1999

Investigation into an optimal model for a maritime education and training system amongst the European Union member states in the light of international legislative instruments and new technologies

Alexander G. Alexandrov
World Maritime University

WORLD MARITIME UNIVERSITY

Malmö, Sweden

INVESTIGATION INTO AN OPTIMAL MODEL FOR A MARITIME EDUCATION AND TRAINING SYSTEM AMONGST THE EUROPEAN UNION MEMBER STATES IN THE LIGHT OF THE INTERNATIONAL LEGISLATIVE INSTRUMENTS AND NEW TECHNOLOGIES

By

ALEXANDER G. ALEXANDROV

Bulgaria

A dissertation submitted to the World Maritime University in partial fulfilment of the requirements for the award of the degree of

MASTER OF SCIENCE

in

MARITIME EDUCATION AND TRAINING

Nautical

1999

Declaration

I certify that all the material in this dissertation that is not my own work has been identified, and that no material is included for which a degree has previously been conferred on me.

The contents of this dissertation reflect my own views, and are not necessarily endorsed by the University.

.....

Alexandrov Alexander G.

Supervised by Professor Peter Muirhead
Course Professor
Maritime Education and Training
World Maritime University

Assessor: Captain Danny Waters
Former Rector
World Maritime University

Co-assessor: Mr. Rajendra Prasad
Research Associate/Lecturer
World Maritime University

Acknowledgements

I would like to thank my sponsor, The European Commission, for providing me with financial aid to successfully complete my study at WMU and for making available research materials.

No achievement would be possible without the kind understanding, encouragement, criticism and professional assistance of the professors at WMU, visiting professors/specialists and my course professor and supervisor Prof. Muirhead, who gave me the opportunity to investigate and create ideas in an atmosphere of freedom. To all of them I am deeply grateful.

My thanks go to those who provided me with valuable information and advice, in particular colleagues from many countries throughout the world, who gave me specific explanations about their national Maritime Education and Training systems. I am indebted for their contribution. I appreciate the friendship shared among my classmates in Maritime Education and Training '99 and colleagues at WMU.

There are no measures available and words to express my gratitude to my parents and family for their understanding and passion over the years of my work.

ABSTRACT

Investigation into an optimal model for a Maritime Education and Training System amongst the European Community member states in the light of the international legislative instruments and new technologies

Degree: **Master of Science**

This dissertation is a study of the Maritime Education and Training (MET) systems in the European Community member states in the light of international legislative instruments referring to maritime education, and of new technology developments. The research focuses on synthesising an optimal model for MET systems with some particular parameters.

A general study is made of the environment where MET systems operate, and on factors which have an impact upon them. International Maritime Organization (IMO) Conventions and European Commission (EC) Directives are examined. A brief survey and analysis regarding some trends and developments in the shipbuilding industry, ship operations and education technologies and methodologies is conducted. All these aspects are examined in relation to past, present and future eras of operating MET systems, and where a created model could be established and put into effect.

An investigation of the information collected in the EU METHAR research project, followed by some additional calculations is undertaken. A quantitative model base and its parameters are determined to support the model hypothesis. The author's understanding of the seafarer's profession and arguments presented are used to justify cohesive links between different levels and make the appearance of the model structure feasible.

The results are collated and evaluated through a number of conclusions, which highlight the proposed optimal model of a MET system. A number of recommendations place emphasis on the necessity of the MET systems to adapt to the changes in the society and the maritime industries. A message is sent that a way this could be achieved is by more open international co-operation.

Keywords: maritime education and optimisation, education methodology, maritime technology

Contents

List of figures

List of tables

Appendices

List of abbreviations

AIS	Automatic Identification System
ARPA	Automatic Radar Plotting Aid
BRM	Bridge Resource Management
CBT	Computer Based Training
CoC	Certificate of Competence
DGPS	Differential Global Positioning System
ECDIS	Electronic Chart Display Information System
ECS	Electronic Chart System
EU	European Union
FSA	Formal Safety Assessment
GMDSS	Global Maritime Distress and Safety System
GPS	Global Positioning System
IALA	International Association of Lighthouse Authorities
IBS	Integrated Bridge System
IMLA	International Maritime Lecturers' Association
IMO	International Maritime Organization
IT	Information Technology
MET	Maritime Education and Training
OBT	On-Board Training
OECD	Organisation for Economic Co-operation and Development
OMBO	One Man Bridge Operation
OOW	Officer on the Watch
RCDS	Raster Chart Display System
SAR	Search and Rescue
SALAS	International Convention for the Safety of Live at Sea
VTS	Vessel Traffic Service

Introduction

The importance of the world's oceans is steadily growing and affecting all aspects of human development. In today's global economy, where markets are inter-linked and raw materials and products are shipped in various stages of the production process before reaching a market, no country can afford to lose out on the gains from trade by neglecting its maritime sector. Therefore, the socio-economic development is linked to the safer and reasonable use of the oceans, where the main role is played by the human factor. Some of the main features of this significance are:

- Life on our planet depends on the oceans, which cover more than 70% of its surface;
- More than half of the world's population lives near the coast and is predicted to double in the next 20-30 years;
- Many countries derive a substantial part of their income from activities along the coastline;
- Over 90% of world trade is transported by sea.

New technical changes taking place in the shipping industry offer great opportunities but they work only if operated by competent specialists. Unfortunately, the opinion that maritime education and training is so substantial is not widely held. This is partly because training is expensive and in times of economic difficulties, governments and industry are always looking how to save money, although education is something essential.

Human error is often the main cause of maritime accidents. In an effort to cut costs, remain competitive and increase profit, the hiring of cheaper and untrained labour can be an attractive option and low wages can become synonymous with low qualifications. Future crew requirements will not only be motivated by cost-effectiveness but also by quality and efficiency.

As a result of the move away from national registers, recruitment and training of seafarers is declining in Western industrialised countries with maritime traditions. Registering and manning ships in developing countries has become widespread, contributing directly and indirectly to economic success. However, such a trend has to be rendered safe and environmentally sustainable for the community. In this respect an

optimal model for a maritime education and training system will be of benefit for all involved in the maritime sector ashore, off shore or at open sea.

Methodology

A literary survey was conducted using the libraries at the World Maritime University, the University of Wales, Cardiff, the International Maritime Organization and the Institute of Marine Engineers. The main source of information about the European Community MET systems was the METHAR report recently co-ordinated by the WMU. Valuable information was also provided by the European Commission Directorate General VII.

Further understanding about processes in the world maritime industry, confirmation of some doubtful and complicated problems and their eventual solutions were received by interviews with many visiting professors and specialists at WMU.

All the information collected was studied, discussed and analysed. Conclusions and recommendations were made from an independent point of view.

Limitations

Defining an optimal model for a MET system needs an enormous amount of statistical data. The information collected and combined in the METHAR report is not enough for an ordinary statistical analysis. However, it is sufficient for some basic findings and orientations, such as: ministries responsible for MET, stages in MET and further procedures in the sea-going career, specialities offered and documents issued, total course duration and equipment availability. Not so clear are numbers of subjects and class hours, academic staff job descriptions and loading/vacation continuance, quantity of entrants/graduates. Missing was any financial information, which can assure a cost-effective analysis of the MET systems presented. Some processes established many years ago, which led to the deep crisis of the Western European MET systems, are too complicated to be shown and discuss clearly without risk of introducing perplexing errors. Therefore, one of the most important and interesting problems, the influence of the political, economical, technical and social factors was covered partly.

An optimal model of MET system was created, despite of the insufficient statistical information and complicated inter-relations between many factors.

Chapter I Challenges facing Maritime Education and Training (MET) systems

1.1 Survey of political and economic changes

The oceans have a decisive influence on the world's life. They act as a large reservoir of heat and carbon. The seas are an important source of food, energy, minerals and space, which need to be effectively exploited. These vital natural resources must, however, be safeguarded from the thread of pollution, whether it is oil from tankers, discharges from the land or dumping of hazardous waste.

Europe, including areas such as Ireland, the Baltic and Black seas, possesses about 35,000 km of coastline with an abundance of over 600 ports situated near to industrial centres. The largest part of the European Union (fifteen Member States together) have about 15,000 km of coastline and the largest concentration of ports in the world. No continent has as much coastline relative to its surface as Europe. The exclusive economic zone of 200 nautical miles around the Member States makes up an area of more than 3 million sq. km.

On a global level it is estimated that 95% of all internationally trading goods are transported by sea and that world seaborne trade, measured in tonnes, is growing by 2.1% per annum up to the year 2000. With the continuing globalisation of the international economy, maritime transport will become ever more important. Shipping is the most appropriate mode to serve the peripheral areas.

The European Union (EU) is the most important trading area in the world accounting for more than 20% of world trade, 90% of the Community's external trade, and about 30% of intra-community trade, is carried by sea. Over the last few decades, shipping has gradually been included as an important asset in the economic policy and law making of the European Union. This was overdue since transport, and particularly shipping, is a key factor in economic life and a fundamental element in international trade relations.

The completion of the internal market will see an increase in short sea transport, that is to say along Europe's coastline and along the Mediterranean, the Baltic and the Black Sea coasts. The changes occurring in Central and Eastern European countries will only contribute to the increase in maritime activity. The European Community is one of

the most important fishing powers in the world with the largest market for fishery and agricultural products.

The anticipated increase in the volume will have to be accommodated and advances achieved in the field of improvements to port facilities, application of new container technologies, new types of ferries, combined transport, development of intermodalism and investment in modern ships. In addition short sea and inland waterway transport can offer an important alternative to congested and environmentally damaging land transport. Vessels consume less energy per tonne carried and cause less environmental disturbance in terms of noise and air pollution than any other means of transport. They can at the same time prove to be a cost-effective option.

The people employed in maritime industries such as shipbuilding, maritime transport, offshore and fisheries sectors number together about 2.5 million. This is a considerably larger number of people than is employed in the energy and water sectors in the Community. At the same time the number of EU seafarers under national flag has declined from its 1983 level of 213,281 to 139,579 in 1995 (including Norway).

Several serious recent maritime disasters have drawn attention to the need of stricter international standards of safety on board vessels as well as in their design and operation. It has to be understand clearly that not only the Master and his crew are responsible, but also a lot of institutions and people ashore bear responsibility, although in many cases they are in "shadow". The following organisations and bodies are considered to have some degree of responsibilities:

- International Organisations: International Labourer Organisation (ILO), International Maritime Organisation (IMO), International Shipping Federation/International Chamber of Shipping (ISF/ICS), Baltic and International Maritime Council (BIMCO), International Transport Workers' Federation (ITF)
- National maritime administrations
- Classification societies: Lloyd's Register of Shipping (LRS), Germanischer Lloyd (GL), Det Norske Veritas (DNV), Bureau Veritas (BV), American Bureau of Shipping (ABS)
- Insurers
- Naval architects and Shipbuilders
- Shipowners and operators

- Manning companies
- Maritime education institutes
- Ships' crews

Collectively they are connected in a chain, but it seems that often blame devolves mainly on the crew and the Master, because it is easiest to find the latter guilty instead of any of the above mentioned elements. Obviously if every one of these players on the ocean scene plays their role in good order the total amount of errors will be diminished.

Safety at sea has always had a strong regulatory component, not least because of the need to protect lives but also because of the direct impact of safety on the efficiency of world sea trade. The adoption of regulations at the international level, under the auspices of the IMO, has been widely accepted for many years. A new phenomenon is the growing multiplication of regulatory efforts, especially at the regional level, such as in Europe.

The enactment of the Single European Act (SEA) was adopted on 28.02.1986 and entered into force in 1987. It established the integrated European Union (EU) and led to the completion of the single European market on 01.01.1993. It provided an important impetus for the 15 member states to review the jurisdictional powers of the Community. These were laid down in the original Treaty of Rome of 1957 and were clarified and enlarged by the SEA. The Act for the first time provided an explicit treaty base for Community activities in the field of environmental protection. The Rome Treaty itself offered considerable scope for the shaping of a common transport policy, including a common policy on shipping.

Nonetheless, the regulatory efforts of the European Commission (EC) have tended to take into account the fact that safety at sea and marine pollution are global problems, which in principal require global solutions. A clear framework for EC initiatives in the field of maritime environmental protection, safety, transport and training must be defined. This should include:

- the interpretation and implementation of IMO rules at the European level,
- the promotion of new technological systems for surveillance, combat and control of marine pollution,
- improved safety on passenger ferries,
- the universal application of navigational aid systems,

- development of waterborne transport,
- logistics,
- measures intended to stem the decline in the size of the Community fleet,
- proposals for a Community shipping register,
- improvements to the effectiveness of Port State Control.

Better training is needed to improve Europe's maritime competitiveness. The fact that the EC is not a low cost zone makes the development of better training all the more important. Directive 94/58/EC, amending Directive 94/58/EC and Opinion of the Economic and Social Committee arranged the Community's standards on maritime education and training.

1.2 Maritime transport and its global role

There is no clear definition what the maritime industry looks like, but nowadays it might consist of the following branches (Appendix 1)

- Ship design and model testing;
- Shipbuilding and repair;
- Register supervision;
- Shipping insurance;
- Shipowning;
- Ship operations, brokerage, forwarding, agents;
- Maritime education and training system;
- Research and development system;
- Manning;
- Port operations and logistics;
- Pilotage;
- Structures involved with search and rescue operations, control, prevention and cleaning of the marine environment;
- Vessel traffic and fairways maintenance services;
- Infrastructure for marine tourism including a system of sea resorts;
- Non-governmental organisations, Associations, Seafarers' unions

All these branches need highly qualified and competent personnel capable of operating in an extremely difficult environment (land–sea–land), with very heavy responsibilities for safety of life, property and the environment. Therefore, the MET should be at the core and linked with all the other branches (Appendix 1). It should be borne in mind that those who are trained to be ship officers will after some years of sea-going service work ashore.

The development of merchant marine officers' training has followed the development in shipping and in safety and pollution prevention requirements. Syllabi of merchant marine officers today contain subjects which deal with the construction of ships, their equipment, their movement, the handling and transport of cargoes and, following the advent of motor-driven vessels, their propulsion. These technical subjects are supported by general education requirements for the entry into maritime academies and, in the academies, by science subjects such as mathematics and physics and, for meeting communication requirements, by maritime English. The present training of merchant marine officers is compulsory, takes years to obtain the required knowledge and about equally as long or even longer to gain the necessary shipboard experience for certificates of competency.

Minimum requirements are specified by the International Convention on Standards of Training, Certification and Watchkeeping (STCW). The training of merchant marine officers differs throughout the world. In some countries STCW is normally exceeded by the range of subjects and by the depth in which they are covered. At the same time some countries are below from the minimum conventional level.

The STCW is limited to requirements that can be met by teaching technical subjects. Although maritime training in most countries also gives attention to science subjects by which technical subjects are supported, syllabi for master mariners used to concentrate solely on the training of seafarers and normally did not comprise technical or any other subjects outside this area.

Considerable changes in the contents of syllabi have taken place during the last decade. Pressure from competition has given the survival of the fittest in a safety sense, an economic bias. Supported by the increased use of modern technology, merchant marine officer training continues to undergo an adaptation to industry requirements. At the same time development of Western Europe societies has had an impact on the attitude of seafarers and those who consider taking up a seafaring career. As a result

facing influences from industry and society, responsible authorities and merchant marine academies appear to have difficulties in setting a clear course for the future of merchant marine officers' training. From the beginning they followed training schemes and dealt with technical subjects that did not exist in the training of any other profession. The moving work place of seafarers and their long absences from the shore enlarged the differences. They were reflected in the particularities which "land lubbers" attached to the seafaring profession, the mutual appreciation among seafarers and the distinction between those aboard and those ashore that were clearly perceived on both sides.

Such specialisation of training and separation from the "rest" of the working population created an aura of independence and isolation around seafarers. They were considered an own species. The Master of a ship was qualified as "first after God" and added to the seafarers' distinction from other professions. Earlier, the Master even used to have mercantile authority and was entitled to act as a prolonged arm of the owner - without having been trained in economic matters when attending a maritime academy.

The two major factors influencing marine officers' training are changing society and changing industry.

- The changing society

Changes in value systems and attitudes in societies have probably made a greater impact on the training of merchant marine officers than economic pressure and technical progress. Living in affluent societies of Western Europe and longer leave periods have made seafarers aware of what they miss being on board. Staying ashore has become more attractive. Shortened lay-times in ports have sharpened seafarers' perception of their physical isolation from shore-based activities and have exposed them to increased stress from a loss of variation and diversion in professional life. Life on board has become less attractive and resembles, more than before, life in a "total institution".

The result of this development is an increased desire to leave the sea for the shore. The fluctuation rate among merchant marine officers in most Western European countries is today higher than ever. At least 50%, sometimes even 70 - 80% of officers leave the sea after no more than five years shipboard service with the highest certificate of competency that can be obtained by studies in a maritime training institution. More and more seafarers tend to choose seafaring as only a temporary career.

There are good reasons to believe that most EU Member States attribute a high societal value to the preservation of Europe's maritime know-how. In this context, the importance of a much wider vocational education for seafarers, preparing them for the shore activities that they in all likelihood will be involved in after their usually short sea-going career cannot be over-emphasised. Shore-based shipping activities are to a significant extent undertaken by ex-seafarers and a shortage of the latter can have detrimental effects on the efficient management of shipping companies and on preserving the necessary shipping know-how.

This type of education should be jointly funded by shipowners, governments and possibly by Community resources, and apart from being self-fulfilling for the seafarer it can contribute in making a seafaring career more attractive. Furthermore, the level of education and training facilities should be upgraded and programmes co-ordinated among Member States. This would make the transferability of sea-going labour between Member States easier and would tend to even out disparities in remuneration and thus in the cost structures of European shipowners. The curriculum should comprise subjects such as maritime economics, law, logistics, and in general, subjects pertinent to the efficient management of modern shipping company.

- The changing industry

The considerable independence and isolation of seafarers has been diminished and partly replaced by dependence and integration. Although seafarers of today continue to be physically separated from the shore, they are integrated into a scheme of close supervision and control from the head office. Shipping is no more an independent and isolated industry. Transport by sea has become part of a transport chain from sender to receiver. Intermodal transport has reduced the weight and importance of particularities in shipping which made this part of the transport industry so special. The traditional shipowner has increasingly disappeared. Shipping companies today are owned by transport companies or, in many cases, are used as a form of investment by enterprises, which have no traditional relationship to the maritime industry. This sort of anonymity of ownership is matched by a change of attitude on board. Seafarers do not refer to "my ship" anymore but to "this ship" or "the company's ship".

The main reason for the change is the exacerbating competition in sea transport. It has given economic matters greater importance than ever before. The rapid progress in

technology has provided shipping companies, ports and other maritime enterprises with opportunities to bring about change and to maintain and increase their competitiveness.

Modern technology allows head offices to stay in permanent contact with ships. The ship's Master and officers take hardly any economic decision anymore. Their influence on the stowage of cargoes on board is reduced and is nil for some types of vessels, e.g. container vessels. Another result of the availability and increased use of modern communication technology is that radio officers could be made redundant.

Progress in technology has also facilitated the building of highly specialised ships, the operation of which requires special qualifications from their masters, officers and ratings.

From a preventive aspect, the necessary specialised training and the training of shipboard personnel in general have also become important because of the consequences in which accidents of such ships has helped unitise and containerise cargoes and to speed up cargo operations.

Another area in which modern technology has changed the operation of ships is the availability and use of advanced shipboard navigation systems, up to automation on ship bridges and of advanced shore-based systems including vessel traffic services (VTS). Movement of the ships can be closely monitored today. The navigation can be precise. Collision avoidance is facilitated by Automated Radar Plotting Aids (ARPA). Modern ferries use radius-constant steering.

Engine automation has led to partly or fully watch free engine rooms. Engine control from the bridge has become possible, e.g. the concentration of all steering and control elements in one location. Processing as well as suitable presentation of data has made one-man bridges possible.

Finally, advances in port technology have considerably reduced lay-times in ports and have increased the ratio of port time to sailing time in favour of the latter. At the same time, this development has increased the demands and the strain on shipboard personnel and has supported the extension of leave periods.

The offer of shipboard tonnage exceeds the demand: the competition is intense and occasionally fierce. Technological progress in the construction and operation of ships, in communication and in ports has helped to meet the challenges of competition.

Assuming that changes in economy and technology and loss of independence were the only challenges that the training of merchant marine officers would have to

meet, the training would have to become more technical in content and would have to be based on a better general education in science. A part integration of the nautical and the engineering training could be considered in a so-called Y - model where the stem of the Y represents the common science and technical subjects and the two branches the nautical and engineering specialisation.

The work of the ship officer could be limited to the operation of the ship, and to a limited and probably even further decreasing extent to maintenance or preventive maintenance of ship equipment. The range for economic decisions on board has in most cases been reduced to those, which are connected to the movement of the ship. The master leads an overseas transport. Considering the costs of ship and cargo the Master could be seen as in charge of a costly, complicated and complex process and enterprise. Considering the power of decision making that he/she lost and the tight schedule that is dictated to him/her today, the Master acts as a sort of advanced taxi-driver of a craft with an expensive cargo to be transported from A to B, safely and efficiently.

Maritime training has been integrated into national schemes of further education by maritime departments in polytechnics and universities (Germany, The Netherlands, Sweden, and UK). This has provided seafarers with an opportunity to obtain an academic degree in nautical and engineering sciences in addition to a professional certificate of competency. Such degrees have also been introduced by those maritime academies that have not become part of larger institutions yet (Belgium, France).

The influence that a changing society has on the training of merchant marine officers and the influence that the changing industry exerts on such training are occasionally contradictory.

Shipping companies tend to prefer a training that concentrates on shipboard subjects. The influence of shore-based education and the emergence of an emotionally detached attitude to work as well as the increased desires for mobility within a wider labour market have led to the extension of syllabi for merchant marine officer training by subjects that facilitate a transfer from ship to shore. The student revolution of the late sixties and early seventies has also stimulated merchant marine officer trainees to speak their mind and to bring forward demands for a broader approach to and applicability of training.

The introduction of academic degrees in addition to certificates of competency has led to an increased attention to entrance requirements in general education and science.

Finally, the number of ships that sail under Western European flags has been considerably reduced by change to flags that offer better economic conditions. This development has resulted in a decrease of need for training places in merchant marine training institutions.

1.3 Proposals for an optimal model in MET systems

The maritime industry, as any other, strongly depends on the human resource, which has to be highly qualified because of the heavy responsibilities for safety of life at sea, expensive vessels, thousands of tonnes of goods and the environment protection.

The human role in any process is the most important factor in ensuring that the final results are successful. It can be accepted that Maritime Education and Training (MET) is an industry, where studying is a process, characterised by: object (trainees) and subject (academy staff) of the education; facilities (i.e. campus, library, simulators, programmes, training vessels); organisation and some methods to manage that process.

Generally the education and training process has three stages: briefing, conducting and monitoring lessons/exercises, debriefing. The following equation can show in general the dependence between outcomes and related factors:

Results (R) = F [Staff (S); Equipment (E); Organisation (O); Methodologies (M)]

All these factors are interrelated and form a specific system, which is defined by some political, economical, technical and social factors (App.2). MET is one of the best examples that show the interactions between these variables, values of the coefficients and results (in quantity and quality measurements).

Some terrible disasters have occurred in the recent past. They are the real indicators that the process of shipping industry management is not what it ought to be. Of course, statistics shows the predominant quantity of human errors. A very general distribution is:

Human errors – 80%; Equipment errors –15%; Force majeure errors – 5%

If this statistical data is carefully analysed it can be seen that the human errors are nearly 100% because of the total participation of the human factor in all stages of the processes. Maybe there are a very few percentage of errors where the reasons are not predictable, i.e. the risk is out of control. Furthermore, following this order it can be seen more clearly who is included in the human factor. Certainly, it is not the ships' crews only. Representatives of all branches of the maritime industry are included but some of the main are: international and national maritime administrations, shipowners and operators, insurers, unions, professional associations.

The main objective of this work is to examine some representative MET systems as a factor in the preparedness and readiness of the people to work at sea or ashore in different branches of the maritime industry. In this regard, this project attempts to construct an optimal model of MET in terms of duration, cost and qualitative results, i.e. within an optimal period of time and cost to produce qualified seafarers, in particular officers. Thus, an optimal model for a MET system will be synthesised. It is intended that the model will combine much of the positive experience gained up-to-now by many professionals around the world. That should reflect the worldwide experience in this kind of activity. The model is characterised by some parameters that can be used to optimise its effectiveness and efficiency. In that way, some useful results will be achieved and the negative influence of some deviations stopped. The objective is to establish a good base for a new harmonised MET system, which may serve as a central point for comparison.

The environment where the model will be developed is defined by the following limitations:

- A base of minimum mandatory international requirements determined by some international legislative instruments (IMO Conventions, European Union Directives);

- Present and future trends for development of the maritime industry (sea and shore) which needs more competent specialists with new safety culture including morality, knowledge and skills;

- New technologies and understandings for general and specialised maritime education: for example, distance learning education, virtual reality classroom,

simulation; more international and nationals administrative, legislative and financial institutions involved in the field of MET.

The international regulatory will form the base of the model, while the technology developments will show the future trends to be followed.

