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Marine engineering education in Ghana

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MARINE ENGINEERING EDUCATION IN GHANA.

(A new approach)

by

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The contents of this paper reflect my own personal views and are not necessarily endorsed by the UNIVERSITY.

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ABSTRACT

Marine Engineering Education in Ghana.

From the 23rd to the 26th of February, 1977, the third Ministerial Conference of West and Central African States on Maritime Transport (MINCONMAR), was held in Accra, Ghana. At the end of this meeting, a convention institutionalizing the conference was adopted. Based on the charter of Abidjan which was established on the sixth of May, 1975, the members agreed among other objectives:

- To harmonise and coordinate their policies on matters concerning maritime transport and,
- To promote the development of appropriate machinery and bodies for the improvement of maritime transport.

Under the second objective was a proposal for setting up regional centres for maritime training. This gave birth to the Regional Maritime Academy (RMA), in Accra. By a subsequent Ghana government legislation, PNDC Law 33, the RMA came into operation from the 5th of December, 1982. The Academy is to rationalize the use of scarce and expensive resources for the benefit of all members. It is to elevate the existing twenty-three year old Ghana Nautical College into a centre of exellence, for multipurpose maritime training of sea going and shore based personnel.

In my paper, I have outlined the existing facility and training schemes for marine engineering that was inherited by the academy at regionalisation. I have enumerated some of the deficiences associated with these schemes and for which reason the industry as well as trainees are not getting the full benefits of time and investment.

For solutions, I have made recommendations for a new approach, which is based on dividing the curriculum into knowledge acquisition and skill training so as to achieve a front loaded system of marine engineering education by which all the fundamental knowledge requirement will be provided in one continuous phase prior to skill training.

PREFACE

Developments in the maritime industry are dynamic ones. As a result, machinery, equipment and operational procedures are changing on a continuous basis. There is no doubt that this trend and level of sophistication will continue. It is, therfore, a must for developing countries to endeavour to prepare their manpower to cope with changes and modern innovations long after graduation.

I believe that by the establishment of a high level basic technical education, and by means of well coordinated continued education schemes, we shall be able to achieve this goal.

The reason for this second approach can be evidenced by the following statement attributed to A. YAKUSHENKOV of the Marine Research Institute of Leningrad, who wrote that: "Now a high school graduate takes the risk of becoming a "KNOW NOTHING" in 7 to 10 years, if he remains at the level of his last examinations."

It is statements such as this one that have enabled me to determine and define a course for marine engineering education, which I believe will provide a solution to our present system, and be appropriate for the future.

At this time of writing, the general education system of Ghana is going through some fundamental changes. It is not as yet clear how these changes will eventually affect the entry level into tertiary education. However, since the new curriculum is based on that of the West African Examinations Council as before, and since it is not expected to have special examinations conducted for Ghanaian students, there is good reason to believe that the "A" level standard will be maintained as the yard-stick. For this reason, I have based my proposals for the foreign going marine engineering course on this qualification.

The source of the descriptions and tables of exsisting training schemes is the course curriculum file for the RMA which is popularly referred to as "ITEM 5" within the academy.

Acknowledgements: In the process of putting this paper together, I gathered useful data and opinions from a number of personalities, especially during field training. To all those people I express my sincere thanks. I am indebted to David Pratt, whose book, Curriculum Design and Development, has been very valuable to me. I am particularly grateful to my former lecturer at Hackney college of London, G. J. Roy, with whose permission I had access to the Institute of Marine Engineer's document on the standards and routes to registration. Finally I am very grateful to D. M. Waters of the Australian Maritime College, from whose ideas as expressed in his paper, "Maritime Education and Training, Policy Objectives and Practical Considerations", I have been able to frame a large percentage of my proposals.

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CHAPTER 1

INTRODUCTION-HISTORICAL BACKGROUND.

1.1 From 1959 to 1982.

The Ghana Nautical College (GNC), was established in 1958/1959 for the purpose of training ratings to man vessels of the Black Star Line, a subsidiary company of the then newly formed State Shipping Corporation of Ghana. In 1962, under guidance of the British, the facility was expanded to train deck and engineer cadets, and the training of ratings discontinued. The Board of Trade (BOT), now the Department of Transport (DTp) training scheme was introduced as illustrated in Figure 1.1. With some slight modifications, such a scheme has been followed until today.

Throughout the stay of the British, facilities were expanded from year to year within the limitations of staffing and accomodation. Attempts were made occasionally to run upgrading courses beyond the pre-sea level, but with only limited success. This was because there were no follow-up facilities or competent lecturers and examiners locally for the certification of seafarers. Consequently, all further studies and certificates have to be obtained by candidates abroad in the U.K. Financing is through grants or scholarships obtained from shipowners or governments, or must come from individual efforts.

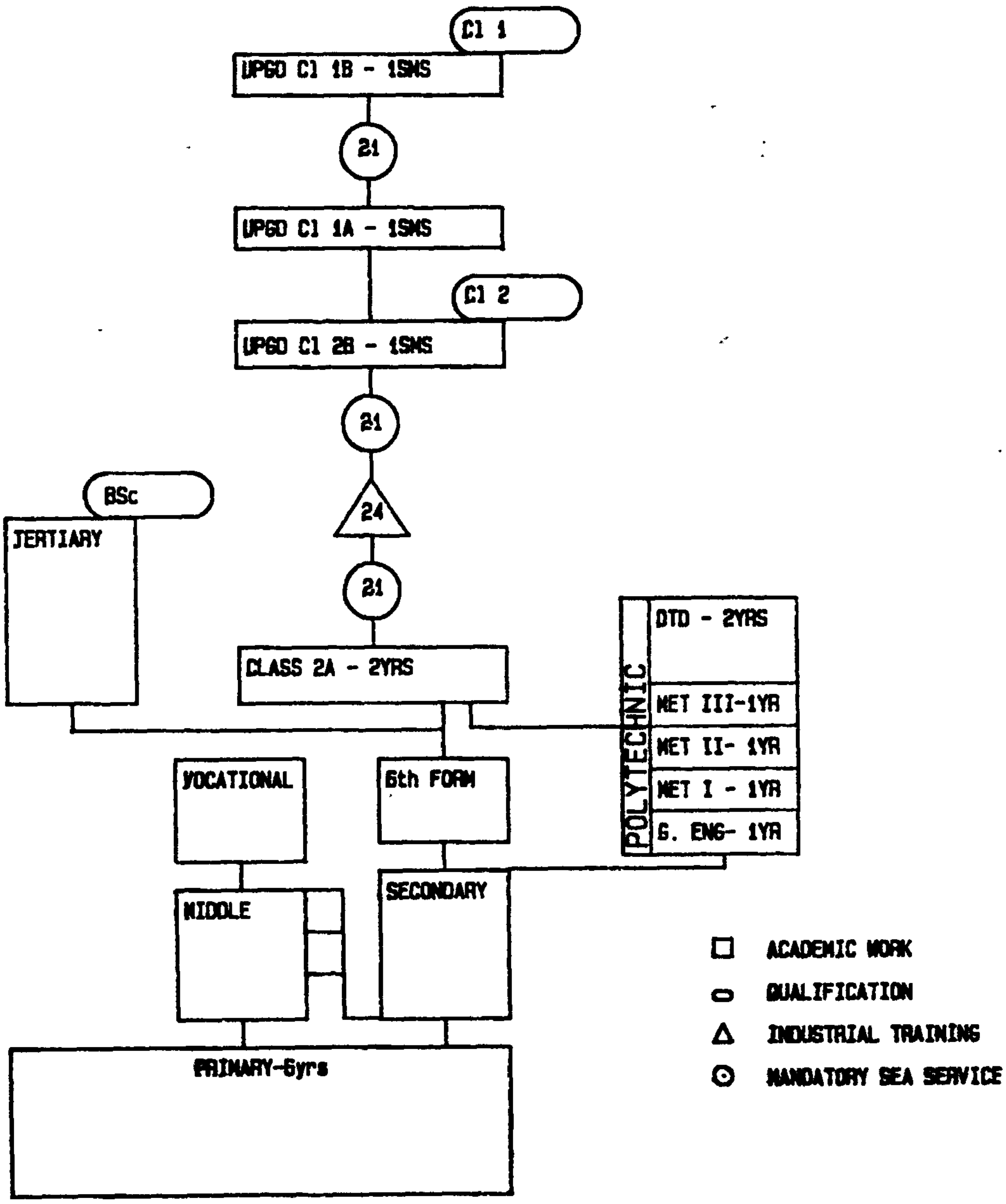

FIGURE 1.1 - PREVIOUS TRAINING SCHEME (FOREIGN GOING).

Fisheries training was introduced in 1966. In 1969, by an agreement with the government of Ghana, the Norwegian Agency for International Development (NORAD), assisted in modernizing the fisheries training facility. This assistance included the provision of lecturers and equipment. The equipment are of a high quality and in some cases, very sophisticated. It now serves for the training of both fishing and foreign going marine engineers.

