MANAGEMENT PROGRAM IN MARINE ENGINEERING ENVIRONMENT

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Abstract

The existing curricula in maritime colleges does not satisfy the growing requirement to provide future marine engineering officers with the basic economic and management knowledge. Introduction of an engineering management program in such a highly specialized engineering school creates its own difficulties and specific challenges, and, as a result, requires a substantial modification of the traditional approach. On one side, being dedicated to a single industry the school can better steer the program and determine the boundaries of the subjects included. On the other side, the already overloaded four-year program limits an in-depth exposure to some vital theoretical concepts. This paper is intended to emphasize the importance of the engineering management training in the maritime environment, and to offer practical resolutions.

I. Reasons For Program Development

There is no doubt that enhanced economic and management education should improve the decision making process on all levels of activities from global projects to routine day-to-day operational decisions. Another important reason for additional economic and management training is to make the marine engineering program more attractive for prospective cadets. Nowadays, when a young man or woman is considering a maritime profession, a couple of questions might pop up: What will happen to me if in a few years after graduation I would not be able or would not want to sail any more? Will I be prepared for a shoreside job? Additional economic and management knowledge offered at school might amplify the management career path ashore. This consideration might appear a decisive one in choosing the profession.

If the question of a possible career change in the future appears, again additional economic and management training helps to get a positive answer. These days, when the romantic attractiveness of the marine engineering profession is getting weaker, the maritime colleges have

to demonstrate to the prospective cadets that they are moving in the same directions as most of the regular engineering colleges; that is, in the direction of an increased scope of the economic and management component of the program.

Yet another important objective for a change of the program exists: to help the graduates to land a better first job. Added economic and management skills will put the graduates ahead of the competition equipped only with traditional curriculum. The statistics of the USMMA shows that approximately half of our engineering graduates never sail, and a large percent of those who find sailing jobs after school, eventually go ashore and assume various engineering positions. Enhanced knowledge of economics and management appears even more valuable for shoreside positions. Especially, after a few years, when the former cadet gains certain experience and is ready to assume a management position.

The list of economic and managerial projects and problems, with which the marine engineering graduates are dealing at different stages of their careers, is practically endless. Lack or deficiency of a proper analysis should be blamed for some negative results in the global area. For instance, the gigantic growth of cruise tonnage in the world, which is happening now, brings to memory the situation in the 70's when the size and total tonnage of tankers jumped through the roof with the resulting collapse of the tanker market in the 80's. Obviously, a serious economic monitoring of the situation is required. Similar attention is needed to the current status of the container-carrying tonnage, where the sizes and capacities of certain types of ships appear very sensitive to the fluctuation of the cargo market.

A similar situation is occurring with lower level decision making. As an example, we might note crew reduction, which is one of the most popular ways of cutting operational cost. On one side, this is a technical problem: the ship should be prepared and capable to have the crew reduced. On the other side, this decision brings up multiple economic and management problems and questions, and there is no guarantee that all crews are ready to operate under reduced conditions. First of all, crew reduction changes the functions and responsibilities of crew members, and the necessity to increase efficiency of every crew member becomes vital for the success of the program. At the same time, certain functions of the reduced crew should be performed now by engineers ashore, which leads to an increase of their number. Moreover, engine room automation leads to increased volume of shipyard repairs. In addition, ships are becoming more complex and automated. Engineering officers on board and ashore are increasingly responsible for managing a wide range of activities related to ship operation, repair and maintenance and would benefit from an economics and engineering management training.

II. Economic And Management Applications

There is the problem of spare parts on board. The ancient wisdom dictates the chief engineer to have as many spares as possible on board. On the other hand, the economic consideration calls for the minimization of inventory. Today's engineering graduates are not equipped with the modern methods of inventory management and economic justification of its size. As a result, many ships which are ready to be scrapped, carry on board millions of dollars worth of inventory. Therefore, when adding spares to the ship's inventory, the engineers should be guided not only by technical consideration, but also by economic reasons. For instance, the cost of having certain spare part on board should be compared with possible economic losses if it is delivered only when needed. And in many cases, this decision should be made on board by the ship's engineer.

Ship repairs present another subject for a decision with the principal question of whether to carry an overhaul or to replace the ship. There are many examples when the answer to this question was wrong: an expensive overhaul has been carried and soon after that the ship had been scrapped. The most likely explanation might be - poor economic analysis due to economic incompetence of the decision maker. An accurate economic analysis can save a lot of money in deciding the scope of upcoming shipyard repairs. How much repairs to request from the yard? What is less expensive in a long run: to include a certain item in the repair specification, to carry it next time, or to do it on board by the crew members or a riding team? All these questions represent typical decision making situations when a properly laid-out economic judgement is needed.