Chapter II MET systems environment and an overview of the international legislative instruments related to MET

2.1 Maritime industry and MET systems

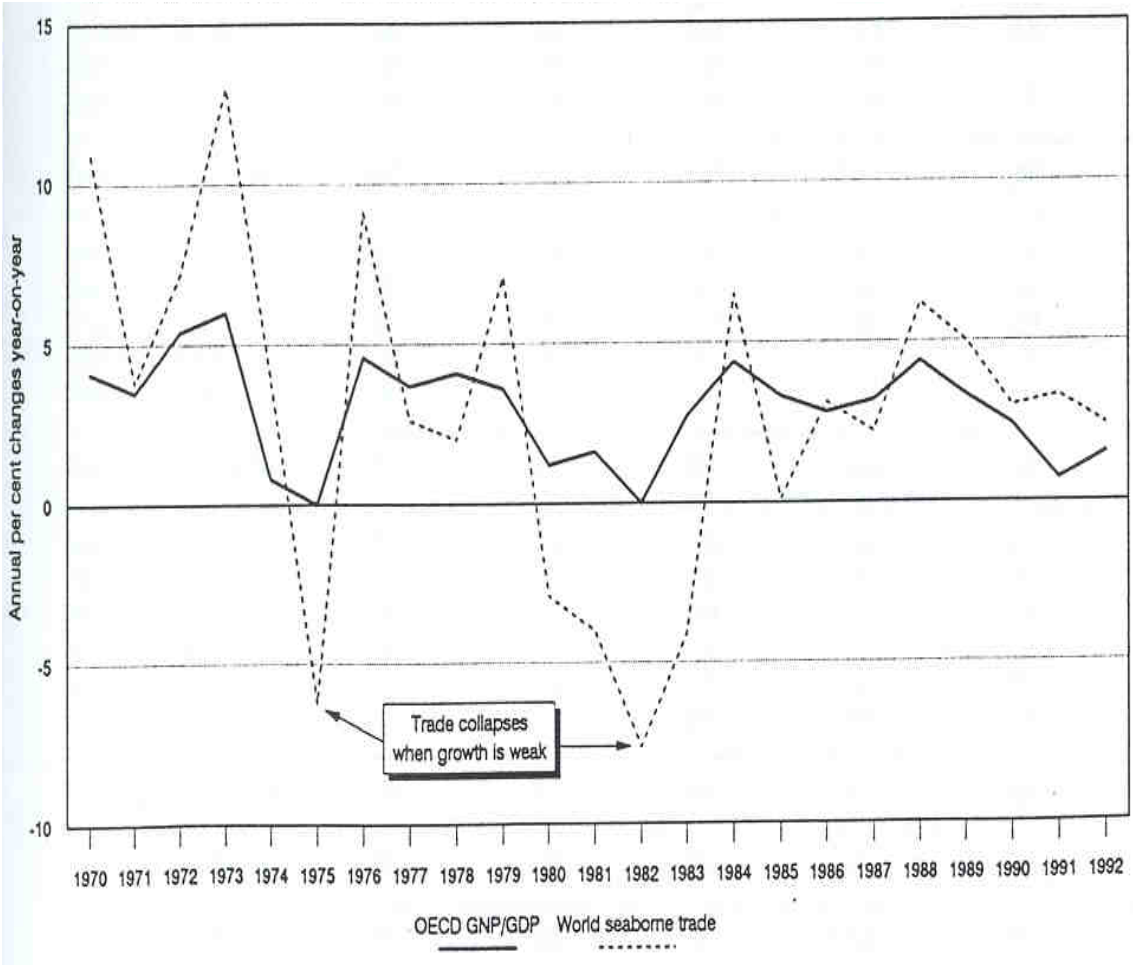
Many branches of an up-to-date maritime industry are composed on appendix 1. Furthermore, appendix 2 shows the environment where any maritime industry and MET system operate. The shipbuilding industry and shipping operations are one of the most important branches even they might be classified as industries themselves. Actually, the MET system produces specialists who can work for these industries and its development depends of their changes. During the study process future officers have to be trained how to steer a vessel equipped with the latest achievements of the automation. The structure of such an automated complex is designed on fig. 2.8. The new automated systems need new of knowledge and skills, which can be delivered at school. Casualties are caused by many factors but obviously human errors are predominant. Lack of knowledge and not sufficient skills together with some other reasons form the base. MET system has to have this influence. Hence, sub-sections 2.1.1, 2.1.2 and 2.1.3 describe the main points of relations between shipbuilding, ship operations and ship navigation from one hand and the importance of the MET system - from the other.

2.1.1 Shipbuilding and ship operations

- **The importance of transport and some factors affecting the shipbuilding industry**

The very powerful factor affecting the overall seaborne trade and hence the demand for ships is the condition of the world economy, which is subject to cyclical changes. This is illustrated in fig. 2.1 from which it may be seen that growth reached a high level in the early 1970s and thereafter declined when many OECD countries showed negative economic growth rates. Furthermore, there are some periods of improvement when the trade development follows the economic trends. Interrelations between economy, trade and demand of tonnage including new vessels are shown in appendix 3.

Fig. 2.1 Relationship between economic activity and trade



Source: Drewry Shipping Consultants, 1995, p.7

Transport is like a shackle between the economy and trade. Particularly water transport, which is the cheapest amongst land, rail and air, especially for large quantities. Shipdesigners, shipbuilders and all involved in the shipbuilding industry follow the world's necessities of goods and people transportation. Therefore, types and kinds of goods are parameters defining shipbuilding developments. On the other hand, trade depends of the countries' import/export needs, weather conditions and political decisions. Kind of cargo transported is on the next level of the hierarchy.

Cargo may be divided into two major parts namely "liquid" and "dry". Movements of crude oil and its derivatives dominate the former, while the latter consists of "bulk" and "general" cargoes. Drewry Shipping Consultants' analysis shows that

from the early 1980s to the end of the decade there was a pattern of continuous growth in the seaborne carriage of all commodities. Trade declined in the 1990s, but later was restored [Drewry Shipping Consultants, 1995, p.8]. An increase or decrease of certain key imports influenced by the world economy and other factors has a direct and immediate impact on the level of seaborne trade. These include mainly imports of iron ore, coal, grain and oil. Fluctuations in domestic production and finance cause sharp changes in the levels of import/export. The wide application of containerisation in the carriage of general cargo has proved of great significance to the shipbuilding industry. It has also radically affected the nature of ports and their infrastructure. Although the level of prosperity affects the movement of tourists, the carriage of passengers on many ferry services has shown great resilience during recent periods of depression in the economic cycle.

Structural changes in the world seaborne trade and regional development have a great impact of the shipbuilding production as well. Extreme financial factors, changes in company management, technological advances, improved agriculture output and not last political restructuring of huge regions modify the world political, economical, technical and social picture.

> "Superimposed on the world economic cycle are changes of a structural nature affecting the carriage of cargo and passengers. These take the form of demand by way of social, economic and political upheaval or more ordered change." [Drewry Shipping Consultants, 1995, p.14].

A brief statistical survey shows that after the mid-1990s US economy started to recover with 4.8% growth. The European economy shrank from 1991 onwards, but later some hopes appeared that there is a trend for an increase. After peaking in 1991, the Japanese economy has remained in retreat. It continues to be in a difficult situation following the economical turmoil in the Far East in the last two years. Developing countries suffered chronically slow growth. Due to some assistance from the inflow of foreign capital from developed countries, and the freeing of markets through economic restructuring and political developments, it is expected that they will enjoy economic growth. The last decade of the twentieth century was marked by dramatic changes in the East European countries. More of them continue to readjust to terms and practices of the free market policy. Some countries from the Far East are now recovering from the latest

crisis with the Chinese economy showing an annual increase. Despite of the crisis, freedom in the transfer of capital, technologies and people ensure that future world prosperity can be expected. These aspects are important for the level and direction of the world economy, trade, transport and shipbuilding industry (Table 2.1,fig. 2.2 and Appendix 4).

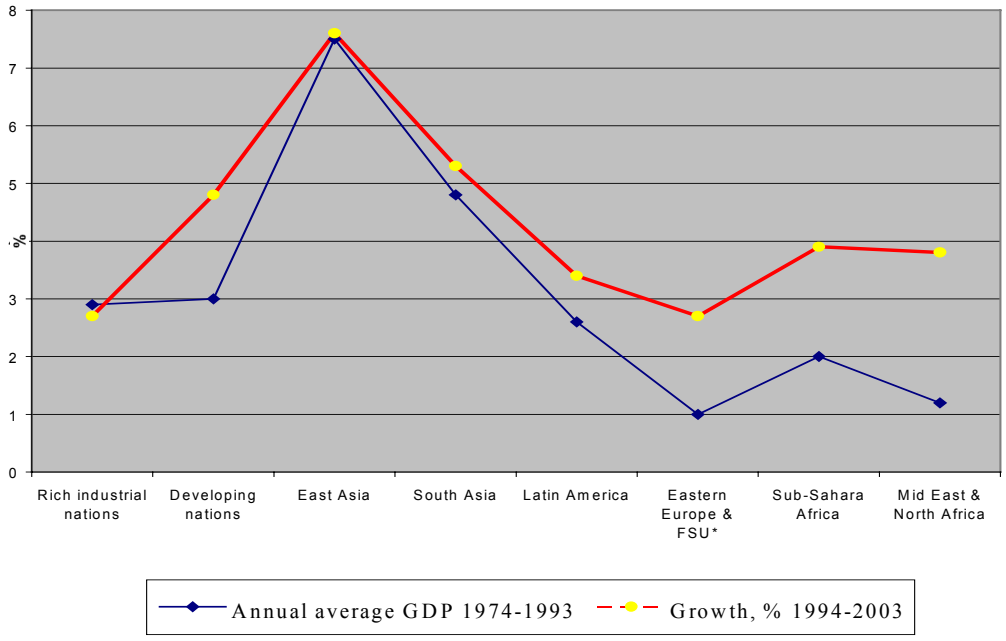
Table 2.1 The GDP annual average present and forecast growth

	Annual average GDP	Growth, %
	1973-94	1994-2003
Rich industrial nations	2.9	2.7
Developing nations	3	4.8
East Asia	7.5	7.6
South Asia	4.8	5.3
Latin America	2.6	3.4
Eastern Europe & FSU*	1	2.7
Sub-Sahara Africa	2	3.9
Mid East & North Africa	1.2	3.8

* (FSU) Former Soviet Union

Source: Drewry Shipping Consultants, 1995, p.1 through the World Bank

Fig. 2.2 The GDP annual average present and forecast growth



- **Present status and forecast for the shipbuilding industry**

There are numerous factors by which the development of the world merchant fleet can be examined. Some of them are: distribution by different types of cargo transported, number of vessels, their tonnage and age. Following the analysis of Wijnolst and Wergeland [Wijnolst, Wergeland, 1996, pp.34-36] we can see how the world merchant fleet succeeds. During the period 1950-1995 there is a general rapid growth both in number of vessels and their tonnage. Figures 2.3 and 2.4 illustrate quite well this trend. It is mainly because of increased post-war economical development demand for energy, grain and raw materials.

Fig. 2.3 Number of ships larger than 100 gt

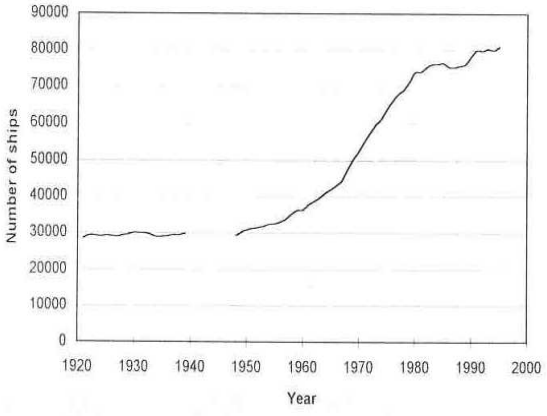
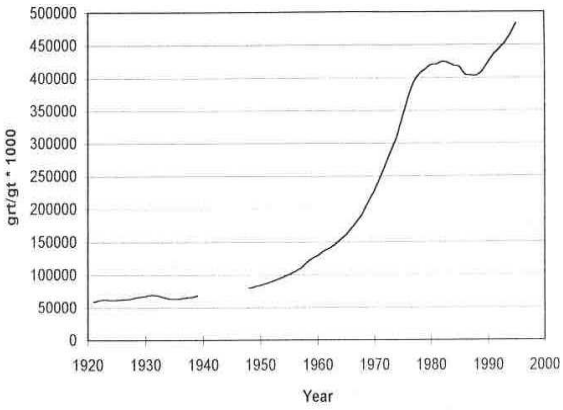


Fig. 2.4 Gross tonnage of the world fleet



Source: (Wijnolst, Wergeland, 1996)

More detailed analysis will present a better picture, where "booms" and "busts" continue approximately every ten years beginning from the 1970s. The ageing nature of the fleet gives cause for concern about tanker, bulk carrier and passenger ship sectors. Vessels for demolishing are aged 25 years. At the same time deliveries into the fleet are not sufficient to hold down the average age (1,119 ships per year), which is visible from appendix 4. Ordered tonnage is more than the real output. It is because some shipowners refuse to purchase before the new buildings are ready. Reasons to do so are many. However, one of them is that the job to bargain a new vessel is very risky. It is because the shipping market is severely unpredictable. Buying a new vessel needs a lot of

money; the process until the vessel becomes property ready for exploitation is too long, while bankers, insurers and registers wait for their assets.

Nevertheless, the trend to larger ships continues with remarkable growth. First, in the tanker and bulk carrier fleets and furthermore, in the container ship sector at the expense of the general cargo vessels. Near boom conditions have prevailed in the cruise ship sector. Ro-Ro ferry services and fast ferries are making a real impact, while a significant volume of new building arises in response to the offshore oil and gas industry. During the last decade and in the near future there are expected to appear some new technologies into the shipbuilding industry because of the conversion after the cold-war period as well. The world merchant shipbuilding capacity by newbuilding completion and forecast newbuilding demand by types of ships is presented by appendix 5. The major European and Far Eastern shipyards are shown in appendix 6. The world merchant fleet consists of different kinds of tankers (oil, chemical, gas, petrol derivatives, water, and wine), bulk carriers, general cargo and container vessels, fishing vessels and others.

Some information and conclusions about humanity's necessities for the next decade can be of help to define the links between economy, trade, water transport and shipbuilding industry. It is a solid base on which to forecast future developments: types and kinds of ships, tonnage, speed and some other ship's characteristics, level of automation. The last one is of crucial importance for the entire maritime community. These parameters are of significant impact for the MET system as well, because it is not only a source of officers and ratings for steering of these sophisticated vessels at sea. The system itself should prepare them accordingly to serve on a larger base, i.e. how to manage the same ships from ashore.

Humanity's necessity for energy grows up by approximately 1,5% annually. Oil and its derivatives are still the main source, but probably there are some serious alternatives too. Until now the most considerable producers of crude oil are countries from the Middle East, while the leading consumers are Western European states, Japan and USA. Certainly, in the near future, oil will be transported, which needs a different number of tankers and highly qualified staff to operate them. Here is the important role of the MET system.

It is expected that in the beginning of the next century the trade and transportation of dry bulk cargoes will have a positive moderate development. The Far

East fast developing countries are the main clients of ore and coal. The transportation of grain depends considerably on the weather conditions and former Soviet Union States purchases. Drewry Shipping Consultants said, however, the demand/supply market will be in near equilibrium conditions. Accordingly, the containerisation possibly will reach its upper level increasing annually by around 4,0%. New general cargo vessels are not expected, moreover the container ships will gain the market with their growing capacity, speed and innovative technological decisions. Movement of ore, coal, grain and general commodities needs the respective kinds of ships and personnel ready to operate both with classical and high technology vessels.

The carriage of passengers by sea nowadays centres upon the cruise ship and Ro-Ro ferry sectors. Both sectors have grown remarkably over the last few decades. According to ISL statistics 70 new vessels have entered the world cruise market over the past ten years, amounting to a growth of nearly 50% by number, 96% by grt and an average 6% increase per annum in passenger berths. The Ro-Ro ferry market has developed in many regions to form an integral part of the land transport. Despite the difficulties in predicting the global fleet of passenger/vehicle ferries and tourist liners, there is a clear trend of a growing demand. Therefore, the MET systems have to adjust quickly to the new international requirements considering service on board and operation with such kind of vessels bearing in mind recent terrible disasters with huge losses of human life. The revised STCW Convention treats these problems.

Nowadays financing the shipbuilding industry is one of the most difficult problems both for professionals and for politicians. Shipbuilding is a branch of heavy industry, so it is connected with many other branches from different light industries, where many people are involved. Any government is an executive power of the political party (s), which consists of a part of those people. They depend on each other namely the party needs peoples' votes to be in power. Consequently, the question is not whether to have or not to have some state financial support, but how it should be arranged and optimised. Therefore, the governments should assure by appropriate methods some subsidies for the shipbuilding industry. In long-term planning that means certain meaningful jobs for many people, including those involved in maritime education and training.

Appendix 5 shows newbuilding completions during the period 1983-93 and forecasts of newbuilding demand between 1994-2010. Vessels are spread in some of the

major categories, such as: oil tankers, bulk carriers, general cargo, containership, fishing vessels and others. The first two are the largest categories. All curves on the first graph fluctuate with some similar +/- amplitude, excluding newbuilding tanker completion development, which has a continuous steadily increase during the whole period examined. The deepest crisis for all types of vessels is in the end of the 1990s, when a very rapid expansion started with two peaks in the end of this century. More interesting for us is the second figure, where we can see future dynamics of the newbuilding demand. Unfortunately, after the highest point is reached in the year 2000 the shipbuilding will fall down in a crisis until the end of the first decade of the new millennium because of diminished demand. A new upward trend is expected in the beginning of the second decade. Vessels included in the category "Others" are much more than before.

- **General assumptions related to the shipbuilding status**

Following on from surveys by Drewry Shipping Consultants for the period 1993-2010, newbuildings demand is expected to intensify, although the existing surplus capacity accumulated during the past years is always present. Due to entry into force of some international legislative instruments part of the aged fleet will go for scrap and the rest will acquire a younger age profile.

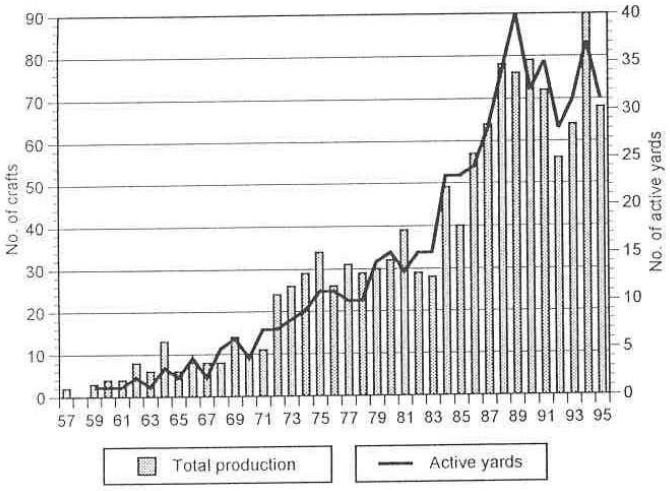
The structure of the world fleet will remain generally the same. Specialised tonnage, including passenger ships, will provide an important part of shipbuilding activity.

> "Over the forecast period the division of newbuildings by ship types, in terms of cgt, is approximately as follows: tankers 28%, bulk carriers 24%, general cargo and container ships 18% other types 30%." [Drewry Shipping Consultants, 1995, p.146]

On the assumption of constant shipbuilding capacity the percentage actually used will remain without deep changes with an average capacity utilisation at about 84% until the beginning of the century. However, beyond this period the forecast worsens.

Whatsoever will be the predicted trend, the existing fleet and the maritime industry together will need enough officers and ratings, appropriately qualified, for their sea going and shorebased career.

Fig. 2.5 Fast ferries development



Source: (Drewry, 1994)

- **Ship operation**

Normally new industry production is followed by management processes innovations. The shipbuilding industry produces different kinds of vessels. Therefore, shipowners and ship operators have to implement innovations in their practice of how to manage these new vessels.

2.1.2 Casualties and safety standards

Risk always follows human activities, in particular those with dangerous characteristics. Generally, the risk has two faces: positive and negative. It is impossible to go ahead without any risk, but any unreasonable actions against community interests are assessed as being a negative risk.

Research shows that the profession of seafarer is one of the most difficult. Safety at sea means that the risk has to be diminished and kept on a minimum level. This might

be achieved through establishment of international standards related to the ship's construction and equipment, crew competence, precise operational and watch procedures, traffic regulations, communication requirements, casualty reports and investigation, notice to mariners, weather forecast and reports.

Sea trade is connected with transport of goods and passengers between two points. During the voyage there are some possibilities for accidents: collision, grounding, fire, missing or foundering. All these are caused because of different types of error, factors and reasons. We can generalise errors as gross, systematic and random, while factors are respectively: human, technique and nature (e.g. weather, tidal streams). Lloyd's Register Casualty Return of 1993 offers the following casualty categories: foundered, missing, fire/explosion, collision, contact, wreck/stranded and lost. The term 'Total loss' refers to a merchant ship which, as a result of being a marine casualty, has ceased to exist, either by virtue of the fact that the ship is irrecoverable or has subsequently been broken up [Muirhead, 1999].

Insurers, registers and national maritime administrations are those who keep data about maritime accidents. Using information from the Lloyd's Register of Shipping and The Institute of London Underwriters, some general trends can be seen in the world's total losses, dispersion by categories and loss ratio from the total world fleet.

Table 2.2 Trends in world's total losses

Item	Capacity of the fleet		Total losses		Total loss ratio, %	
Year	No ships	Tonnage	No ships	Tonnage	No ships	Tonnage
1950	30 852	84 853	222	260 000	0,72	0,31
1960	36 311	129 770	171	358 000	0,47	0,28
1970	52 444	227 490	352	613 000	0,67	0,27
1980	73 832	419 911	387	1 804 000	0,52	0,43
1990	78 336	423 627	188	1 126 000	0,24	0,27
1992	79 726	445 169	213	1 223 000	0,27	0,27
1998	86 000	-	-	-	0,28	-

Note: tonnage x 1000 gt; merchant ships of 100 gt and above

Source: (Muirhead, 1999)

The following general trends appear:

- The number of ships and tonnage of the world's fleet have increased steadily

- The number of "total loss" ships is variable but in comparison with the growth in tonnage there is a general decrease. Moreover, the differences in number and ratio between 1970 – 90 and later decade show less damaged vessels.

This decline is because of the technological advancements in the shipbuilding industry, legislative base, traffic organisation and probably due to the crew competence. An important part belongs to the International regulations for preventing collisions at sea, 1972 (COLREG).

Statistical information presented by the Institute of London Underwriters and other sources give not only constructive total losses (Table 2.3), but more details about different categories of casualties as well (Table 2.4).

Table 2.3 Total losses caused by different kind of casualties

Nature of casualty	1988 No/Tonn.	1989 No/Tonn.	1990 No/Tonn.	1991 No/Tonn.	1992 No/Tonn.	1988-92 No/Tonn.
Weather	44/ 309	52/ 293	51/ 552	64/ 638	27/ 372	48/ 430
Grounding	13/ 129	19/ 126	20/ 196	23/ 201	8 44	17/ 140
Collision	7 42	21/ 72	14/ 95	18/ 72	17/ 210	15/ 98
Fire/Expl.	20/ 251	28/ 212	31/ 290	36/ 514	21/ 196	27/ 292
Machinary	9 57	9 43	9 28	12 561	6 1 472	7 660
Miscellan.	22/ 57	16/ 67	19/ 194	29/ 256	32/ 109	24/ 137
Totals	115/ 845	145/ 814	144/ 1 355	182/ 1 737	111/ 1 079	139/ 1 166
World tonn.	393 799	400 697	413 515	425 657	433 984	413 530
Loss ratio %	0,21	0,20	0,33	0,41	0,25	0,28

Note: tonnage x 1000 gt

Source: (Shipbuilding Technology International, 1994, p.167)

According to this table the number of total loss vessels because of collisions as a percentage of the total is 11%, while in tonnage is 8%. Accidents might be caused by the following reasons:

- Bad weather conditions
- Manoeuvring not in compliance with the COLREG requirements
- Misunderstanding of the COLREG provisions
- Inefficient bridge procedures during bad weather conditions
- Unreasonable reduction of the team on the bridge

- Lack of knowledge and skills using the radar and ARPA, especially the differences between true motion and relative motion; Too great reliance on ARPA
- Difficulties communicating with the radio
- High speed in restricted and shallow waters
- Black out, steering gear, main engine and other equipment not proper operation
- Incompetence in respect of risk assessment
- Not enough safety culture developed
- Proceeding at a speed commensurate with the visibility and traffic density

Most collisions occur in coastal waters, approaching anchorage or port area, or crossing traffic separation schemes. The time interval is 0000-0100 or 0500-0600 when normally the work ability is on the lowest level, fatigue.

Recently throughout the specialised literature it is quoted that some 80% of accidents at sea are caused by the so called, "Human factor". However, who are included there is not clear. The crew only is visible from everywhere, Master and duty officers, in particular. Of course, it is much easier to blame those at sea. Firstly, the environment is more risky than ashore. Secondly, the number of any crew is limited and everyone knows his duties and working place while ashore who is who is a complicated question. Organisations, associations, societies, companies, unions and many more institutions and structures with known (sometimes unknown) management forms and shapes of different kinds make a huge amount of efforts to regulate the life at sea. However, there is an unwritten proportion – the more the people, the less the responsibility.

Using some statistics, which have been compiled by the Institute of London Underwriters (ILU) it is possible to draw some graphics and conclude some general trends. The statistics refer to vessels of 500 gt and over and include Constructive Total Losses. War losses are not recorded.

Table 2.4 Annual total losses by tonnage 1985-1995

Years	1985	1986	1987	1988	1989	1990	1991	1992	1993
Tons	1120	1220	1090	850	800	1400	1700	1000	900

Note: Gross tons in thousands

Source: The Nautical Year Book, 1997

Fig. 2.6 Annual total losses by tonnage 1985-1995

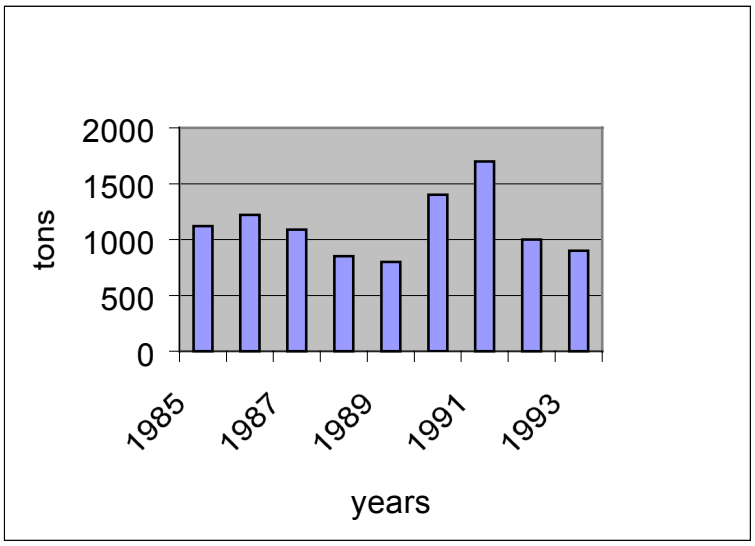


Table 2.5 Annual total losses by number of ships 1985-1995

Years	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995
Number	175	145	140	135	140	149	175	135	140	120	90

Source: The Nautical Year Book, 1997

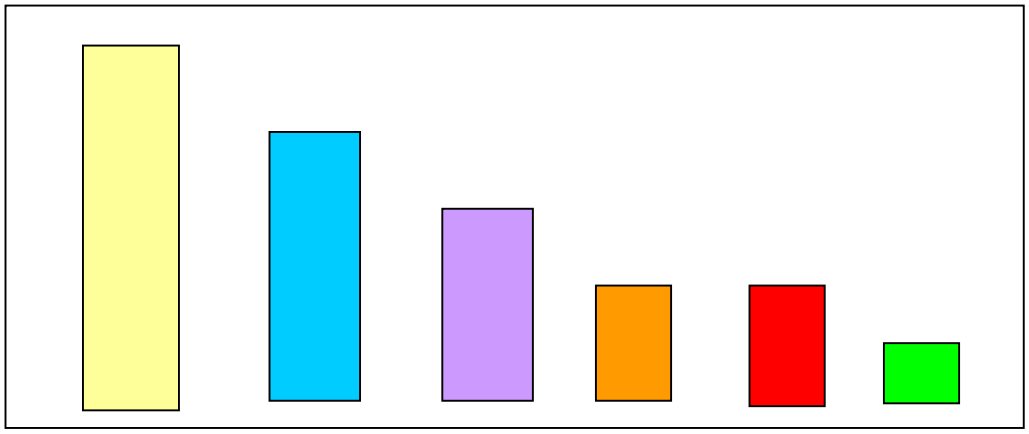
Obviously, the general trend of losses by tonnage has a sinusoidal shape with some peaks above and below the average sum. It is well known that normally the main part of human being activities is shown graphically by this form. Therefore, we can conclude that it follows usual working process, i.e. world shipping trade to be followed by some mistakes. As far as the author knows, until now there has been no information about the optimal level of these errors, expressed by some parameters, e.g. tonnage, number of vessels, amount of money. There is only a desire that these figures might be reduced. However, where is the limit? Of course, it is not a reason to stop the improvement of maritime education and training, ship design and construction, international standardisation, operational organisation and procedures.

