

Employment of Project Oriented Approach in Training of Marine Engineers

Dr Iryna Morozova, Dr Svitlana Onyshchenko

Project oriented approach in training at the ONMU is considered in this Article. Implemented and suggested ideas provided in this Article are elaborated on the basis of competitive and project oriented approach in the training. Project oriented educational system formation at the Maritime University has been performed grounding on systematic approach with the use of decomposition methods.

Keywords: competitive approach, project oriented approach, educational system, maritime transport.

1. Introduction

Project oriented approach in training has been successfully and continuously employed at various universities, though, the level of extension and frequency of use of the said method in Ukraine unfortunately are not enough.

The aim of the Article is to generalize the experience and form further directions for the use of project oriented approach in training at the ONMU and therefore to increase marine engineers' capacity and the University competitiveness on the training services market. .

2. Project oriented approach in training at the ONMU

2.1 Competitive approach in training at ONMU

Competitive approach is the basic one for nowadays development of higher education of Ukraine taking into consideration its orientation to the European standards of education.

As it is well known, the general idea of competitive approach is development of not just a knowledge system but a system of competencies, i.e. abilities to solve particular problems in definite sphere grounding on knowledge and skills.

Distinguishes in competencies and other final products of educational process are in the fact that the former ones are integral and exist in a shape of activity not just in a form of knowledge about the ways of activities. Professional competency exists as a union of key, basic and special competencies.

Special competencies become available for the student in the process of mastering disciplines that belong to his professional block. Special competency reflects specific features of a definite objective sphere of professional activity and, finally, makes this very graduate distinguishable not only comparatively to the graduate of the other institution but his very mates he has been studying with. Such qualitative training can be achieved only when precise competency pattern built in compliance with requirements of modern labour market is available. Let us also clarify that this model is quite flexible structure and it reacts to the variations of employers' requirements and achievements gained due to scientific and technical progress in the given sphere.

Odessa National Maritime University (ONMU) possesses the following adjustment system for competency patterns of graduates (Figure 1).

Therefore, the ONMU developed constant connections with employers and graduates; consequently, some of latter also have a tendency to become employers for the further generations of the graduates. This system of feedbacks allows to consider in full amount the requirements of modern labour market while training the experts in maritime transport sphere.

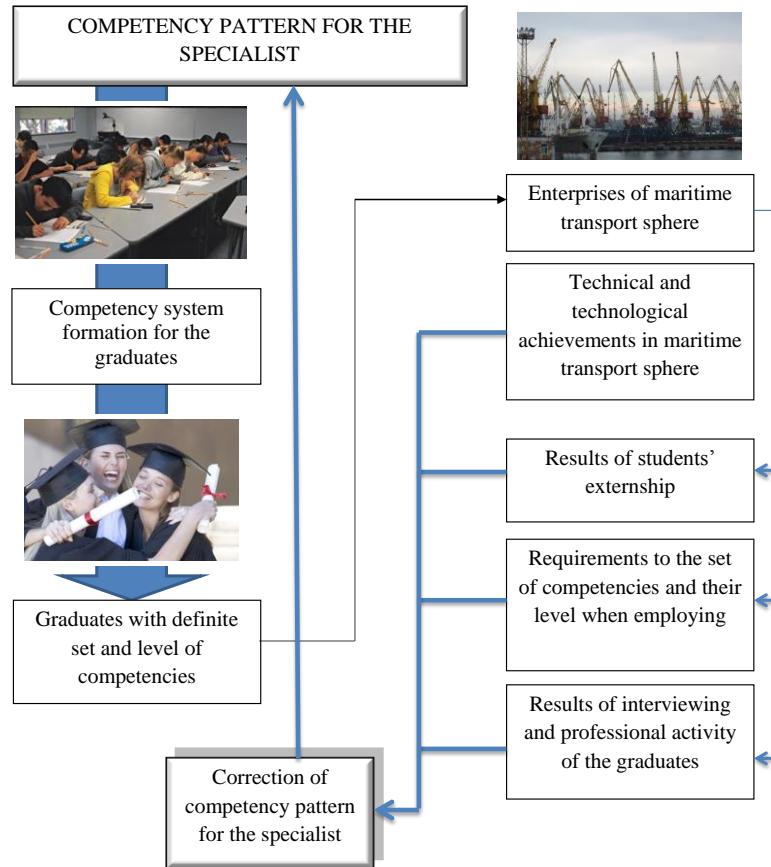


Figure 1 Adjustment system for competency patterns of graduates at ONMU

2.2 Experience of project oriented training at the ONMU

Implementation of competency approach in specialist formation is impossible without use of specific educational forms, one of which is project oriented training. The aim of project oriented training is “education via experience”. Basic distinctive features of the given training:

- Students deal with real problems instead of exercises and imaginary situations;
- Students learn not only from teacher but from each other;
- Students work with data of real processes;
- Students learn to think critically.