There is no doubt that an institution cannot continue to function without a faculty. But this was exactly the situation in the academy towards the end of 1982, when, quoting from the present principal's progress report, "Well qualified and experienced teachers had left the GNC for other West African states where salaries and conditions of service were much more attractive. At that time, there were no lecturers having master mariner or chief engineer qualifications. Lecturers having academic degrees to conduct studies at international level were rare". In addition to that, "the equipment and training aids available were deteriorating due to lack of technical expertise or spare parts"(1.1).

This situation should not have arisen if the performance of lecturers, and their willingness to remain teaching under the difficult economic situation at that time, were matched with adequate remuneration and living or working conditions. Power struggle and in-fighting amongst members, which seemed to be fueled by both internal and external forces became the order of the day. Eventually, the situation got to such a destructive state that, to save the academy from collapse, outside help was sought as the most logical solution. Four experts from the Arab Maritime Transport Academy (AMTA), were therefore seconded to the academy.

1.2 From 1982 to the present period.

The Egyptians assumed office on 22nd May 1984 and immediately set themselves the task of reorganizing the various organizational structures; academic and administrative.

For the education and training sector however, the situation remained essentially the same. The programmes followed on the same lines of the British as before. Students were prepared by the academy, and the examinations were conducted by the DTp of the United Kingdom.

This set-up remained until February 1987. The United Kingdom at that time introduced structural changes in its system, and all external examinations conducted for the benefit of other commonwealth countries were discontinued. The academy, and hence the maritime administrations of the members were now on their own.

As an immediate solution the academy proposed the establishment of a unified legal instrument (LI), to authorise it to conduct the liscensing exams for merchant marine officers. This was not accepted as proposed. Instead the board of governers (BOG), decided that it was better for each country to set up its own machinery for the issuance of licenses to its nationals. In accordance with this, the government of Ghana has since the 16th of March, 1988 issued LI 1358 on merchant shipping concerning certificates of competency for masters, mates and engineers.

It is this unusual turn of events that has prompted me to propose a new approach to marine engineering education in Ghana. I believe that the opportunity has presented itself to remedy the deficiencies in the existing system, and to adopt a front loaded system of education into the future. However, in so doing, we must maintain whatever is good about the present sandwich system and be flexible enough to allow for changes and innovations that will take place in the industry.

CHAPTER 2

TRAINING FACILITY

2.1 Infrastructure and equipment.

The RMA is situated by the sea at a distance of about sixteen kilometers to the east of Accra, Ghana's capital. The campus covers an approximate area of one hundred and seventy-four acres. Presently there is a twelve room classroom block, an auditorium, a library and a number of administrative offices. There are a number of laboratories and workshops for training and demonstrations including the following for the engineering department:

1. A thermodynamics laboratory,

2. An electrical/electronics laboratory,

3. A workshop building which houses:

   a. a control engineering laboratory,
   b. a refrigeration and air conditioning laboratory and workshops,
   c. a machine shop, a foundry and a welding shop for training in metalwork technology,
   d. a diesel laboratory in which two diesel generators serve a second purpose of supplying stand-by power for the campus, and

e. finally, there is a collection of used and reconditioned machinery items such as a thrust block, cylinder covers, crankshafts, pumps and turbochargers, which are used for teaching.

In the classroom situation, we have the usual overhead projectors, in a ratio of one to three rooms and one TV/video set for the whole academy. Each classroom can take up to thirty students.

With the exception of short seminars, and depending on the availability of places, all the main courses are residential. To that effect, there is a one hundred and forty-four bed students hostel and a social ammenities building which also houses the cadets dining hall.

2.2 Present training schemes

The Academy runs a number of courses under three main departments of nautical, marine radio and marine engineering. More courses are being considered for the future, especially to train shore based personnel, but presently those offered by the marine engineering department may be broadly divided into two categories:

1. Courses for the training of merchant marine officers, and

2. Courses to provide for the fishing industry.

Under category one the following are offered:

1. Basic studies in marine engineering for pre-sea

cadets.

2. Upgrading course for obtaining the class three certificate of service.

3. Upgrading courses for obtaining the second class certificate of competency foreign going, abbreviated (FG), in two parts, A and B.

4. Upgrading courses for obtaining the first class certificate of competency (FG), also in two parts of A and B.

Under category two, there are six courses that prepare students to obtain licences as a:

1. Marine engineer class two, home trade/fishing, abbreviated (Cl 2 HT/F).

2. Marine engineer (Cl 1 HT/F).

3. Marine electrician (Cl 2 HT/F).

4. Marine electrician (Cl 1 HT/F).

5. Marine refrigeration engineer (Cl 2 HT/F).

6. Marine refrigeration engineer (Cl 1 HT/F).

In accordance with the title of my paper, I wish to limit my writing to only the courses listed under category one, and a little on the home trade and fishing marine engineering courses listed under category two. These schemes are illustrated in Figure 2.1.

2.2.1 Pre entry education

In Ghana, formal or general education begins from the age of six and continues for thirteen years. This period is divided into two parts, six years primary education, and seven years secondary. The latter is further sub-divided into two parts. The first five years of secondary educates students to obtain the general certificate of education, ordinary (GCE"O") level. With this qualification, a student is elligible to enter a polytechnic or an equivalent institution for technical, vocational, commercial or agricultural training. The remaining two years leads to the general certificate of education, advanced (GCE"A") level. This is the minimum qualification required to enrol for most university degree courses.

Since the begining of September 1987, a shorter system is being introduced to replace the seven years of secondary education. This system will consist of three years each of junior and senior secondary schools, and the middle school course will be phased out.

The systems of general education in Sierra Leone and the Gambia are essentially the same as that described for Ghana. Being former British colonies, the three inherited similar structures. They are also members of the English speaking West African Examinations Council (WAEC). This is a regional body responsible for conducting a number of academic and professional examinations, including the GCE "O" and "A" levels.

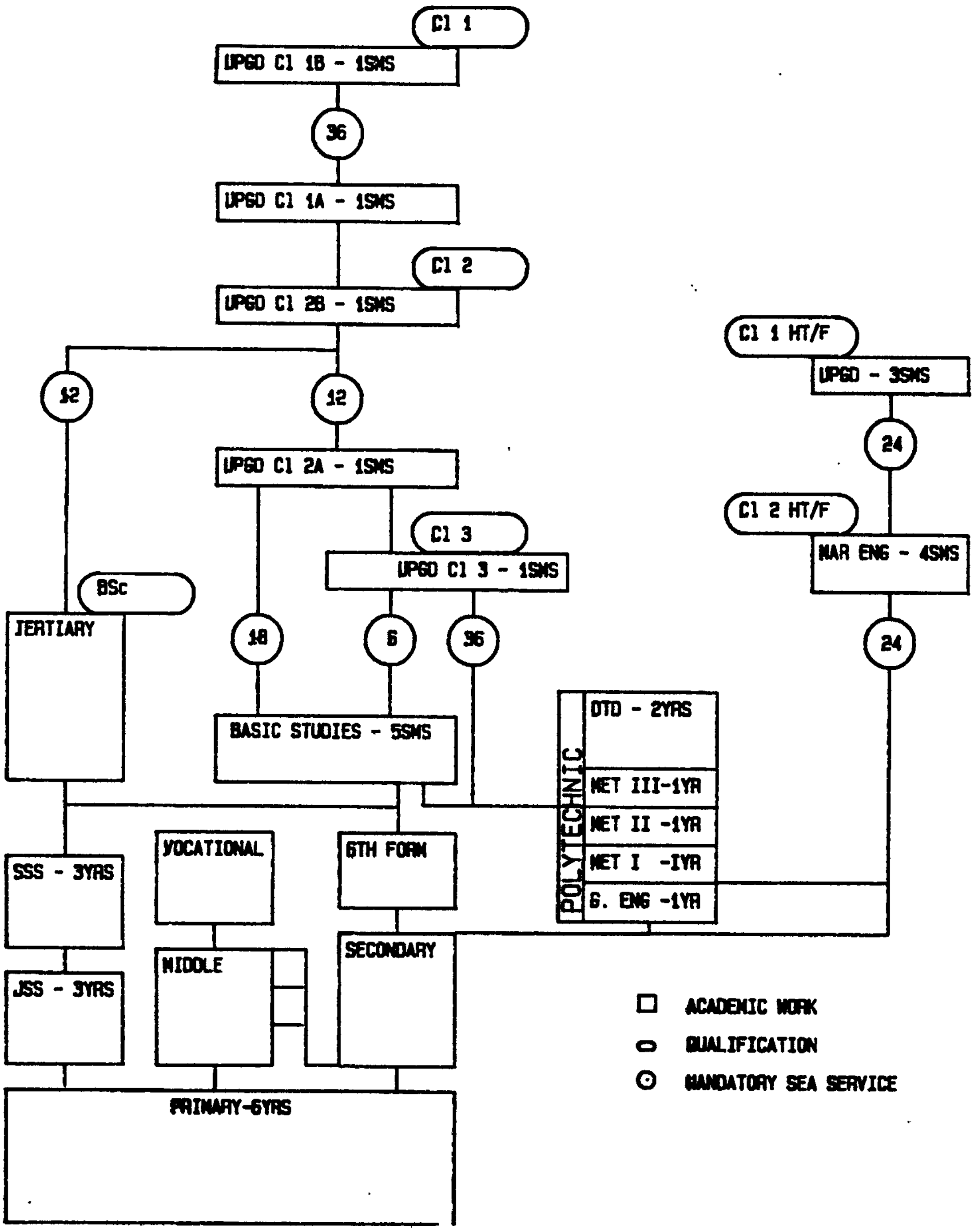

FIGURE 2.1 - PRESENT TRAINING SCHEMES.

