INTERNATIONAL ASSOCIATION OF MARITIME UNIVERSITIES
PROCEEDINGS OF INAUGURAL GENERAL ASSEMBLY
26-29 JUNE 2000, ISTANBUL, TURKEY

ACADEMIC EDUCATION FOR MARINE ENGINEERING AT ADVANCED MARITIME UNIVERSITIES

T. Nakazawa

Kobe University of Merchantile Marine, **JAPAN**

Abstract

A basic concept of marine engineers is that "marine engineers have to be able to make judgements at the time of incidents in the engine room with providing logical explanations to justify their choices". By using the basic concept, the relationship between the level of education for marine engineering at advanced maritime universities/faculties and the level of minimum requirements accredited with the revised STCW95 is discussed. Consideration to improve education and research for marine engineering in the near future is introduced in this paper. The author would also like to propose, from this comparative study, what the education and research for marine engineering at advanced maritime universities should be.

1. Introduction

According to the Webster's English Dictionary[1], "marine engineering is defined as a branch of engineering that deals with the construction and operation of the power plant and other mechanical equipment of seagoing craft, docks, and harbor installations". Thus, marine engineering is not a simple discipline and its structure is an integrated engineering associated with mechanical, civil, electrical, chemical engineering, etc.

On the other hand, the main objective of engineering is, generally speaking, to find the optimum solution of practical problems by applying scientific knowledge and mathematical analysis. The major functions of engineering consist of Research, Development, Design, Construction, Production, Operation and Management. In addition, engineering has to show the reason why the solution is the best. From the standpoint that marine engineering is a branch of engineering, it is reasonable to support that these engineering functions can also be applied to marine engineering.

Marine engineers on board ship, who are defined as "Engineer Officers" in Regulation I/1 of STCW convention, are basically responsible for safe and efficient operation as well as operation complying with environmental protection. Their tasks, therefore, are in a wide range varying from watchkeeping to management of both machinery and crews of the engine department on the ship. Additionally, the important nature of marine engineers is that marine engineers make judgements at the time of accidents or incidents in the engine room and to provide the logical explanations to justify their choices. These definitions will be useful to consider the optimum solution of marine engineering education at advanced maritime universities/faculties.

2. Level of Engineering Education

2.1 Engineering knowledge and academic programs

Before considering the level of marine engineering education at advanced maritime universities/faculties, it will be useful to discuss the level of engineering knowledge using a certain example. Let us suppose that there is an engineering law or principle which students of the marine engineering course will be taught, such as the first law of thermodynamics or the Kirchhoff's current law. The level of engineering knowledge can be classified into four categories as follows;

E1: To know the principle
E2: To understand the principle
E3: To apply the principle
E4: To find a new principle

The knowledge on E1 means that the students know only the name of the engineering principle. In contrast, the students on E2 and E3 can explain the principle to their juniors since they understand the principle, and some of them can apply the principle to solve their problems. Consequently, the boundary between E2 and E3 is not so clear. The students on E4 may be able to find a new principle by using their advanced engineering knowledge. Therefore, a man on E4 may be called as a researcher rather than a student since the man can seek an engineering problem that he has to solve.

On the other hand, academic programs of engineering schools can also be classified into four categories as follows;

A1: High school
A2: BSc
A3: MSc
A4: PhD

It is difficult to define the locations of these boundaries between the above categories because the level of the academic programs basically depends on the policy of a school. The boundaries between these categories will be illustrated in a figure after combining the level of engineer officers.

2.2 Operational and Management Levels

Maritime universities and technical institutions related to maritime affairs normally have a marine engineering course, which one of the purposes is to obtain the engineer officers' license for oceangoing vessels. Therefore, their academic programs have to be reflected in the revised STCW'95. To grasp what kind of engineer officers the STCW'95 really requires, words used in the standard of competence tables, A-III/1 and A-III/2[(2)], are checked in details. This quite easy analytic work will give us appropriate suggestions.

First, verbs used with high frequency in the Column 1(Competence) are picked up and listed in Table 1 for both A-III/1 and A-III/2. Secondly, words used with high frequency in the Column 2(Knowledge, understanding and proficiency) are shown in Figures 1 and 2 as bar charts with frequency in the percentage of total number of the words.