At present the project oriented approach in the training is applied in two versions at Odessa National Maritime University (ONMU).

The first version reflects solution of technical milestones arisen in practice for the enterprises of maritime branch (port terminals and shipping companies that cooperate with the University). The given project category foresees collaboration of the Masters from different faculties in frames on the joint team. Activities over the project are implemented in specifically equipped Centre of Marine Engineering. The Project for Port Operator “Brooklyn-Kiev” Development in Odessa Port can serve as an example to show the solution of tasks in such a manner:

- Students of Hydro Technical Faculty are designing new berths;
- Students of Port Engineering are identifying the content of equipment complexes (grain, container);
- Students of Faculty of Economics and the Faculty of Transport Technologies and Systems are studying demand, clarifying pricing policy, analyzing future terminals’ competitiveness, drafting business-plan, and developing the concept of informational tools to secure the functioning of the future terminals.

Similar project implies continuous exchange with the certain activities outputs among the stakeholders that facilitates the gaining of such skills: team work, use of “brain-storm” approach, appropriate processing of research results, and the most vital one – ability to use theoretical knowledge in real operational conditions. The students can be motivated with the opportunity to get employed or obtain recommendations to commence the PhD studies. Certain project results can be used by students while elaborating their Master’s thesis.

The second version of the project oriented approach in the study process at the ONMU is connected with such subject as “Theory of marine transport services market” studied at the University. The objective of this subject is to gain skills in market research, forecasting and assessment of commercial and investment risks in maritime business. Students form teams of “experts” and each of them obtains a certain task related to a separate sector of maritime business (e.g. time-charter section of dry cargo tonnage freight market). To solve the given task students use knowledge base for the disciplines they have studied before: Marketing, Maritime Transport Economics, Statistics, Probability Theory, Operations Research, Information Technologies.

2.3 Project oriented training as a tool secure competences’ availability for the ONMU Graduates

Further development opportunities for the project oriented approach in education can be introduced in a shape of a system, which would include all the educational levels and all the basic competencies of maritime engineers. To construct the said system primarily we need to form the following:

- Hierarchic structure of competencies and numerous corresponding disciplines;
- Assembly of instruments employed within the project oriented approach in education.

Figure 2 shows the example of three systems’ integration: “Project oriented training”, “Educational subject” and a block of particular competencies of “competency model” for professional sphere “Commercial maintenance of transport process” (Figure 3) in specialty “Transport Technologies” for Bachelor’s Degree. The given sample is a part ONMU educational system implemented since 2014.