It means that students from Sierra Leone and the Gambia will normally enter the academy at an equivalent level of education as their Ghanaian counterparts.

The Cameroon has a general education system based on that of France which was also inherited through colonialism. Students of that country obtain the baccalaureate on completion of general education and in all respects this qualification is equivalent to that of the previous three. Cameroonian students are therefore at an equivalent level at entry.

The Liberian school system consists of six grades of primary education, followed by three years of junior, and three years of senior high schools. On completion students obtain the National School Certificate or Diploma as it is sometimes called. After this stage students can proceed to college or to a university. Liberia is presently in the process of adopting the WAEC syllabus and examination system, and has this year entered six cadets into the pre-sea engineering course who are said to be performing satisfactorily. This indicates that Liberian students are also at a comparable level with the others.

2.2.2 Marine engineering education-HT/F.

From the early to mid sixties a rapid expansion of the fishing industry took place in Ghana, and mechanised methods of fishing were introduced. At that time however there did not exist a ready supply of engineers to draw from. Therefore able young men with some secondary education up to the "O" level, or training in general engineering from a polytechnic were recruited for work on board whilst undergoing training. With time they usually progressed from apprentices to become assistant or junior engineers. This has largely created a tradition for employment and a system for the initial education of fishing engineers that exists today.

During the second half of the seventies, a demand for better trained engineers became apparent with the introduction of more sophisticated vessels like factory ships. The GNC, working in cooperation and with full backing of the industry then introduced the HT/F engineering training scheme we have today, and as illustrated in Figure 2.1.

Under the scheme, junior engineers with a minimum of twenty-four months sea service, twelve of which must have been spent as a watchkeeper, are given education in the academy for two years. An academic year in this case consists of two semesters of fourteen weeks each. An average of one week is allowed for examinations, public holidays and other eventualities. That leaves thirteen weeks, or about four hundred total hours as the effective lecture time. A lecture extends for a period of sixty minutes.

On completion, successful students obtain the second class HT/F certificate of competency. With this qualification, they are eligible for employment as second engineers on fishing vessels or ships engaged on coastal trade.

After a further two years mandatory sea service, they are eligible to return to the academy for a three semester upgrading course. Candidates who complete successfully, obtain the first class HT/F certificate of competency. They are then at the zenith of their careers and may be employed as chief engineers on the same class of vessels as before. The subjects offered for the two classes of certificates are listed in tables 2.1 and 2.2.

Table 2.1 COURSE PROGRAMME FOR CLASS 2 HT/F.

Subjects	Hours/week.				
Semester	1	2	3	4	Total
1. Seamanship.	2				24
2. Mathematics.	6	6			144
3. Applied mechanics.	4	4			96
4. Thermodynamics.	4	4			96
5. Engineering drawing.	6	6			144
6. Workshop theory.	2	2			48
7. Workshop practce.	6	6			144
8. Electrotechnology.		4	4	4	144
9. Engineering knowledge motor.			6	6	144
10. Engineering knowledge general.			4	4	96
11. Engineering knowledge practice.			6	6	144
12. Refrigeration theory.			4	3	84
13. Naval architecture.			4	3	84
14. Instrumentation and control engineering.			2		24
15. Marine automation.				2	24
16. First aid.					16
17. Fire fighting.					30
18. Survival at sea/Life saving.					30
19. Leadership training.	2	2	2	2	96
20. Physical education.	2	2	2	2	96
Total					1708

Table 2.2 COURSE PROGAMME FOR CLASS 1 HT/F.

Subjects.		Hours/week.			
	Semester	1	2	3	Total
1. Mathematics.		8			96
2. Engineering science.		6			72
3. Workshop theory.		2	2	2	72
4. Workshop practice.		6			72
5. Engineering knowledge motor.			6	6	144
6. Engineering knowledge general.			6	6	144
7. Engineering knowledge practice.			6	6	144
8. Naval architecture.		4			48
9. Refrigeration theory.			6	6	144
10. Electrotechnology.		6			72
11. Marine automation.				3	48
12. Instrumentation and control engineering.		2			24
	Total				1080

2.2.3 Marine engineering education-FG

For the mainstream marine engineering education, students are selected from among those with "A" level qualification who have passes in any two of the three subjects, mathematics, physics and chemistry, or with an MET-II (Mechanical engineering technician - part two) certificate. In addition candidates must satisfy the following:

1. They must pass the academy's competitive entrance examinations, and

2. They must be medically fit to the academy's standards.

Successful candidates are admitted into the RMA for a five semester course to study marine engineering. Cadets choose their own specialisation to become either an engineer or a deck officer at the time of application. In between semesters, cadets are allowed home for vacation.

Unlike the HT/F courses, the semesters are eighteen weeks long for the foreign going programmes. Two weeks are allowed for examinations, public holidays and other eventualities. Hence there are sixteen weeks or four hundred and eighty total hours for formal lectures. A lecture period is again sixty minutes.

The syllabus consists of basic, applied and practical subjects. Refering to Table 2.3, there are thirty-two subjects which include first aid, life saving and fire fighting training. In addition to that, cadets undergo physical education and leadership training on a daily basis. The third semester is devoted to skill/practical training in industry. During this period, cadets spend various times in the diesel locomotive/boiler workshops of the Ghana Railway Coorporation at Sekondi, with the Tema Shipyard and Drydock coorporation, and in the academy's refrigeration and control engineering laboratories. The total programme is to give cadets the opportunity to have a general knowledge of maintenance procedures and practices, and to learn about ship repair and ship construction in the context of a heavy engineering industry.

Throughout the course, performance of cadets is assessed on a continuous basis, by means of class tests, homework and end of semester examination. On successful completion, there are two options along which to proceed with a sea career.

1. A cadet may sail for a continuous period of eighteen months after which he or she becomes elligible to join at the class 2A upgrading course stage to proceed to the top, or

2. A cadet may sail for six continuous months then return to the academy for a one semester refresher course. At the end of this he must pass an examination to obtain the class three certificate.

The class three certificate is considered a watchkeeping certificate as required by the STCW convention. After this stage the cadet becomes a junior engineer officer and can proceed with the remaining sandwich programme to become a chief engineer. This requires a minimum of an additional four and a half years mix of sea service and upgrading studies to obtain the class one certificate of competency. The upgrading courses are listed in Tables 2.4 to 2.8.

Table 2.3 COURSE PROGRAMME FOR BASIC STUDIES.

Subjects.						Hours/week.
Semester	1	2	3	4	5	Total
1. Maritime English language.					2	32
2. Mathematics.	4					64
3. Physics.	4					64
4. Chemistry.	4					64
5. Applied mechanics.	4	4				128
6. Engineering drawing.	6	4				160
7. Thermodynamics.		5				80
8. Electrotechnology and electronics.		5		4	3	192
9. Strength of materials.		3				48
10. Hydraulics and hydraulic machinery.		3				48
11. Machine drawing.				6		96
12. Marine instrumentation.				3		48
13. Marine automation.					3	48
14. Machine design and theory of machines.					6	96
15. Naval architecture.					4	64
16. Engineering knowledge steam.				3		48
17. Engineering knowledge motor.				4	3	112

continued on next page

Subjects. Semester	1	2	3	4	5	Hours/week. Total
18. Engineering knowledge general.				4	3	112
19. Engineering knowledge practice.				6	6	192
20. Workshop technology.		6	6			192
21. Seamanship.	2					32
22. First aid.						16
23. Life saving.						30
24. Fire fighting.						30
25. Physical education.	2	2	2	2	2	160
26. Leadership training.	2	2	2	2	2	160
Industrial training (3rd semester).						
27. General marine machinery.						114
28. Refrigeration.						72
29. Boiler workshop.						72
30. Diesel workshop.						144
31. Electrical workshop.						72
32. Instrumentation and control engineering.						96
Total						2886

Table 2.9 shows the courses which are mandatory for obtaining certificates of competency at all levels.