Moreover, if we linearise the results throughout the period a tendency of diminishing the tonnage total loss will appear. It is a general indicator that the entire efforts of the maritime community are successful. The same bias is confirmed by the

number of ship total losses (table 2.6). The amplitudes are not so large, while the inclination of decreasing is more evident.

More interesting is the next chart, which shows the world total losses by nature (cause) of casualties with associated numbers and gross tons (ships of 500 gt and over).

Fig. 2.7 World total losses 1991–1995 by causes



Weather	Fire/expl.	Other	Grounding	Collis./cont.	Machinery
(212)	(143)	(141)	(63)	(74)	(34)
2,022,792	1,426,258	1,045,559	485,559	475,407	378,514

Notes: (...) Number of vessels, Tonnage in gross tons

Source: The Nautical Year Book, 1997

Excluding losses caused by weather and other reasons all the rest belong to the crew. Groundings are definitely because of lack of navigational knowledge and skills, fatigue, insufficient lookout. Collisions or contacts have the same nature but relate to subjects like: Rules of the road (COLREG), Operational use of radar/ARPA facilities, Ship's manoeuvrability, Maritime English and Radio communications. These matters are examined during the deck officers' education and training. Number/tonnage of vessels totally lost by these reasons are 137/960,966 gt. Percentage from the total is respectively 20,5/16,5%. Maritime education and training institutes, Masters and duty officers are directly responsible for their proper competence and implication of the regulations. Fatigue depends on the company fleet management policy (number of crewmembers) and onboard organisation. Often collisions are caused due to high speed in bad weather

conditions, but it has became a common practice that vessels are steered so because the shipowners/operators are in a hurry and Masters don't like to make troubles for themselves.

It is supposed that machinery losses referred mainly to the engine rather than to the crew, poor maintenance and operations. Generally engineers and supporting staff are for emergency situations and not to make serious maintenance although the shipowners are happy to save time and money, if the crew can carry out repairs on board the vessel instead of having repairs done in the port.

Summarising, safety in shipping can be broken into two parts: the "hardware" and the "software". The former are well-maintained ships built at or above the internationally recognised standards, while the latter are well-trained crews familiar with all the equipment and safety requirements.

2.1.3 MET in raising standards

Officers' (deck, engine) duties during the last decades are changing. These changes are mostly connected with the application of new machinery, equipment and software on board vessels, leading to their complete automated operation. The idea as a philosophy, organisation and technical performance is being realised by some industrialised countries in West Europe, Japan and USA. The level of automation differs, but the trend is clear. This trend presumes that in the near future the tension will grow up not only in developed countries themselves but on the international level as well. This is so because giving the "green light" to much shore based industries to develop this automation will cause over-capacity of the seafarers demand/supply market due to reduction of ship crew. At present it appears that developed countries, which have the potential to build new generation automated vessels, will have not sufficient officers to steer their middle aged vessels, which numbers dominate the world fleet. Soon it is expected that after some international legislative instruments enter into force many old vessels will go to scrap. This process is increasing. Within a decade they will be replaced by the new generation automated vessels. The industry is producing such kind of ships and is ready to enforce its use. The problem is that countries-producers of this heavy industry product do not have enough competent human resources to operate these vessels either today or in the near future. One of the solutions is to use a cheaper labour

force from the East European and Far East countries. However, some precautions must be taken into account, namely the danger of monopolisation and insufficient competence of the eastern officers [Telegraph, August 1999]. Consecutive steps are being made so that more cheap and capable Chinese seamen are involved in the seagoing profession despite the fact that there are some problems with their communications skills, a problem, which could be solved. Therefore, the social factor dynamic has two directions: probably, Asian seafarers will be happy that they have a job, while Europe and the USA will be unhappy that they have not. Recently and in the near future in such an environment the main tasks of ship deck officers are traced out to be navigating the vessel using automated systems and manual operation in emergency situations. Generally, the same relates to the engineers. Nowadays there are four countries only, where MET systems offer polyvalent (deck/engine) maritime education: France, The Netherlands, Germany and Japan.

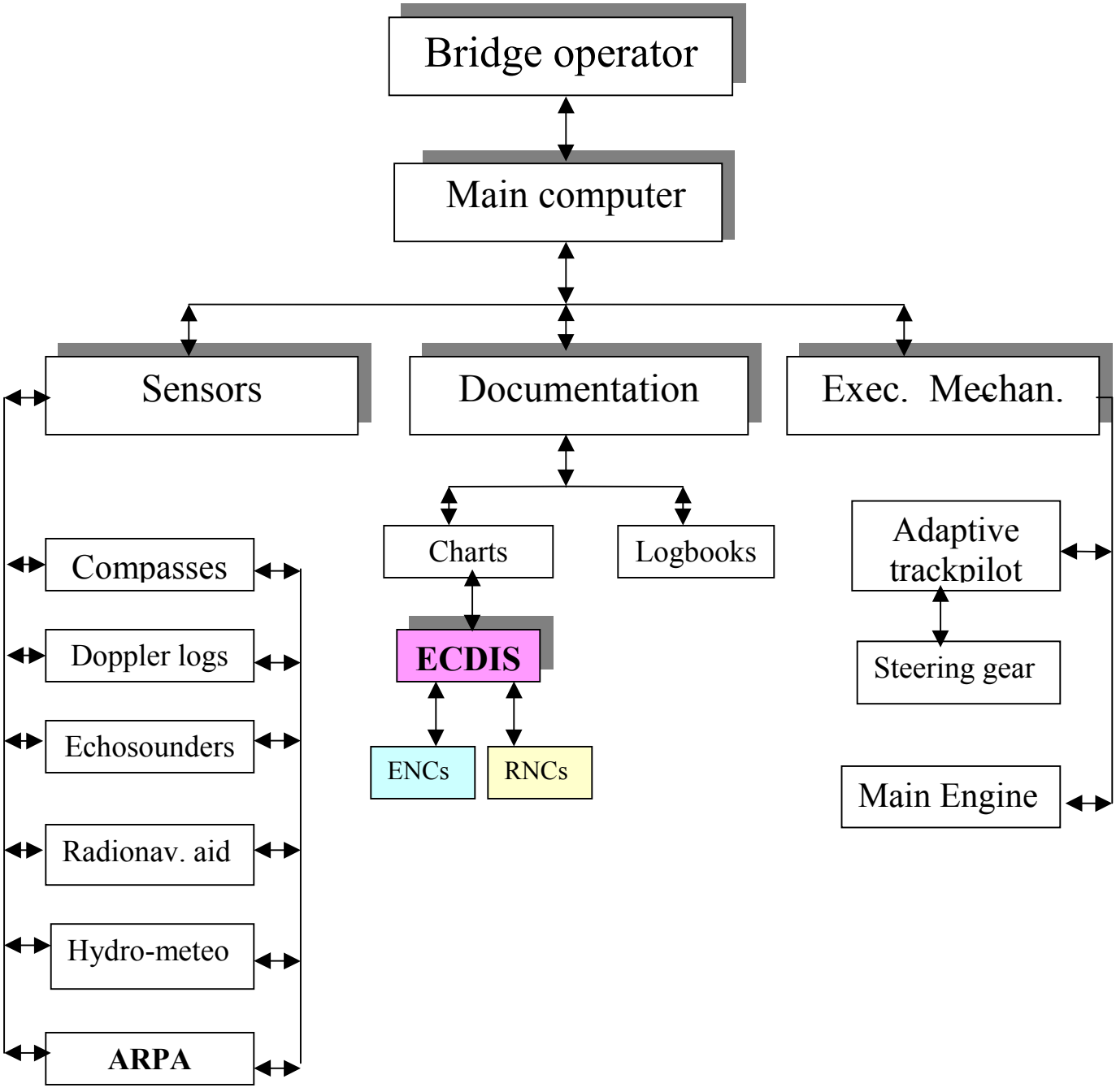
The present transitional period, however, requires both classical and new methods of work so that MET should adjust itself to these requirements to provide sufficiently competent officers. Changes are necessary in:

- Teaching programmes, new equipment, updated and upgraded lecturers;
- Implementation of new methods and tools for education and training, such as: Distance Learning, Computer Added Learning (CAL) and Computer Based Training (CBT), use of multi-media.

Application of new technologies in ship navigation and maintenance

The main aim of shipping is to transport goods and passengers between two points in a safe and environmentally friendly manner, using an optimal way. Parameters for optimisation could be the risk, distance and time. It has to be borne in mind that the shortest distance in miles may not be either the shortest in time, or the safest. Only a highly competent crew can realise this aim using modern vessels and sophisticated equipment.

Fig. 2.8 Integrated Bridge System (IBS)



The passage in restricted waters when approaching/leaving in port area or crossing straits, is the most risky part of the voyage. It needs to be carefully pre-planned and accurately executed. Nowadays when the traffic is heavy by number and different types of vessels this task is enormous for the watchkeeper without new, more precise and automated equipment. It is so because the watchkeeper needs quantitative and qualitative information, checked and supplied by many canals simultaneously. The operator is only to control the current situation and to make decisions in emergency situations. The ship's track is controlled automatically through the use of a computer-based track keeping systems. Furthermore, the risk assessment shows that the main error holder is the human factor. Generally the distribution is human error – 80%; equipment errors–15%; error caused by force major – 5%. One of the solutions referred to is the replacement of the error holder i.e. Human factor by automated complexes. A general block-diagram of such a system is shown on fig. 2.8. In the same time new technologies and equipment influence safety operational management and bridge procedures. There is a necessity of new approach to the maritime education and training and bridge resource manage~~ment~~.

As it is shown in fig. 2.8, the Bridge operator (watchkeeper) supervises the entire operation.

The main computer monitors all procedures previously ordered.

Sensors consist of some equipment (echosounders, logs, compasses, hydro meteorological devices, positioning systems and ARPA facilities), which supply the necessary information for the Track Control System (TCS). The Global Positioning System (GPS), its modification Differential GPS and Automated radar Plotting Aids (ARPA) are the latest technological achievements for the navigation. The use of GPS/DGPS improves the accuracy and reliability of the ship's fix and it is a source of more precise information about the real track and vessel speed. The ARPA is helping the operator in two fields - a dynamic overview around ownship in any visibility and support decision making process concerning collision avoidance situations. Actually, ARPA in a combination with some sensors, ECDIS and the Executive Mechanisms is a sub-system inside the Integrated Bridge System (IBS). The application of this equipment totally changed the philosophy of the navigation, bridge procedures and safety not only on board but ashore as well.

Executive mechanisms consist of an adaptive autopilot and automated system for main engine control from the bridge. Actually, the helmsman is replaced by an adaptive autopilot.

Documentation combines an Electronic Chart Display Information System, which in general substitutes the navigational chart, log books and a black box, which is intended to memorise all voyage information like it is in the air transport. The emphasis is made on the implementation of the first device - ECDIS.

The data exchange and process of steering can be explained as follows:

- navigational environment – radar picture of the coast line if the vessel is nearby (ARPA or radar) and the depths under the keel (echosounder);
- hydro-meteorological environment – wind speed and direction; stream speed and direction (absolute Doppler log); temperature, salinity and other parameters characterising the ocean water, which are used for normal ship operations;
- ship's positioning – measurements processed to make the ship's geographical co-ordinates, which is possible by comparison of two methods: dead reckoning and observations. The dead reckoning is settled by measuring the course and speed (compasses and logs). Observations are fixed by the radionavigational aids (Decca, Loran, GPS, differential systems) and radar distances/bearings;
- ship's track control – all in advance stored information in the main computer memory plus newly received real data is calculated for continuous comparison of the voyage passage planning and actual ship track. The computer track control system is designed to make these comparisons. If they are greater than the preliminary order (track limit) the system produce a monitoring signal to the autopilot, main engine or both together.

Therefore, there is always a difference (Dif.) between the planned passage (Dp) and sailed distance (Ds).

$$\text{Difference} = Dp - Ds$$

This difference appears because until now it is impossible to steer the vessel just on its planned track. That is why a vessel's trajectory is not a line but a band. The narrower the band, the more accurate the vessel's route, i.e. safer and economical. The accuracy of the on-scene information depends on the accuracy of the sensors and

processing mathematical methods. In this sense new technology sensors are much better than the old because they produce digital information, instead of the former, which are mainly analogue formatted.

Track limit dimension is a very important parameter. The entire safety and effective philosophy is concentrated in its value. Actually, this value presents the human factor understanding about safety management and ability to recognise the risk sailing in different navigational and weather conditions. Considerable track limit in calm and open sea is not a good indicator, while small deviation in restricted waters is a reasonable parameter. The safety culture can be stated numerically by the track limit. It is not only a simple number but comprises the existence (or lack) of morality and experience. The MET systems have the privilege to be on the front of this important process of establishing, developing and implementing it into the shipping practice.

One Man Bridge Operation (OMBO) is a relatively new organisational technology to monitor the vessel. It is in compliance with the Integrated Bridge System implementation on the bridge. It is known for a long time ago, even when the automation was not so developed, that under the Master's responsibility in some cases is possible to steer the vessel under the one man bridge technology. Then the helmsman can help the other seamen with general work on the deck or in the holds. Sometimes the chief officer stays alone on the bridge during his watch between 0400-0800, which is one of the most dangerous periods. A report [Lloyd's List Press, November 10, 1997] indicated that a ship had run on the rocky island, after the watchkeeping chief officer had fallen asleep on the bridge. The alarm was not activated. There was nobody in addition on the bridge. Recently, the IMO member states decided to stop any further experiments and it is prohibited for any vessels sailing in the European Union waters to practice this operational method during dark time. It is because the investigation on some casualties has shown, despite automated precautions, that the main reasons for accidents could be avoided if there are on the bridge. However, the MET systems are obliged to inform and keep the officers up to date with this method of work, to train them how to make a thorough risk assessment sailing under different navigational and weather conditions. Then the automation will be of complete help.

Ship maintenance

The maintenance relates usually to the technical processes. It is an activity intended to reduce the consequence of failures. Two aspects of ship maintenance need to be taken into account. One is the "reliability", the other is the "prediction". Equipment reliability depends very much on the designer and producer while prediction is more concerned with those that operate with equipment, i.e. ships' engineers. It is only the manufacturer who can predict a potential failure if the machinery is under continuous supervision and diagnosis. However, until now, it is practically impossible that all manufacturers can arrange onboard the vessel their laboratories. Therefore, the engineers serve as extended arms. Their job is to supervise, assess and predict machinery status on the basis of risk control. Child says [Child, 1997, 101-109] that the risk management process should be analysed and risk targets should be set and identified. Control measures can be established to reduce the risk to an acceptable level. The most important part of the risk based maintenance loop is performance monitoring. It consists of the following stages:

- Hazard identification of the equipment failure modes;
- Risk assessment and establishment of consequences of failure;
- Risk evaluation and determination of the acceptability of failure and effective maintenance;
- Risk control and its optimisation through sufficient maintenance;
- Monitoring based upon an initial assumptions and competent maintenance.

Certainly, MET systems have to concentrate on how to create a balance between classical preparedness of engineers to make any repair at sea and new methods for prediction and risk assessment.

Changing standards in MET systems

Some practical problems might arise in the use of the automated track control systems. They have an influence upon the MET because of the following reasons:

- manufacturing a lot of different kinds of equipment if there is no international agreement and performance standards - MET cannot concentrate on teaching and training officers within an optimal scope of equipment; supply of different types is very expensive;

- incompatibility among the sensors themselves and the other parts of the complex could cause lack of correlation between the monitoring signal and executive mechanisms (auto pilot, rudder machine, main engine), which might lead to some breakdowns of the system - MET should offer a balanced course programme including classical and modern package of knowledge and skills; it is a highly intellectual product, which somebody has to create;
- very expensive prices for the new generation vessel and remaining old vessels; The ISM Code might be a regulator
- insufficient knowledge and skills of the crew when operating complex automated equipment particularly in restricted waters and emergency situations - MET systems should provide short term postgraduate courses for those officers who are in service now;
- deep lack of "cultural relations and understanding" in the Man-Machine interface - a comparatively new area where there is not enough precise information and clear understanding amongst the researchers, therefore, MET systems have to decide themselves which way to follow in the study process;
- Manufacturers' attitude and co-operation will be of help.

Certainly, the automation, new technologies and track control systems are useful supporters for the bridge operator. However, it is difficult to predict changes of the nature and adjust the system work. Therefore, the man on the bridge is always the most important factor in the loop - environment, operator, machine and safety management.

2.2 Global seafarers' labour market

The BIMCO 1990 study predicted a 10% shortage in the number of officers ideally required to man the world fleet. This prediction has not yet materialised for a number of reasons. Firstly, as the world fleet grew at only half the rate anticipated, demand levels reduced, wastage rates were lower than projected, recruitment of trainees increased over the past five years and the manning scales for newly built ships did not drop as much as anticipated.

The data from the 1995 update shows that there is a technical shortage of officers required to man the world's fleet amounting to 18,000 or 4%. However, this does not

imply that 4% of the world fleet is laid up because of the unavailability of officers, although reports from some countries do confirm that a shortage exists. The report shows a substantial overall surplus of ratings and predicts that the officer shortage will escalate unless corrective action is taken.

Some sources of information including the above-mentioned BIMCO reports drown the following conclusions and suggested responses measures:

1. The numbers of seafarers from the OECD countries have continued to decline, whilst Far Eastern supply has increased. The Philippines remain the major supply centre with almost 20% of the world's seafarers and increasing international demand for Chinese seafarers is expected;
2. The emergence of substantial numbers of officers and ratings from Eastern Europe has not had a major global impact;
3. The needs of shore based sectors are an important feature and those sectors all have a responsibility for the recruitment and training of seafarers. This issue has yet to be properly addressed;
4. The age profile of OECD officers is higher than other regions and, as is generally known, the majority of senior officers on the international fleets are currently from these countries. The industry needs to discern from where the next generation of officers will be recruited;
5. Ten percent of OECD national officer training and 15% of Eastern Europe ratings fail to complete their training courses and leave the industry;
6. The quality of the labour supply continues to be an area of concern;
7. Recruitment levels peaked in 1993 when, on average, just fewer than 12% of officer employees were trainees. This compared to 6% in 1990 and 10% in 1995.

Some of the suggested response measures include:

1. Abandonment of any go-slow in recruitment and training. Particularly in areas where there has been a tradition of shipping and marine industry involvement, there remains a strong residual interest in a sea career. It is important to nurture this interest, lest it become merely a "fringe" activity. The industry needs a consistent approach and a steady throughput of trainees;

2. Consideration of the marine career in a holistic fashion. More emphasis should be placed on it with entrants being encouraged to view their future as a lifetime within the marine industry as a whole. Recruitment and training programmes should be planned accordingly, based on vocational qualifications. Most importantly, as training progresses, there should be opportunities to obtain a selection of marine qualifications, similar to the approach envisaged by the STCW revision. Additionally a link must be forged between specialities for ship service and those beneficial to a subsequent maritime career ashore. The industry also needs to address the serious dilemma of how to attract the best-educated young people into a sea career, against considerable pressures for them to go into further education or other industries;

3. Move of staff from sea to shore needs to continue and to be further encouraged;

4. On-board structure must change away from the "officers and ratings" delineation to a more cohesive unit in which managers, operators and technicians work together in a functional fashion;

5. Awareness of national characteristics needs to improve. Barriers of culture, language, roles, skills, wage levels etc. divide the industry;

6. Above all, an industry approach is needed to manpower, which effectively addresses future personnel needs afloat and ashore.

2.3 Overview of methodologies and practices in MET

Education is a process when information is exchanged between the object and subject of the teaching. It is realised by different means of communication. Generally the following structure exists:

- Relevant environment (shore based school, training vessel, workshop);
- Object of the education (students, cadets, trainees);
- Subject of the education (lecturer, instructor, senior deck/engine officer);
- Default level of knowledge and skills, which differ in quantity and quality in the object and subject;
- Teaching tools (intellectual products like programmes, books, software) and hardware (buildings, multi-media, training vessels);

- Appropriate organisation, which has to stick all these components in an integral process.

The transfer of information containing theoretical knowledge is an interactive double direction process - mostly from the subject to the object, which needs an appropriate environment. Later on during the study process when students are involved in research the flow could be partly changed, i.e. from them to the educators. An extreme criterion of effectiveness is the status when students reach or even go beyond their mentors' experience, which could be accepted as anomaly. As Brown and Atkins state effective teaching is intellectually demanding and socially challenging [Brown, Atkins, 1997, p.1].

Following one of the philosophy laws, namely that quantitative accumulations convert into new qualitative changes we can see that some theoretical knowledge can be transform into practical skills. This scheme is realised with different teaching methods and techniques (tools). The methodologies (methods) are relatively old (classical) because of human nature, which is not so much changeable. More flexible are techniques, which are developing with technologies.

A classical method for maritime education is lecturing in small or large groups, mainly ashore. The transfer of the theoretical knowledge could be in the same place using laboratory/workshop or individual research. With technology development nowadays lecturing is possible not only in the classroom, but on a long distance as well. It is possible to consider the easy way to exchange information between several points, using the Internet, satellite communications and different types of multi-media equipment. Practical skills can be established not only with onboard training but, with appropriate simulation training too, using different types of simulators. Generally, computer based technologies (Computer Assisted Learning (CAL) and Computer Based Training (CBT)) have changed the face of MET. According to Bates [Bates, 1997, 90-110] the use of new technologies allows the following advantages:

- To improve access to education and training;
- To improve the quality of learning;
- To improve the cost-effectiveness of education.

The main disadvantage of educational process is a progressively diminished direct link between the objects and subjects. This cohesion can be realised predominantly by

any electronic equipment, which excludes the most important part of the total exchanged amount of information - feelings. Good feelings are invaluable. They are the best connection, which can motivate, stimulate or depress the potential effectiveness of the study process, i.e. capabilities of the parties involved in this endeavour. Of course, bad feelings can transform this advantage to a disadvantage. Than it is better for multi-media to be used. Nowadays searching for an optimal level between fundamental theory and skills, between routine education and innovative research is a long-term investment for the future. Such efforts are made at WMU. Establishment of students' scientific centre possibly can provoke the best part of the students to create more ideas and methods for their realisation. Understanding and initial financial support is an important factor for a successful start.

It is considered that in any teaching process there is exchange of information. Thus, some sensors, transmitters and receivers are necessary. These are educators and students with their eyes, ears and brains. Two channels exchange sound and visual information. The latter one is much more effective. The best performance can be achieved using an integral system of sound and visual devices.

The multi-medium is defined as a combination of several media: visual (film/video), sound (speech/music). Thus, the entire system structure includes some:

- Traditional means (radio, TV teleconferencing, video), which help the transmission of information through our visual and sound sensors;
- New sophisticated means (Internet, local networks, different types of simulators and virtual reality).

The Internet is a global network for information exchange both for education and research. A decade ago there were some difficulties due to lack of relevant and reliable information. Nowadays the management of process is challenged by the avalanche speed and enormous quantity of data distributed by the Internet facilities world wide. There is a significant influence of this resource on MET, which is changed from a lecturer-centred to a learner-centred process.

Local networks are the smallest cells of the www Internet. They are intended to serve a limited community for some specialised purposes. Academic institutions, in particular MET are able to connect different types of computer laboratories in computing networks. These networks can be utilised in CAL and CBT. The latter is a kind of simulation training based upon the advantages of the PC simulation.

However, Zhang formulates the difference between an ordinary computer system and multi-medium as follows:

> "A multi-media system thus differs from a basic computer system in that it adds to the computer based learning experience the dimension of computer-controlled integration of images, full motion pictures and sound for purposes of teacher/student interaction." [Zhang, 1998, 33]

This innovation is a challenge for MET, in particular in the West European countries, which suffer from lack of applicants, although it is not a radical solution of the problem, because the real cause is that profession of seafarer is no longer attractive for the Western Europeans. However, better something small than nothing at all. At the same time on the other end of the market (Eastern Europe and the Far East) this profession is still attractive but there are some shortages, which can be covered utilising new methodologies and techniques for MET. In addition:

- Brown and Atkins think that education is an international activity [Brown, Atkins, 1997, 2].
- Dyrli pointed out that exchange of information via distant learning motivates students, enhances their communications skills and increases their cultural understanding, if there is an international co-operation [Dyrli, 1996, 57].

The STCW-95 highlights the importance of simulators in MET. Moreover, simulation training is included as an alternative method to the use of full-scale training on board a vessel. In the not so far future possibly the simulators will completely replace the real practice within undergraduate and postgraduate education. A classification of simulators could be:

- Full mission - simulates visual navigation bridge operations including manoeuvring in restricted waters;
- Multi task - the above mentioned but excluding manoeuvring in confined waters;
- Limited task - simulates some bridge/engine room procedures;
- Special task - simulates limited part of bridge/engine room procedures.

Presently, the virtual reality is the latest stage of multi-media developments known to the community interested in MET in particular. Therefore, it is not so well

examined and defined and for the prospective future is doubtful. The following definition synthesised by Earnshaw can be of help:

> "The virtual reality is characterised by the illusion of participation in a synthetic environment rather than external observation of such an environment. The virtual reality relies on three-dimensional, stereoscopic, head-tracking displays, hand/body tracking and binaural sound. The virtual reality is an immerse, multi-sensory experience" [Earnshaw et al, 1993].

Despite some positive aspects some troubles exist too, such as: lack of understanding from the top to the base of the structure (Administration-Industry-Academic staff/students) designed above and vice-versa. For example, updating and upgrading programmes are rarely offered to the academic staff (3.1.6). Insufficient and expensive equipment is quite a difficult obstacle for many MET institutes. The software market is variable because international standards have not been created yet.