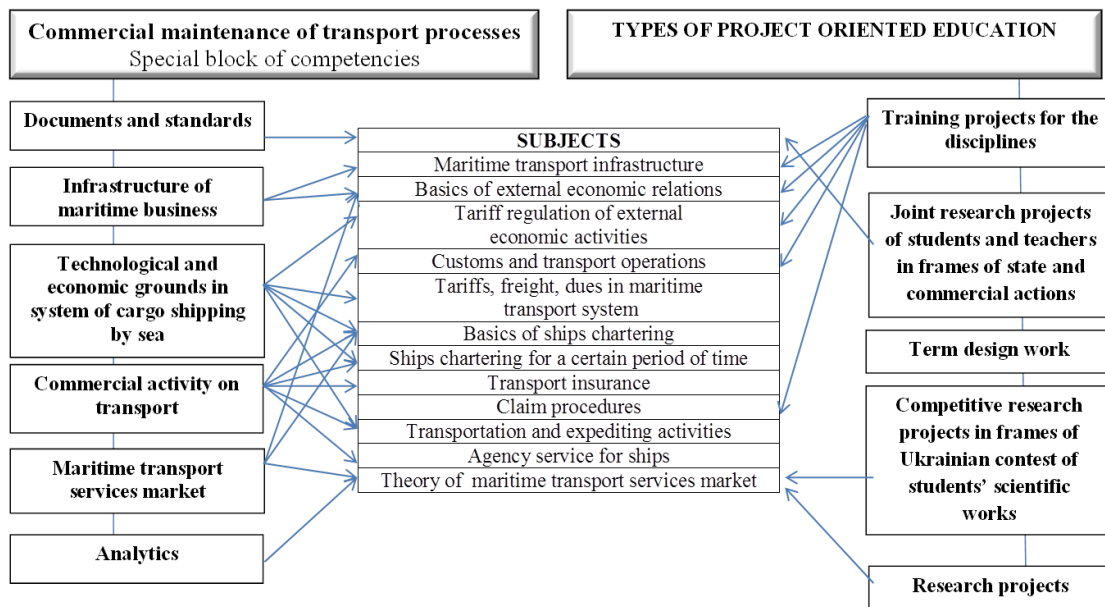


Figure 2 Three systems’ integration

Besides special competencies students ought to gain the following skills within the project oriented training [1]:

- Social – is a skill to make joint decisions and responsibilities, ability for team working and interact with representatives of various cultures and religions;
- Reflective – is the ability to make a notice of own mistakes, analyze and adequately assess the work of the others and to provide self-assessment in the given social surrounding;

- Communicative – is the ability to verify and stand up for taken decisions, to express thoughts, to set out inter-individual connections, to choose the most appropriate style of communication in various situations, to master means on verbal and non-verbal communication and to perform knowledge exchange;

- Informational – is the ability to gain new informational technologies. Therefore, the assembly of development, correction and continuous monitoring in system of special competencies (skills), set of disciplines and students’ projecting works allows to maintain efficient level of students training at ONMU, so that they would comply with requirements of modern labour market in sphere of maritime transport.