A month of qualifying sea service is equal to a month spent aboard a ship on employment in the engine department. It includes time in port, at anchorage, or in a shipyard during repairs. The nature of work carried out must be properly documented on a certificate of service signed by both the chief engineer and master of any vessel on which a trainee serves.

Table 2.4 COURSE PROGRAMME FOR CLASS 3.

Subjects.		Total hours.
1.	Engineering science.	96
2.	Engineering knowledge (general).	96
2.	Engineering knowledge (motor).	96
4.	Electrical technology.	64
5.	Mathematics.	96
6.	Engineering drawing.	96
	Grand total	544

Table 2.5 COURSE PROGRAMME FOR CLASS 2 PART A.

Subjects.		Total hours.
1.	Thermodynamics.	96
2.	Mechanics and hydromechanics.	96
3.	Naval architecture and ship construction.	96
4.	Electrotechnology and electronics.	96
5.	Instrumentation and automation.	48
	Grand total	432

Table 2.6 COURSE PROGRAMME FOR CLASS 2 PART B.

Subjects.	Total hours.
1. Engineering knowledge motor.	96
2. Engineering knowledge steam.	96
3. Engineering knowledge general.	96
Grand total	288

Table 2.7 COURSE PROGRAMME FOR CLASS 1 PART A.

Subjects.	Total hours.
1. Thermodynamics.	96
2. Mechanics and hydromechanics.	96
3. Naval architecture and ship construction.	96
4. Electrotechnology.	96
5. Instrumentation and automation.	48
Grand total	432

Table 2.8 COURSE PROGRAMME FOR CLASS 1 PART B.

Subjects.	Total hours.
1. Engineering knowledge motor.	96
2. Engineering knowledge steam.	96
3. Engineering knowledge general.	96
Grand total	288

There are two possible side entries to the mainstream programme. Referring to Figure 2.1:

1. Any person with an MET-II qualification who has served for thirty-six months continuous period at sea as an apprentice or a junior engineer may join the one semester upgrading course to become a class three engineer. One finds it hard to understand the rational behind this option.

2. The second possibility is at a higher level and a rather extreme one. A graduate mechanical engineer may join at the class two part B stage and work his way up to the top.

So far the records do not show any cases of the second possibility having been followed.

Table 2.9 MANDATORY SHORT COURSES FOR CLASSES 1,2 & 3.

Subjects.	Total hours.
1. Fire prevention and fire fighting.	30
2. Life saving.	30
3. Medical aid.	30
Grand total	90

2.3 Teaching staff.

The marine engineering department has a teaching staff strength of twenty. There are fourteen lecturers and five instructors. Their qualifications are, three MSc's, two BSc's, two class one (FG), and one class one (HT/F) in marine engineering, one class one marine refrigeration engineer, five mechanical engineering diplomates and five mechanical engineering technicians. Teaching experiences range from one to twenty years, and together they assist the head of department in running all academic programmes. Lecturers teach the core and academic subjects, and the instructors are in charge of all laboratory work and practical training within the academy. Visiting lecturers teach subjects like first aid.

At the begining of each course programme, every lecturer or intructor prepares a file which states clearly:

- The plan, the sequence and the teaching period to be allocated for each material presentation,

- The teaching methodology to be applied,

- The teaching aids to be employed and,

- A student assessment plan.

This is referred to as a course file and it is based on the curriculum objectives. Each lecturer or instructor is fully responsible for setting all examinations and assessing students in the subject or subjects he teaches. It is worthwhile to mention at this stage that the manner in which examinations are conducted in the academy may need to be reorganised. Presently the setting, marking, and grading of examination papers are practically the responsibility of one person, the lecturer in charge of a subject, and hence the chances of assessment becoming overly subjective is very high. A system which involves several people at different levels would greatly reduce the possibility or the appearance of unfair practices in the assessment of students.

CHAPTER 3

PROJECTED MANPOWER REQUIREMENTS

From a recent IMO survey, it has been observed that all five countries involved in the RMA project, hereinafter referred to as "Members", are highly dependent on maritime transport for both domestic and international trade. Maritime transport is vital for their economic development and prosperity, and for raising the standard of living and improving the quality of life for their people. The Members have long recognised that the carriage of their seaborne trade in their own ships is vital to their social and economic growth (3.1).

While the developing countries generate about 40% of world seaborne trade, the latest UNCTAD figures for 1986 show that only a little over 19% of shipping deadweight tonnage (dwt) belongs to them. Out of this amount some 94% are under the control of a few Asian and South American countries. That leaves Africa with an ownership of a mere 1.17% of the world's total, as indicated in Table 3.1.

Even though Liberia has the largest registry in the world that country does not really own any ships as shown by the latest figures for 1984. See Appendix A.1.

Table 3.1 Cargo turnover/fleet ownership for Africa

	Seaborne trade * 10^6 tons	% of trade	dwt tons * 10^6	% dwt tons
World	6835.00	100.0	639.10	100.00
Developing countries	2456.00	35.9	127.00	19.90
Africa	459.00	6.7	7.50	1.17

Source: Pages 4,7,80-82 of UNCTAD Review of Maritime Transort; 1986.

At the regional level, Table 3.2 indicates that the West African countries (refer to Appendix A.2 for the list of countries) generate 35.4% of the continent's total seaborne trade, and own 24.1% of the dwt tonnage. Out of this amount 15% belongs to Members. Considering that Liberia does not own any tonnage, and that 44.8% of the West African total belongs to Nigeria, then with respect to the role maritime transport plays, and the amount of tonnage owned presently, it may be concluded that the basis and the potential for more tonnage acquisition exists for Members.

In my opinion this potential has remained largely unexploited for a number of reasons. Since maritime transport is vital to the economic development and well being of Members, then it would be appropriate for various governments to have considered the development of this sector a matter of utmost priority. Unfortunately the industry has mostly suffered from intermittent investments which have left it struggling for survival.

Table 3.2 Cargo turnover versus fleet ownership for West Africa.

	Seaborne trade * 10^6 tons	% of trade	dwt tons * 10^6	% dwt tons
Africa	459.8	100.0	7.50	100.0
West Africa	162.6	35.4	1.81	24.1
Members	-	-	0.27	3.6

Source: UNCTAD Review of Maritime Trade 1984.

Perhaps the failure to commit resourses into shipping is justified if we take a look at the history of the national shipping lines which were established at great costs to lead the way in the maritime industry. Simply put, they have not performed very well.

However their performances must not be blamed on lack of proper management alone. According to Ernst G. Frankel, an American economist, "the contribution of national shipping is often overestimated without realising that expenditure on items such as vessel acquisition, fuel, foreign port stevedoring, repairs and manning costs are often paid for in the foreign exchange which is supposed to be saved or generated by them."

He also comments that "increased participation in liner conferences has often been found to be of doubtful national advantage". This is because of the "inherent conflict between the shipping interest in low freight rates versus national flag liner shipping interst in maximising profits"(3.2).

It is hoped that the UNCTAD "Code of Conduct for Liner Conferences" will go a long way to remedy some of the ills of this situation.

The economies of Members have been stagnant for many years. Under such conditons it was unimaginable to expect continual investment in a sector which has not lived up to expectations. However as the countries emerge from their various crises, there are signs that rational measures will be taken to remedy this situation.

From the foregoing there is reason enough to expect that the maritime industry will eventually get the boost it needs. This means a probable expansion of existing fleets or the setting up of new ones. It also means a demand for more engineers.

This is one justification for thinking of a new curriculum development. According to David Pratt, a writer on education:

"The world for which students must be prepared is not the world of today, but the world of the next fifty years"(3.3).

thirty

Doxiadis, a Greek educationist, puts it in another way when he wrote that:

"Dealing merely with the present is unrealistic because by the time we have analysed the situation, defined our problems, and planned how to meet them, the present has become the past; by the time we are ready to act and create new conditions, the present is the distant past", therefore "it is time we learned to think about the present as a dynamically changing situation"(3.4).

Given that the "lead time" required to produce qualified manpower is very long, it is imperative that the future be planned at least a decade in advance.

An IMO manpower survey report on maritime training needs for Members suggested an estimated annual student number for the following technical and engineering courses. See Table 3.3.

With the preceding statistics and the following figures, it can be predicted that there will be a demand for training, and hence the time for planning is now.

Table 3.3 Estimated annual student number.

	Cameroon	Gambia	Ghana	Liberia	Sierra Leone	Total
1. Ship surveying.	2	1	2	1	2	8
2. Machinery surveying.	2	1	2	1	2	8
3. Port engineering	8	2	10	10	12	43
4. Cargo handling technology,	15	6	10	8	12	51
5. Shipyard engineering.	13	6	10	6	15	50
6. Fishing engineering.	10	12	20	10	12	64
7. Watchkeeping certification.	4	2	5	4	6	21
8. First and second class certification.	4	3	6	4	6	23

Source: IMO manpower survey report No RAF/86/023 (1986) pp 94

CHAPTER 4

CURRICULUM DESIGN AND DEVELOPMENT.

