applies also to OBT period implementations.

The findings, reported by Ms. Sampson 2004, suggest that the quality of provision for learning environment and the teaching provided is far from homogenous (Sampson 2004, 259).

It is true that unevenness of provision exists in METs across the world and natural variation can be attributed to the individual characteristics of teachers or key individuals. But crucially from the uneven distribution of resource across such institutions and between nation States (Sampson 2004, 259). Crucial quality problem also exists if the MET-providers doesn't but attention to details in theirs plans to teach. A question remains, do they in practice manage the evaluation processes of the students as should be done? The Author would say that a critical internal analysis for this issue would be essential to do in certain intervals.

8 THESIS RESULTS

Shipping is such an old industry and has been at the forefront of global development and it is real global and multilateral industry. Through the IMO this 'backbone of globalization' has dealt with challenges by developing an efficient framework of regulatory and contractual relationships between the parties. In this context, also MET-learning methods and results (i.e. quality for seafarers) is a broadly discussed topic.

For the preparation myself, it was necessary to carry out a comprehensive study of the past. This was necessary, because to develop of education and training is a long term process. It was essential to study, what kind of steps has been in the past. For this purpose, it was first intended to conduct some on-the-spot interviews in the maritime sector. However, because of restrictions caused by the Covid-19 epidemic, this method was replaced by expanding the literature review. Being a part of Traficom's evaluation group that assessed MET-provider and its training programmes in Namibia (2019) and in Greece (2020) were an essential influence for this thesis. These trips offered a great opportunity to learn a wider view of the MET overall and gave a knowledge of prevailing teaching practices.

In the thesis, I have looked at MET from a variety of sources and perspectives (i.e. historical traditions, socioeconomic impact, legality criteria). Purpose was to deal with the implementation of the STCW Convention, focusing on on-board training, and evaluate the effectiveness of standards of competence, education and training in this perspective. The aim was to descript how the onboard training should be understood as part of an approved training programme and how should it therefore be realized.

The minimum standards of competence required for seagoing personnel are given in detail in a series of KUP-tables as presented in the STCW Convention. KUP-table, for example A-III/1 relevant for OEW, consist of four columns, which are: competence (1); knowledge, understanding and proficiency (2); methods for demonstrating competence (3) and criteria for evaluating competence (4). Required competence (column 1) and included subjects may be studied during a single course but very often these subjects are divided with two or more courses. This is mainly because of structure of

training providers courses differs with the structure of KUP-tables (i.e. the current curriculum structure is poorly compatible with the structure of the KUP table).

The column 2 contains relevant subject areas that shall be included in training. The column 3 gives the approved assessment method how to obtain the evidence of each of subject for evaluation. MET-providers should ensure that the competence of these subjects are evaluated as criteria is given in the column 4. The KUP-table A-III/1 relevant for OEW studies contains 18 competencies and approximately 41 different subject areas is possible to calculate to be found (see appendix). With certain differences, column 3 contains ten (10) different types of groups of methods for demonstrating competence. From this point of view, it can be determined that:

- less than 5% of all needed subjects that has to be fulfilled can be considered to being evaluated solely by the exam (letters C and I in the table 3); and
- in many cases, an exam for evaluation is only one part of the whole evaluation concept, and it is mentioned together with other essential methods in nearly 59% of all subjects.

Depending of competency and subject, the evaluation shall consist also additional elements. Essential is also to note that about 37% of subjects the evaluation and criteria for that must be carried out by other assessment methods than examination. Even if this remaining part consist of methods which can be conducted by using the MET-providers facilities, are 3-4 of 6 such a kind of methods that requires to use real onboard environment.

The 1978 STCW Convention had a major influence on training within the industry. It was the first to establish basic requirements on training, certification and watchkeeping for seafarers on an international level and at same time introduced a system of enforced self-regulation. Where the developed world, with vast resources, expertise and experience, may have a fairly good situation in general for its adoption the less developed countries may face a number of challenges. This imbalance at global level is due to when the developed countries have had the economic resources at state level to devote to the provision of quality vocational training for seafarers. They have had recourses to implement the requirements set by the STCW Convention. But not perhaps as well

as should. At the same time developing countries have had, and will have, a multiple kind of difficulties for to develop their economies with aid by their own maritime sector.