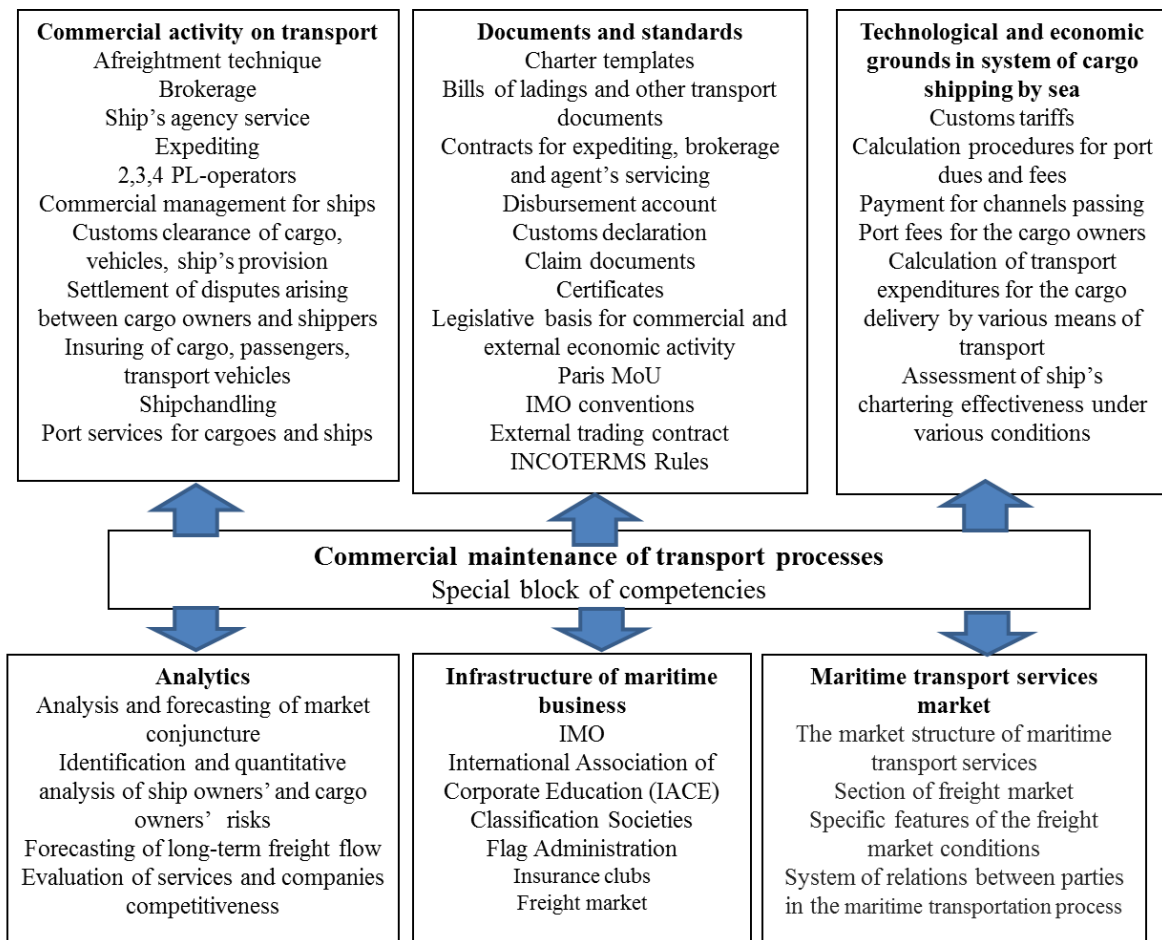


Figure 3 “Competency model” for professional sphere “Commercial maintenance of transport process”

The result of project oriented approach in training implementation in Maritime University is as follows:

- Improvement of trained specialists’ competence;
- Compliance of knowledge and skills gained by the alumni with the requirements;
- Mutually beneficial cooperation of the university with the enterprises of maritime industry;
- Improvement of the University status on the market of the educational services.

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Closing the Gap Between the Training Needs and Current Training Practices for Modern Marine Engineers

Mr Gamini Lokuketagoda, Mr Delai Vakasilim, Prof Dev Ranmuthugala

Australian Maritime College

The training of marine engineers around the world traditionally tends to target the competencies outlined within Standards of Training Certification and Watchkeeping (STCW) and its interpretation by the relevant national regulatory authorities. Although the regulations are developed with input from the relevant stakeholders, it is argued by many that they do not always meet the changing requirements of an industry that is continuously modernising both in technology and work practices, nor are programmes tailored to address the needs of diverse cohorts of trainees entering the industry. This has resulted in a number of employers developing in-house training, not only in specialised areas, but also to address shortcomings in the fundamental knowledge and skills of new graduates. Thus, it is important when developing integrated training programmes to consider a range of parameters, much broader than those stipulated within the regulations. Issues that influence modern seafarer programmes include: quality and competencies of new entrants, facilities and staff at Marine Education and Training (MET) institutions, programme curricula and delivery/assessment strategies, and industry training philosophy and methods.

MET providers must also address present and future specialist training needs, which stem from current industry demands and operational requirements. It is generally accepted that the traditional role of the marine engineer is changing due to the modernisation of systems, different operational requirements, new regulations, modern work practices, and the drive for increased efficiency. Thus, competence requirements by the modern marine engineer are significantly different to that in the past. However the competence requirements specified in STCW and its interpretations in various nations struggles in many instances to upgrade adequately, or more likely in time, to meet the demands of the industry. There is a trend among some towards resisting change and viewing flexibility as diminishing the quality of the training, rather than considering them as opportunities to enhance learning.

Thus, engineering graduates from MET institutions do not always meet the expectations of the industry nor are sufficiently competent to deal with a rapidly changing industry. In many cases, the training does not take advantage of modern learning and teaching practices or the use of technology based training strategies. This paper looks at these issues and suggests some options within the boundaries of the current regulatory framework to improve the competence of the graduates to bridge the gap between industry needs and the competence of modern marine engineers.

Keywords: Maritime Engineering Education, Seafarer Training, STCW requirements.

1. Introduction

Although shipping is more than 5000 years old, a standard for seafarer training and certification was not established until 1978, when the first International Maritime Organisation (IMO) Standards of Training Certification and Watchkeeping (STCW) conference was held in London. The IMO Maritime Knowledge Centre [1] states:

“The 1978 STCW Convention was the first to establish basic requirements on training, certification and watchkeeping for seafarers at an international level. Previously these standards for officers and ratings were established by maritime authorities in respective countries, usually with little reference to practices in other jurisdictions. As a result standards and procedures varied widely, even though shipping is the most international of all industries. The Convention prescribes minimum standards relating to training, certification and watchkeeping for seafarers which countries are obliged to meet or exceed.”

It is however widely accepted that the intentions of the IMO was not achieved by the first convention, which resulted in two subsequent major amendments in 1995 and 2010. The 1995 amendments addressed the competence, knowledge requirement, and assessment criteria, which were relatively vague in the previous 1978 standards. This vagueness in the 1978 document led to different interpretations of the convention and the regulations there-in by member countries, resulting in the dilution of the very purpose that the convention was meant to achieve. The 2010 Manila amendments were adapted to address a raft of outstanding issues, including:

- new certification for Electro-Technical Officers (ETO);
- new requirements for Electronic Chart Display Information Systems (ECDIS);
- new requirements for security training, leadership and teamwork, environmental awareness, and liquefied gas tankers’
- new training guidance for polar waters and Dynamic Positioning (DP) systems; and
- introduction of modern training methodology including distance learning and web-based learning.