Judging from the present programmes, it can be concluded that the maritime education system inherited by the academy is a purely certificate oriented one. Over the past twenty-five to thirty years however, this has been adequate to provide for the needs of the shipping industry. This does not mean the curriculum in itself was or is lacking in quality. What it lacks is scope.

With rapid containerisation, reduced manning, and more emphasis on short turn-around time in ports, ships of today are becoming increasingly sophisticated with high technology. This calls for a new generation of marine engineers.

Borrowing from D. M. Waters' paper on maritime education and training, it is apparent that the trend will be to issue certificates which encompass the whole range of shipboard duties including the commercial and managerial work (4.1).

But then as rationalisation came, the glamour and romance in sea-going have disappeared. Automation and reduced manning have imposed harsh social conditions to such an extent that more and more engineers are unwilling to remain working at sea for very long. Therefore to enable them to make an easy transition from ship to shore, they must be initially well educated so as to make it easier for assuming new responsibilities ashore.

Presently, there is a comprehensive project going on to provide ports, shipbuilding and ship repair facilitis, and other supporting infrastructure to cater to a whole new system of inland water transportation on the Volta Lake in Ghana. This is said to be the largest man-made lake in the world. It formed after the construction of a hydroelectric dam, and has a surface area of 8482 square kilometers. It is 402 kilometers long, has 4830 kilometers of shore line and a storage capacity of about 148 million cubic meters.

On the ocean side, the Tema Shipyard and Drydock Corporation is in the process of being privatised so as to revitalise the company to become profitable. Considering its location and size; it has two docks, one of dimensions 1277.4m * 45.4m * 6.7m for vessels up to 100 000 dwt, and a second of dimensions 106.7m * 13.4m * 5.5m for smaller vessels, it could coveniently become an important repair yard within the region.

These examples are indications of the better times ahead, at least for Ghana, and for which well trained marine engineers will be required.

My concept is an engineer who will exercise the powers of logical thinkng and technical judgement in maintenance and management of the operations for which he or she may be responsible, an engineer who will use resources efficiently and effectively. The future engineer must not become a victim of tomorrow's technology, and to be able to cope with the changes that will take place, he must develop a love for lifetime learning. To say that sophisticated technology requires sophisticated engineers will not be an exageration.

Traditionally it had been the practice of shipping organisations to deliberately keep ship's officers, particularly masters and chief engineers out of the decision making process. Meanwhile these men are engaged in activities that incur costs crucial to profitability. Now more companies are realising that by involving their ship's officers in the budgeting of the ships on which they work, or by making them aware of the reasons and the need for cost minimisation, they can play a very important role in revenue generation.

Training in economics and management is hence a growing necessity. The purpose is not to change sea-going staff into economists or management specialists. It is to facilitate their inclusion in the management teams of the organisations they work for, and to prepare them adequately for new tasks should they decide to work ashore.

This calls for a new curriculum, a curriculum that will satisfy the needs of industry, the needs of society, and, a third factor that has often not been given the requisite attention but which is of equal relevance, the human needs of trainees.

According to Tyler an educationist, in developing any curriculum and plan of instructions, four fundamental questions must first be answered. These are:

A. What educational purposes should a school seek to attain?

B. What educational experiences can be provided that are likely to attain these purposes?

C. How can these educational experiences be effectively organised? and

D. How can we determine whether these purposes are being attained? (4.2).

From the foregoing analyses a curriculum may be designed which has the following goals.

- A course work that will teach fundamentals and principles to keep up with the pace of development.

- A course work that will emphasise the complementary nature of theory and practice.

- A course work that will be relevant to the future careers of trainees and will aim at developing their intellectual powers.

This is to be complemented by a training programme which aims at avoiding the creation of a gap between theory and practice, by teaching engineers to use principles in solving problems. In other words engineers must be trained to think and not to merely push buttons.

A study of courses from a number of institutions in developed countries, especially Western Europe, indicates two main philosophies of marine engineering education.

The first philosophy deals with detailed understanding of the technologies that constitute marine engineering systems, and their efficient maintenance and management.

The second is for the development and application of new technologies, design or design methods, and the pioneering of new marine engineerng systems and management methods. It is predominantly intellectual and requires the exercising of original thinking and judgement.

It can be said that the first concept is geared towards direct ship operations whilst the second is concerned with creativity, innovation, and change. Nevertheless, they are both for application, but with different inclinations.

Courses under the first concept are usually associated with the traditional maritime institutes. The second concept, which is highly academically oriented, is almost exclusively offered by universities.

Our present system is based on the first philosophy. When examined critically, the course contents do not appear to match the ever changing levels of practice and sophistication. I therefore advocate an improved course content which will be grouped under the following categories.

a. pure and applied sciences.
b. engineering science.
c. marine engineering.
d. safety and enviromental protection studies.
e. social studies which will comprise the commercial and management subjects.

It will start with the pure and applied sciences as the core subjects. They will form the basics upon which the profesional and specialist subjects will be built. As the concepts become established, the volume of practical work will be increased and, at the closing stages, the social subjects will be phased in. Figure 4.1 gives a pictorial view of such a programme.

The reasoning for this sequence lies in the fact that engineering and technology are primarily concerned with the application of scientific knowledge, to redirecting the resourses endowed on us by nature to the beneficial use of mankind. Engineering education must hence take cognizance of this fact, and commence with a programme for the acquisition of basic and relevant scientific knowledge.

The aim of the social studies is to widen the scope of students' knowledge about the enviroment, and to prepare them adequately for possible job transferabilty.

It may be asked, that why do we need to spend money on educating students for careers in which they will never remain. Well, except for a few seasoned individuals, the sea has never been a permanent place for most seafarers, and this situation is not likely to change for the better in the future. We must therefore accept this as a reality of the seagoing occupation and prepare students accordingly.

It is expected that at the end of the learning process:

- Engineers will employ sound fundamental principles as the basis for solving technical problems.

- Engineers will possess a broad and firm understanding of the commercial and economical aspects of shipping and its allied industries.

- Engineers will be critical and analytical when making judgements or taking decisions.

- Engineers will develop the capability and the love to continuously upgrade their knowledge.

The end in view is to ensure that engineers meet the future with confidence, and that the education should form the basis of future development in post graduate studies.

When it comes to the course contents, I repeat again that, even though the present curriculum may be good in itself, it is no longer adequate for the changing trend within the industry.

For example, in the study of hydraulics, students are immediately introduced to shipboard machinery, without having first studied enough fundamentals, or the relationship these items have with principles such as, Pascal's law on the transmission of pressure through fluids. In practical subjects like metalwork technology, only the barest minimum of underlying principles necessary to strike an arc with an electrode is provided prior to asking students to carry out exercises in welding. This shows that the present system of education is aimed purely at getting students to obtain competency certificates. It has worked well for these limited objectives.