The physical resource that supports education and training includes wide range of needs be available on site or in an accessible location (i.e. laboratory facilities, simulation equipment, audio and visual aids, libraries, computers and computer-based training programmes, swimming pools, lifeboat and fire drill equipment). In 2004 Ms. Sampson noted that such resources are not evenly distributed across MET (2004, 252). Even if there has been a good development, still same lack of the resources exists in less developed countries. However, they seem to be really committed to training, which is always a good sign to succeed in developing these activities.

Traditionally training of seafarer has focused on the acquisition and use of practical skills. An on-the-job training paradigm has been in use widely over the world. This kind of vocational education provides specific and restricted competence outcomes. The global trend in maritime education and training is increasingly to link an essentially vocational education with more general or deeper academic components leading to an academic qualification. This trend has led to some dilemmas for curriculum development, for training legislation in a global industry, and for achieving desired learning outcomes in a professional setting in the shipping industry. Dr. Manuel has presented a list of challenges what exists. He mentions: qualifications of instructors; content and the time available; relevant learning activities/teaching methods; availability of capital resources; assessment approaches; and synergies between quality standards systems. Similar topics was noticed also when Traficom carries out the assessments. It seems that two last ones (assessment methods and synergies between QS-systems) are generally prominent observations. Meaning that there are challenges related to facets of curriculum design and implementation.

When the curriculum, moreover details given by course description is not coherent enough it is fairly difficult to show objectively if the MET truly meets the required standard. Even if the both parties, MET-provider and the supervising authority should recognize possible discrepancies and together to handle these aspects it is entirely the

responsibility of MET-provider for the context and validity of the information provided. Trainees and employees may be connected to this being targets (i.e. object to assess) during the assessment process but they are not involved as a party in approval of the MET.

The 1978 STCW recognize the a.m. traditional paradigm on multiple ways and makes many references to the onboard training. For certification, (s)he shall have completed combined workshop skills training and an approved seagoing service of not less than 12 months. Or alternatively, 36 months combined workshop skills training and an approved seagoing service. These are identical methods when certain skill objectives required for qualification are applied in real work environment (i.e. theoretical studies are combined with the real one and applied with practical skills). When the '12 months' option is chosen, training and seagoing service shall include onboard training (OBT) that meets the requirements of section A-III/1 of the STCW Code and is documented in an approved training record book (TRB). Basis of this kind review, these two options (i.e. 12 mths vs. 36 mths.) should give an equal practical skill objectives required for qualification.

There are several models and habits how the OBT periods are organized. Training vessel owned by the MET-institution, the merchant fleet of the nation or the cadet system. In Finland is used the Apprentice Mill and it seems that because of many is the MET-provider almost necessary to be able to trust shipping companies that they offer traineeship opportunities. Whilst it is evident that the Convention requires the onboard training, and stipulates the minimum amount of seagoing service, which is required, it does not require parties or companies to provide the onboard opportunities for students. This have caused genuine problems for METs who could not organize appropriate sea-time for their students. For example, currently Namibia has only minor training facilities for onboard training.

If we assume compliance with the letter of the STCW 'law', therefore, and overlook concerns about the pragmatic application of regulation in the sector, the question nevertheless remains as to whether party states comply with the 'spirit' of the code in successfully raising standards of competence amongst their officer corps, and standards of education and training in their maritime colleges?

Even if the quality of provision for learning environment and the teaching provided is far from homogenous. It can be said also, that STCW is a proactive output, but it would be more significant to understand that the proper exploitation of its spirit will provide a proactive way to prevent accidents.

9 CONCLUSIONS

Thesis deals with the implementation of the STCW Convention, focusing on on-board training. And evaluate the effectiveness of standards of competence, education and training in this perspective.

The ship. Means of transport at the center of shipping is the main instruments of the maritime industry that is becoming more advanced and sophisticated. Whatever will be in the future, the ships will be required to have better educated and trained marine type engineers to operate. New technology requires to have broader skills than older times.

Influences on global economy and technical development. The modern international transport system is the forefront of global development. The wheel of development on this maritime sector will not stop and the shipping is in many ways, due to the long history, nature of its activities and the extent of its globalization, unique where all the parties involved shall be able to develop their own professionalism. With the rapid emergence of the new technologies, the ships are becoming more advanced and sophisticated. This vast development will require also better educated and trained crew.