The intent of this paper is to investigate the past and current marine engineer training methodologies and explore the gaps which are not identified and addressed by the current practices in Maritime Education and Training (MET) providers to suit the current and future trends in marine engineering. It also explores the possibilities of using modern training methodology, including distance learning and web-based learning in the context of marine engineer training for the future.

2. Background and past training pathways

In the pre-STCW era, there were a number of pathways for school leavers to become marine engineers on merchant vessels [2]. Gospel [3] points out that the most common pathway in the past in Commonwealth countries was the apprenticeships route, which attracted the school leavers to commence a four-year training programme heavily skewed towards practical training, reflecting the knowledge and skills required by the traditional marine engineer. Major ship building/repair/maintenance establishments offered apprenticeships to school leavers at a very early age, even as low as 16 years. The apprenticeship usually commenced at a ship building or repair yard or maintenance workshops, culminating in on-board, on-the-job training as a junior engineer on a merchant vessel. After a stipulated sea service requirement, the junior engineer appeared in front of the relevant marine authority for written and oral examinations (with or without following a pre-examination college based training course) to gain the relevant Certificate of Competency; first as a second engineer, followed by further sea service and examinations to a chief engineer.

According to Brooks [4], many European and some Asian seafaring nations offered training berths to school leavers to start as ratings in the engine-room or as a deckhand, enabling them to experience sea life in general, before deciding on the path they wish to pursue. Those electing to become marine engineers followed a structured shore and ship based training programme spread over five to six years, where the trainees commenced at the bottom of the ladder and worked their way up with the accumulation of the required sea service and successful completion of the relevant written/oral examinations. However, the sea service requirements, as well as the frequency and level of examinations (if any) varied between nations, governed by their respective marine authorities.

In the post STCW 78 era, a shift from the traditional general cargo ships to containerisation and the upward trends in world shipping during the 1980’s made way for marine engineer cadet training programmes, initially complementing the four-year apprenticeships. The cadet training programmes had more compact competence based training carried out in shore establishments, with the on-board training conforming to the recommended minimum durations in the STCW Code. In many cases the on-board training was directed and monitored through training record books, usually administered by the MET institutions but overseen on-board by the vessel’s crew. It was distinctly different to the workshop and college training given to apprentices. This trend towards cadet training has continued

and has evolved to encompass competence standards and structured on and off-the-job training, becoming the preferred cadet training mode for shipping and recruiting companies worldwide.

The journey to become a chief engineer, either through apprentice route or cadet pathway was a long-term sandwich training programme, consisting of intermittent sea service and college training. The factors that influence the training outcomes of modern competent marine engineers include:

- quality and competencies of new entrants to the industry;
- facilities and staff in MET institutions ;
- programme curricula and delivery/assessment strategies; and
- industry training philosophy and methods.

These will be discussed in detail in the following sections.

3. Quality and competencies of new entrants to the industry

Various socio-economic factors will influence a school leaver's decision for a career at sea. One of the major factors is the high remuneration associated with the industry evidenced by the advertisements in many countries offering wages well above the national average. Many school leavers who join the industry attracted purely by these high salaries find it difficult to adjust to the maritime world and thus leave the industry before making a career as a professional marine engineer.

Many countries struggle to attract high achieving school leavers to careers at sea, as they are exposed to a plethora of attractive career opportunities from competing industries. Thus, in many instances those selecting careers at sea may lack the required educational background or aptitude to chart a rewarding career in marine engineering or push the boundaries within the industry. This leaves the MET institutions with unenviable task of moulding competent marine engineers from student cohorts that in many cases lack the motivation and/or aptitude to engage with the higher level knowledge competencies. The issue is compounded as the institutions compete among themselves for the diminishing 'cream of the crop' and the need to secure sea training berths for their cadets.