Information Technology has been widely used in shipping operations, which in consequence has led to the fact, that operators' both on board and ashore must be very well trained in computing techniques. Therefore, MET institutions, shipping companies, port authorities, maritime administrations, representatives from the other branches of the maritime industry and international organisations and funds should co-operate in a closer manner to find what is essential to improve MET in compliance with the STCW-95 requirements.

The implementation of information technologies should reflect to the academic staff, students, course programmes (reducing or partially replacing some classical subjects), equipment and operational organisation of the study process.

Bearing in mind that the seafarers' profession extends internationally, it has to be concluded that co-operation between MET institutes is the best way of achieving success with new methods and technologies in MET.

2.4 Impact of the international legislation on MET

2.4.1 International Safety Management Code (ISMC)

Quantity and quality are philosophical categories known centuries ago. Any process starts with some primary quantitative accumulations, develops, passes through a

boundary limit and enters upon a new stage named qualitative achievements. Bearing in mind this fundamental law it could be assumed that the more goods and services are produced, the better are relations between people. However, the latter is very difficult to be seen recently. Possibly it belongs to the future to become reality.

The problem about quality, in particular, in the maritime industry is not new. The industry itself comprises many branches, which interests and methods for achieving objectives are different, e.g. some ship owners prefer to operate new vessels, while some others exploit second hand. This understanding will modify safety standards, crew competence and expenses. Not everyone from the chain 'producer-customer' is ready to invest for better quality. For example, the establishment of Open registers, is an indicator of exactly how quality standards can be avoided, although there is a saying they (FOC) are not below the international standards.

The formation of some new politico-economical, technical, and social processes influence the maritime industry which is probably one of the most important nowadays. Unfortunately, and not with any view of negativism, the crisis inside it has shown how irresponsible and inactive is the community at all. Human factor with its knowledge, skills and competency is the cohesion between industry and running developments. Therefore, the maritime education and training system is so important, because it is the place for general and specialised education and qualification, i.e. it is impossible to expect some extraordinary positive results in quantitative and qualitative aspect without a solid maritime education and research system.

There are many acting personalities on the world maritime scene. They are producers and customers, brokers, constructors, traders, researchers, people linked by known and unknown links with the ocean nature. Turning back to the main acting personalities they are the following:

- Ship designers, ship builders and surveyors;
- Ship owners, operators, brokers and agents;
- Insurers;
- Cargo owners;
- Port authorities and operators;
- Governmental maritime agencies and non-governmental organisations;
- Pilots and VTS operators;

- Search and rescue and environmental protection structures;
- Coast Guard and Naval Forces.

All they need well-educated, trained and qualified specialists with sea experience.

Herewith, there is a brief historical note of the International Safety Management Code - an international legislative document with importance for the quality policies and standards in the maritime industry produced by the IMO. Together with some other international legislative instruments, e.g. the ISO series of standards it completes the system of requirements to all involved with the maritime industry. By such means it is intended the maritime community will raise the quality level of its production. The Code relates directly to the Flag State Administrations and Companies, but there are some others indirectly involved as well. This involvement is due to many factors. One of the main ones is that the shorebased branches of the maritime industry need personnel with maritime background and sea practice. The quality of their experience depends of the MET system where they were qualified. This connection is shown in paragraphs 6.2, 6.4 and 6.5 as follows:

> 6.2 The Company should ensure that each ship is manned with qualified, certified and medically fit seafarers in accordance with national and international requirements.
>
> 6.4 The Company should ensure that all personnel involved in the Company's SMS have an adequate understanding of relevant rules, regulations, codes and guidelines.
>
> 6.5 The Company should establish and maintain procedures for identifying any training, which may be required in support of the SMS and ensure that such training is provided for all personnel concerned.

Of course the insurers are also engaged with morality and skills of the ships' crews. It is supposed that the more moral, motivated and competent mariners, the lesser accidents.

The ISM Code is intended to improve the safety of international shipping and to reduce pollution from ships. It will have a major impact on the way shipping companies are managed and operated.

The Code's origins can be traced back to the late 1980s, when concern was growing about poor management standards in the shipping industry. In 1989, IMO

adopted guidelines on management for the safe operation of ships and for pollution prevention. These guidelines were revised in November 1991 and the ISM Code itself was adopted as a recommendation in 1993. However, after several years of practical experience, it was felt that the Code was so important that it should be mandatory. It was decided that the best way of achieving this would be through the International Convention for the Safety of Life at Sea, 1974 (SOLAS). This was done by means of amendments adopted on 24 May 1994, which added a new Chapter IX to the Convention entitled 'Management for the safe operation of ships.' The main purpose of the new chapter is to make the International Safety Management (ISM) Code mandatory. By adding the ISM Code to SOLAS it is intended to provide an international standard for the safe management of ships and for pollution prevention. The chapter entered into force under the tacit acceptance procedure on 1 July 1998. It applies to passenger ships, oil and chemical tankers, bulk carriers, gas carriers and cargo high speed craft of 500 gross tonnage and above on that date and to other cargo ships and mobile offshore drilling units of 500 gross tonnage and above not later than 1 July 2002.

The Code is intended to be introduced in two phases encompassing 90% of the world's fleet (39,400 vessels) and approximately 8,000 shipowning and operating companies.

The ISM Code establishes safety management objectives, which are:

- to provide for safe practices in ship operation and a safe working environment;
- to establish safeguards against all identified risks;
- to continuously improve safety management skills of personnel, including preparing for emergencies.

The Code requires Administrations to issue a Document of Compliance to every company that meets the standards laid down in the Code. The Company is defined as the shipowner or any person, such as the manager or bareboat charterer, who has assumed responsibility for operating the ship. The document can be issued by an organisation recognised by the Administration (or even another Government) and a copy must be kept on board each ship so that it can be produced on request during inspections. Ships operated by a company that meets the Code's requirements must also be issued with a Safety Management Certificate. Verification may be carried out during Port State control inspections.

The Code requires a safety management system (SMS) to be established by the company. This system should be designed to ensure compliance with all mandatory regulations and that codes, guidelines and standards recommended by IMO and others are taken into account.

The SMS in turn should include a number of functional requirements:

- a safety and environmental protection policy;
- instructions and procedures to ensure safety and environmental protection;
- defined levels of authority and lines of communication between and amongst shore and shipboard personnel;
- procedures for reporting accidents, etc.;
- procedures for responding to emergencies;
- procedures for internal audits and management review.

Companies are required to prepare plans and instructions for key shipboard operations and to make preparations for dealing with any emergencies which might arise. The importance of maintenance is stressed and companies are required to ensure that regular inspections are held and corrective measures taken where necessary.

The Code outlines the responsibility and authority of the Master of the ship. It states that the SMS should make it clear that 'the master has the overriding authority and the responsibility to make decisions ...' Stress is emphasised on the importance of training. The procedures required by the Code should be documented and compiled in a Safety Management Manual, a copy of which should be kept on board. Regular checks and audits should be held by the company to ensure that the SMS is being complied with and the system itself should be reviewed periodically to evaluate its efficiency.

Recalling again the list with acting personalities on the world maritime scene it can be concluded that all together they are customers on the seafarer labour market and it is reasonable for them to take part in the financial support and co-ordination of the MET more actively.

2.4.2 Standards for Training and Certification of Watchkeeping Officers

The maritime community started the process to create standards for competence of seafarers with some conventions prepared by the International Labour Organisation (ILO) between 1936 and 1946. Furthermore, since its inception in 1959 IMO has endeavoured not only to improve the safety of ships and their equipment but also to raise the standards of the seafarers, who operate them. Some resolutions were adopted in 1960 at the International Conference on the Safety of Life at Sea (SOLAS). It also recommended that IMO and the International Labour Organisation (ILO) should co-operate with each other and with interested governments to achieve these objectives.

In 1964 an ILO/IMO Joint Committee on Training prepared the Document for Guidance 1964 on the education and training of masters, officers and seamen in the use and operation of ships' equipment contributing to safety at sea. The document was subsequently amended, expanded and supplemented by the Joint Committee in 1975, 1977 and 1985.

Despite its success the IMO Council in 1971 decided that still further measures were needed to strengthen and improve standards of competence. Therefore, the IMO Assembly, which met in 1971, decided to convene a conference to adopt a convention on the subject. The conference related to the International Convention on Standards for Training, Certification and Watchkeeping (STCW) met in 1978 and was attended by delegates from 72 countries. It was the largest conference ever held by IMO and the Convention that resulted was regarded as one of the most important maritime safety conventions ever developed.

The STCW Convention was the first attempt to establish global minimum professional standards for seafarers. Previously the standards of training, certification and watchkeeping of officers and ratings were established by individual governments, usually without reference to practices in other countries. As a result standards and procedures varied widely, even though shipping is the most international of all industries. The Convention entered into force on 28 April 1984.

However, despite its broad global acceptance, it was realised by the late eighties that the Convention was not achieving its purpose. Instead it was gradually losing credibility as its acceptance widened. The main cause for this appeared to be the general

lack of precision of its standards, the interpretation of which was left "to the satisfaction of the Administration". This resulted in widely varying interpretation of standards and many Parties failed to effectively administer and enforce Convention requirements. STCW certificates could no longer be relied upon as evidence of competence. Other factors had reduced the effectiveness of the STCW-78 such as the reliance placed on seafaring skills and competence being acquired through service on board ship or in machine shops. The Convention had prescribed minimum periods of seagoing or other appropriate service and specified knowledge requirements without defining the skills and competence required. Crew reductions, faster turn-rounds, more frequent crew changes and the mixed of different education and training backgrounds resulting from multinational manning, undermined the effectiveness of this on-board training.

Since the development of the Convention in the seventies, many changes had taken place in the structure of the world merchant fleet and in the management and manning of ships. Emerging economies had acquired greater maritime expertise and expended their fleets. The fleets of traditional maritime countries had declined and the major sources of supply of seafarers had also shifted. The traditional organisation of duties and responsibilities on board ship was also changing. Some felt that management response to emerging safety, efficiency and career development needs and expectations had become hampered by the traditional departmental structure upon which the STCW-78 Convention had been exclusively based. Within the industry, the need for greater flexibility in the training and certification of seafarers became a significant force in the demand for change.

The loss of credibility of the Convention and political and public concern regarding human related causes of shipping disasters generated growing criticism not only of the Convention itself but also of IMO, which some claimed to be ineffective and unresponsive to the safety and environment protection needs.

Revision of the STCW -78 Convention

A limited review of Convention provisions was already in hand, when the MSC decided, in May 1993, to give high priority to its comprehensive review. The use of consultants and four sessions of an inter-session working group of the STW Sub-Committee allowed basic texts to be approved by IMO and circulated for the 1995

Diplomatic Conference. The Convention was adopted in July 1995 and entered into force on 1 February 1997. Until 1 February 2002, however, Parties may continue to issue, recognise and endorse certificates, which applied before that date in respect of seafarers who began training or seagoing service before 1 August 1998.

The main objectives and tasks of the revision are:

- To make Parties to the Convention accountable to each other, through IMO, for their proper implementation of the Convention and the quality of their training and certification activities;
- To require Administrations to maintain direct control over and endorse the qualifications of those masters, officers and radio personnel they authorise to serve on their ships;
- To clarify the skills and competence required;
- To have the amendments enter into force for all Parties to the Convention with the least possible delay;
- To transfer all detailed technical requirements to an associated Code;

The changes to the new Convention constitute a comprehensive package of measures designed to improve standards of competence globally. In the process they create new responsibilities for governments, the maritime industry, maritime education and training systems and seafarers. Indirectly involved are many others: seafarers' unions, insurers, research institutes and governmental and non-governmental agencies.

The STCW-78 Convention is the principal international treaty regulating seafarers' training, certification and watchkeeping arrangements, and forms the basis of national standards world-wide. However, even when adopted in 1978 it was regarded as a compromise between those nations wanting very high standards and those countries concerned about their ability to implement such measures.

In more recent years, three particular concerns about the STCW-78 have been identified, which the 1995 amendments are intended to address [ISF, 1995, 6]:

- The STCW-78 does not in fact contain precise standards of competence relating to the abilities needed to perform shipboard functions safely and effectively - it only stipulates minimum knowledge requirements for the issue of certificates. Because the provisions of the Convention have been open to different interpretation, they have failed to establish a uniform minimum level of competence internationally.

- Neither the process by which countries have ratified the old Convention, nor the provisions of the Convention itself, have been sufficient guarantees to ensure that STCW requirements have been implemented world-wide or sufficiently enforced. Consequently, there has been a loss of confidence in the reliability of STCW certificates issued by certain governments as an indicator of seafarers' competence.
- The STCW-78 is written in terms of conventional shipboard work organisation based on traditional divisions between the deck and engine departments. It has therefore failed to accommodate modern developments in training and shipboard organisation. This has already proved too restrictive, limiting the potential career developments of seafarers and preventing any safety - enhancing redistribution of workload on board during intensive working periods.

Briefly, STCW-78 lacks the flexibility to meet the industry's anticipated needs in the 21st Century.

Amended STCW-95 Convention

As it is stated in [ISF, 1995, 7], the 1995 amendments to the STCW Convention represent a comprehensive package of interrelated measures, which referred directly to governments, shipowners/operators, MET systems and seafarers. Collectively they are designed to address the inadequacies of the STCW-78 and improve overall standards of seafarers' competence worldwide.

The following sections highlight some of the major changes introduced by the 1995 amendments.

- Responsibilities of companies

Regulation I/14 stipulates the explicit responsibilities of shipping companies for ensuring that the seafarers they employ meet minimum international standards of competence, that ships are manned in accordance with flag state requirements and that detailed records are maintained of all seafarers. Companies will also have to ensure that all seafarers, on being assigned to their ships, undergo familiarisation on board and that measures are adopted to ensure effective co-ordination between seafarers.

The “appropriate certificate” that companies will have to ensure seafarers hold will include:

- the national certificate of competence;
- an endorsement from the government issuing the national certificate and attesting that it meets STCW standards
- individual Flag State endorsements which flag states will be required to issue to seafarers whose certificates have been issued by another government.

In order to help companies ensure that seafarers hold appropriate certificates the revised Convention allows them to request foreign administrations to confirm that certificates issued to seafarers serving on their ships are actually valid and authentic. At the same time governments shall maintain a register of all certificates and endorsements for masters and officers, which are issued, revalidated, suspended, cancelled, reported lost or destroyed. The companies shall keep all information about certificates accessible, but this task could be delegated to manning agents or other third parties. This is the reason that companies and governmental representative agencies are engaged together not only on a national but on an international level as well.

The problems about manning schemes for different kinds of vessels and zones of sailing have not had a clear answer for a long time. Until now manning has to be in compliance with applicable Flag State demands accordingly the SOLAS safe manning requirements. The IMO Resolution A.481 (XII) recommends that the safe manning document should specify the number and qualifications of personnel required to be carried on a ship from a safety standpoint. However, there is no clear solution to this problem. Preparatory work to define the exact crew is being carried out. Until it finished the IMO has decided to stop one-man bridge sea trials.

The revised Convention also states that seafarers on board will have to be able, if required, to present original certificates for inspection.

Section A - I/14 from the STCW Code deals with shipboard familiarisation. Under this regulation the company shall provide written instructions to the Master about the policies and procedures to be followed to ensure that all seafarers who are newly employed on board the ship are given a reasonable opportunity to become familiar with shipboard equipment, operating procedures and other arrangements needed for the proper performance of their duties, before being assigned to those duties. Furthermore a

knowledgeable crew-member will be designated to the newly employed seafarer for any assistance.

All this is useful as theory, but in practice is difficult to realise because company strategy is to reduce crew numbers and port delays. Ship operations are very fast and there is no free time for any familiarisation during changeover of crew-members.

Part B of the STCW Code contains recommendations concerning shipboard familiarisation, which some governments may decide to apply on a mandatory basis.

These provisions will be enforced by requiring governments to apply penalties to companies found to be in breach of the Convention and by expanding the circumstances in which Port State Control inspectors can question the operational competence of seafarers.

The requirement concerning the crew ability to co-ordinate activities embraces the ability of seafarers to communicate effectively with each other, in particular during emergencies. In order to develop the confidence and competence of seafarers who may be involved in actual emergencies, drills and exercises have to be regularly practised. Records should therefore be maintained for verification purposes.

As a part of the watchkeeping provisions in the revised Convention, Flag States will have to enforce mandatory minimum rest periods that must be taken by officers and ratings, forming part of a watch, in order to prevent fatigue. Sections A-VIII/1_and B-VIII/1 of the STCW Code stipulate about the fitness for duty and definition of fatigue. The requirements for rest periods are not maintained in the case of an emergency or drill or in an overriding operational condition. Notwithstanding these provisions, the minimum period of ten hours may be reduced to not less than 6 consecutive hours provided that any such reduction shall not extend beyond two days and not less than 70 hours of rest is provided in each seven-day period. The new requirements address this issue in the context of safety only: they do not concern themselves with social matters such as when overtime rates might be payable. Part B recommends to governments that Flag States consider requiring records of working hours and rest should be kept by shipping companies.

Nevertheless, it should be considered that one of the main reasons for fatigue is related to the total duration of the contracts, which are on average more than 6 months (sometimes even much more). Earlier research conducted by a range of experts in the

field of medicine and sea transport has shown that after the third month on board the seafarers receive non-reversible changes in physical and mental aspects.

Although not directly addressed to shipping companies, there are other major amendments to the STCW Convention which companies must nevertheless be aware of in order to ensure that they comply with rules.

Further to the requirement that companies must ensure that newly employed personnel are familiarised with equipment and procedures specific to their shipboard duties, governments will also have to ensure that seafarers, on all ship types, undergo additional familiarisation and basic training in shipboard safety matters, such as:

- Familiarisation in very elementary safety matters applying to all shipboard personnel other than passengers;

- Basic training in more comprehensive safety matters applying to seafarers with designated safety or pollution prevention duties in the operation of the ship.

- New uniform standards of competence

These establish for the first time uniform standards for the attainment of competence in particular maritime skills. The revised Convention contains specific criteria detailing the standards of knowledge, understanding and proficiency to be achieved in each element of competence by candidates for certification, and the criteria for evaluating them. The STCW-95 also extends elementary standards of competence to categories of shipboard personnel not addressed by the STCW-78. The Convention places much more emphasis on the outcome of training, the ability of qualified seafarers to perform their duties competently. Stress was given to the importance of on board training in particular.

In addition to meeting the required standards of competence, candidates for certification as navigational watchkeepers will require a minimum of 12 months seagoing service, including 6 months supervised bridge watchkeeping, provided that they follow a programme of structured in-service training approved by their governments. If, however, this is not followed then 3 years seagoing service will be required. For engineer watchkeepers 6 months seagoing service in the engine department will be required, although as part of the 30 months education and training approved by the government, which must include workshop skills. The approved seagoing service has to be recorded in a training record book approved by the government. Simulators and

specialised laboratories can be used to some extent as well for a limited period of time. At least two difficulties appear: how the time for replacement of the real on board practice will be measured, and how qualitative will be the in-service practice led by a non-professional instructor?

The approach adopted to develop precise standards of competence relevant to all of the safety and pollution prevention tasks that must be performed on board a ship comprises the following elements:

- Competencies: all of the individual tasks and skills required to operate a ship have been identified and grouped together which represent small practical units of ability that can be readily assessed.
- Functions: competencies for all of the tasks, duties and responsibilities that need to be performed on board have been grouped together to form self-contained shipboard “functions”.

In total, the revised Convention defines standards of competence for seven functions: navigation; cargo handling and stowage; controlling the operation of the ship and care for persons on board; marine engineering; electrical, electronic and control engineering; maintenance and repair; radio communications. The standards of competence that will need to be achieved for each of these functions are defined at up to three levels of responsibility in Section A-I/1 of Part A of the STCW Code as follows:

> "Management level" means the level of responsibility associated with: serving as a master, chief mate, chief engineer or second engineer officer on board a seagoing ship and ensuring that all the functions within the designated area of responsibility are properly performed.
>
> "Operational level" means the level of responsibility associated with: serving as officer in charge of a navigational or engineering watch or as designed duty engineer for periodically unmanned machinery spaces or as radio operator on board a seagoing ship…
>
> "Support level" means the level of responsibility associated with performing assigned tasks, duties or responsibilities on board a seagoing ship under the direction of an individual serving in the operational or management level.

The management level thus corresponds with senior officers, the operational level with junior officers and the support level with ratings.

Some specified standards of competence in the revised Convention relate to the outcome of training and to the content of the training itself. These standards are presented in detailed competency tables throughout Part A of the STCW Code. The standards relating to specified competencies are grouped together to form functions at different levels of responsibility.

The difference between STCW-78 and STCW-95 is that the old convention only specifies knowledge required by candidates for certification, while the revised gives detailed criteria for each element of competence to be achieved. Referring to the table these criteria include:

- Knowledge, understanding and proficiency (column 2);
- Methods for demonstrating that competence has been achieved (column 3);
- Criteria for evaluating the competence (column 4).

The format of the competency tables used for all of the functions, as well as for special competence requirements such as advanced fire fighting or medical care, is consistent throughout the STCW Code.

Although the competency tables in the STCW Code will place greater emphasis on proficiency and the actual ability of seafarers to perform their tasks satisfactorily, the need for the acquisition of necessary academic knowledge will not be eliminated. In general, the basic knowledge and skills expected of seafarers under the revised Convention will not be fundamentally changed. However, the knowledge that underpins most maritime skills will now be clearly allied to the practical skills necessary to carry out tasks safely and efficiently.

Depending on the particular competence, the methods specified for its demonstration will vary, but in addition to using specific, relevant materials demonstration methods will frequently include examination and/or assessment of evidence obtained from approved in-service training and simulator training.

The competency tables in the STCW Code contain specific criteria for evaluating competence, which relate to the actual ability required by a seafarer to become qualified to perform his/her job effectively.

In-service training and assessment

The revised Convention contains new provisions regarding the qualifications of instructors and assessors, including a requirement that they are qualified for the specific task for which the training or assessment is being conducted. Training institutions, in particular, will need to anticipate the implications of these requirements concerning the qualifications of instructors.

Simulator training

The revised Convention (Section A-I/5) contains extensive mandatory requirements and guidance concerning performance standards for simulators, although equipment in use before 1 February 2002 may be exempted from such standards. The use of radar and ARPA simulators in training and as a method of demonstrating competence will be a mandatory requirement for watchkeepers in the deck department [ISF, 1995, 31].

- Implementation measures

The revised Convention incorporates measures designed to help ensure that governments that are Parties to the Convention actually implement STCW requirements and that certificates are only issued to seafarers who meet the minimum competency standards. The STCW - 95 will also clarify the responsibility of flag states regarding the competence of seafarers serving on their ships, whatever country has issued the seafarers' certificates.

Some of these measures represent a radical departure from the scope of previous IMO regulations. Because there is no single measure that can guarantee that the Convention's standards will be adequately enforced, a "well-balanced package" of controls has been adopted to ensure compliance by industry and to require effective implementation and enforcement by governments. It is implicit in such a package that there will be more than one layer of measures to ensure compliance and that in some cases there will be a degree of overlap.

Companies

In addition to stipulating explicit company responsibilities the revised Convention reinforces these measures with specific provisions requiring governments to apply penalties to shipping companies and seafarers found to be in breach of the Convention's requirements.

A new Regulation I/5 governing national provisions states:

"...penalties or disciplinary measures shall be prescribed and enforced in cases in which:

- a company or a master has engaged a person not holding a certificate required by the convention;
- a master has allowed any function or service in any capacity required by these regulations to be performed by a person holding an appropriate certificate, to be performed by a person not holding the required certificate, a valid dispensation or having documentary proof (that an application has been made for a state flag endorsement of a certificate issued by another government)…;
- A person has obtained by fraud or forged documents an engagement to perform any function or serve in any capacity required by these regulations to be performed or filled by a person holding a certificate or dispensation."

Provisions expending the authority of PSC inspectors to verify the qualifications and competence of seafarers will also reinforce the responsibilities of the shipping companies under the STCW-95. As at present, PSC inspectors will be entitled to check that:

- the seafarers hold required certificates or dispensations. In future this will include Flag States endorsements of certificates issued by countries other than the Flag State or evidence that applications for such endorsements have been made;
- the number and the certificates of seafarers on board are in compliance with flag state's safe manning requirements.

Inspectors will also be entitled to undertake an assessment of seafarers' abilities if the ship has been involved in a collision, grounding or stranding, if there has been an illegal discharge of substances from the ship, or if it has been manoeuvred in an erratic or unsafe manner.

The revised Convention, however, expands the "clear grounds" under which inspectors will be permitted to undertake an assessment of seafarers' abilities to maintain watchkeeping standards whenever a ship is deemed as "otherwise being operated in such a manner as to pose a threat to persons, property or the environment".

The STCW Code also states that:

> The assessment ...can require the seafarer to demonstrate the related competency at the place of duty. Such demonstration may include verification that operational requirements in respect of watchkeeping standards have been met and there is a proper response to emergency situations within the seafarer's level of competence.
>
> (Section A-I/4 (4))

Governments

A particularly important part of the package to restore confidence in the validity of STCW certificates, regardless of where they are issued, is the measures designed to ensure effective implementation of the Convention requirements by governments. These measures include:

- Communication of information to IMO

Governments issuing the STCW certificates will be required to submit to IMO documentary evidence of compliance with the standards of the Convention including:

- Legal and administrative measures effected nationally with particular regard to training, assessment and the issue of certificates;

- Details of training courses, examinations and assessment systems; details of the procedures followed to approve the conduct of training and assessment nationally.

These reports had to be submitted to IMO by governments before 1 August 1998. With the assistance of "competent persons" appointed by IMO, including at least one person with knowledge of the particular country's training and certification system, these reports will be examined prior to publication by IMO of a list of governments that have provided sufficient documentary evidence.

Non-appearance on this IMO list will not in itself be construed as representing a statement by IMO that the seafarers holding certificates issued by certain governments are not competent. However, other governments through their port state control inspectors will be entitled to use the list for purposes such as deciding particular nationalities of crew or ships' flags to target for inspection purposes. Flag states will be entitled to use the list to assist in decisions on matters such as whether to recognise

certificates issued by other governments for service by foreign seafarers on board their ships.

Given that major labour supply countries will be concerned to ensure that demand for their seafarers is not diminished, the provisions concerning the communication of information to IMO should do much to encourage compliance with the requirements of the revised Convention.