Countries with no significant maritime history or MET-traditions have candidates into maritime labour market. But these countries may suffer some or more lack to provide a sufficient education and training. The study has revealed that, the development of the world economy, social needs and technological innovations have impact on maritime education and training. However, this impact is also a different direction, i.e. by increasing skills in shipping, in the long term affecting the country's economy. The international regulations such as the STCW should be received with a high priority in national education system. It is also essential to keep in mind the factors of labour markets in context to development the regulation of standards for education and training.

Less developed countries have a real commitment and an effort to educational activities that also make sense, because the development of their own maritime sector has had a significant impact on the national economy of the state itself over the course of history. That is why it is reasonable to give a multiple type of support by the other MET-providers who have opportunity and skills to do that. In the nation where this kind of operation are in force also the body who supervise these providers should be involved. Otherwise provided support will be only a partial because of approval of the MET done by any of the country is needed for to fulfill the STCW requirements.

If there is one area where history should teach us clearly, it is to be hesitant in making predictions, particularly with respect to subject areas that are impacted by technology. The question remains as to whether it is desirable, indeed possible, to have global uniformity in curricula that encapsulates both the STCW objectives of a narrow competence-based MET curriculum and the academic inclusions leading to the award of degrees?

Needs for upgrade the contents in the curriculum is seen in the marine engineering field. Global change of technical development would necessitate the restructuring of the curriculum where the technological advances must be reflected. The updating of the skills of teaching staff and the increase in staff should also be assessed periodically. A systematic and logical approach should be taken when restructuring the curriculum. This is the most logical first step in solving the quality problem. Significantly, it is notable to note that the non-implementation of the upgraded curriculum cannot be justified by financial shortcomings.

National and international regulatory influence. The 2010 Manila amendments to the STCW Convention and Code was second major revision of the STCW Convention, and the Code. The Convention can be said to be a one that makes possibility for this industry to be a proactive. It is a IMO instrument which takes into account the above-all the elements of human factor (HF). Training and education do have essential role on this. The MET-factors are primary elements of this contribution and closely linked with the HF.

The standards pointed out in the STCW do not lay limitations in the curriculum developments. It established minimum standards for the education and training of seafarers for the safety operations of the world merchant fleet. The standards that might well be achieved at a minimum cost. The inter-relationships between the MET-providers, the industry and the national maritime authorities are very vital to the continued relevance and efficiency of the MET programmes. Any changes in the demands of society must be communicated together so that adaptation measures could be taken. Feedback and information from the regulatory bodies and industry can further fine tune the design of the curriculum and promote both internal and external efficiencies. Weaknesses in the system can be identified and rectified. The supply of manpower to the industry could be better regulated if this flow of information is maintained. The success of such evaluation depends on the continuing cooperation and working relationships between the parties. The lack of a clear and objective institutional framework to coordinate and manage the multiple uses of the sea is likely to hinder its optimum utilization.

The importance of educational resources for accidents. The marine engineer is expected to have the good skills of many. Even if (s)he is aided in arriving at the correct decision and taking the most appropriate action by the work station and instrumentation. In addition, as vessels equipped with different hybrid technologies, non-fossil fuels and other methods become more common, marine engineers are required to have skills that go beyond older times. However, the human element must not be overlooked. Changes in the curriculum should focus on ‘new-age’ technologies when powering the propulsion and ship is equipped with energy efficient innovations. Special attention should also put to the teaching processes and to the methods how the competencies has been in truth assessed. His/her training for modern hi-tech ships is likely to be not perhaps polyvalent but polytalent.

The specific kind of maritime education and the related curricula elements that will foster a sustainable paradigm of highly competent seafarers, who are optimally equipped with academic qualifications, could be the subject of further research. The pro-active decisions in the developments of curricula way ahead ‘spirit’ of the STCW could be action how the compliance with the letter of the STCW ‘law’ could be achieved. Even if it may be too abstract an objective to pursue a homogenize quality of provision for learning environment and the teaching provided at global level, should

not underestimate the efficiency of the STCW as a proactive source to prevent accidents. More significant is to understand that the proper exploitation of its spirit will provide a proactive way *to promote safety of life and property at sea and the protection of the marine environment.*

Training provider must have a curriculum which includes specific details. The written curriculum together with course descriptions shall include all learning objectives as required. Structure for the curriculum shall indicate that all subjects as required are covered. Should be proofed that every candidate for certification receives education and training as required in accordance with the standard of competence (meaning the STCW Convention) with the methods for demonstrating competence (column 3) and evaluation the competence fulfills the criteria as per columns 4 of the KUP-table are being fulfilled. Like lack of physical recourses may understand to be resulted because of economic and infrastructural of the state on national context, the intension to evaluate the MET-process where specific training is left to be learnt during OBT is not influenced so much by the financial matters. This is what can be done easily just if wanted and human recourses are efficiently used.