Organization and management of ship repairs at a shipyard is one more subject where appropriate basic training is very useful. And again, most of engineering programs do not include any substantial training in this direction. As a result, resources are wasted, ships loose extra time out of operation, and the final shipyard invoice appears much higher than it could be if the proper procedures have been followed. Similar problems are found with ship maintenance. Huge resources are being spent to carry out traditional maintenance procedures while modern computer based maintenance system can save a lot of labor and material resources. The crew members should be taught these modern management procedures.

III. Marine Engineering Programs Worldwide

Program Duration. The average length of a program, which leads to the Third Assistant (or just Forth Engineer) license, is four years, including about a year of sailing. However, there are three- year programs, on one side, and five-plus-year programs, on the other side, like in Russia, Ukraine, China, Thailand and Poland. The diagram below presents an approximate distribution of the duration of the marine engineering programs among 60 maritime schools. The program at USMMA, Kings Point, represents a typical example.

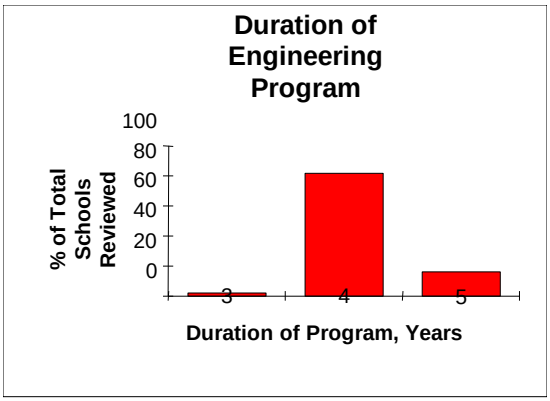

Fig. 1. Duration of Marine Engineering Programs

As might be judged from the limited information available, there are just a few countries, like China, Indonesia, Netherlands, and some others, where economics and management became an integral segment of the maritime engineering curriculum. Particularly noteworthy is the Dutch training system for integrated officers. Their program includes a special combination of business courses, which closely corresponds to our understanding of a basic business oriented curriculum. Most of maritime schools, though, offer just a couple of general courses, if any. Even Russia, Ukraine and Poland, with their more-than-five-year programs, have only basic economic courses included.

*Program Structure.*Composition of the marine engineering programs varies. First to mention is the share of the sea portion, which normally takes one year. However, there are exceptions, like in Belgium and Israel, where the cadets spent much more time at sea. Secondly, every program might be looked upon as a combination of the building blocks. In most of the marine engineering programs the following blocks or components might be found:

a. Mathematics and basic science
b. Humanities - language, history and culture. Social science and economic courses, if offered, normally belong to this portion of the program
c. Engineering science - mechanics, materials, thermodynamics, fluids, basic electricity, etc.
d. Special engineering - propulsion plant, power plant, systems and machinery, naval architecture, etc.
e. Physical education - offered either as mandatory classes, or as activities beyond the scheduled hours
f. Naval reserve training - offered by some schools as an integral part of the program
g. Navigation and ship handling - several introductory courses are normally offered in a plain marine engineering curriculum and a special core of courses is provided for the integrated officers training.

The distribution of time among the above portions of a program and the list of academic courses vary quite substantially from country to country, and even among different schools of the same country. The Table below presents the comparison of marine engineering programs at USMMA and the St. Petersburg Maritime Academy of Russia:

Table 1. Marine Engineering Programs at American and Russian Federal Academies

Program Component	Federal Maritime Academy, %	
	USA	Russia
Mathemathics and Science	20	16
Humanities and Social Sciencies	13	18
Basic Engineering	20	18
Special Engineering	26	35
Others	21	13

IV. Alternative Engineering Management Training

The most popular and, possibly, the easiest way of amending the curriculum with economic and management subjects is by developing special courses. Most schools have, at least, one mandatory economic course, most likely a general theoretical course in macro and micro economics. Although, it provides certain economic fundamentals, it does not add substantially to the practical applications of the economic theory in the maritime industry.

An important component of the maritime educational system in some countries is post-graduate training. This is a very efficient way of improving the qualification of maritime officers by introducing them to all the latest changes and developments in maritime practice. This training might also be used to provide the officer with the principal economic and management subjects. Many schools are offering various advanced courses for former graduates, not necessarily of their own school. Some courses might be geared to a relatively narrow area, like management of shipyard repairs, economic analysis of new technology and methods, etc. Incidentally, many companies are sending their engineers to regular universities for economic and management training on the continuing education basis.

However, because the basic economic training has not been provided before graduation, these short-term advanced courses might not produce the expected results. On the other side, if this training includes the basic courses, it will cost much more than if it was done during the original training at the maritime school, and it will take valuable time.

V. Marine Engineering Management Program

As an alternative to the existing marine engineering curriculum a special program with enhanced economic and management content has been developed at the U.S. Merchant Marine Academy.