- Quality standards

Governments issuing certificates will be obliged to demonstrate that their training and certification regimes incorporate quality standards subject to independent evaluation;

In particular, STCW 95 Regulation I/8, section 1 states:

> ... all training, assessment of competence, certification, endorsement and revalidation activities carried out by non-governmental agencies or entities under its authority are continuously monitored through a quality standards system to ensure the achievement of defined objectives, including those concerning the qualifications and experience of instructors and assessors and where governmental agencies or entities perform such activities, there shall be a quality standard system.

Governments will be required to ensure that all aspects of their national training and certification regime are subject to independent evaluation at least every five years. A full report of this evaluation, including details about the qualifications of those undertaking it, will also have to be submitted to IMO as part of the process of communicating documentary evidence of compliance described above.

- Flag State responsibility

Flag States will be obliged to accept responsibility for checking the competence of foreign seafarers serving on their ships and hold certificates issued by other States. They will be required to issue either their own certificates to foreign seafarers or individual endorsements of foreign seafarers' certificates. The Flag State will issue an endorsement as a separate document attesting to the recognition of the foreign certificate. A three

months' period of grace will be permitted between the time when the seafarer joins a "foreign flag" ship and when the endorsement has to be issued by the flag state, providing that documentary proof that an application for an endorsement has been made can be presented.

Of particular significance, however, is that the amended Convention states that flag states will only be allowed to issue endorsement, if:

> The Administration (Flag State) has confirmed, through all necessary measures, which may include inspection of facilities and procedures, that the requirements concerning standards of competence, the issue and endorsement of certificates and record keeping are fully complied with.
>
> (Regulation I/10)

This requirement incorporates two principles. First, it means that flag states will have to satisfy themselves that foreign governments issuing certificates to officers serving on board their ships are actually doing so in compliance with the Convention's standards. Secondly, the requirement means that flag states will, as a minimum, have to ensure that individual foreign certificates are valid and authentic by making necessary checks with the issuing Government. Separate provision in the Convention requires that governments issuing certificates will have to maintain a national register of certificates and answer requests for information received from other maritime administrations.

Checking that the authority issuing the certificate appears on the IMO list of governments that have submitted sufficient documentary evidence of compliance may be one of the "necessary measures" applied by Flag States. However, the requirement for criteria for ensuring compliance "through all necessary measures, which may include inspection of facilities and procedures" implies that some additional measures to ensure compliance will also have to be undertaken, as does the fact that flag states will also be required to submit reports to IMO summarising the measures taken to comply with this specific regulation [ISF, 1995, 39].

The revised Convention contains a wide range of other provisions the most significant of which includes the use of simulators in training, the qualifications of training instructors and assessors, measures to prevent fatigue and principals governing

alternative arrangements for issuing certificates that depart from conventional departmental divisions. Together with the three major components outlined above, these provisions form part of the total STCW package intended to ensure that the principal factors determining standards of training and crew competence will be sufficiently regulated internationally.

To take account of the International Tonnage Convention, the tonnage thresholds applying to standards in the deck department required for various sizes of ship will be

- 500 gross tonnage instead of 200 gross registered tonnes and
- 3000 gross tonnage instead of 1600 gross registered tonnes.

However, Governments will be permitted, if they choose, to treat seafarers holding existing certificates issued according to old gross registered tonnage thresholds as if they held certificates that had been issued according to the new gross tonnage limits. In the engine department, the thresholds of 750 kW and 3000 kW main propulsion machinery power will remain unchanged.

Standards of Training and Certification for Fishermen (STCW-F)

While the amendments of the STCW-78 Convention were considered, a separate conference running concurrently adopted an International Convention on Standards of Training, Certification and Watchkeeping for Fishing Vessel Personnel (STCW-F).
Because of the nature of the fishing industry it is extremely difficult to develop regulations for other sections of the shipping industry which can be applied without modification to fishing vessels as well. The Convention will apply to crews of seagoing fishing vessels, generally of 24 metres in length and above. It was originally intended that requirements for crews on fishing vessels should be developed as a Protocol to the main STCW Convention, but after careful consideration it was agreed that it would be better to adopt a completely separate convention. The Convention is the first attempt to make standards of safety for crews of fishing vessels mandatory.

The STCW-F Convention is comparatively short and consists of 16 articles and several chapters contained in an annex. Chapter I contains general provisions, Chapter II deals with certification of skippers, deck and engine officers and radio operators.
Previously efforts to improve the training, certification and watchkeeping standards of fishing vessels' personnel have been adopted as recommendations in Assembly

resolutions and the Document for Guidance on Fishermens' Training and Certification produced jointly by IMO and the Food and Agriculture Organisation (FAO) and the ILO.

2.4.3 The European Community attitude and response

The most important European Community (EC) documents referring to the standards of maritime education and training (MET) are:

- The Council Directive 94/58/EC of 22 November 1994 on the minimum level of training of seafarers

- A Proposed Council Directive amending Directive 94/58 EC on the minimum level of training of seafarers

The Council Directive 94/58/EC

The Council noted the importance of the human element in the safe operations of ships in its conclusions of 25 January 1993 on maritime safety and pollution prevention matters. In its Resolution of 8 June 1993 on a common policy on safe seas, the Council set the objective of removing substandard crews and gave priority to Community action aiming at enhancing training and education by developing common standards for minimum training levels of key personnel. The question of a common language on board Community vessels was included as well.

Having regard to the proposal from the Commission, opinion of the Economical and Social Committee and decision of the European Parliament of 16 November 1994 the Council adopted Council Directive 94/58/EC of 22 November 1994 on the minimum level of training of seafarers.

It was decided to define a minimum level of training for seafarers in the Community actions based on the standards of training already agreed at international level, namely the IMO Convention on Standards of Training, Certification and Watchkeeping for Seafarers, 1978 and the relevant amendments.

Due to the fact that standards of training for vocational competency certificates for seafarers vary from one member state to another, such a diversity of national laws in

the area of training covered by the directive does not ensure the consistent level of training required in the interests of maritime safety.

The Council Directives 89/48/EEC and 92/51/EEC on the general system of recognition of professional education and training apply to maritime occupations covered by this directive. They will help promote compliance with the obligations laid down in the Treaty abolishing obstacles to the free movement of persons and services between member states. The mutual recognition of diplomas and certificates provided for under the general systems directives does not always ensure a standardised level of training for all seafarers serving on board vessels flying the flag of a member state including ships registered in EUROS once that register is approved by the Council.

The Directive defines measures should be taken to ensure that seafarers holding certificates issued by third countries have a level of competence commensurate with that required by the STCW Convention. For this purpose the Council decided to act on the common criteria in accordance with the conditions of the Treaty. A committee should be established to assist the Commission in carrying out the tasks related to the exercise of the recognition of certificates issued by training institutes or administrations of third countries. Also measures should be taken for allowing seafarers serving on board ships flying the flag of a member state, including ships registered in EUROS once that register is approved by the Council, and holding certificates not issued according to this Directive, to continue their work during a transitional period up to and beyond the adoption of the common criteria.

Article 12/2 of the Directive provides that the Council, acting on a proposal from the Commission shall decide the detailed arrangements for ratifying new instruments or protocols to the STCW Convention while ensuring that they are applied uniformly and simultaneously in the Member States.

Article 9/3 (a) of the Directive provides that the Council, acting in accordance with the conditions of the Treaty will adopt before 1 July 1995 a set of common criteria for the recognition of types of certificates issued by institutes or administrations of third countries. It is mentioned that member states shall notify the Commission and the other member states of the types of certificates they have recognised or intend to recognise in compliance with the common criteria.

The Directive highlights the importance of communication among crew members on board ships sailing in Community waters for maritime safety and preventing loss of

human life and maritime pollution. In this context all relevant provisions of IMO Resolution A.770 (18) on minimum training requirements for personnel on board passenger ships nominated to assist passengers in emergency situations should be taken into account. The same is relevant for crews serving on board tankers carrying noxious polluting cargo, oil, chemical and liquefied gas tankers flying the flag of a member state. The Master, officers and ratings are able to communicate with each other in a common working language(s). Furthermore, there should be adequate means for communication between the ship and the shore-based authorities either in a common language or in the language of those authorities.

Proposed Amendments to Council Directive

In the context of a common policy on safe seas and based on Article 84(2) on maritime transport linked with Article 75(1) (c) on transport safety, the Council adopted in 1994 a Directive on the minimum training requirements for seafarers. It was recognised the need for common EU maritime training standards with a view to improving maritime safety and prevention of sea pollution.

In July 1995 the STCW-78 was revised and from 1 February 1997 the new STCW-95 entered into force. In accordance with Article 12 of the Directive 94/58 the Commission presented a proposal on the necessary amendments to this directive in the light of the revised STCW provision.

The following proposals for adaptation and amendment of the Council Directive 94/58 are stated at the amendments to the Council Directive [Commission for the European Community, 1994]:

- The adaptation of the training and certification rules of Directive 94/58 in the light of the revised STCW Convention. Introduction of common criteria for the recognition in the EU of certificates issued by third countries; and
- Enhancement of the protection of human life of European citizens and marine environmental protection by measure reducing the risk by improving the human element performance on board vessels.

The proposal to adapt Directive 94/58 concerns:

a) The new STCW training and certification requirements including watchkeeping provisions which deal with mandatory minimum rest period for watchkeeping personnel;

b) The introduction of common criteria for the recognition of seafarers' certificates issued by third countries

The proposal does not change the articles of Directive 94/58 concerning on board communication and Port State Control. However, the Commission has the opinion that provisions should be proposed in edition to the existing Articles 10 and 11 in order to take into account the requirements of regulation I/4 of STCW-95.

The proposal therefore amends the Directive as follows:

a) Article 4 is amended to take account of changes in existing definitions and introduce certain new STCW-95 definitions;

b) A new annex replaces the existing annex to the directive containing, as appropriate, the revised STCW chapters;

c) New articles are inserted to deal with the STCW-95 principles contained mainly in chapters I and VIII and the associated sections of part A of the Code. These articles concern in particular:

- certificates and endorsements (Article 3a) corresponding to STCW new regulation I/2,
- near-coastal voyages (Article 5a) corresponding to STCW new regulation I/3,
- national provisions (Article 5b) corresponding to STCW new regulation I/5,
- quality standards (Article 5c) corresponding to STCW new regulation I/8,
- medical standards - issue and registration of certificates (article 5d) corresponding to STCW new regulation I/9,
- use of simulators (Article 5f) corresponding to STCW new regulation I/12,
- responsibilities of companies (Article 5g) corresponding to STCW new regulation I/14,
- transitional provisions (Article 5h) corresponding to STCW new regulation I/15,
- fitness for duty (Article 5I) corresponding to STCW new regulation VIII/1.

d) Article 7 is amended in order to conform with the STCW new regulation I/6 on training and assessment;

e) Article 9 (3) (a) is replaced in order to define the common criteria for the recognition of seafarers' certificates issued by third countries. The criteria proposed are in conformity with STCW-95 provisions, in particular regulation I/10;

f) New articles 10a and 11a are inserted to reflect the requirements of regulation I/4 on Port State Control;

g) Article 12 is amended in order to make possible that amendments to the Directive which will be required because of future changes in the STCW Code can be decided in accordance with the procedure laid down in Article 13.

- Comments on the effectiveness of the STCW -78 Convention

Each Party to the Convention may require, in respect of ships entitled to fly its own flag, standards higher than those internationally agreed upon. This right to establish national standards at a higher level has been exercised to some degree by various Parties. However, such national standards cannot be applied to seagoing ships of other Parties.

Furthermore, the European Commission document examined role of the education and its approval, accreditation criteria, procedures and authentication of documents [Commission for the European Community, 1994].

Approval of MET

The approval of maritime education and training under STCW-78 did not require masters and deck officers to specifically have completed any education or training other than to have attended an approved fire-fighting course. Practice under STCW-78 has varied from Party to Party but in general, approval of training for deck officers has been required only when the institution has applied to the Administration for a reduction in the length of seagoing service required of their graduates. On the other hand marine engineer officers are required under STCW-78 to have completed not less than three years of approved education or training. This is not as strict as the revised STCW-95 requirement to have completed both education and training.

The quality of education and training provided at maritime training institutions depends upon a number of factors including:

- the entry standards applied by the institution, the standards of general education prevailing within the country and the levels of supply and demand in respect of well educated persons;
- the priority accorded to the maritime training sector by the government and the relative attractiveness of sea life and shore life to the population;
- the quality of the teaching staff that the institution can attract and retain and the adequacy of facilities and training equipment and aids provided;

- whether or not the institution has been accredited or approved and is monitored by the maritime administration or department of education and whether or not an effective quality system is in place;
- whether or not the institution has received the particular assistance and attention of, or has been sponsored by a donor government or agency, shipping company or shipping companies directly or through an agency.

All of the above factors may apply to the training institutes located in countries which supply labour to international shipping and in such cases, the receipt of assistance or attention mentioned above is of particular relevance. The motivation and management skills of those in authority must also be kept in mind.

Diplomas issued by MTI

The diplomas are generally issued on the basis of scholastic achievement demonstrated while attending a pre-sea, sandwich or, in some cases, pre-certification courses at a maritime training institute or academy. One of the major weaknesses in the STCW-78 was that its standards are knowledge based and incorporate very few practical competencies, ability, proficiency or skill requirements. However, where an integrated training programme is involved which incorporates in-service training on board ship, the on-board training may be monitored through a training record book, which under STCW-95 will have to be expressly approved by the Party, which is to issue the certificates. The entries and projects contained in this training record book may, in some cases in the past, have been reviewed by the student's supervising instructor of the training institute after completion of all seagoing service requirements. The practical knowledge and skills required during service at sea might also be tested by the supervising instructor or other assessor through oral, practical and/or simulator based examinations.

In some countries an appropriate STCW certificate may be issued on behalf of the Party by the training institute in addition to the diploma. Alternatively, the diploma may be presented to the government department responsible for administration of the STCW Convention, which may then issue an appropriate STCW certificate without further examination or assessment.

Role of education and training

The role of education and training in recognition of certificates can be explained as follows:

If little credence can be placed in the certificates issued by or on behalf of a Party, then there is equally no reason to place much credence in any approval or accreditation of a training institute granted by the maritime administration of that Party. However, factors such as the involvement of another governmental department or agency dealing with education must be taken into account.

In some labour supplying countries a small number of good quality training institutions are known to operate in direct competition with others of poor quality. However, the certificates issued under the STCW-78 to those seafarers that receive a good standard of education and training do not differ in any way from those issued to poorly trained seafarers. While the situation under the STCW-95 could show early improvement through closure of inadequate training institutes, it will take some years for standards to be raised at all remaining institutes to more than marginally meet the minimum standards. Still many more years will pass to meet the standards attained by institutes located in EU member states.

The quality of training provided at any institution can only be reliably established through inspection of facilities and procedures as provided for under regulation I/10 of STCW-95. The procedure followed should, as a minimum, be based on the provisions of the STCW articles and regulations I/6 to I/12 inclusive and all relevant sections of parts A and B of the STCW Code, including section B I/9, paragraph 13, and take into account all information provided by the issuing Party. Such an inspection may indicate that one or more of the training institutes approved or accepted by the issuing Party provide maritime education and training of such poor quality that it does not meet the minimum standards required by STCW-95. A Flag State Party, which reaches that conclusion, cannot recognise any certificate issued by the other Party. However, recognition of any or all certificates issued by or on behalf of the other Party becomes possible if, pursuant to the provisions of STCW-95, the issuing Party:

- Approves only the education and training provided at those training institutes which meet the minimum standards of STCW-95;
- Establishes and requires the holders of certificates which reflect a lesser standard of competence to successfully complete appropriate refresher and updating or assessment; and

- Meets all other requirements of the revised Convention.

STCW-95 prescribes minimum standards for certificates that are to be recognised by a Flag State Party under Regulation I/10. As noted under paragraph 6 on "Standards of individual Parties", this does not prevent a Flag State Party from requiring the holders of certificates issued by another Party to meet higher standards of competence before they are authorised to serve on ships of its flag, by issue of an appropriate endorsement attesting recognition of their certificates.

Shipping companies themselves can and occasionally do demand of their prospective employees, even higher standards than their administration requires. On that basis, some shipping companies already recruit only those seafarers who graduate from institutes which meet or exceed the shipping company's own higher standards of maritime education and training and competence.

Authentication of documents

Given the ease, with which documents can be forged or altered today, there is a need for access to reliable records so that at least any suspicious document may be authenticated. The simplest method of achieving this is to require, as part of the accreditation process, the provision of computerised records of all seafarers, who have graduated from the academy or training institution. Sufficient detail should be incorporated in these records to reasonably ensure reliable identification of each graduate. Records of those graduating in successive years can then be progressively added.

Institute accreditation criteria and process

Establishment of a training institute based recognition system would necessitate the development and uniform application of precise criteria upon which recognition is to be based. These criteria should reflect the requirements of STCW-95. It should also take account of all decisions of IMO relevant to the Convention. Additional requirements, over and above those of STCW-95, are possible to be applied in the case of recognition of certificates for service on board ships of a member state.

The procedures followed to confirm that STCW-95 standards are fully met should comprise two parts, the first being the communication of documentary evidence

regarding the standards and quality of education and training provided by the institute. If reviews of such documentary evidence confirm that minimum standards of STCW-95 are met, it would then be necessary for the institute concerned to be visited and assessed.

Comparison of the STCW-78 and STCW-95 standards

Given that STCW-95 entered into force on 1 February 1997, attention should be focused on that instrument alone. Regulation I/11 requires each Party to compare the standards it previously applied under STCW-78 with those specified in STCW-95. Assessment of the outcome of this comparison should be incorporated in the EU recognition process. While the date of 1 February 2002 is employed in the regulation I/11 so as to ensure that all certificates that may be issued under STCW-78 are covered. It is in the interest of each Party that it should have complete the required comparisons prior to 1 August 1998, by which time it have to communicate all information required under regulation I/7 and section A-I/7 of the STCW Code. Any arrangements deemed necessary to upgrade or update the knowledge, skills and competence of seafarers certified under STCW-78 should also have been in place by that time although an orderly process of upgrading may take up to five years to complete. Access to employment on board ships of member states provides a powerful incentive to Governments, training institutes, and seafarers alike.

Port State Control aspects

As previously stated only STCW minimum requirements concerning education and training should be applied to ships entitled to fly the flag of other Parties.

The control provisions of regulation I/4 have been broadened to include:

- The production of documentary proof that application has been made for an endorsement attesting recognition;
- Verification that the numbers and certificates of seafarers serving on board conform to safe manning requirements of the Administration; and
- Assessment of ability to maintain watchkeeping standards if the ship is operated in such a manner, as to pose a danger to persons, property or the environment.

Detention of the ship in case of:

- failure to comply with safe manning requirements of the Administration;

- failure to comply with the watchkeeping requirements of the Administration;
- absence in a watch of persons qualified to operate equipment essential to safe navigation, safety radio communications or the prevention of marine pollution;
- inability to provide watchkeepers who are sufficiently rested and otherwise fit for duty.

Language aspects

Ability to communicate orally and to understand orders, instructions and advise in all circumstances is essential to ensure proper co-ordination of the activities of a ship's complement. Careful attention must therefore be paid to the language capabilities of holders of certificates, which are to be recognised.

Knowledge of Flag State legislation

Although a number of alternative approaches are available, knowledge of the legislation of a member state could be ensured through distribution of a summary of key relevant legislative provisions. Some form of written test to be completed and forwarded with each application for recognition of a certificate or for a revalidation of an endorsement attesting recognition. This requirement concerns seafarers who are to serve on board at the management level.

Endorsement attesting recognition

A format for an endorsement attesting recognition of certificates is prescribed under Regulation I/2 of the revised STCW Convention and in section A-I/2 of the STCW Code. However, Regulation I/2, paragraph 8 states that:

> Administrations may use a format different from the format given in section A-I/2, provided that, as a minimum, the required information is provided in Roman characters and Arabic figures, taking into account the variations permitted under section A-I/2.

Conclusions

It is entirely feasible for member states to recognise, by endorsement issued in accordance with regulation I/2 of STCW-95 certificates issued by other Parties and thus authorise the employment of the holders on board ships entitled to fly their flag. The

conditions governing the issue of such endorsements can include proof of completion of approved maritime education and training at an accredited institute, within or beyond the jurisdiction of the Party concerned.

The advantages of such a system include:

- assurance that the holder of each individual certificate recognised has completed education and training considered to be equivalent to that approved by a member state under STCW-95 and including, at least in the future, approved monitoring of in-service training and assessment activities and their supervision and monitoring on board ships flying its flag ;
- the ability to initiate corrective action in respect of any weakness in the education and training of endorsement holders which may become apparent through their in-service performance and
- upgrading of the education and training provided at the selected training institutes in labour supplying countries to fully meet STCW-95 standards.

The disadvantages of such a system include:

- the significant human and financial resource demands involved;
- the necessity to obtain the co-operation of each Party whose certificates are to be recognised in this particular manner which could be viewed as undermining the value of certificates otherwise issued by or on behalf of that Party.

Entry into force

The entry into force of the Convention is done under the tacit approval laid down in Article XII of the Convention. It is stipulated that:

> ...an amendment to the annex shall enter into force with respect to all Parties, except those which have objected to the amendment under subparagraph (a) (vii) and which have not withdrawn such objections, six months after the date on which it is deemed to have been accepted.

It is expected that all member states apart from Austria, which is not yet a contracting Party to the STCW-78, will accept the revised STCW Convention.

Under these circumstances the Commission believes that the present proposal should not raise particular difficulties for member states and it would therefore urge the Council to adopt as soon as possible the proposal with a view of making it possible for the amended Directive to come into force in 1997.

The EC Economic and Social Committee review on the "Proposal for a Council Directive, amending Directive 94/58/EC on the minimum level of training of seafarers"

The section 'Transport and Communication' prepared the Committee's opinion in the following format: background; revision of the STCW-78; general comments and specific comments.

The Background explains that the Council Directive 94/58/EC was based on the IMO Convention STCW-78 and also contained provisions on language skills of the crew, especially on passenger vessels. The Committee noted that the text would have to be amended shortly after adoption since the revision procedure of the STCW-78 at IMO level was completed by 1995.

The revision of the STCW-78 Convention shows that the main aim of the process was to reformat it ensuring it is up to date and to establish guaranteed unified standards of competence through modern methods of education and training, making Parties to the Convention accountable to each other through IMO.

Some important points of the revised Convention relate to the linkage between the alternative certification provisions identified by the crew's functions on board the vessel; levels of responsibilities (management, operational and support); methods for demonstrating competence and criteria for its evaluation. The revised Convention STCW is therefore a much more complex instrument than the previous Convention and each part is integral to the others. The Committee recalls as well as that when the Directive 94/58/EC was adopted, Article 9 (3) (a) required the Commission to propose a set of criteria for the recognition of types of certificates issued by institutes or administration.

In the general comments the Committee expressed the opinion that the EC directive does not cause any unnecessary duplication of requirements and will not require frequent revision. It will not create legal conflict between the international and national obligations of member states, which are also, Parties to IMO instruments and it does not prejudice the aims the IMO articulated when it adopted the revised STCW.

It introduces a new article covering fitness for duty, which reproduces the minimum rest provisions in Chapter VII of STCW-95. However the Committee cannot ignore the fact that the ILO has adopted its new Convention No180 on seafarers' hours of work. Therefore, it recommends to the Commission to develop a single instrument addressing both the IMO and ILO standards so as to avoid any confusion relevant to the measures to be applied by member states.

In the same time, the Committee is doubtful about the Commission proposal, that member states can meet the STCW-95 requirement related to the officers at management level and their knowledge of the national (Flag State) legislation by providing a summary and some form of written test, which is completed and forwarded to the Administration.

There are some proposed amendments, which IMO MSC adopted on its 69th session in May 1997 concerned about:

- some additional requirements related to the training and qualification of the crew on passenger ships, in particular ro-ro, and replacement of relevant text in section A-V/2 of Part A of the STCW Code;
- the addition of a new paragraph 5 in section A-V/2.5 of Part A of the STCW Code (Crisis management and human behaviour training); and
- the addition of a new section A-V/3 in Part A of the Code (Mandatory minimum requirements for the training and qualifications of Masters, officers, ratings and other personnel on passenger ships other than ro-ro passenger ships).

The new text of article 9(3)(a) is in conformity with the requirements of regulation I/10 of the revised convention, which obliges the administration to confirm that the demands concerning standards of competence, the issue and endorsement of certificates and record keeping, are complied with. Confirmation may include inspection of facilities and operational procedures. Such inspections will take place on a random basis. However, the necessity and practicability of these inspections have to be carefully considered in view of the requirements contained in Regulation I/7 and I/8 of the revised

Convention. The Committee suggests that the criteria for the inspection of non-EU training institutions contained in Article 9 (3) (a) subparagraphs 2 and 3 should be better presented by way of recommended guidance.

The Committee urges the Commission to encourage the member states to ratify some new relevant to the training of seafarers international instruments (ILO conventions, STCW-F Convention) in order to ensure a harmonised EU approach on the standards of training and certification of seafarers.

The section 'Specific comments' contains some proposals, which could be grouped as follows:

- the amending directive should contain an express provision that it establishes a minimum European standards, but the member states are free to adopt higher national standards of competence;
- the Committee noted that the IMO SOLAS Convention, which enters into force on 1 July 1997 contained a new regulation in Chapter V, which relates to the manning of every passenger ship and refers to the determination of an appropriate working language, recorded into the log-book, to ensure effective crew performance in safety matters.

The Committee noted that the IMO SOLAS Conference adopted a resolution calling for such a requirement to be extended to all ships. Therefore, it recommends the Commission utilises this opportunity to adopt a requirement that there is a single working language on all ships flying European flags and those, irrespective of flag, which call at European ports.

There are two specific comments directed to the criteria for the approval of a maritime training institution: the provision in section 2 article 9 (3) (a), sub-paragraph 2.1.1 could be interpreted as requiring that MTIs must be able to provide living accommodation. In the same section and article but sub-paragraphs 2.6, 2.7 there is a requirement that a MTI must provide the member state with computerised copies of their records.

The Committee considered that the first requirement is unnecessary and recommends that the potential ambiguity must be removed because many training institutions do not possess their own living accommodation facilities. Regarding the second requirement it would be reasonable that MTI to provide an alternative method through the provision of records in a suitable written form.

The Committee notes that article 5 (a) (4) restricts the rights of member states to make their own judgements and decisions concerning the definition of near coastal voyages and the standards to be prescribed for them by requiring approval through the procedure under article 13. The STCW-95 regulation I/3, paragraph 5 states that 'Nothing in this regulation (concerning near coastal voyages) shall, in any way, limit the jurisdiction of any state, whether or not a Party of the Convention.'

There are two articles, 5 (b) and 5 (d), which correspond to regulation I/5 and I/9 of the revised Convention respectively. These articles refer to the non-EU states and member states relations. The Committee recommends that the text should be more transparent, showing a co-operation is necessary.