Gare [5] argues that in general, the average standard of education in schools worldwide deteriorated during the last three decades, especially in the areas of science and mathematics which are essential elements within any engineering discipline. The academic level of new entrants to the marine engineering field is no exception to this trend. Unlike traditional tertiary engineering programmes, the entry standards to courses for students aspiring to be marine engineers on merchant ships vary significantly across the world, although minimum competence in mathematics is expected. The model marine engineering courses developed by the IMO [6] states:

“Administrations will wish to specify their own educational standards for entry. With this in mind, attention is drawn to the fact that while the mathematical standards of the courses to be followed are not high, trainees continually use fundamental mathematics as a tool throughout the whole of their training;...”

Technical subject within engineering programmes are generally complex in nature and usually include a considerable mathematical content. According to Wilcox & Bounova [7], these together with the inadequate fundamental mathematical knowledge and skills in some students, have traditionally posed frustration in students learning engineering. Thus, MET institutions are faced with the uphill task of educating ill prepared students entering marine engineering programmes to meet the standards stipulated and required by the industry.

4. Facilities and staff in MET institutions

In addition to the above problem, many MET institutions struggle to employ qualified and dedicated trainers. Many trainers joining MET institutions are either retired marine engineers or active marine engineers who have chosen to be ashore for a period of time to attend to various external or personal reasons, with the intention of returning to sea once the issues are resolved. Both these categories of trainers in many instances lack the passion for teaching, the devotion necessary to be an effective teacher, and the motivation to embrace and introduce innovative delivery and assessment strategies. The lack of commitment and innovation from the teachers will affect the quality of teaching and learning.

Although STCW insists that new trainers and assessors undertake 'Training of Trainers' (ToT) programmes, innovation and pedagogy are heavily dependent on self-motivation. Many trainers and assessors, who were recruited by MET institutions in the early stages of the maritime training and education boom in the eighties and nineties, settled into purely following the IMO model courses to the letter. It is therefore important to attract educators who are passionate about training and are motivated to create and innovate, thus taking the lead in developing programmes and delivery/assessment methodologies to levels that will attract good students, motivate existing students to think beyond just 'passing' examinations, and ultimately provide the industry with competent marine engineers.

The facilities available at MET institutions also play a vital role in effective delivery of engineering courses. Unlike the navigation cadets, who undertake most of their practical training on-board a vessel, the marine engineer cadets receive a significant proportion of their hands-on skills in shore based establishments. It is not viable to sustain a workshop with significant capital investment unless it is also operating for purposes other than training, such as a fabrication workshop or a repair yard. Thus, the MET institutions usually outsource the training involved with workshops to third parties. Although some MET institutions operate selected resources such as workshops and laboratory equipment, it is rare to find an institution that can provide a well-rounded practical training programme covering all the required competencies without accessing external providers.

The introduction of simulators to impart higher level knowledge and skills, also require significant initial outlay as well as ongoing maintenance and upgrade costs. It is interesting to note that although navigation simulators and their associated programmes have been made mandatory within STCW, the same is yet to be achieved in the marine engineering discipline.

5. Programme curricula and delivery/assessment strategies

As mentioned previously, the curricula for marine engineer training courses adopted by MET institutions were mostly based on the IMO model courses. However, it can be debated as to the extent the model courses align with the competencies actually required by marine engineers to function effectively within a changing industry. This is especially the case since the STCW Code does not explicitly state the performance level, criteria, or context, which can encourage individual interpretations as to what benchmarks should guide competence assessment, resulting in regional weakness in assessment against the STCW Code.

This is exacerbated by the slow pace of upgrading these programmes undergo to meet the development of technology in the engineering field. Although IMO insist that the model courses must be used only as a guide, many MET institutions and their respective regulatory authorities have embraced these programmes as mandated courses, thus adhering to them as rules rather than guidelines.

The influence of various industry standards in countries also dictate terms to programme curricula of marine engineer training. For example in Australia, training providers have to follow the Australian Quality Framework (AQF) and the Transport Industry standards. Another important stakeholder in this

group is the labour unions. Depending on the country and their industry regulations, they can exert significant influence on the training curricula and practices.

Many MET institutions tend to hold on to tradition, with their programmes reflecting structures and outcomes that reflect the past that was linked to the old apprentice route, rather than developing programmes that embrace modern education practices and those that suite the modern student. Many are yet wedded to the old theoretical Part A and the professional Part B sections that ‘must’ be delivered separately and in a predefined order. This conflicts with modern engineering education that promotes integration across theory and practice promoted by many such as Johns-Boast & Flint [8], nor is it a requirement within STCW, even to the extent where it is not reflected within the model courses. However, old practices are hard to change.