Onboard training. A specific OBT is vital. It is a axiomatic result if the student does not receive appropriate onboard training (i.e. the provision of a well-skilled maritime workforce is endangered) and consequences are significant. Not exclusively, but without the training in seagoing service the candidate cannot fulfill the required standards of competence.

Unfortunately, it is not obviously that this will happened as should and there are disadvantages in worldwide. This is a topic that should get more consideration by all the parties involved. Not only by the IMO but moreover on national levels (i.e. MET-providers, national authorities and agencies). In case like Namibia, I believe that new development cooperation projects would open new opportunities. The Apprentice Mill (in Finnish: Merenkulun Harjoittelu Mylly) is a concrete example of how a party in need of labour (shipowners) is committed to enabling access to traineeships. Perhaps something new could be developed from this model and take advantage of new forms of learning from the Covid-19 epidemic. A postmodern ‘Covid-19 MET-method’ that would be based on ‘old times’ cadet system. A major part of training would be done

when the student is onboard. During theoretical studies (s)he could be anywhere. Only what needed is a proper IT-facilities.

In conclusion, onboard training and use of practical skills should addresses a degree of new methods for to fulfill the 'spirit' of the STCW Convention. Very much should but attention to evaluate existing curriculums and use a critical judgement if it is up-dated for being fully relevant for this day and future purposes. The key elements, given by the STCW Code, B-I/8, for this are:

(a) an expressed policy regarding quality and the means by which such policy is to be implemented;
(b) a quality system incorporating the organizational structure, responsibilities, procedures, processes and resources necessary for quality management;
(c) the operational techniques and activities to ensure quality control;
(d) systematic monitoring arrangements, including internal quality-assurance evaluations, to ensure that all defined objectives are being achieved; and
(e) arrangements for periodic external quality evaluations as described in the following paragraphs below.

A blend of the competence-based education to specific standards as descripted in STCW mixed with wider and/or deeper academic study programmes should be adapted in a way where the practical competencies can be assessed with similar qualitive methods as what are performed during the theoretical studies.

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APPENDIX

Table A-III/1

Specification of minimum standard of competence for officers in charge of an engineering watch in a manned engine-room or designated duty engineers in a periodically unmanned engine-room

Column 1	Column 2	Column 3	Column 4
	Competence	**Knowledge, understanding and proficiency**	**Methods for demonstrating competence**	**Criteria for evaluating competence**
	Function 1: Marine engineering at the operational level			
1	Maintain a safe engineering watch	Thorough knowledge of */1/* Principles to be observed in keeping an engineering watch, including: .1 duties associated with ta-king over and accepting a watch .2 routine duties undertaken during a watch .3 maintenance of the machinery space logs and the significance of the readings taken .4 duties associated with handing over a watch */2/* Safety and emergency procedures; change-over of remote/automatic to local control of all systems Safety precautions to be observed during a watch and immediate actions to be taken in the event of fire or accident, with particular reference to oil systems */3/* Engine-room resource management Knowledge of engine-room resource management princples, including: .1 allocation, assignment, and prioritization of resources .2 effective communication	Assessment of evidence obtained from one or more of the following: .1 approved in-service experience .2 approved training ship experience .3 approved simulator training, where appropriate .4 approved laboratory equipment training Assessment of evidence obtained from one or more of the following: .1 approved training .2 approved in-service experience .3 approved simulator training	The conduct, hand-over and relief of the watch conforms with accepted principles and procedures The frequency and extent of monitoring of engineering equipment and systems conforms to manufacturers' recommendations and accepted principles and procedures, including Principles to be observed in keeping an engineering watch A proper record is maintained of the movements and activities relating to the ship's enginee-ring systems Resources are allocated and assigned as needed in correct priority to perform necessary tasks Communication is clearly and unambiguously given and received Questionable decisions and/or actions result in appropriate challenge and response