Table 1 Top three-ranking verbs in Column 1 of tables A-III/1 and A-III/2

Ranking	Operational level (A-III/1)	Management level (A-III/2)
1	Use	Monitor
2	Operate	Control
3	Maintain	Maintain

As the results from this work, the following facts are obtained, namely, competence for the operational level is to Use, to Operate and to Maintain something, moreover, the knowledge of ensuring the competence are concerned with System, Equipment, Operation, Safe, etc. In contrast, competence for the management level is to Monitor, to Control and to Maintain something, while the knowledge of ensuring

the competence are concerned with Operation, Law/Convention, Maintenance, System, Theory, etc. What needs to be emphasized from the results is that the knowledge with theoretical background may not always be needed for the engineer officers on the operational level.

Apart from the minimum standard of competence in STCW'95, let us consider the knowledge required for the marine engineers who can make judgements with logical explanation. It may be acceptable that the knowledge of giving logical explanation for a certain engineering incident is not so easy and the level should be over the level of "to know the principle".

There is an opinion that a marine engineer does not always need theoretical knowledge if he has adequate experience. But if he meets an incident, which he has not experienced so far, and he has no theoretical knowledge regarding the incident, then he will be in a panic. This may be an acceptable story regarding the way to Human Error. The author, therefore, would like to point out that the education for engineer officers at maritime universities has to be higher than the minimum standard of competence in STCW'95. The relationship among engineering knowledge, academic programs and engineer officers' level is conceptually illustrated in Fig. 3.

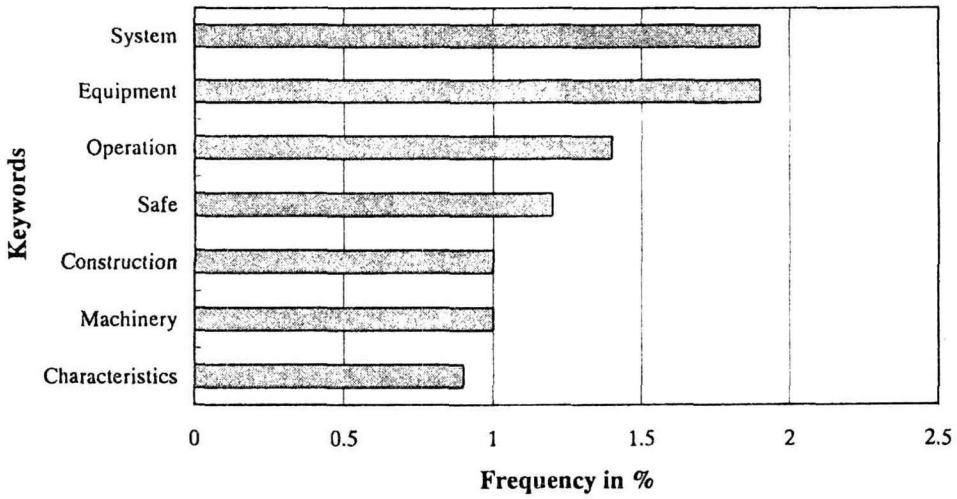

Fig.1 Keywords selected from Column 2 of table A-III/1 (Operational level)

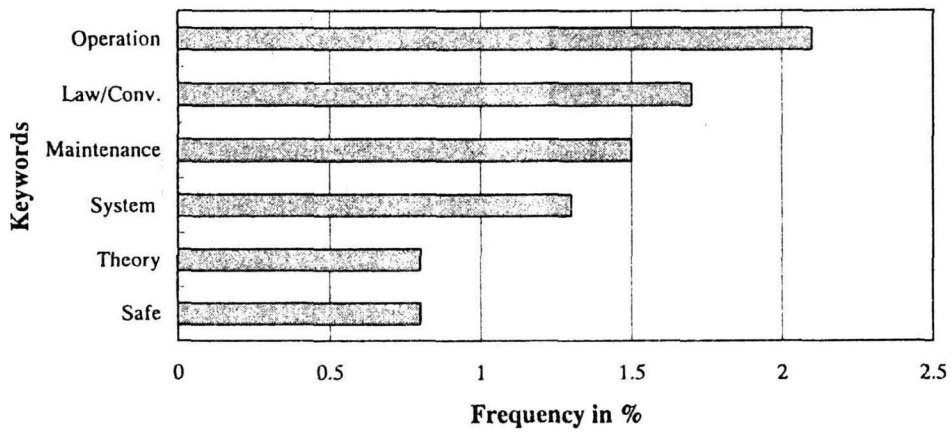

Fig.2 Keywords selected from Column 2 of table A-III/2 (Management level)