The Committee is firmly of the view that the Commission should use the opportunity to ensure that solo watchkeeping during periods of darkness cannot be carried out on European flag vessels nor within European waters by foreign flag vessels (the correspondent text is contained in the STCW-95, regulation I/13).

Chapter III MET models in selected countries

3.1 Maritime Education and Training in the European Community member states

This subsection is intended for examining the information necessary about creation of an optimal model of MET system. As explained before the original idea was that the information package would include all groups of countries. However, due to time constraints, the author will use only information covering the European Community Member States. Much service material has been obtained from the project METHAR, which is co-ordinated by the World Maritime University with partners Bremen Polytechnic, University of Trieste, Rotterdam shipping and Transport College and Portugal national maritime academy. The European Union financed this research. Its main objective is:

> ...to increase the competitiveness of the European maritime industry by helping to improve the qualification of seafarers and other maritime personnel so that higher safety, environmental protection and efficiency standards can be achieved.
>
> The project aims at exploiting the not yet full potential of MET institutions by facilitating and encouraging communication and co-operation among them and by providing guidelines, a framework as well as examples for a bottom-up approach to harmonisation. [METHAR, 1998].

The working content is divided into three main parts:

- Description and evaluation of existing European MET systems and provisions;
- Identification of present and expected future shortcomings in European MET;
- Recommendation of measures, above all harmonisation measures, for overcoming present and pre-empting expected future shortcomings and for improving the overall quality of European MET.

3.1.1 The role of National Maritime Administrations

The initial survey on the condition of Maritime Education and Training (MET) systems in the European Community member states shows that a variety of ministries are in charge of it. This provides an overall picture of how Governments are involved in the administration and financing of MET institutions and the manner in which certificates of competence are linked to national education systems.

The following comments provide a breakdown on responsibilities in European MET systems.

Funding/overseeing

Appendix 8 shows that in most of the countries (66.7%) the Ministries of Education are in charge of MET funding/overseeing in their individual capacity (46,7%) or together with other ministries (20%). In 20% of the cases the Ministry of Transport is obliged with these activities. Maritime education and training is monitored by ministries neither of transport nor of education only in three of the countries (20%).

The data (METHAR, wp 1.6) shows that the Ministry of Education has together with the Ministry of Transport the highest percentage in the list. This combination seems to be the most appropriate. Moreover, in many Ministries of Transport the Water Transport Division deals not only with the maritime education, but also with seamen's progress in the hierarchy of sea-going career, ships' crew register, casualty investigation procedures and many other maritime activities. If the respective responsibilities have not been previously defined the joint management approach could result in some disorders.

However, in recent years the Ministry of Education has been more and more involved in the administration of MET because studies have now university level in some countries and provide qualifications for positions both on board ships and ashore. This

development has led to the establishment of the general Bachelor degree in some countries.

Approval of MET courses

The relevant Ministry of Transport alone (26.7%) or together with Ministry of Education (20%) approves the courses and programmes offered by the institutes. In only one country (6.6%) does the Ministry of Education alone retain an involvement. The various Marine Safety Authorities perform this function in 46.7% of the countries. In all cases a Government Authority is involved in the approval process leading to alterations in the MET certificate of competency programmes.

MET courses leading to certificates of competency are also recognised within the state education system through the granting of a separate educational award (75%). The most common awards are either a certificate and diploma with degree or degree equivalent being gained at the highest levels of study (Master/Chief engineer) in about 27% of the countries.

3.1.2 Structure of Maritime Education and Training systems

The maritime industry and its significance for MET

Any MET system may exist and develop if the specialists it trains could find work places in the industry branches they have been intended for. Some of these branches are shown on appendix 1**.** The modern maritime industry could be divided into two groups: shorebased and sea going. Numerous research investigations confirm that after a certain period of working at sea the seafarers having maritime education change their position from a sea-going career to a related job in the shore based branches of maritime industry.

The data from METHAR, wp 1.7, p.130 could serve as a kind of reference point for optimising MET systems by connecting the needs of the maritime industry with the number of students at the maritime institutes provided that they offer relevant specialities and education of high quality. Some branches are shown below:

Shipowners	P & I
Crew management	MET

Marine equipment	Port/ Stevedoring
Towage/ Salvage	Pilotage
Offshore	Surveyors/ Inspectors
Classification	Ship chartering
Ship builders	Ship management
Consultants	Ship agents
Maritime Authority	Port services/ VTS
Dredging	Cargo surveyors
Pollution control	Ship/Cargo brokering
Insurance	Legal

Thus, the educational system could have a significant social and economic effect. Certainly, nowadays conditions and future changes should be considered as well. Obviously, the number of professions and positions in the shorebased branches of the maritime industry are much greater than those in the sea-going ones.

The statistics show that graduates with sea-going certificates (officers) after having several years' positions on ships move to positions in the shorebased branches. This means that they must have acquired the necessary theoretical and partial practical training already during the process of their education, or have had to pass through necessary additional training before starting a new job. The main training has to be connected with the respective maritime specialities. Besides, there are a number of compulsory international requirements regarding crew staff (number and competency). The MET system must take into consideration all those indices and to train specialists fulfilling the necessary conditions (the ILO and IMO Conventions and the relevant National Maritime Administration Regulations). In that sense the requirements for occupying a definite position on a ship as well as the opportunities for any further development in a sea-going career are the broadest fundamentals of maritime education. It could be assumed that the sounder the fundament is, the better following training and career development should be.

Having examined a number of international documents regarding the manning scales, it can be concluded that no common level of manning can be applied to special vessel type. Experience shows that in the course of time, position levels and number of people employed are very variable in conforming with some ILO Conventions, STCW-

78/95 Convention and the good sea practice. That means unless the international maritime community agrees to some proper manning schemes, i.e. number of crew members and job characteristics, MET systems cannot adjust their programmes in order to educate and train the future demand for officers and ratings. Recently the system of factors defining the manning scale appears as [METHAR, wp 1.1, p.13]:

Tonnage
Type of ship
Power of main engine
Competence of crew
Proper and qualified lookout
Ensuring that all type of emergencies can be properly handled
Ensuring maintenance work can be carried out
Ensuring that required crew has the required rest hours
Ensuring crew is not over-worked (Fatigue)
Ensuring that there are enough people onboard to carry out mooring activities
Ensuring that onboard technology can be handled

The survey in EC member states shows that in two thirds of them certificates asserting not only the specific but the comprehensive parts of the education are issued along with the certificates of competence for sea work.

Maritime Education and Training systems: necessities, classification of institutes, present status

Absolutely the process of education has a continuous character - we learn throughout our life. For the objective of this research it could be assumed that the sea-going career needs three stages of education, as follows:

- For acquiring basic skills and knowledge - level of primary and secondary schools education;
- For acquiring specific skills and knowledge in navigating, maintaining and operating a ship - level of higher education (university, vocational);
- For updating and upgrading knowledge and skills already acquired - postgraduate education.

These stages can be used for setting up the structure of a Maritime Education and Training system. The information collected by METHAR, wp 1.1 and wp 1.5 is useful in this respect. There are three kinds of institutes depending upon the type of certificates issued. They offer courses only for unlimited, limited or both kinds. In nearly fifty percent of the countries together with courses leading to unlimited certificate of competence some academic degrees are offered. The exact levels of these degrees are not shown. However, it is mentioned that they are equivalent of BSc. The data gives an opportunity for assessing the number of maritime institutes but it is impossible to judge, if they can train specialists for the classical maritime specialities only (navigators, engineers) or for some other branches of the maritime industry as well. It cannot be clearly seen, whether there is a system in which maritime schools are concerned not only with the education, but also with the post-graduation training of sea officers (upgrading, bringing up-to-date, preparation for a next degree of competence exam, etc.).

Types of maritime institutes could be classified according to various characteristics or factors, e.g. ownership, courses delivered, document issued. Among the most important ones is the type of ownership - state owned or private and the respective financing. This is a very important indication for establishing curriculum, running exams, issuing necessary certificates of competence and/or academic degree, especially as these are one of the significant requirements of the STCW-95 Convention. The other parameter is the type of certificates issued - unlimited or limited and for officers or ratings as well.

According to the METHAR project, WP 1.1 the number of state owned maritime academies in the EC countries that offer courses for an unlimited certificate of competency is 124. Still this figure may be worth consideration. Greece has three privately owned academies. Courses for limited certificates of competency are not offered in Belgium and Greece. In most other countries courses for limited certificates are offered in the same institutes that offer courses for unlimited certificates.

Furthermore, research data shows (Appendix 9) that the number of maritime education institutes in different countries varies. Aiming at optimisation of the MET systems in any member state, followed by a centralised European MET (eventually) an acceptable number of institutes in the individual countries should be defined, even absolutely. Probably this method can be of help as a first approximation. Of course, establishment of training institutes is a multy-factorial process, which often is influenced not only by objective factors, e.g. existence of coastline, maritime industry, and fleet but

by subjective factors as well. So the average number of institutes counted for all EU member states is 8. Seven countries (46.6%) combine systems with institutes around this figure. In the rest 53.4% of the states the difference is notable, for example in Italy - 34, Norway - 22. Countries like Belgium, Portugal and Ireland have only one school each, but it is enough for them. Obviously Italy and Norway are much behind the average number - 8. In the rest of the world are known some other examples like Philippines with 120 and Indonesia with 40 colleges. Certainly there are some other factors like fleet size, national priorities, life standard level, and attractiveness of the seafarer profession in the respective country, which are substantial for defining a state's strategy about the number of maritime institutes.

3.1.3 Specialities classification

According to the existing manning scales the officers must have monovalent (deck, engine) or polyvalent (deck/engine) qualification. The figures from METHAR project, WP 1.1, show that an ordinary type of MET study offers monovalent speciality (80%). Only France, Germany and the Netherlands have a polyvalent system (20%). One detail which, possibly, could be mentioned only - in the last edition of METHAR is implemented the term "bivalent" instead of "polyvalent". Probably, because the specialities are two, "deck" and "engine". However, if we try to examine in depth not the term but the processes behind it, we can see that the "radio" speciality together with respective functional obligations are squeezed in the so called "bivalent" (or monovalent) officers, i.e. they can/must perform more than two duties. Then definitely the mathematical definition that everything more than one is many, i.e. "poly" will be fully realised. Ironically thinking about the future the term "polyvalent" is still valid.

It must be pointed out that for a very long time France, Germany and the Netherlands have had no followers in training poly-functional staff. Certainly both types have their advantages and disadvantages. No matter how the problem is viewed, if separate training of navigators and engineers exists, an availability of candidates wishing to combine skills and knowledge of both specialities is to be expected. Until now the maritime community (maritime administrations, shipowners, ship operators and manning companies) have not been ready to work to the full extent with such specialists. It still is

only a matter of time before more and more polyvalent specialists will control the ships. An interesting question is at what cost and at whose expense this will be done.

For the time being it is of great significance, that marine officers' training in Western Europe and the USA is in crisis. It impacts upon not only the shipowners but on the maritime institutes as well. Due to a shortage of candidates they cannot afford any new training experiments. Obviously this shortage decreases the possibilities for an appropriate selection. Besides, it has to be envisaged that an eventual cut in crew numbers will lead to the loss of a certain number of workplaces as well as to the reduction of human factor costs. The maritime industry, in particular shipowners, has to be clear about its preference to have at its disposal intelligent officers ready to navigate ships safely and effectively or to employ operators only of high intelligence automated systems. The difference is notable.

3.1.4 Course development and career advancing organisation

Factors that can influence the design and level of the study process are: its overall continuity, the number of subjects, proportions between lectures and exercises, sea practice and self study time.

Most of the EU member states pay attention to the theoretical schooling. It is considered as being reasonable because the theoretical aspects drop off subsequently and acquired practical skills prevail. In this sense if, in the years when an individual is conducive to accept easily large amounts of information, the theoretical education is not comprehensive enough, then subsequently the mariner could find himself/herself restricted to perform a narrow range of functions. The danger of staying at the same level without broadening his/her level of knowledge is indirect but real. This does not exclude the necessity of looking for a balance between theoretical and practical orientation during the education and for maintaining the required qualification after graduation.

The practical knowledge and skills are of high significance for the effective and safety ship exploitation.

The METHAR project, wp 1.1, p.15 shows several approaches used by the EU member states' maritime education and training systems. Seagoing practice can be organised during different stages of the education. All countries replay that they have sea time after studies, sea training sandwiched between shore studies being a common

system (73%), while some countries have both sea practices before and after studies as well. There are some variations: 26.6% of the responses show sea practice is in three stages (before, during and after) shore studies; 13.3% of the institutes offer sea practice before or after studies. The most distributed variant (46.6%) is when the practice is between studies and post studies. It seems this is the optimal level. Duration of this practice is under consideration. Knowledge based training is the most usual system (100%), but in some cases (73%) it is shared with skill based training. This percentage is high enough to be contrary to the distributed opinion that after the STCW-95 MET has to be more practical. Seventy three percent express the educators' opinion that the system of education is practical now. We can ask ourselves: Where is the limit of practicality? Is it possible to be 100% or less is normal as well? What exactly is the meaning of this figure? Does this means that between a graduate and a watchkeeping officer should not be any difference? One is sure - practicality has a limit. MET is obliged to find and show what must be the ration between theoretical knowledge and practical skills. This can be of help for a good design of the course programmes.

None of the countries organises the curriculum to include all the enumerated factors namely: polyvalence, practice before the shore schooling, in between and after it, balanced knowledge/skills based approaches. This model is the most extensive (and probably, expensive) combination. It can be taken as a far future optimal model, not nowadays.

The author's calculations using statistical data from METHAR project, wp 1.1, sub-section 11.2 (Appendix 10) show that the average continuity of the study process up to receiving the watchkeeping officers' certificates of competence including on-shore training and sea practice is about 3.5 years. Some 25% of this period is for the practice itself. The practice time (seagoing and ashore) for both specialities (deck and engine officers) is the same, while the theoretical part of the education differs. For the engineer officers it is ten months longer.

The officers of both specialities reach the highest rank respectively of Master and Chief Engineer after an average of about 9 years including school and sea-going time. One of those years is generally assigned for schooling activity before passing the exams for the higher degree of competence. Thus the total schooling activity is about 4.5 years.

METHAR, wp 1.3, p.39 shows the total number of classes in the programmes for each individual certificate of competency (CoC). The STCW-95 doesn't make any

statement how long in time the study process has to be. In this sense the data collected is very useful because it can help for the establishment and optimisation of an optimal model, in particular for unlimited CoC. Classes are delivered in 45 or 60 minutes duration. The calculated average hours are shown in table 3.1.

An elementary statistical analysis with a normal distribution character shows that for the Master competency certificate most countries (33.3%) prefer duration between 4000-5000 class hours; 26.7% - 3000-4000; equally distributed (20%) are for 2000-3000 or above 5000. The most probable is the first one.

Table 3.1 Average course duration

Positions			Positions		
	60 min.	45 min.		60 min.	45 min.
Master	3125	4167	Ch. engineer	3231	4307
Ch. mate	3276	4368	II Engineer	3282	4376
Mates	2491	3321	Engineers	2539	3386
Average	2964	3952	Average	3017	4023

The picture for Chief engineer certificate is somewhat different. Two parts (each 40%) believe the intervals between 3000-4000 and 4000-5000 is the best; 13.3% accept it is above 5000 and only 6.7% support education between 2000-3000 class hours. The results about the rest of the deck/engine certificates are as follows:

- Chief mate - most countries (36.5%) are close to 4000-5000 class hours, 27.5% prefers hours above 5000 and 9% between 1000-3000;
- Deck watchkeeping officers - supporters of the interval 3000-4000 considerably predominate (55.5%), while the next has almost 22% (1000-2000 class hours) and only 11% use for MET less than 1000 or more than 5000 hours;
- Second engineer - the most common outcome (45.5%) are those who utilise 3000-4000 hours, followed by next part (27.5%) with hours between 4000-5000. Comparatively high percent (18%) work above 5000 and 9% - 2000-3000;
- Engine watchkeeping officers - generally the result is the same as the second engineer programme duration. Some 45.5% are using interval of 3000-4000 class

hours. However, 33.5% stays between 1000-2000 and two parts (each 11%) have preferences for 4000-5000 or above 5000 class hours.

Final comments and design of an optimal model will be made in sub-section "Foundations for an optimal model".

The number of classes, where each one is 45 minutes usually measures the duration of training process in a quantitative sense. The table below shows the different group of majors and their continuance in 45-minute classes.

Table 3.2 Main groups of subjects

Subjects	Deck	Engine	Polyvalent
IMO courses	168	104	124
GMDSS	90	-	66
Speciality	1339	2038	1977
English	203	192	142
General education	603	733	437
Others	829	677	193
Total	3330	3675	2939

Note: classes are in 45 minutes periods

The following trends are noted:

1. The number of all specialities differs. Those for the polyvalent officers are less (2939), despite the fact that they are educated to work in two specialities - deck and engine. Therefore, it is supposed they need more education, not less. This reality could mean that probably:

- Candidate polyvalent officers are much more talented;
- The National Maritime Administrations of the EU member states might be divided into several categories: very receptive to change; too risky; not responsible for what happens in the MET system;
- These hypothesis to be taken together.

2. The mandatory courses required by IMO (Medical care, Personal survival, Fire fighting) have the same duration in polyvalent and engine, but greater in the deck speciality,

3. English language lessons are not so many in comparison with the others,

4. Polyvalent officers have many more speciality lessons than the other subjects do. Their lessons under "Others" are three to four times less than the other specialities, i.e. here there is a room for optimisation;

5. Deck and engineer officers have many lessons included in the category "Others".

The principal content of the curriculum needed for the functional suitability of future officers (deck, engine, polyvalent) for shipboard and shorebased work includes:

- Administrative, financial, commercial and legal aspects;
- General and crew management;
- Simulator training and practical skills;
- English language;
- General and vocational subjects.

The opinions from the EU member states assessing programmes varied in three levels (not quite satisfactory, satisfactory, completely satisfactory) and could be summarised in the following scheme:

<u>Shipboard functions</u>

Deck officers - in general the education programmes are considered “satisfactory” and slightly higher demand of attention for practical skills and general management. However about 30% indicate “not quite satisfactory”;

Engineer officers - the data shows some differences in particular more attention to the management and administrative subjects, while less demand for the mathematics, physics, chemistry;

Polyvalent officers - more attention to simulator based training and practical skills; respondents show that they agree with number of classes for some general subject.

<u>Shore based functions</u>

Deck officers - there is an 'intra' comparison between the two monovalent specialities. It appeared the deck officers' programmes are less fitted for the shore-based

functions. That is why more attention is recommended to the management and administrative subjects;

Engineer officers - in general the programmes are considered satisfactory for the shorebased functions with special remarks for more knowledge of English language, management and administrative subjects;

Polyvalent officers - English language and administrative subjects are in more depth.

3.1.5 Availability of advanced MET facilities

No training could be run effectively without the presence of all the necessary technical means of education. Thus, the ship officers' training is one of the most expensive. From this standpoint there are several versions of training:

1. In real surroundings on a ship;
2. On the shore with the most indispensable technical means;
3. On the shore, without any technical means;
4. On the shore by simulator facilities;
5. A combination of shorebased + simulator facilities + on board training.

Summarised characteristics show that the most expensive but the most effective method is the first one, while the second one is the cheapest but the least effective. The third, fourth and fifth methods have different weight in respect of the equilibrium between financing and effectiveness. At the present time generally, the international requirements are orientated towards the fifth method. However, it seems in future it will be probably more and more displaced by the fourth one. For the current survey objectives the following technical tools have been chosen (Appendix 11):

<u>Simulation Facilities</u>

- Navigation, Radar and ARPA simulators - these tools are compulsory under the STCW-95 Convention. Therefore, the percentage of their availability is high (more than 80%). They are used for training/assessment (91/75%) as well;
- Shiphandling training simulators - availability approximately 60%;
- Cargohandling training simulators - availability approximately 50%;

- GMDSS simulators - availability approximately 60%, which is too low, despite that such education is now compulsory; Then, how were so many officers certified?
- Engineroom training simulators - availability 40%;
- Inert gas and Refrigeration systems - not available;
- Oil spill simulation trainer - not available; Here is the role of all environmentalist bodies - if they are not happy with seafarers' work, they can supply some simulators for training;
- Automation.

The following picture analyses this information: it is difficult to say that the simulators are not welcome in the European Union maritime schools. However, the highest percentage is Radar/ARPA, which is obligatory. The others are slightly above 50%, i.e. not so favourable. Maybe they are too expensive, or the academic staff is too conservative to accept them as a training tool equal to the real practice at sea. If we combine this result with the average age of the academic staff, which is quite high (around 50 years) [METHAR, wp 1.5, p.92], it seems the conservatism is the predominant factor. There is one idea more: not to attach blame to teachers but those who made the use of simulators mandatory. If simulators were so good, the majority either would have used them or they do not understand the advantageous approach for education by simulators. Cost and lack of money is faced very often on the front as well. Comparing two departments deck and engine the former is much more supplied with simulators than the latter.

<u>Workshops and laboratories:</u>

- Diesel engine laboratory - 75%;
- Electrical and electronic laboratories - 75%;
- Fitting, turning, welding and cutting workshops - 75%;
- Navigation aids laboratory - 80%;
- Language laboratory - 55%;
- Fire fighting, personal survival, boat-launching equipment, which are compulsory requirements in compliance with the STCW 95 requirements - less than 30%;

- Training vessels - "Only 39% of institutions today operate training vessels and the trend is downwards, mostly because of high operating and maintaining costs..." [METHAR, wp 1.4, p.79].

Computing facilities

Without any research it is quite evident that the last decade of this century will be remembered for the enormous growth of computing technologies and facilities. Personal computers are everywhere including maritime education and training. Internet and its functionality link the world. New methods for educational purposes are Computer Assisted Learning (CAL) and Computer Based Training (CBT). Accordingly METHAR, wp 1.4 these facilities are quite wide spread in Europe. However, comparison between them and simulators in MET shows in advantage to the latter. Partly it is explained due to uncertainty in using computers for assessment of knowledge and skills. In addition lack of good training software in many practical areas of ship operations causes some problems as well. Thus the CAL, CBT and Internet are presented by some 60-70 % approximately, while the CD-ROM is about 90%. It should be expected that in the near future an expansion of this approach would appear because it is much cheaper and flexible than the classical techniques. Moreover, new technology for education and training, such as distance learning needs these tools. It is worth remembering that computer based education presents in reality a two-dimensional system, which is different from normal existence and some special approaches are needed to adjust the imagination.

Instructional media

Whiteboard/blackboard, overhead projection, video projection and some other ordinary teaching tools available in all maritime institutions.

3.1.6 Academic staff and assessors

The staff at any MET institution can be classified as follows: administrative, academic and technical. The first one is concerned mainly with managing, arranging and accounting the institution activities; the second one is engaged exclusively with the training and research process; the third one performs functions related to the operation

and maintenance of the equipment. The academic body is a producer. The others cannot create directly added value. They support the work processes. Therefore, lecturers and their activities will be examined and discussed further on (Appendix 12). The METHAR, wp 1.6 states that their average age varies between 41 - 55 and is 47 years. In some 20% of the countries it is higher - 50 years. The maximum age of employment for tenure is 45; the maximum retirement age is 70 years. Politely speaking, like Dante said in his famous work "Hell" they are passed the middle of their life with all positive and not so positive characteristics. The unhappy conclusion is that there is not any incentive for younger entrants.

The staff number and qualifications are different and depend mainly upon the amount of people being educated (students) and subjects/lessons to be taught. This criterion is followed by 87% of the countries. Nearly 62% have one factor more, namely the number of students, although the ratio staff : students is officially known in 27% of the countries. Further analysis shows that 62% is a predominant indicator for two factors as an optimal model. The problem is that the exact value of this ratio is not mentioned in the report. In Bulgaria, for example, some years ago the ratio was 1:8-11. However, as in many of the human activities, trends to cut some positions and transfer their duties to other services could be seen, e.g. from the administrative and technical staff towards the academic. One of the reasons for doing so is that the manufacturers of modern simulator facilities produce their products in a way that reduces their maintenance and part of the repair work to simple actions not requiring any special training. Some more complicated failures can be eliminated by special services that might be out of the school stricture. This tendency and a number of other reasons draw attention towards the academic staff as it turns out to be one of the most important factors that the study process is dependent upon. That is why in the STCW-95 Convention an explicit criteria is pointed out. All the lecturers, instructors and assessors have to conform to it. They must be specialists having senior sea-going positions, experience, and good theoretical background and teaching skills. As an addition the abilities for performing some of the functions described above should be taken into consideration. One of the rising questions is how to find and motivate highly qualified specialists in the present situation of losses from the sea profession.

Referring to the decision about the number of lecturers employed, in 60% of the countries MET institutions are officially involved in the process. MET institution decides

alone in 17% of the cases, in some 20% - maritime administration only, in 47% it is the educational authority and only about 7% combine both. Logic, including author's, indicates that the three parties all together have to decide this important task. That means it is the optimal model.

The ratio between lecturers and administrative staff varies from 2:1 to 16:1 and between lecturers and others - from 1,5:1 to 19:1. Obviously the differences are very high, which means at least, that either the individual cases are very special or the environment is very deformed because of the influence of multiple factors. These wide intervals show that the working environment is too complicated over the Europe MET system. Somewhere the academic body is the main core of the institute but on the other hand there are some institutions where the ratio between Administrative : Academic parts is nearly in equilibrium. These institutes are very expensive because the administration is mainly a consumer of services rather than producer. Therefore, if there is a market competition the prices offered by such institutes will be expensive leading to less candidates, although the shortage of officers actually is not because the maritime education is too expensive. More and precise statistical information is needed for an accurate result with a larger area of acceptance. The ratio could be correlated with the entire activity of the institute and the microclimate (relations between employees) inside the institute, which is a factor with significant importance as well. This indicator can serve indirectly for the cost-effectiveness of the optimal model and its value ought to be known precisely.

Concerning the main lecturers' activity - teaching/instructing there is another one indicator - obligatory number of lecture hours per week. This indicator is very variable. It lies between 7-28 hours/week or on average 17.5 hrs/week (3.5 hrs/day). The other staff work on average 38 h/week (7.5 hrs/day), i.e. double more. Of course, the readers who are familiar with the real teaching process know that one hour lecture/exercise preparation needs 2-3 hours groundwork, sometimes much more. Moreover, lecturers' obligations don't terminate only with entries in classroom/simulator. That means their working time is equal or more than the other staff because the study process needs more obligations, which take time, not only at school but everywhere.