		.3 assertiveness and leadership .4 obtaining and maintaining situational awareness .5 consideration of team experience		Effective leadership behaviours are identified Team member(s) share accurate understanding of current and predicted engine-room and associated systems state, and of external environment
2	Use English in written and oral form	*/4/* Adequate knowledge of the English language to enable the officer to use engineering publications and to perform engineering duties	Examination and assessment of evidence obtained from practical instruction	Examination and assessment of evidence obtained from practical instruction
3	Use internal communication systems	*/5/* Operation of all internal communication systems on board	Examination and assessment of evidence obtained from one or more of the following: .1 approved in-service experience .2 approved training ship experience .3 approved simulator training, where appropriate .4 approved laboratory equipment training	Transmission and reception of messages are consistently successful Communication records are complete, accurate and comply with statutory requirements
4	Operate main and auxiliary machinery and associated control systems	*/6/* Basic construction and operation principles of machinery systems, including: .1 marine diesel engine .2 marine steam turbine .3 marine gas turbine .4 marine boiler .5 shafting installations, including propeller .6 other auxiliaries, including various pumps, air compressor, purifier, fresh water ge-nerator, heat exchanger, refrigeration, air conditioning and ventilation systems .7 steering gear .8 automatic control systems .9 fluid flow and characteristics of lubricating oil, fuel oil and cooling systems .10 deck machinery */7/* Safety and emergency procedures for operation of	Examination and assessment of evidence obtained from one or more of the following: .1 approved in-service experience .2 approved training ship experience .3 approved laboratory equipment training	Construction and operating mechanisms can be understood and explained with drawings/ instructions

		propulsion plant machinery, inclu-ding control systems		
5	Operate main and auxiliary machinery and associated control systems *(continued)*	*/8/* Preparation, operation, fault detection and necessary measures to prevent damage for the following machinery items and control systems: .1 main engine and associated auxiliaries .2 steam boiler and associated auxiliaries and steam systems .3 auxiliary prime movers and associated systems .4 other auxiliaries, including refrigeration, air conditioning and ventilation systems	Examination and assessment of evidence obtained from one or more of the following: .1 approved in-service experience .2 approved training ship experience .3 approved simulator training, where appropriate .4 approved laboratory equipment training	Operations are planned and carried out in accordance with operating manuals, established rules and procedures to ensure safety of operations and avoid pollution of the marine environment Deviations from the norm are promptly identified The output of plant and engineering systems consistently meets requirements, including bridge orders relating to changes in speed and direction The causes of machinery malfunctions are promptly identified and actions are designed to ensure the overall safety of the ship and the plant, having regard to the prevailing circumstances and conditions
6	Operate fuel, lubrication, ballast and other pumping systems and associated control systems	*/9/* Operational characteristics of pumps and piping systems, including control systems */10/* Operation of pumping systems: .1 routine pumping operations .2 operation of bilge, ballast and cargo pumping systems */11/* Oily-water separators (or similar equipment) requirements and operation	Examination and assessment of evidence obtained from one or more of the following: .1 approved in-service experience .2 approved training ship experience .3 approved simulator training, where appropriate .4 approved laboratory equipment training	Operations are planned and carried out in accordance with operating manuals, established rules and procedures to ensure safety of operations and avoid pollution of the marine environment Deviations from the norm are promptly identified and appropriate action is taken
	Competence	**Knowledge, understanding and proficiency**	**Methods for demonstrating competence**	**Criteria for evaluating competence**

Function 2: Electrical, electronic and control engineering at the operational level