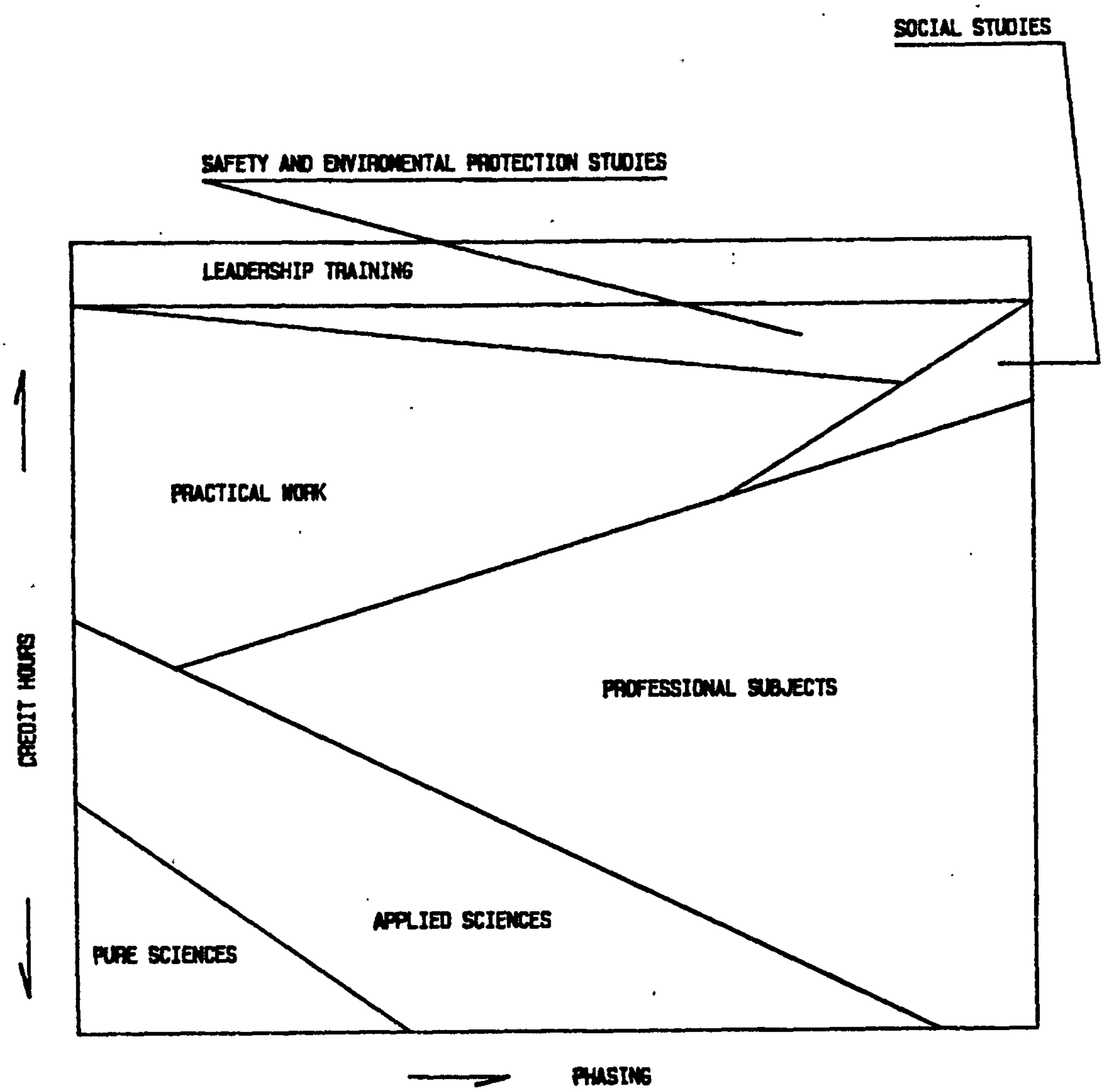

FIGURE 4.1 COURSE CREDIT HOURS-TENTATIVE PATTERN

One thing the curriculum did not provide however, is that this approach has largely created a situation in which most of our senior marine engineers are presently trapped into remaining at sea because they lack the background education and diverseness to face other challenges.

Hull and Pedrotti, two American engineers, summarise it in another way when they wrote that, "if we were to tear into some of the modern equipment" we work with, we would find that they are extensively composed of "electrical, electromechanical, electronic, optical, fluidic and thermal devices, and computers". Because of this, they reasoned that engineers "must have a strong interdisciplinary background to be successful in today's and tomorrow's work force" (4.3). In order that the academy might cater to this kind of requirement effectively, I will like to see the course contents re-defined with arguments such as the following in mind.

Mathematics: Nowadays empirical methods are becoming more difficult for use in solving modern complex problems, and experimental methods have become complicated, time consuming and expensive. Mathematical methods therefore offer the best solution. The mathematics in question is that which deals with the areas most important for practical applications, such as the use of diffrential calculus in mathematical modelling. It is hence necessary to redesign the curriculum to provide an effective technical mathematics programme which will establish the foundation essential to subsequent course-work. Fortunately the background of most students at entry is such that they are already familiar with the elementary calculus required for an engineering mathematics of that nature.

Physics: Concurrently with mathematics, it is desirable to have a course in physics which will emphasise on building a strong foundation in the principles of classical physics and their uses in the solving of problems, with an inclination towards practical application.

Thermodynamics: This is a very important subject at the core of a marine engineer's daily activities. For the operation of power plants, refrigeration machinery and the maintenance of valuable liquid cargoes in good condition, the principles of thermodynamics are constantly in use.

For example, as manufacturers strive to develop more fuel efficient engines, the application of all the known thermodynamics principles are becoming the order of the day. Their efforts will not be worthwhile if the operating engineers of such machinery are not given adequate education to measure up to these developments. For this reason there is a need to raise the level of the course in applied thermodynamics to that of a bachelors degree.

Electrotechnology: At sea we used to have an unwritten rule amongst engineers concerning electrical machinery. This says that whenever there is a fault, however small or simple it may appear, call the electrician immediately. Most marine engineers will defend this rule as a measure to prevent trespassing on an electrician's territory. But the truth is that most engineers lack the confidence to solve practical electrical problems. The present training scheme has created this because it fails to establish a good relationship between the many theoretical calculations engineers go through, and the practice. It is hence necessary to redesign the course to change that attitude. The aim is not to make electricians out of engineers, but to give them enough confidence to handle the normal electrical faults unassisted as much as possible.

Navigation: A course in navigation as an important part of a ship engineer's training is long overdue in our system. First of all, experience has shown that a proper understanding of the nature of activities on the bridge helps the engineer to appreciate any difficulties better, and to play his role in ship operations accordingly.

Secondly, the prediction is that ships of the future will be manned by multipurpose officers and crew, and the division in occupations is more likely to be along the lines of technical versus commercial, rather than an engineer versus a deck officer as we have today.

Since 1963, France has introduced a multipurpose training scheme based on this projection, and the Netherlands and other countries are doing the same. For our situation, it is not likely that such a change will be considered in the near future. However by providing marine engineers with an education in navigation, the first requirement will be met, and whenever the need arises for multipurpose training, the basis for doing that would have been established.

Computers: A major change in technology that affects everybody is the increasing use of computers, for both problem solving and process control. At the rate at which ship operations are being automated, it can be predicted that in the near future, even the simplest book--keeping jobs on board will require the use of computers.

We have therefore arrived at the stage where some training in computer science is a must.

Similar arguments can be advanced for other subjects, and at the end of it all, the following conclusion may be drawn.

Technology is rapidly becoming advanced on ships, and there is no doubt that this trend will continue. The curriculum for the education of marine engineers must therefore be appraised and upgraded to meet these developments.

CHAPTER 5

RECOMMENDATIONS AND CONCLUSION

Reccomendations.

As said earlier, if our engineers are going to meet the future with confidence, then they must be given a broad based education.

For foreign going officer training, our present sandwich system is lacking in that respect. It has been specifically designed for safe operation, and tends to produce highly specialised technicians.

If we are to judge the total programme on time basis alone, then there will be a tendency to believe that perhaps the length of coursework is more than adequate to provide a good engineering education.

It requires a minimum of ten and a quarter years from cadetship to become a class one engineer. This period is made up of:

- Two and half years of basic education,
- Two and half years of upgrading studies,
- Three and half months of shore based industrial

training, and

- Four and three-quarter years of mandatory sea service, out of which only the first six months may be considered as training in the academic sense. The remaining period is meant for the experience necessary to obtain the various certificates of competency.

If, however, we consider the level of knowledge, and the sequence in which it is provided, then another picture emerges. As far back as 1984, Thomason, a consultant who worked for the IMO in Ghana, remarked that the academic qualification for cadet entry to the pre-sea engineering course was set at too high a level for the course, and this meant that the potential of the student was not utilised to the fullest extent (5.1). The situation has not changed very much since then, and, besides that, since the upgrading courses are strictly designed for obtaining licenses, the contents are practically limited to examination topics alone. Aboard ships, training is not academically oriented, and because there are no links with the academy, whatever supervision is necessary to ensure the expected continuity of education is non-existent.

I will therefore recommend the adoption of a front loaded system of education for the training of future marine engineers. The curriculum for that will be divided into two parts, knowledge acquisition and skill training. The knowledge acquisition period will form the first phase, and will include a period of guided sea training. The entry qualification will be the GCE"A" level certificate or its equivalent. To be able to attain a level in education to match the trend in developments, I propose that the existing pre-sea engineering course be restructured and extended into a four-year degree programme as the phase for knowledge acquisition and as illustrated in figure 5.1. On successful completion, cadets will obtain a bachelors degree in marine engineering to be awarded by the academy.

Since this paper is writen primarily for the purpose of selling an idea, an idea of a new education policy and objectives, I will not go into lengthy details at describing the mechanism by which degrees will be awarded. The modalities for doing that can always be worked out when my proposal is accepted, but one solution is to affiliate the academy to an accredited institution which already has a considerable experience with this kind of approach. This will ensure international accreditation of whatever degree the academy may choose to award.

The second phase, will be assessed by the maritime administrations, and will proceed in packages along the lines of the STCW convention as follows:

- Package one: Six months of mandatory sea service after which graduates automatically obtain the class three (watchkeepers) certificate of service.

- Package two: Twelve months of mandatory sea service, followed by a semester of preparatory studies to obtain the class two certificate of competency.