Introduction of an engineering management program in a highly specialized engineering school creates its own difficulties and specific challenges, and, as a result, requires a substantial modification of the traditional approach. On one side, being dedicated to a single industry the school can better steer the program and determine the boundaries of the subjects included. The Academy accepted a rather pragmatic route by combining the theoretical stuff with very extensive practical applications in the maritime industry. The program is based on the core of the regular Marine Engineering curriculum, and relies heavily on the practical marine engineering subjects.

On the other side, the already overloaded four-year program limits an in-depth exposure to some vital theoretical concepts. Every graduate of the Academy takes a U.S. Coast Guatd test to receive a marine license, a mandatory requirement for sailing as engineering officers. This quite comprehensive and exceptionally practical test makes it necessary to provide an in-dept training as a mandatory portion of the curriculum. Moreover, this four-year program is in reality being presented in three years while the students are in residence, because each of them has to sail a year on board American flag ships. Actually, the total number of hours is equal to the one of a regular college, but the day is longer and the academic year lasts over ten months. As a result, any idea to increase the total number of credits immediately runs into a very tough resistance from both, the faculty and the students. Talking of a new program, there is an advantage, though, compared to a regular engineering school – all students enrolled into a certain program take the fixed set of courses, with one or two restricted electives only.

There were two principal questions to be answered while the program has been developed. The first one: where to find the time needed to introduce the new courses? Some courses had to be replaced and a few more courses had to be added which had increased the total time budget by twelve academic hours. And the other question: what additional knowledge is needed and what is the relative importance of certain subjects to be considered? The following represents an attempt to prioritize economic and managerial topics relative to a marine engineering management curriculum:

- the first and obvious consideration is a general course in economics and management of marine transportation, as a portion of the introductory to profession package;
- the highest priority is given to a course in economic decision making, which was entitled engineering economics;
- operations management represents another important area of knowledge, which comprises of a rather theoretical course in managerial processes as a foundation for a set

of separate courses and topics in ship engineering operations, manufacturing processes, shipyard design and production management, management of ship design and shipyard production design;
- another major component of the program is a set of theoretical subjects related to the optimization of managerial decision making: operations research, management statistics, and information systems;
- a significant area of required knowledge is how to manage projects, because every marine engineer, on board or ashore, is constantly involved in performing projects. This training includes one fundamental course on methods and procedures, and also separate topics related to various types of projects, such as maintenance and repairs, ship design, ship construction, shipyard development, etc.;
- also included in the program is the basic training in accounting and finance, related to engineering operations on board and ashore.

A vital portion of the program is a six-week internship in a shipyard or a similar facility. The objectives of the internship include learning procedures and obtaining practical skills in specific areas of shipyard operations and management, improving the midshipman's potential by exposing him to the practical management functions. While working as an assistant to a project or ship manager or an assistant to engineer in a production department, the student should familiarize himself with various aspects of organization, production and management at the shipyard.

Another task during the internship is collecting data for a capstone design project to be completed during the Senior Class year. There are three types of projects which are offered:
- developing a project of an overhaul of an assigned ship at a shipyard
- developing a ship construction project
- developing a ship modernization/conversion project

The design project is performed by a team of three-four midshipmen during the first and the second trimesters of the senior year. A typical project consists of the following parts:

- cost estimate and development of a bidding package
- economic evaluation and justification of a proposed ship, ship conversion or an overhaul
- project management strategy and procedures for implementation of the project at a shipyard or a similar production facility including a project plan, a work breakdown, a network diagram and a computerized schedule, and optimal workforce distribution
- design of modernization and/or improvement proposals intended for ship construction or repair including justification of the proposals, necessary design calculations to support the intended design, preparing supporting diagrams, drawings, charts, etc.

- design of production processes for selected items including development of production procedures with flow charts, manufacturing processes, equipment and tooling, transportation diagram, etc.
- shipyard capacity analysis and evaluation including optimization of labor force, facility and installations, analysis for “bottlenecks”, design and modernization proposals intended to increase capacity and production output
- relevant statistical analysis and optimization assignments based on the quantitative analyses technique

Conclusion

A variety of tasks facing the engineering graduates of the maritime academies, who are either sailing or working ashore, require certain economic and management skills. Therefore, the basic economic and management knowledge should be included into the curriculum of the maritime schools on a substantially higher level and scope than it is done now. However, providing an engineering license remains the first priority of any program, which puts a strenuous time limitations. Therefore, the endless list of economic and management subjects and topics, which are useful for the students, should be prioritized. And the highest priority should be given to the subjects of economic decision making, engineering management of operations, optimization of managerial decisions, engineering project management, etc. Development and introduction of special courses in accordance with the priority list is the simplest and most widely used method of economic and management training.

An ultimate solution to a need for increased economic and management training presents a special curriculum in marine engineering management which combines the required core of engineering license subjects, and necessary general engineering nucleus satisfying the baccalaureate degree requirements with a package of management oriented courses. The succesful introduction of such program at the U.S. Merchant Marine Academy at Kings Point provides a good example.

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