7	Operate electrical, electronic and control systems	*/12/* Basic configuration and operation principles of the following electrical, electronic and control equipment: .1 electrical equipment: .a generator and distribution systems .b preparing, start ing, paralleling and changing over generators .c electrical motors including starting methodologies .d high-voltage installations .e sequential control circuits and associated system devices .2 electronic equipment: .a characteristics of basic electronic circuit elements .b flowchart for automatic and control systems .c functions, characteristics and features of control systems for machinery items, including main propulsion plant operation control and steam boiler automatic controls .3 control systems: .a various automatic control methodologies and characteristics .b Proportional–Integral–Derivative (PID) control characteristics and associated system devices for process control	Examination and assessment of evidence obtained from one or more of the following: .1 approved in-service experience .2 approved training ship experience .3 approved simulator training, where appropriate .4 approved laboratory equipment training	Operations are planned and carried out in accordance with operating ma-nuals, established rules and procedures to ensure safety of operations Electrical, electronic and control systems can be understood and explained with drawings/instructions
8	Maintenance and repair of electrical and electronic equipment	*/13/* Safety requirements for working on shipboard electrical systems, including the safe isolation of electrical equipment required before personnel are permitted to work on such equipment */14/* Maintenance and repair of electrical system equipment, switchboards, electric motors, generator and DC electrical systems and equipment */15/* Detection of electric malfunction, location of faults	Examination and assessment of evidence obtained from one or more of the following: .1 approved workshop skills training .2 approved practical experience and tests .3 approved in-service experience .4 approved training ship experience	Safety measures for working are appropriate Selection and use of hand tools, measu-ring instruments, and testing equipment are appropriate and interpretation of results is accurate Dismantling, inspecting, repairing and reassembling equipment are in accordance with ma-nuals and good practice Reassembling and performance testing is in

		and measures to prevent damage */16/* Construction and operation of electrical testing and measuring equipment */17/* Function and performance tests of the following equipment and their configuration: .1 monitoring systems .2 automatic control devices .3 protective devices */18/* The interpretation of electrical and simple electronic diagrams		accordance with manuals and good practice
	Competence	**Knowledge, understanding and proficiency**	**Methods for demonstrating competence**	**Criteria for evaluating competence**
	Function 3: Maintenance and repair at the operational level			
9	Appropriate use of hand tools, machine tools and measuring instruments for fabrication and repair on board	*/19/* Characteristics and limitations of materials used in construction and repair of ships and equipment */20/* Characteristics and limitations of processes used for fabrication and repair */21/* Properties and parameters considered in the fabrication and repair of systems and components */22/* Methods for carrying out safe emergency/temporary repairs */23/* Safety measures to be taken to ensure a safe working environment and for using hand tools, machine tools and measuring instruments */24/* Use of hand tools, machine tools and measuring instruments	Assessment of evidence obtained from one or more of the following: .1 approved workshop skills training .2 approved practical experience and tests .3 approved in-service experience .4 approved training ship experience	Identification of important parameters for fabrication of typical ship-related components is appropriate Selection of materials is appropriate Fabrication is to designated tolerances Use of equipment and hand tools, machine tools and measuring instruments is appropriate and safe

		/25/ Use of various types of sealants and packings		
10	Maintenance and repair of shipboard machinery and equipment	*/26/* Safety measures to be taken for repair and maintenance, including the safe isolation of shipboard machinery and equipment required before personnel are permitted to work on such machinery or equipment */27/* Appropriate basic mechanical knowledge and skills */28/* Maintenance and repair, such as dismantling, adjustment and reassembling of machinery and equipment */29/* The use of appropriate specialized tools and measuring instruments */30/* Design characteristics and selection of materials in construction of equipment */31/* Interpretation of machinery drawings and handbooks */32/* The interpretation of piping, hydraulic and pneumatic diagrams	Examination and assessment of evidence obtained from one or more of the following: .1 approved workshop skills training .2 approved practical experience and tests .3 approved in-service experience .4 approved training ship experience	Safety procedures followed are appropriate Selection of tools and spare gear is appropriate Dismantling, inspecting, repairing and reassembling equipment is in accordance with manuals and good practice Re-commissioning and performance testing is in accor-dance with manuals and good practice Selection of materials and parts is appropriate
	Competence	**Knowledge, understanding and proficiency**	**Methods for demonstrating competence**	**Criteria for evaluating competence**
	Function 4: Controlling the operation of the ship and care for persons on board at the operational level			
11	Ensure compliance with pollution-prevention requirements	*/33/* *Prevention of pollution of the marine environment* Knowledge of the precautions to be taken to prevent pollution of the marine environment Anti-pollution procedures and all associated equipment	Examination and assessment of evidence obtained from one or more of the following: .1 approved in-service experience .2 approved training ship experience .3 approved training	Procedures for monitoring shipboard operations and ensuring compliance with MARPOL requirements are fully observed Actions to ensure that a positive environmental reputation is maintained