- Package three: twenty-four months of mandatory sea service, followed once again by another

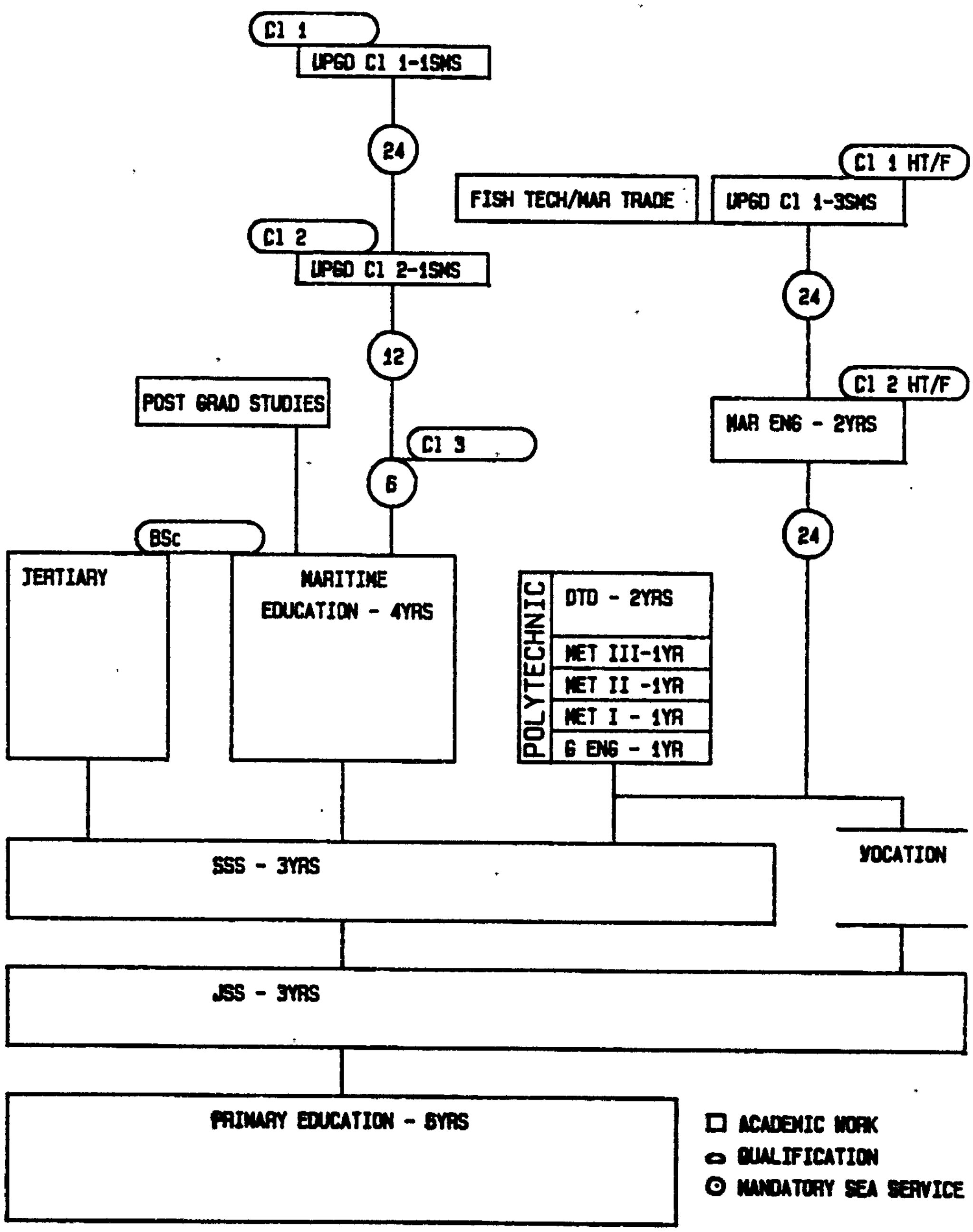

FIGURE 5.1 - PROPOSED TRAINING SCHEMES.

semester's studies to obtain the class one certificate of competency

The one-semester periods of preparatory studies included in packages two and three are for the following purposes:

1. To help graduates prepare for licensing examinations, and

2. To provide the forum for the exchange of information on new technological developments in the context of a continuous education scheme as proposed earlier.

The degree programme will be sub-divided into three phases.

- Phase one will cover the first two years. This period will be used to teach fundamental knowlegde and its application to technology in general, and will include workshop technology.

- Year three will be equivalent to phase two. This phase is for industrial training and the time will be proportionally divided into shipboard training and shore based industrial experience to be determined. To encourage itellectual education, each cadet will be required to undertake a sea project work during the period. Typical subject areas which may be considered for this project are: propulsion machinery, auxiliary machinery, marine automation, electrical machinery, and deck machinery.

- Year four is the final phase. This year will continue mainly with the professional marine engineering subjects and will see the introduction of social studies. It is also for preparation towards degree examinations and the presentation of project results.

At appropriate times during the four years, maritime conventions and regulations regarding safety and enviromental protection will be introduced.

Even though the minimum knowledge requirements as laid down in chapter III of the STCW convention have been taken into account, they have not solely formed the basis of my curriculum design. I have based my proposals on the reasoning that, the new generation of marine engineers must be adequately equipped to meet the ever changing job market both at sea and ashore. They must be useful unto themselves, and with the high level undergraduate training they will receive, a desired prerequisite for postgraduate education will be met.

I envision that such a programme will form a necessary first step in the creation of a group of technocrats who will lead the way in the attainment of true technical development of our maritime industry. After graduation, successful engineers with further ambitions may proceed to post-graduate school for specialisation in subjects such as shipbuilding, marine automation, naval architecture, and the design of marine engineering systems. In effect the post-graduate studies is aimed at providing education within the context of the second marine engineering philosophy as mentioned earlier on page 32. The proposed restructured degree programme is listed in Table

5.1, and Figure 5.2 gives a pictorial view of it.

If the sea training programme is to provide the appropriate knowledge, the continuation, and the skill required, then it would be ideal for the academy to own its own training ship. As this is not feasible at our present stage of development, the alternative is to reconsider a system which was operated in the sixties and seventies, and which was quite successful. That system was operated by the Black Star Line of Ghana. Under this, one of the company's vessels was outfitted specially as a cadetship for twenty-four trainees at a time. She carried two second engineers and two chief officers. One second engineer was for the normal ship operations and the other served as a training officer. The same system applied in the deck department. I propose the adoption of a similar system, which must again be operated under a commercial shipping line as before. The following modifications will however be necessary to ensure its effectiveness.

1. In place of a company training officer, the academy will employ a full time lecturer on board whose responsibility will be to supervise the guided sea training acccording to the course objectives.

2. The training ship should preferably be placed on liner service originating from West Africa, so as to ensure her availability to the academy at the right times.

Table 5.1 RESTRUCTURED PROGAMME FOR DEGREE COURSE.

Subjects.		Hours/week.									
		Academy							Sea		
	Semester	1	2	3	4	7	8		5	6	Total
1.	Mathematics	4	2					96			
2.	Physics	3	1					64			
3.	Chemistry	2						32			
4.	Applied mechanics	3	2	2	1			128			
5.	Applied thermodynamics	3	3	2	1			144			
6.	Fluid mechanics			1	1			32			
7.	Electronics		2					32			
8.	Electrotechnology			2	1	4	4	176	4	2	150
9.	Materials engineering		1	1				32			
10.	Control engineering			1				16			
11.	Ship machinery			2	2	5	4	208	16	16	800
12.	Naval architecture					4	4	128		1	25
13.	Ship construction					2	2	64	2	1	75
14.	Marine automation					2	2	64		2	50
15.	Navigation			1	1			32			
16.	Safety practice and enviromental protection			1	1	2	2	96	2	2	100
17.	Maritime trade					1	1	32			
18.	Maritime law					1		16			
19.	Principles of management and administration						2	32			

continued on next page

Semester	1	2	3	4	7	8		5	6	Total
<u>Practical subjects</u>										
20. Engineering drawing	6	6	4	4			320			
21. Workshop technology	6	6	6	4			352			
22. Computers			1	1			32			
23. Practical navigation								8	8	400
24. Seamanship			1	1			32	1	1	50
25. First aid	1	1					32			
26. Fire fighting				1	1	1	48	1	1	50
27. Project								6	6	300
<u>Laboratories</u>										
28. Physics	2	1					48			
29. Thermodynamics			1	1			32			
30. Mechanics			1	1			32			
31. Materials engineering		1					16			
32. Fluid mechanics				1			16			
33. Naval architecture					2		32			
34. Eletrotechnology				2	2	2	96			
35. Electronics		4					64			
36. Control engineering			1	1			32			
37. Automation				1	2	2	80			
38. Diesel			2	4	2	4	192			
39. Leadership training	2	2	2	2	2	2	192			
40. Physical education	2	2	2	2	2	2	192			
Total	34	34	34	34	34	34	3264	40	40	2000