Current STCW regulations require an approved assessment strategies for marine engineer training. However, assessment methods adopted by many MET institutions are heavily skewed towards formative assessment patterns. Although a number of marine jurisdictions are trialling out new assessment techniques, many marine administrations tend to favour the traditional processes such as written and oral examinations. Properly executed they do provide rigorous outcomes, however they may in some circumstance affect the validity and restrict the use of innovative assessment techniques that can target a wider range of competencies and students. In marine engineering the use of simulators in assessments is yet in its infancy, although they are highly advanced in other areas, such as aviation and navigation.

6. Industry training philosophy and methods

Complementing the shore based MET institution programmes is the on-the-job training component carried out on-board vessels. Although many companies have designated training officers on their vessels, their role have become one of monitoring and validating what the trainees have done rather than guiding them through the tasks and providing the environment and tools to make the learning a success. The ship’s training officer may not have undergone a formal ‘Training of Trainers’ programme to effectively impart the required knowledge and skills or to create a conducive learning environment for a new entrant within the engine department and the vessel to provide quality learning.

The end users of the marine engineer trainee are the shipping companies, who often find that the trained engineers lack certain specialist knowledge required to meet the operational requirements on their vessels. Thus, companies resort to providing this specific training through other means. Berg & Skotgard [9], states “often large shipping companies would establish and operate their own training centres for these specialised training, as it proves much more effective than to rely on MET institutions.”

As stated in the introduction, the shipping industry is over 5000 years old but international standards for training and certification was established a mere 25 years ago. A downside of the delayed introduction of the standards is that the industry yet lacks a coherent training philosophy. The philosophy and culture that dominated marine engineer training and assessment for decades before the introduction of STCW continued, as marine authorities and training institutions grappled with changes to regulations and learning practices, unfortunately at a much slower rate than within comparable industries such as the aviation industry.

Lewarn & Ranmuthugala [10] suggest that a reason why the personnel within the seafaring industry are reluctant to change is the rigid and authoritative hierarchical management structure prevalent in most ships. This is possibly a carryover from the naval links in the past and a perceived need to have absolute obedience to avoid dangers at sea, and some MET institutions tend to follow this practice within their administration, and teaching and learning practices.

Although some companies and MET institutions have moved away from traditional class room teacher centric learning to student centric learning using new technology, there is yet a long way to go before it is globally accepted and practiced within the industry.

In this backdrop, the role of most marine administrations within training is restricted to enforcing the national legislation and to facilitate the state remaining on the IMO white list. The development of new training philosophy or actively promoting the modernisation of the curricula or the programmes remains with the MET providers and the industry. However, the legislation enforced by the marine administrations can and will influence the training regimes, thus changes have to be brought about with agreement between the MET providers, industry, and the relevant marine administrations. Some marine authorities are influenced by past training regimes before STCW was introduced that they were involved with, and may display some reluctance to actively promote change. However, it should also be noted that others are willing and indeed leading change, although the impact is yet relatively low. In some nations, the seafaring community lacks the necessary influence to convince their respective governments to legislate changes to training and attract funds to support those changes.

7. Emerging training needs for marine engineers

Thirty years ago a main engine unit of a motor ship was pulled out and overhauled after 6000 – 8000 running hours. A turbo-charger of this main engine may have been overhauled at intervals of 10,000 running hours. The time between major overhauls of a diesel engine generator was similar. These tasks involved skilled personnel, spare parts, and most importantly time. In contrast, a modern main engine unit according to MAN ME Engines [11] need not be opened even after 20,000 running hours, as technology involved in the design, manufacture, and maintenance of such machinery have evolved. With the possibility of Liquefied Natural Gas (LNG) replacing Intermediate Fuel Oil (IFO) 380 in the future, the frequency of maintenance of engines may further reduce, as Condition Based Overhaul (CBO) replaces the current Time Between Overhaul (TBO) practice.

New developments in modern large marine diesel engines have resulted in the replacement of many traditional components and systems by a fewer number of integrated systems. For example Woodyard [12] suggests that components and systems such as the Hydraulic Power Supply (HPS), Hydraulic Cylinder Units (HCU), and the Engine Control Systems (ECS) have replaced a plethora of essential components and systems such as the chain drives, camshafts, fuel injection systems, exhaust actuators, governors, starting systems, etc. Thus, modern training programmes and outcomes have to target these technology replacements, while maintaining the skills to service the older technology that is still in use. MET institutions have to provide a balanced programme that mixes technology advancements, modern work practices, and student expectations with the broad and diverse nature of the industry. In addition, it has to be done within a tight time span dictated by legislation and industry demand.