3. Dilemmas

From the discussion in the previous chapter, a dilemma is coming up as another subject. The dilemma results from the difference between the level of academic programs at maritime universities and the level for engineer officers. It is quite obvious that the graduate courses at maritime universities are not always needed if the target of the academic programs is only for obtaining the engineer officers' certificates. Because engineer officers accredited with STCW'95, in particular on the operational level, need the experience to operate machinery on board ship rather than the knowledge with the theoretical background. Moreover, shipowners' demand for a young engineer officer is to be just an operator accredited with STCW'95 of which requirements are for the operational level. Therefore, the dilemma is, in other words, for maritime universities having the marine engineering course. The selection that the maritime universities have to determine is whether to be an advanced maritime university having the master and doctoral courses or to be a traditional maritime training school. Needless to say, the decision for this selection must be the way to be an advanced maritime university. However, this decision will lead to the second dilemma.

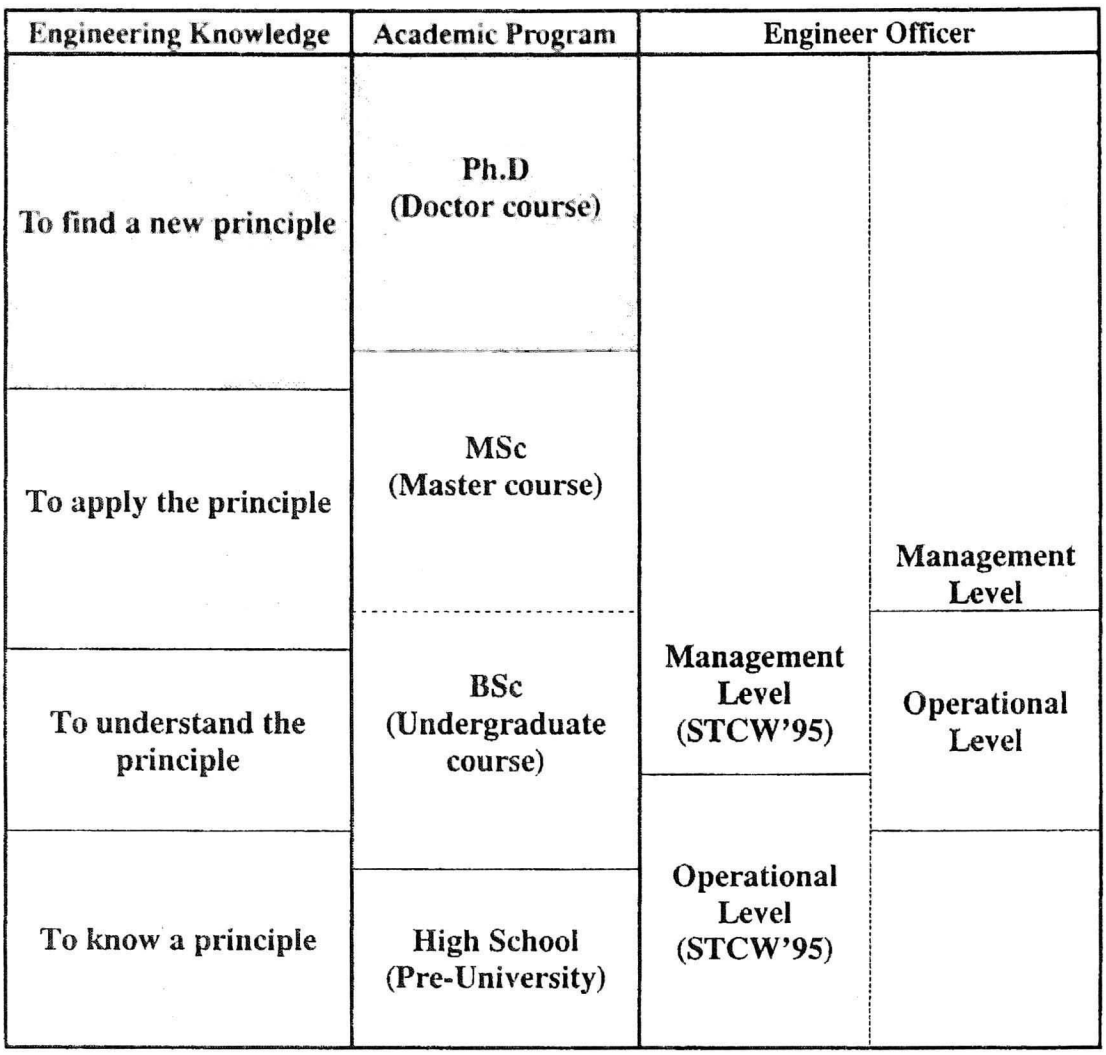

Fig.3 Relation among Engineering Knowledge, Academic Programs and Engineer officers