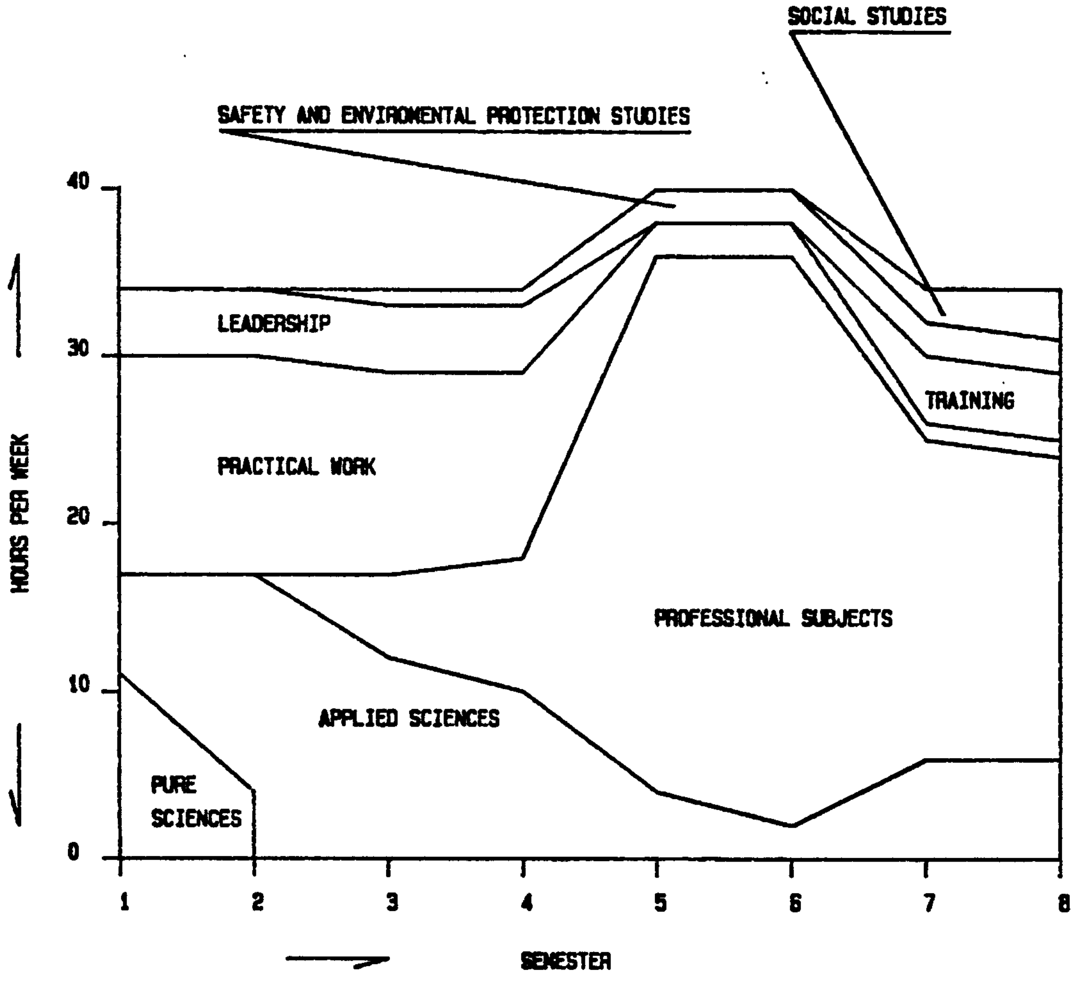

FIGURE 5.2 COURSE CREDIT HOURS - ACTUAL PATTERN

For the home trade and fishing engineers course, the feedback from the fishing industry in particular suggests that the programme is quite adequate, but only as far as safe operation of ships is concerned. This means that one of the primary objectives for offering this course appears to have been lost. That objective is to train fishermen to be able to catch fish more efficiently. The safe operation of fishing vessels must therefore be considered a necessary and an integral part of a course to train fishermen.

I will therefore propose the introduction of courses in fishing technology at both levels of the certificate of competency programme, and to establish a fishing training school or department which will be responsible for this training.

For the benefit of those who will be working in coastal shipping, an alternative course in maritime trade will be offered, as illustrated in Figure 5.1.

The certificates of competency will be assessed by the maritime administrations as is done presently, and the fishing technology and maritime trade courses will be the full responsibility of the academy.

Having worked at sea under real conditions for a minimum of twenty four months, candidates have had the time and opportunity to reflect on their chosen careers, and are not likely to face problems of adjustment that might be expected to happen to new graduates joining an occupation for the first time, especially one such as fishing.

Secondly, since all students are sponsored by fishing companies or governments, they are definitely guaranteed jobs after graduation.

For these reasons, I believe that the existing system for entry to the home trade and fishing engineers course is beneficial to both candidates and sponsors and must be maintained. The academic qualifications at entry will however need to be reviewed occasionally to bring them in line with changes in course level and content.

Conclusion.

It is often argued that, without an adequate background experience, it is difficult to understand and appreciate certain subjects and principles better. On the other hand, skills are better acquired when there is proper undestanding of underlying fundamental principles. Hence there is good reason to first provide all the basic knowledge required before obtaining a skill.

The facts show that, the marine engineering degree progamme being proposed is nothing new. It has long been the practice of most other professions like law, medicine and the other engineering professions, to first educate students, and then allow them to acquire experiences after graduation. D. M. Waters puts it rightly when he said that, "the maritime industry does not need to "re-invent the wheel" because all this has already been recognised by most other professions."

I firmly believe in that, and in conclusion, I will like to say that, for training of foreign going officers, the front loaded system is a better approach for educating our future marine engineers.

For the home trade and fishing courses, the additional education in maritime trade or fishing technology will ensure that engineers operate both safely and efficiently in whatever field they may find themselves engaged.

APPENDIX A

APPENDIX A.1

TRUE MANAGEMENT OF THE LIBERIAN FLEET.

Country of true owers	No of ships	dwt * 1000
1. US	394	38636
2. Hong Kong	452	28467
3. Japan	202	10264
4. Greece	136	9385
5. UK-based Greek owners	75	5444
6. UK	99	5747
7. Monaco	36	3727
8. Norway	123	4559
9. Germany FR	85	2151
10. Switzerland	52	2991
11. US-based Greek owners	26	1673
12. South Korea	10	989
11. Singapore	9	376
12. Netherlands	17	696
13. Italy	12	782
14. Indonesia	17	252
15. Israel	18	1011
16. Denmark	21	766
17. 70 countries, entities or territories	63	3027
18. Unspecified	45	1652
19. Unidentified	10	335
Grand total	1902	122930

Source: pp 211 Shipping Statistics yearbook, 1897

APPENDIX A.2

LIST OF WEST AFRICAN COUNTRIES AND THEIR TONNAGE.

		grt	dwt
1.	Angola	92 285	127 431
2.	Benin	4 887	4 880
3.	Burkina Faso	-	-
4.	Cameroon	76 660	88 679
5.	Cape Verde	14 095	22 092
6.	Congo	8 458	10 840
7.	Cote d'Ivoire	120 679	151 496
8.	Equatorial Guinea	6 412	6 700
9.	Gabon	97 967	170 176
10.	Gambia	2 588	4 046
11.	Ghana	165 644	178 268
12.	Guinea	7 179	2 927
13.	Guinea Bissau	4 070	2 843
14.	Liberia	-	-
15.	Mali	-	-
16.	Mauritania	22 752	10 230
17.	Niger	-	-
18.	Nigeria	563 912	809 278
19.	St Helena	3 640	2 829
20.	Sao Tome & Principe	1 488	1 172
21.	Senegal	50 429	41 651
22.	Sierra Leone	6 979	1 752
23.	Togo	54 882	78 009
24.	Zaire	65 883	91 012
Total		1 370 839	1 806 311

Source: UNCTAD, Review of Maritime Transport, (1986).

APPENDIX B

DEFINITIONS

BOG - Board of governors.

dwt - Deadweight tonnage.

DTp - Department of tranport of the United Kingdom.

FG - Foreign going.

Front loaded - A system of education in which the fundamental knowledge requirement is provided in one continuous phase prior to skill training and experience acquisition.

GCE "A" level - General certificate of education, advanced level.

GCE "O" level - General certificate of education, ordinary level.

GNC - Ghana Nautical College.

HT/F - Home trade/fishing.

Members - The five participating countries of the RMA, (Camerron, Gambia, Ghana, Liberia, Sierra Leone).

MET - Mechanical engineering technician.

RMA - Regional Maritime Academy, Accra.

Sandwich system - The system of marine engineering education which consists of alternate periods of academic studies and skill training.

STCW - Standards of training certification and watchkeeping for seafarers.

WAEC - West African Examinations Council.

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3.1 A. Simpson & A. Essien - IMO manpower survey on maritime training in Members countries, (pp 70), project RAF/84/023(1986).

3.2 Ernst G. Frankel - Management and operation of American Shipping (pp 75).

3.3 David Pratt - Curriculum design and development, (pp 62; paragraph 4).

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4.1 D. M. Waters - Maritime education & training, policy objectives and practical consideratins, (para 4.19).

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4.3 Daniel M. Hull and Leno S. Pedrotti - Challenges and changes in engineering technology, Engineering education (May 1986; pp 727/728)

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