		Importance of proactive measures to protect the marine environment		
12	Maintain seaworthiness of the ship	*/34/* *Ship stability* Working knowledge and application of stability, trim and stress tables, diagrams and stress calculating equipment Understanding of the fundamentals of watertight integrity Understanding of fundamental actions to be taken in the event of partial loss of intact buoyancy */35/* *Ship construction* General knowledge of the principal structural members of a ship and the proper names for the various parts	Examination and assessment of evidence obtained from one or more of the following: .1 approved in-service experience .2 approved training ship experience .3 approved simulator training, where appropriate .4 approved laboratory equipment training	The stability conditions comply with the IMO intact stability criteria under all conditions of loading Actions to ensure and maintain the watertight integrity of the ship are in accordance with accepted practice
13	Prevent, control and fight fires on board	*/36/* *Fire prevention and fire-fighting appliances* Ability to organize fire drills Knowledge of classes and chemistry of fire Knowledge of fire-fighting systems Action to be taken in the event of fire, including fires involving oil systems	Assessment of evidence obtained from approved fire-fighting training and experience as set out in section A-VI/3, paragraphs 1 to 3	The type and scale of the problem is promptly identified and initial actions conform with the emergency procedure and contingency plans for the ship Evacuation, emergency shutdown and isolation procedures are appropriate to the nature of the emergency and are implemented promptly The order of priority, and the levels and time-scales of making reports and informing personnel on board, are relevant to the nature of the emergency and reflect the urgency of the problem
14	Operate life-saving appliances	*/37/* *Life-saving* Ability to organize abandon ship drills and knowledge of the operation of survival craft and rescue boats, their launching appliances and arrangements, and their equipment, including radio life-saving appliances, satellite EPIRBs, SARTs, immersion	Assessment of evidence obtained from approved training and experience as set out in section A-VI/2, paragraphs 1 to 4	Actions in respon-ding to abandon ship and survival situations are appropriate to the prevailing circumstances and conditions and comply with accepted safety practices and standards

		suits and thermal protective aids		
15	Apply medical first aid on board ship	*/38/* *Medical aid* Practical application of medical guides and advice by radio, including the ability to take effective action based on such knowledge in the case of accidents or illnesses that are likely to occur on board ship	Assessment of evidence obtained from approved training as set out in section A-VI/4, paragraphs 1 to 3	Identification of probable cause, nature and extent of injuries or conditions is prompt and treatment minimizes immediate threat to life
16	Monitor compliance with legislative requirements	*/39/* Basic working knowledge of the relevant IMO conventions concerning safety of life at sea, security and protection of the marine environment	Assessment of evidence obtained from examination or approved training	Legislative requirements relating to safety of life at sea, security and protection of the marine environment are correctly identified
17	Application of leadership and teamworking skills	*/40/* Working knowledge of shipboard personnel management and training A knowledge of related international maritime conventions and recommendations, and national legislation Ability to apply task and workload management, including: .1 planning and coordination .2 personnel assignment .3 time and resource constraints .4 prioritization Knowledge and ability to apply effective resource management: .1 allocation, assignment, and prioritization of resources .2 effective communication on board and ashore .3 decisions reflect consideration of team experiences .4 assertiveness and leadership, including motivation .5 obtaining and maintaining situational awareness	Assessment of evidence obtained from one or more of the following: .1 approved training .2 approved in-service experience .3 practical demonstration	The crew are allocated duties and informed of expected standards of work and behaviour in a manner appropriate to the individuals concerned Training objectives and activities are based on assessment of current competence and capabilities and operational requirements. Operations are demonstrated to be in accordance with applicable rules Operations are planned and resources are allocated as needed in correct priority to perform necessary tasks Communication is clearly and unambiguously given and received Effective leadership behaviours are demonstrated Necessary team member(s) share accurate understanding of current and predicted ves-

		Knowledge and ability to apply decision-making techniques: .1 situation and risk assessment .2 identify and consider generated options .3 selecting course of action .4 evaluation of outcome effectiveness		sel state and operational status and external environment Decisions are most effective for the situation
18	Contribute to the safety of personnel and ship	*/41/* Knowledge of personal survival techniques Knowledge of fire prevention and ability to fight and extinguish fires Knowledge of elementary first aid Knowledge of personal safety and social responsibilities	Assessment of evidence obtained from approved training and experience as set out in section A-VI/1, paragraph 2	Appropriate safety and protective equipment is correctly used Procedures and safe working practices designed to safeguard personnel and the ship are observed at all times Procedures designed to safeguard the environment are observed at all times Initial and follow-up actions on becoming aware of an emergency conform with established emergency response procedures