The qualification of academic staff corresponds to the types of certificates issued by institutes. Normally, lecturers and instructors are graduates from maritime institutions. They have sea-going experience, senior certificate of competence and deliver lessons in

subjects on the level of their competency. In general, the academic degree is a milestone of many disagreements deeply implemented into the base of the MET system many years ago. Why? Because in the past the community decided that the maritime profession has people who didn't need any academic recognition. There are two suppositions: firstly, the seafarer profession itself doesn't need this award (it is so simple to steer a vessel?!) and secondly, seafarers' life will be spend at sea. Why is a shore link necessary in sense of the education and respective documents. Possibly, there is an "idea" based upon the image of mariners and pirates? However, the second part of this century shows an extensive development of the shipbuilding industry, which is jointly with many other parts of industry producing sophisticated equipment. Presently, on the bridge is like in the space shuttle cabin. If some decades ago it is was valid that "...professors designed and built vessels, which were driven by "drivers", nowadays is in contrary" [unknown colleague from Norway during full scale sea trials in Varna Bay, Bulgaria, 1993-95].

The METHAR report says, "qualification requirements are laid down in official regulations in 13 of 15 countries" (87%), followed by a qualitative assessment that many lecturers have an academic degree, the nature of which is not mentioned [p.93]. This basis is not suitable as an optimal model to be acted upon. Imperatively, at least a BSc + watchkeeping certificate is for those who graduate from a maritime institute. Obviously, the lecturer should be one step ahead.

Statistical data from METHAR, wp 1.1, p.42 regarding the examination process shows the following results:

- examination held by the school's staff only - 53.3%
- examination held by specialists working out of the school - 13.3%
- examination held by a combined staff - 33.3 %

Obviously the opinion is that the academic staff is the most competent to do this job and preferably, without any external help. However, a team supported by different specialists is a better solution, although surprisingly, the answer is confirmed by 33.3% only. The real difficulties will appear later because there are some IMO requirements (STCW-95, 1994) that the assessors must know how to use the simulators for assessment. It is easy, if academic staff from the MET institute only undertake the examination process. But if the team consists of specialists from the industry and

maritime administration they have to be trained in accordance with these mandatory requirements, which in practice is not an easy job.

3.2 Foundations for an optimal model

3.2.1 Definitions and general notes

Before commencing, it is useful to consider the following definitions of "optimal" and "to optimise":

> "Optimal - optimum level or state of something is the best level or state that it could achieve;
>
> To optimise a plan, system, or machine means to arrange or design it so that it operates as smoothly and efficiently as possible." [Cobuild, 1995, p.1162]

This philosophy can be realised mathematically by processing some statistical data. All collected information has to be relevant, reliable and sufficient, which in the normal process in the technical area is very difficult to be calculated. These are processes and developments, which refer to society. The information that relates to the MET systems in the countries included in the METHAR project has this nature. In practice for the objective of this dissertation, where possible, some ordinary statistical characteristics are used.

The entire MET system consists of some parts, namely:

- MET system - Part A

Undergraduate maritime education ending with exams and certificate of competence (CoC) as watchkeeping officer (Deck/Engine) plus a document for any academic degree;

- MET system - Part B

Postgraduate maritime education ending at the highest CoC as Master/Chief engineer and a relevant academic degree.

Throughout the dissertation the whole system was examined. However, the optimal model created herewith is the first one, i.e. MET system - Part A.

The model of this system has some parameters, which are grouped in two large groups, such as: general education and professional education (MET). The emphasis is made to the latter, but the model starts with the stage of the general education.

- Authorities responsible for General education (GE) and MET systems;
- General education requirements;
- Entry requirements to MET;
- MET system parameters: Specialities offered; Shore based education, sea-going practice, pre-study sea practice; Documents issued; Lecturers characteristics; Equipment available.

3.2.2 MET model and its environment

The model operates in an environment, which has three levels: Macro (international), mini (national) and micro (institutional) [Appendix 7]. These levels are influenced by some political, economical, technical and social factors. They all depend of the changes in the nature (environmental factor). Because the seafarer's profession is international and relates to many branches of the maritime industry (Appendix 1), the interaction between these factors always has to be borne in mind. Hence, examining the international level we can see that there are mainly two schools of thought world-wide - West and East European. Nowadays, many labour-supply countries from the Middle East, Far East and Pacific islands are former Western colonies and their systems are attached to the Western school of thought, while some countries from East Europe relate to the former Soviet Union understanding. The main difference is that the latter tries to build a large base believing it will be suitable for any particularities in the future, instead of the Western, which is more practically oriented. The two systems, we could say in advance, differ in terms of their economical approach to the society. One is centralised, while the other is decentralised. So understanding the working of each other can be of help, probably. A clear indicator about centralisation as a possible solution to the problems in the Western European MET systems is offered in METHAR, wp 3 [METHAR, 1999, p.82].

The model development strongly depends on the world demand/supply ratio. Until now there is no equilibrium. Demand is greater that supply. This ratio combines all

of the above-mentioned factors. The shortage of staff with sea experience is in the Western market, while the surplus of seafarers is in the Eastern market. The entire shipping market needs two categories of personnel - firstly, those who will serve at sea and secondly, those who will be involved with shore-based branches of the maritime industry. A significant trouble is that the number of employees, which the shore-based branches need, cannot be identified. Consequently, MET systems are in an uncertainty coupled with a continuously diminishing number of applicants for sea-going career.

It is a very simple and ordinary understanding that the education has two parts - general and specialised. Therefore, MET for a long time had the same components, although it is not world wide accepted idea. Accordingly, any maritime education and training institute is a part of the national system (general and professional). General education in MET is needed because without a wide enough basis later on the officers will become too "narrow" specialists without opportunities to find a job ashore. The normal life cycle requires that after some years at sea land is more attractive. It is not heroism if somebody stays for a long time at sea. It is a outcome often caused by some very deep personal reasons. Therefore a better solution is how the MET programmes can be optimised so that the main partners (seafarers and shipowners) are satisfied, instead of focusing efforts on how to keep the seafarers on board forever. In that sense the revised STCW is anti-seafarer because its main core deals with several on board functions only. The opponents of this opinion possibly will answer that the Convention arranges minimum requirements only. It is well known there are not so many countries ready to go beyond conventional requirements. That means the STCW-95 indirectly predetermines the way things will go. The international legislative base is a very important factor, which may play a contradictory role if it is too limited or too large. Although any convention cannot stop member states going further than its level, it should be made to assure some universality. Therefore, it should have optimal requirements, otherwise Flag State Administration may have different understandings than the Port State Administration. So it will be a vacuum not useful for both parties.

3.2.3 The model main parameters

Funding/overseeing

As it was explained in sub-section 3.1.1 MET systems are predominantly governmental. Ministry of Education (MoE) and Ministry of Transport (MoT) are responsible for funding and supervision. MoE assures financing, approval of programmes and procedures referred to the general education activities including issue of degree document. MoT approves professional programmes and issues CoC. The combination between these two ministries is mostly distributed (67%) and can be followed.

Documents issued

In the case of a successful graduation some 75% of the countries recognise not only a CoC but a general education award as well. This award is not equal to the BSc degree, although there are some countries where they are adequate.

Number of institutes and their capacity

Unfortunately, this parameter until now cannot be optimised, although the information collected is comparatively sufficient. An optimal number of institutes can be defined as a general average but for some countries it could easily be achieved by closing some schools, while for the others it seems to be unreasonable to establish new ones if the number of employees for the industry is not known. The uncertainty in this parameter leads to another variable - the number of institute personnel (mostly academic).

Specialities offered

There are three specialities, namely: deck officer, engine officer and polyvalent officer. Some eighty percent of the countries prefer monovalent speciality.

Shore study time, programmes content and sea practice

This aspect is one of the most important because it directly relates to the quality of the process and its financial impact. Moreover, the succession of sea practice is also

important. The IMO has a requirement only for 12 months sea-going practice. The shore study time is not defined by the STCW-95. There is no information in METHAR about sea practice duration. But there is data for shore study in tables 3.2 and 3.3. The difference between specialities is about 300 lecture hours:

Polyvalent : Deck : Engine = 3000 : 3300 : 3600

The optimal number should be around 3300 hours for all specialities. Some restructuring of the course programmes should be done to cover the implementation of new technologies in the shipping industry.

The sea practice could be spread in three stages - pre-study, in between and after study but there are mainly two stages in operation. Seventy three percent of the answers in METHAR support a monovalent speciality with two sea practices - one between the study process and the second one after that.

Summarising the above parameters leads to the following optimum outcome: Monovalent speciality - 3000 hrs - 12 months sea practice spread between and after study period. It should be noted that it is the average duration for all officers' ranks amongst all specialities. Sub-section 3.1.4 herewith provides more detailed information.

Academic staff characteristics

The academic staff plays a significant role in the study process. Hence lecturers'/instructors' characteristics should be examined and analysed precisely.

First of all, there is a regulatory base and academicians are employed by the state administration - predominantly in 47% of cases it is the Ministry of Education. MET institutions perform this activity independently in 13% of the cases, Ministry of Transport - 20%. Looking at the figures the optimal solution could be if the latter institutions are more involved. It is possible because the institutes as academic bodies have a status of independence. Ministry of Transport takes the main responsibility for the CoC that is directly connected to the staff performance.

Secondly, there is a working time, which differs between 27-44 weeks per year, from 7 to 28 hrs/week. The average is 3.5 hrs/day. Compared with a normal administrative working day it is enough because academic duties are connected with much preliminary preparatory duties. In general, if it is accepted that any academic

activity needs double time for preparation than the routine administrative performances that means the academic staff should be obliged to do only teaching. However, the nature of this job is larger. It could be supposed that research and consultancy are in touch with it. Then the staff should be encourage to do more research which will be of help for the individual, institution, students and industry. Some good regulatory planning of time and resources will be necessary.

Personal updating and upgrading should be a compulsory stage in the academic staff members' career. This parameter is not so well developed, i.e. not organised.

Technical equipment

The conventional requirements and new technology innovations influence spatial environment as to how this parameter can be optimised. Compulsory simulators are defined by the STCW-95. The problem with them is how to find the money. But for the rest part of the training where there are not any requirements the needs are not clear. The optimal can be a level with an engine room simulator in addition to the navigational, GMDSS and familiarisation facilities. The MET institute may have a choice which type of simulators to be supplied - PC based or full mission type. The former is 2D, instead of the latter which are closer to reality. A combination between them is the optimal solution until now.

3.3 Cost-effectiveness and social effects

As it was explained in sub-sections 1.2 and 2.1, any professional education system is mostly designed to train and qualify specialists for the industry to which it is linked. Actually, the capacity of the educational system as a production unit depends of the industry necessities and a correction for losses during the training process and for a short time after that. Determinant is the number of working places in the industry. This principle is valid for the MET systems as well. It is important to note that due to its international character the maritime industry can be examined on both national and international levels.

In this sense MET systems in the European Union member states are in a very complicated situation. On a national level there is a demand for officers, so MET systems should be at their full capacity. However, they are not competitive on the

international market level. Therefore they are caught in a long-term crisis, which has developed for the following reasons:

First, national fleets consist of vessels registered under the Flag of Convenience (FoC), because this status allows shipowners and ship operators to use a cheaper labour force from outside western countries, i.e. the third world countries. Hence, if MET systems want to survive they have to force the shipowners to come back to the national registers. Practically, this is an impossible task.

The second significant reason for the exodus is the normal life cycle recurrence. The applicants for a sea-going career are willing to work at sea for a short time only. Their goal is to earn some money and then to leave the sea, preferably to work in the shore-based maritime industry.

The third reason is connected with the specific reputation of the seafarer's profession. In the recent years some sea disasters resulted in many life losses and environmental pollution. These are factors, which gave the mariner's career undeservedly unpleasant and unappealing reputation. An approximate comparison with the automobile transport will reveal that daily victims and pollution caused are not less than in the water transport. However, unfortunately, they are not always included in the media reports.

The fourth reason for the crisis in the METHAR countries MET systems originates from the socio-economic development of the communities and the nature of sea-going profession. It is one of the most difficult, although the community often links the sea with romance and tourist attractions. At the same time over the years the Western Europeans have increasingly refused to accept this difficult job and left it to the Eastern Nations. It seems that after producing many generations of seafarers, the western nations have learnt that a sea-going career is very demanding and requires a great deal of personal sacrifice, thus fewer and fewer individuals nowadays are willing to become sailors.

The fifth reason consists of all imperfections, which the examined systems include. It is known that even the best systems still have some shortcomings.

The following example taken from the METHAR project can be added to the above explanations:

The widely held phrasing 'Supply-Demand' could be expressed in a different way: “Vacancies - Maritime institutes capacity - Candidates". There are two points in between

as well - not everyone who wishes and enters those institutes can graduate; and not everybody who graduates successfully goes to work at sea right after the graduation.

Surveys (METHAR, wp 1.9, p.168) (Appendix 13) show that in 1996 the maritime schools in the EU member states were entered by approximately 10,000 students altogether. About 40% of them had secondary school education level and all the rest had higher education. The total number of the graduates in those schools was approximately 6000. On this basis it appears that about 40% of the maritime schools' entries did not finish their education. It is accepted with an approximation that maritime schools offer about 10,000 places too. This case allows the conclusion to be drawn that there is a huge 'loss' during the academic years. Furthermore, the general attraction of a seagoing career to young people in West Europe suffers from a declining reputation in particular if compared with shore based conditions. Consequently considerably fewer people choose this career. Finding shipboard conditions in social and financial terms unattractive, many students who intended to take a shipboard career alter their minds sooner or later even before completing the education. Those who graduate get an academic degree and unlimited certificate of competency. Engineer officers are slightly dominant in number.

The above-mentioned reasons are not the only ones, which influence the crisis in the MET systems in Western Europe, but in the author's opinion, they are the most significant. Whether the MET systems are effective or not it is another problem, because now under the present circumstances those systems can operate 100% effectively, hence comparatively some years ago it can be pointed out as ineffective. It is expected that these systems should be on a higher level than many others, because Europe is a source of many original traditions, research findings and scientific discoveries. Money markets are nearby as well. All these are factors ensuring, that in general term an optimal model of a MET system might be created in such of environment, amongst those MET systems.

Chapter IV Conclusion and Recommendations

4.1 Conclusions

Since some ten years ago the world underwent a transitional period when countries from the former Eastern Block changed their politico-economical and social systems. It is accepted to call this period a "globalisation". During any transitional period the current processes are confounded and complicated. At the same time, existence of the two politico-economical systems is a precondition for the existence of the two schools of thought in maritime education and training. Only the future will show, if one global MET system can incorporate the two schools or will take the particulars of solely one of them. Any variations are possible in transition.

MET systems develop not only in national but in an international environment as well. Therefore, the ongoing transitional processes in the global context will influence them.

Despite the crisis during recent years economic sectors such as agriculture, industry, energy and branches linked with them will continue to develop. That is why water transport, shipbuilding and supporting light industries will play an important *role* in this development for two reasons:

- Economic - water transport is cheaper than other types of transport with respect to large amounts of commodities;
- Political - politicians will support these processes of expansion because many people are involved.

Automation will continue to grow. The only chance for MET systems to survive is, to adopt their work to this trend implementing new methodologies and technologies.

The predictions show that in a quantitative aspect number of vessels will decrease, while in a qualitative - their quality will be better. This is supposed to be *real* made possible by the implementation of automation.

Furthermore, the number of casualties and the amount of losses are indicators, which can serve as a clarification of the role of MET systems in the training of competent officers. Until now there is not enough evidence to show the extent to which automation ensures safety of shipping and pollution prevention.

Definitely in the European Union member states there is an exodus from the sea-going career. The candidates are less and less, and the sea service is unpleasant and short. The shore-based branches of the maritime industry would like to employ people with sea-going experience, but because of their shortage on a national level and regulations against employment of foreigners they are forced to engage any personnel.

Presently the seafarers market is, predominantly supplied by mariners from the Far East, Pacific islands, Indo-China and Eastern Europe. Finally, the shortage of officers in developed countries is a chronic problem and there are no indications of compensatory actions being taken.

In the beginning of 1990s, some international professional organisations pressed the IMO to produce a revision of the STCW-78 Convention, which obviously was not adequate and outdated. Simultaneously the European Commission through its specialised committees prepared its own proposal to the European Parliament. It is Council Directive 94/58 as amended. Furthermore, the STCW-95 itself is directed only to the sea-going functions. There are no requirements or recommendations for shore-based functions and levels of competence. In this sense the Convention serves to the interests of the shipowners and operators only. Such an international document should be broader in its scope.

The crisis in the Western European MET systems started a long time ago. It is not a result of random error by so many governments done for some decades of

governing through the executive authorities. Therefore, it could be concluded that the processes are known. If the national MET systems struggle, which is quite evident, that means the major solution is not linked with the radical improvement of these systems. Probably, the pool has to be supplied with a cheaper labour force from eastern countries followed by some regulatory restrictions for quality assurance. It will lead to some social benefits both to the East and West but not for MET systems.

Maritime academies in too many countries used to lack sufficient contacts and co-operation with the shipping industry. Many shipping companies tended to look at maritime training rather as a necessity resulting from legal requirements than as a partner that contributes to the safe and efficient operation of ships by producing well-qualified merchant marine officers. Refreshing and updating courses have given maritime academies an opportunity to get in contact or to improve their contacts with the shipping industry and to find out about its training needs. This development is of great importance for the necessary recognition of the “producers” by the “users”.

An optimal model for MET system is created including values of the most important parameters (quantitative part) and explanation of some non-measurable parameters (qualitative part). This model can be used for a comparison on a national level within the European Union member states and outside where the education including MET is well correlated with the West European culture.

New technologies have the capability to be integrated with the classical methods of education and training. In principle, there are good opportunities for a fast exchange of information at unlimited distances, which leads to a better level of efficiency and effectiveness of the MET systems. In the present situation of unbalanced equilibrium of the ratio "demand/supply" of officers distance learning and computer-based education are useful alternatives.

MET systems in the METHAR countries are privileged to operate in a region with traditions in the education, intensive economic life and technical innovations. Therefore, it is easier for them to find enough resources and the willingness to put into practice all these advantages of the industry and community.

Programmes are too different in content (quality) and time duration (quantity). There are too many hours for general education purposes, which can be examined. The future is well defined in respect of technological developments.

Sea-going practice is very important for the officers' qualification. It is the most expensive and organisationally the most difficult stage of education. The number of training vessels is decreasing. The STCW-95 requires 12 months sea-service. Therefore, the institutes are trying to optimise this requirement, costs and use of simulation training.

Academic staff updating and upgrading is very important but in general it is not organised. Requirements about academic development are doubtful.

4.2 Recommendations

In the light of the foregoing conclusions the following recommendations can be noted:

1. MET systems in METHAR countries, using different research findings, should define trends in the development of new transitional processes. Re-design of mission statement, goals and objectives is necessary because of the changes in society and industry. From a MET point of view national priorities should be re-examined, discussed on a broad basis followed by an agreement for future considerations between parties involved. Restructuring of the national MET system will be necessary in accordance with the international, national and institutional criteria for quality assurance standards. New research projects are needed in co-operation with some other MET systems outside the European Union for a continuous supervision of the current transitional processes.

2. MET systems have to increase their activities to work in co-operation with the maritime industry. This will be necessary for a better implementation of its requirements in the study process, ensuring of financial support and close links for research and consultancy.

3. MET systems together with some other institutions and professional organisations can accommodate to the reality of the unbalanced labour market. This can be accomplished through some changes in the legislative basis on national, regional and international levels. Education has to play the leading role in the processes of preparing new regulatory documents because MET is the foundation of any industry. Therefore, its representatives must submit to the IMO proposals for further changes to the STCW-95 Convention directed towards shore-based functions. Requirements to the insurers and classification societies for financial support of the education should be also considered.

4. Restructuring of the national MET systems will be necessary in accordance with some international national and industrial criteria. Establishment of some new combined specialities for sea-going and shore-based maritime professions will attract more youngsters willing to serve at sea. Continuing education by updating and upgrading courses are forms for training which the maritime industry needs.

The author's intention is to continue this work collecting more information for the next stage of the seafarer career, which work has already started.

5. Based upon national conformity MET staff, in particular the academics, should be supported and encourage for further career development at sea and ashore.

Course programmes can be optimised in respect of their quantity and quality, using the proposed optimal model. Restructuring should affect the general education topics and their links with the principles of automation and man-machine interface.

New technologies for MET, distance learning, computer-assisted learning and computer-based education will be of help for a better training process.

In reference to the sea-going practice it is recommended that more comprehensive research to be undertaken to optimise outcomes using the simulator training in combination with on board training.

Optimisation is a double directed process - increasing some aspects decreasing others. Both cases are linked more with planning than with free market nature. Maybe, here is the globalisation cross way for MET, where people from different politico-economical systems can co-operate instead of continuing to avoid transparency actions. Nowadays we can see how developed countries depend upon the labour supplying developing countries. Maritime Education and Training is in the middle of this complicated knot because many branches of the maritime industry are linked with the education (Appendix 1). The idea should be how to keep and develop all positive achievements created by each system during the past years, and simultaneously to start to limit the negative symptoms.

Bibliography

Bates, A.W.T. (1997). "The impact of Technological Changes on Open and Distance learning". *Distance Education,* Vol. 18, No 1, pp. 93-109

BIMCO/ISF (1990). *The world wide demand for and supply of seafarers.* Institute for Employement Research, Warwick University, UK

BIMCO/ISF (1995). *The world wide demand for and supply of seafarers.* Institute for Employement Research, Warwick University, UK

Boyle, T. (1997). *Design for Multimedia learning.* Prentice Hall Europe, UK

Brown, G., Atkins, M., (1997). *Effective teaching in higher education.* Methuen & Co Ltd., London, UK

Child, M. T. (1997). "Risk based maintenance". *Conference on Marine Risk Assessment- a better way to manage your business.* The Institute of Marine Engineers, London, UK

Cobuild, C. (1995). *English dictionary.* Harper Collins publishers, London, UK

Commission for the European Communities (1994). 'Proposal for a Council Directive amending Directive 94/58/EC...' *Official Journal of the European Communities,* No C 367, pp. 1-23

Conference, *Plymouth, UK, 20-21 March 1995*. London: INMARSAT, pp.145-154
Cukier, J. (1997). "Cost-benefit analysis of tele-learning: Development of a methodological framework". *Distance Education,* Vol. 18, No 1, pp. 137-152

Directorate General VII (1998). *Harmonisation of European MET schemes (METHAR) No WA-96-ca.005.* European Commission, WMU, Malmö, Sweden

Drewry Shipping Consultants (1995), *The shipbuilding market - analysis and forecast of world shipbuilding demand, 1995-2010.* Drewry Shipping Consultants, London, UK

Dyrli, O E, Kinnaman, D. E., (1996). "Connecting with the world through successful telecommunications projects", *Technology and learning.* March, 16 (6), pp. 57-62

Earnshaw, R. A. et al (1993). *Virtual reality systems.* Academic Press Ltd., London, UK

Frankel, E G (1990). 'Promoting efficiency in shipping'. *Marine Policy*, vol.15, September, pp. 438-448

Gold, E. (1998). *World shipping: a global industry in transition.* Lecture at WMU, Malmö, Sweden

Holder, L.A. (1996). *Training and Assessment on Board.* Witherby & Company Ltd., London, UK

IMO (1995). *Training Course for Instructors, Sec. edit.,* IMO, London, UK

IMO (1996). STCW-78 Convention as amended in 1995, IMO, London, UK

Institute of London Underwriters (1999). Hull casualty statistics, ILU, London, UK

International Shipping Federation (1995). *The Revised STCW Convention.* ISF, London

Jacobs, G. and Roger, C. (1997). "Remote teaching with digital video". *British Journal of Educational Technology,* October, vol. 28, No 4, pp.292-304

Mottram, D (1999 a). The management structures of shipping companies. In *BIMCO review 1999,* Stroudgate plc, London, UK

Mottram, D. (1998). Reliability effects with regard to modern manning standards. *CIMAC International Congress*. CIMAC, Copenhagen, Denmark

Mottram, D. (1999 b). Interview by the author. WMU, Malmö, Sweden

Muirhead, P. (1996). "Implementation by maritime training institutes of the Revised STCW: meeting the challenge of change amid a world of evolving methodologies and new technology". *IMLA International Conference on MET* (September 1996), Kobe University of Mercantile Marine, Kobe, Japan

Muirhead, P. (1999 a). "Integrated Navigation Bridge Systems". *Navigation and Communication System II,* Handouts, Malmö, Sweden

Muirhead, P. (1999 b). *Ship casualties - lessons to be learnt.* Handouts, WMU, Malmö, Sweden

National Research Council (1996). *Simulated Voyages - using simulation technology to train and license mariners.* National Academy Press, Washington, USA

Nautical Institute (1997). *Maritime Education and Training: a Practical Guide.* The Nautical Institute, UK

O' Neil, W. (1994). "Implementing IMO Convention - the role of nations." In *Shipbuilding Technology International,* p.167

O'Neil, W. A. (1997). *Optimum maritime safety demands a focus on people.* IMO, London, UK

Parker, C. J. (1997). "Continuous professional development for maritime educators" In *Maritime Education and Training - a practical guide.* Nautical Institute in conjunction with WMU, London, UK

*Proceeding of International Conference on Maritime Education and Training (*September 1996), Kobe University of Mercantile Marine, Kobe, Japan

Proceeding of the NATO Advanced Research workshop on Advanced Educational Technology - Research Issues and Future Potential (September 1993), The NATO Science Committee, New York, USA

Proceedings of International Maritime Lecturers' Association (September 1997), The Fisheries and Marine Institute of Memorial University of Newfoundland, Newfoundland, Canada

Stevenson, C. (1998 a). "Recruiting and retaining seafarers", *Seaways,* February, pp. 2-4

Stevensson, C. (1998 b). "Who is tomorrow's seafarer?", *Seaways*, June, pp. 3-6

Tarver, S (1999). *Skills shortages in the UK shore-based maritime industries - a qualitative analysis (unpublished research).* Southampton Institute, Southampton, UK

Telegraph, August 1999, No 28, London, UK

UNCTAD (1997). *Review of Maritime Transport.* UNCTAD, New York and Geneva

Warnfeldt, S (1995). 'Shipboard interactive training?' *Third International GMDSS Conference, Plymouth 20-21 March 1995.* London, INMARSAT, pp.145-154

Wijnolst, N., Wergeland, T. (1996). *Shipping.* Delft University Press, Delft, The Netherlands