The second dilemma is for academic staff of the marine engineering course at a maritime university. As academic staff at an advanced maritime university having the graduate course, the ability to undertake research activities and the outcomes has strongly been needed for the staff in charge of the department of marine engineering. As shown in Fig. 4, marine engineering is an integrated engineering associated with mechanical, civil, electrical, chemical engineering, etc. In other words, marine engineering can be expressed as interdisciplinary study. Consequently, once young academic staff in the department of marine engineering starts studying marine engineering with great effort, the direction of his or her research activity is going to the cores of other engineering as shown by the arrows in Fig. 4 because of the nature of research activities. Therefore, after several years, he or she will be no longer an expert of marine engineering but an expert of other engineering. This is difficulty for academic staff at advanced maritime universities to be an expert of marine engineering.

4. The solutions

The major functions of marine engineering are Research, Development, Design, Construction, Production, Operation and Management, as discussed in the introduction of this paper. However, the roles of engine officers on board ship are mainly Operation and Management, which are actually only two of the major functions of marine engineering. The important point which academic staff in charge of marine engineering at advanced maritime universities have to notice is that the functions of marine engineering as a discipline and the roles of engineer officers are not the same, namely the former is much greater than the latter.

According to the ability as a qualified engineer officer, which is to make judgement with logical explanation, the level of engineering knowledge should be on the undergraduate level or beyond, even for the operational level. It is obvious that academic programs for undergraduates at advanced maritime universities should be kept on high standard without being deluded by minimum requirements.

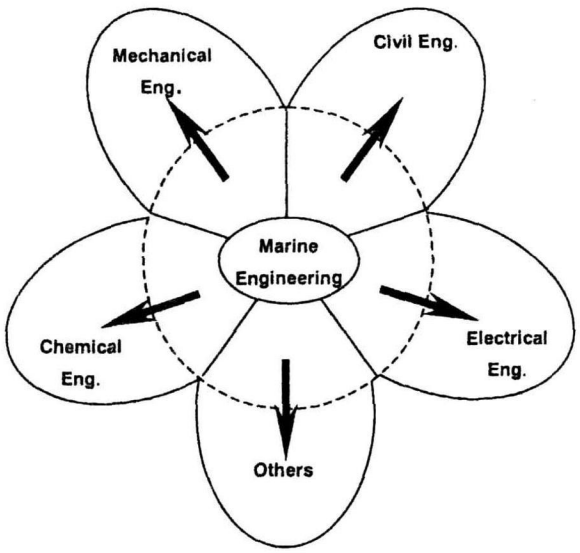

Fig. 4 The concept of marine engineering as an interdisciplinary study

Without doubt, the main target of the marine engineering programs at advanced maritime universities will be to educate the students for the marine engineer who can contribute the development of maritime industry. Thus, the department of marine engineering at advanced maritime universities should provide the superintendent engineers[3] to maritime industry, who have adequate experience and theoretical knowledge of both engineering and management.

As far as the research activities for marine engineering are concerned, the marine engineering staff at advanced maritime universities should have at least two types of research projects. The first one is of dealing with somewhat specialized topics, so that the staff can go to the cores of other engineering. The second one is the joint research of which the members are not only from engineering, but also from other disciplines such as law,

economics and sociology. The aspect of this sort of joint research really shows the same structure of marine engineering as an interdisciplinary study.

5. Conclusion

As academic staff for marine engineering education at advanced maritime universities/faculties, we should note that education for marine engineers is only a part of marine engineering. Therefore, the academic program for the department of marine engineering should contain not only the education for operation, but also the education for research, development, design, construction and production related to marine engineering. The education programs for the superintendent engineers, which recent maritime industry really needs, may be the most appropriate program for the master course at advanced maritime universities/faculties.

The research activities for marine engineering should be interdisciplinary study according to the structure of marine engineering. Joint study together with researchers from several disciplines may be the most appropriate research topics for marine engineering.

References

(1) Webster's Third New International Dictionary, Encyclopedia Britannica, Inc., 1985.
(2) STCW 1978 as amended in 1995, International Maritime Organization, 1996.
(3) Harrold, A.F., "The Executive Role for the Marine Engineer", TransIMarE, Vol.100, pp.1-4,1988.