A control room of a modern ship has a number of computers and touch screen mimic panels instead of the older dial gauges and instruments. Most of the controls for the machinery is available through these touch screens. Boris, Butman, & Butturini [13] state that the engineers check the ‘health’ of main engines by diagnostics rather than taking indicator cards. In essence, the engineers can operate, monitor, and control highly sophisticated machinery by very simple means.

Electric propulsion is another area gaining ground in marine engineering where IMO and most MET institutions are in the process of identifying the potential and the requirements. It is evident from a number of accident reports published round the world that this is an area that needs upgrading of legislation and training. For example the Marine Accident Investigation Bureau (MAIB) [14] report dealing with the harmonic filter explosion on the Queen Mary II in 2011 emphasise the importance for ship’s crew to gain a thorough understanding of the issue of harmonic distortion and harmonic mitigation equipment, so that they are better able to appreciate the importance of the equipment on-board and take timely action if such equipment fails or deteriorates. A similar recommendation is made by MAIB [15] on the accident report on MV Savannah Express, where the engineers had very little knowledge on the working principles of the electronic control system of the main engine.

MAIB reiterate that the modern vessels increasingly rely on complex, integrated control and operating systems. Often these systems cannot be separated to enable operation of the equipment in a ‘limp home’ mode. The rapid introduction of such technology has placed an ever-increasing demand on the shipboard engineers, who have often not had the requisite training with which to equip them to safely

operate, maintain, and fault find on this complex equipment. Another specialised training requirement is high voltage, with many ships and offshore vessels employing such systems [16]. This again is an area that needs specialist training as it can result in life threatening situations.

STCW stipulates only the basic generic requirements for competence in the operation of electrical and electronic control equipment. In reality, individual shipping companies are requesting maritime training institutions to provide specific technology centred training courses to supplement the basic training given to marine engineers at the STCW level. Unfortunately, it is unlikely that all shipping companies with such requirements recognise a training deficit for their engineers and provide remedial action, or are willing to absorb the additional financial and time penalties, rather accepting that the STCW requirements are sufficient to cope with developing technology. The inability to effectively diagnose faults in these complex systems can put vessels, their crews, and the environment at considerable risk. In many cases the present generic training requirements of STCW are insufficient to cope with the 'system engineering' aspects of complex, integrated engine control and operating systems of modern marine systems [17]. Thus, it is important that these training requirements are reviewed to determine their present and future effectiveness.

8. Conclusion

Current training in many MET institutions focuses on the STCW competencies, which may not always address or lag behind the changing requirements of the industry and technology. In an effort to develop integrated training programmes, issues influencing modern seafarer programmes and the need to change the competence requirements for modern marine engineers were discussed.

As Lewarn and Ranmuthugala [10] state, it is important that the global maritime industry develops clear and appropriate competency standards targeting the roles of the modern seafarer on modern ships. Thus, STCW must have clear and targeted competencies for the relevant performance outcomes, linked to the appropriate attributes to enable and assist MET institutions to develop suitable programmes to meet changing industry needs. However, as this is a relatively long drawn process, MET institutions in collaboration with the national marine authorities, can modernise training programme curricula to reflect modern practices, and employ modern technology and innovative methodology to deliver training. Given the diverse nature of the global fleet it is important that the programmes are sufficiently flexible to incorporate the older technology while embracing the new to train marine engineers for the future.

Thus, it is important that MET institutions take the lead in developing and introducing modern and innovative delivery and assessment strategies. They must exploit modern technology and strategies to the fullest to deliver their courses from a modern training context. Delivery and assessment should include tasks contextual to the workplace situations that will replicate the complexities and challenges students will confront in the real world, which will develop the necessary transferable skills. Although some are moving towards modernising their training methods, the industry as a whole lags behind many compatible sectors. It is important to recognise the strengths and weakness of the modern learner and provide them with suitable integrated information packages utilising modern technology to achieve the required competencies.

Change is important, and should be across all aspects that influence learning, including STCW competencies, programme outcomes, programme structure, innovative delivery, assessment strategies, and teaching tools. MET institutions and those regulating the processes must realise the need for change and actively seek solutions and strategies to train students from varying backgrounds to meet changing industry and environment needs. Modern training technology and methodologies need to replace or at least complement older methods, which require a change in mindset of those who train, develop training, and implement related policy.

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