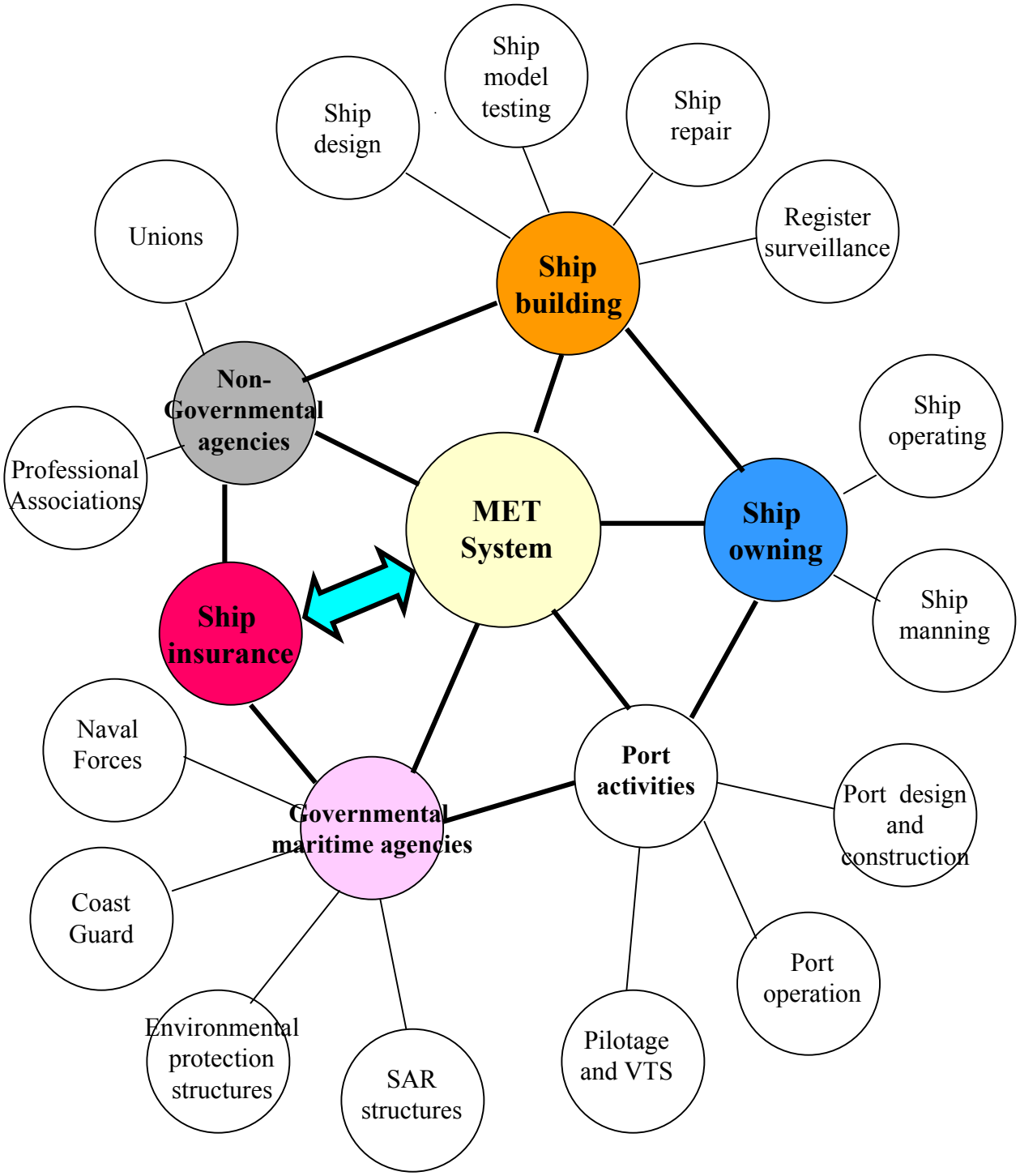
World Maritime University (1997). *METHAR-Project 6.4.3/43.* WMU, Malmö, Sweden

Zade, G. (1999). *Harmonisation of European MET schemes (METHAR), wp 3*, WMU, Malmö, Sweden

Zhang, P.R. (1998). *A vision of Chinese MET in the 21st century.* Dissertation submitted to the World Maritime University for award of MSc degree, WMU, Malmö, Sweden

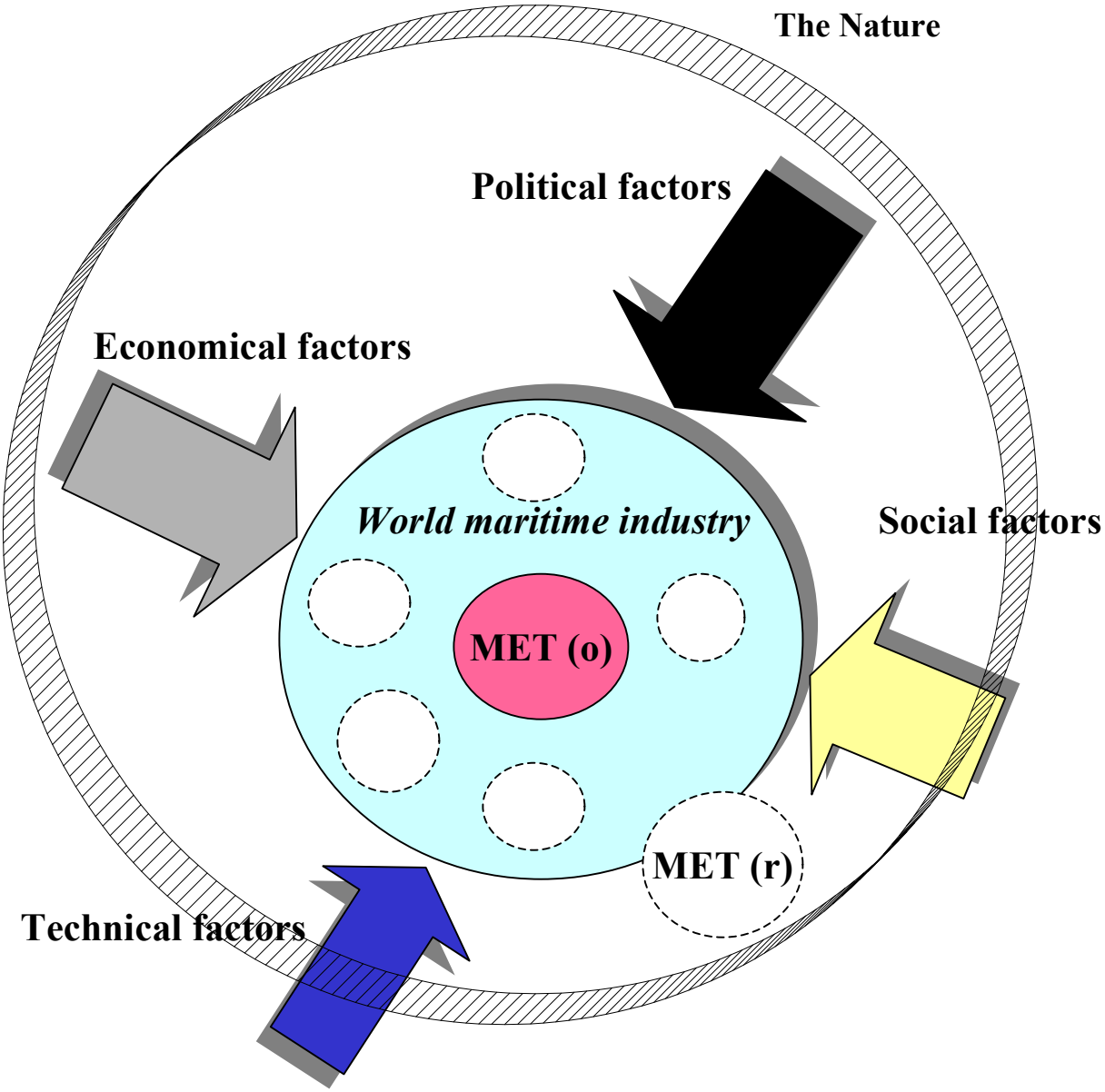
Appendix 1

The Maritime Industry



Appendix 2

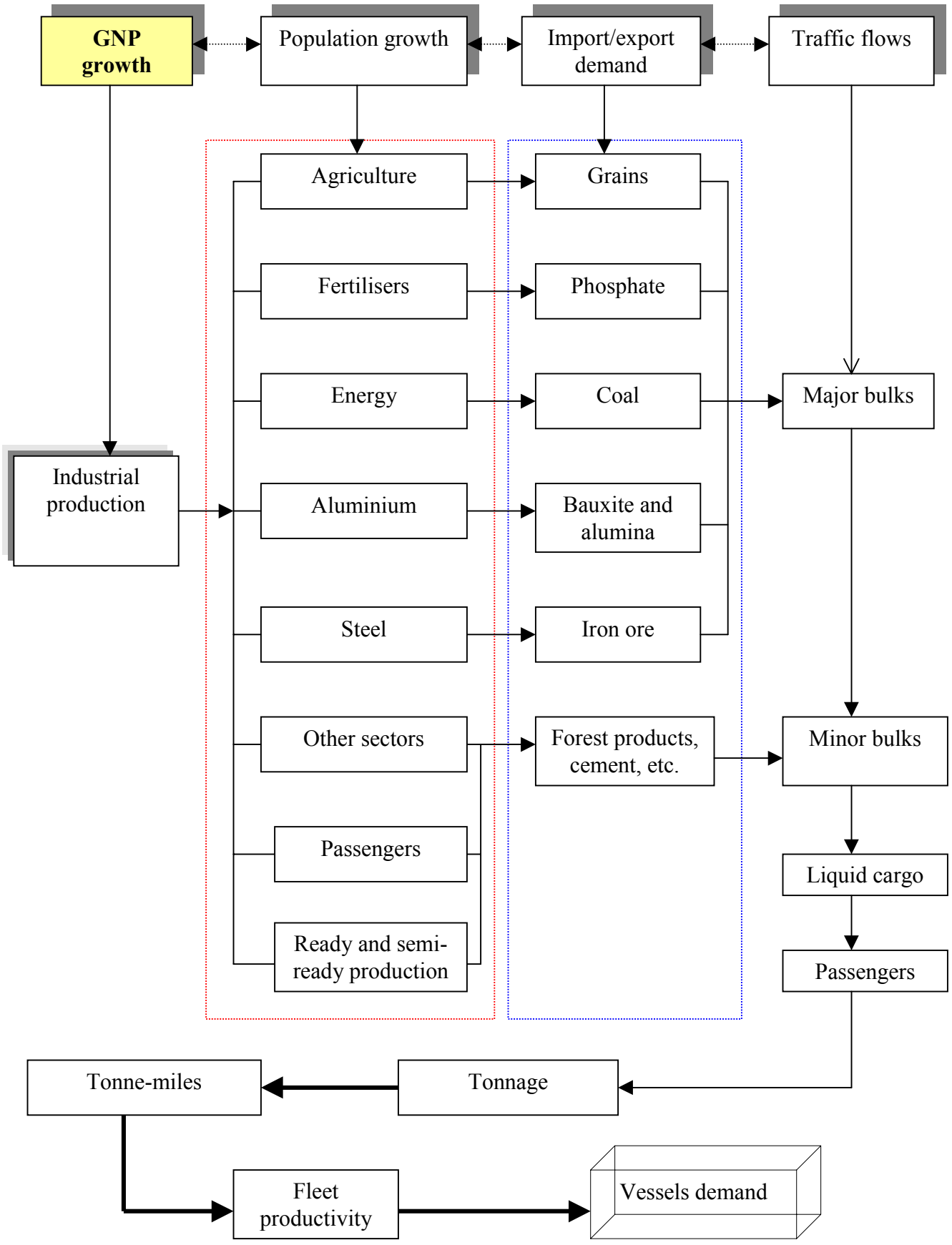
Factors influencing MET model



MET (o) - Optimal position of the MET system
MET (r) - Real (nowadays) position of the MET system
- Branches of the marine industry

Appendix 3

Economy - Trade - Vessels demand



Appendix 3

The GDP annual average present and forecast growth

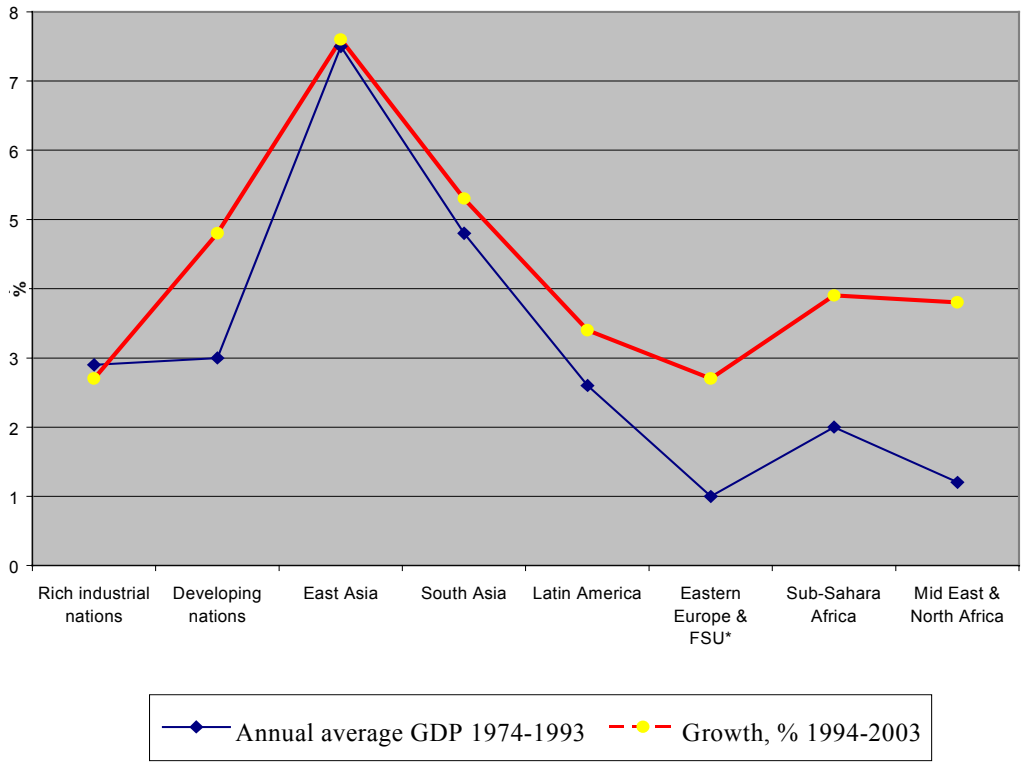
Table 2.1 The GDP annual average present and forecast growth

	Annual average GDP	Growth, %
	1973-94	1994-2003
Rich industrial nations	2.9	2.7
Developing nations	3	4.8
East Asia	7.5	7.6
South Asia	4.8	5.3
Latin America	2.6	3.4
Eastern Europe & FSU*	1	2.7
Sub-Sahara Africa	2	3.9
Mid East & North Africa	1.2	3.8

* (FSU) Former Soviet Union

Source: Drewry Shipping Consultants, 1995, p.1 through the World Bank

Fig. 2.2 The GDP annual average present and forecast growth



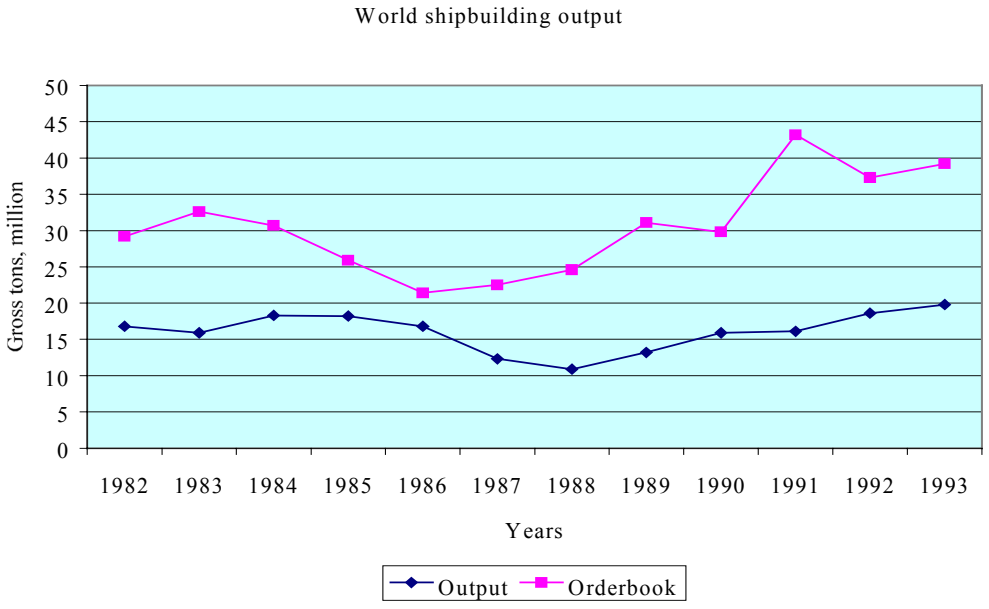
Appendix 4

World shipbuilding output/order book

World shipbuilding output/order book

Year	Output	Order book
1982	16.8	29.2
1983	15.9	32.6
1984	18.3	30.7
1985	18.2	25.9
1986	16.8	21.4
1987	12.3	22.5
1988	10.9	24.6
1989	13.2	31.1
1990	15.9	29.8
1991	16.1	43.2
1992	18.6	37.3
1993	19.8	39.2

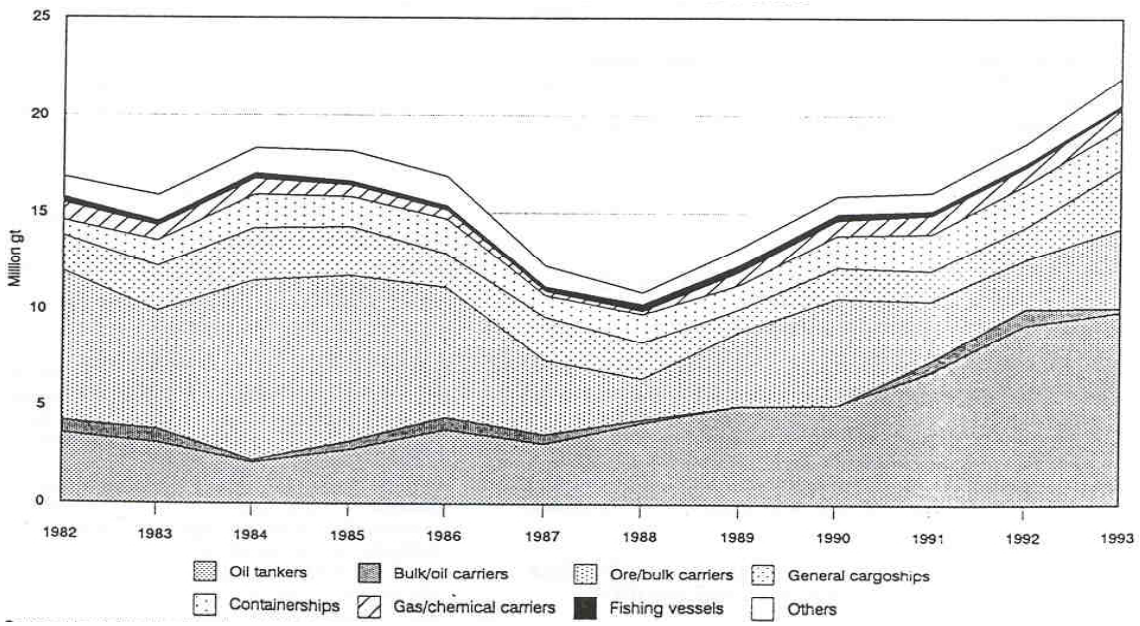
Source: Drewry Shipping Consultants, 1995, p.37



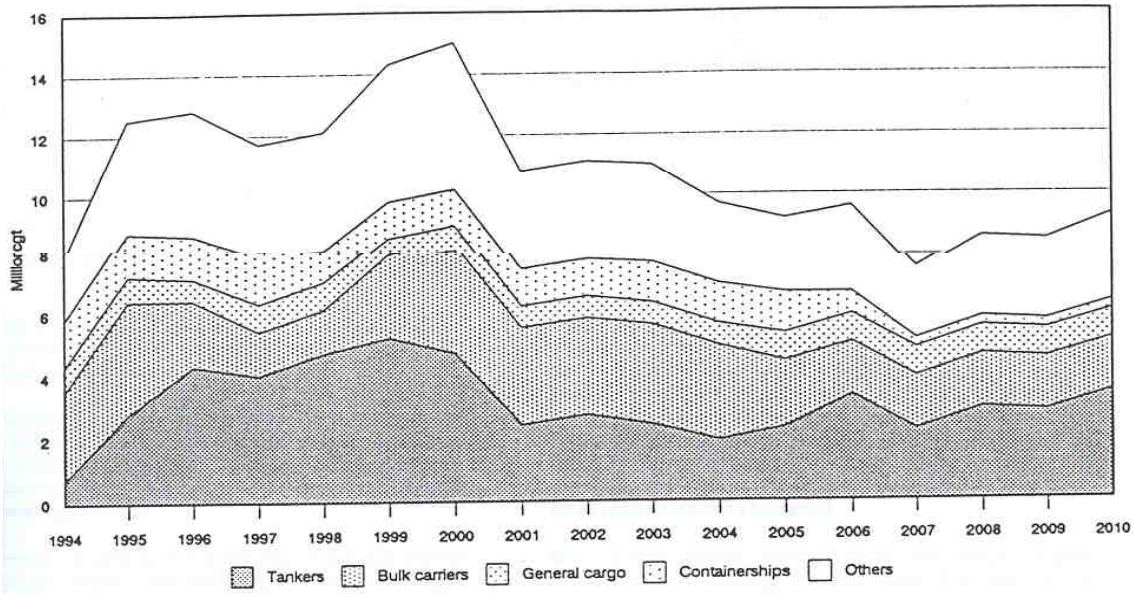
Appendix 5

Newbuilding completion and forecast demand

Newbuilding completion



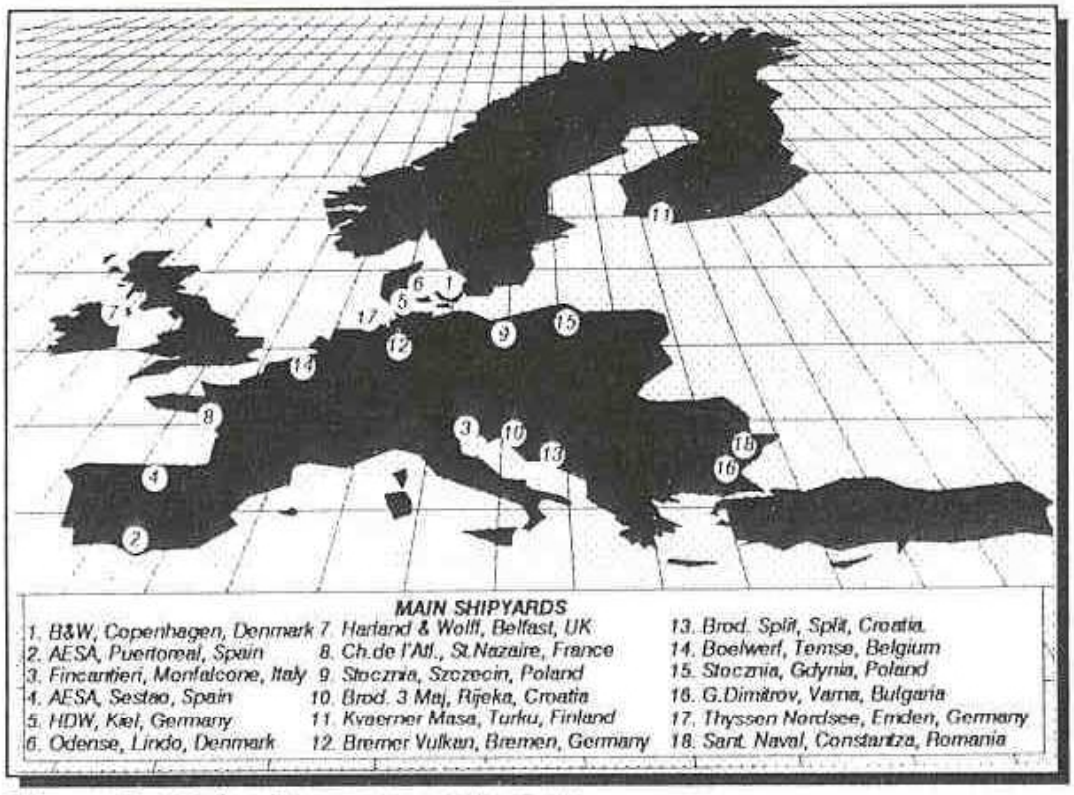
Newbuilding demand

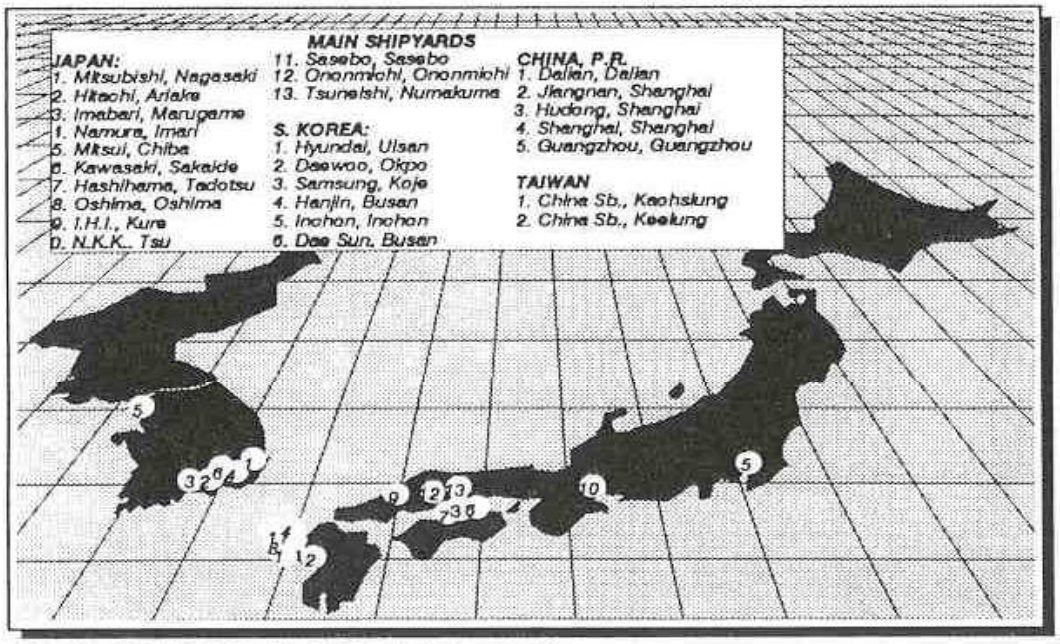


Source: Drewry Shipping Consultants, 1995, p. 7,130
Lloyd's Register "Merchant Shipping Returns"

Appendix 6

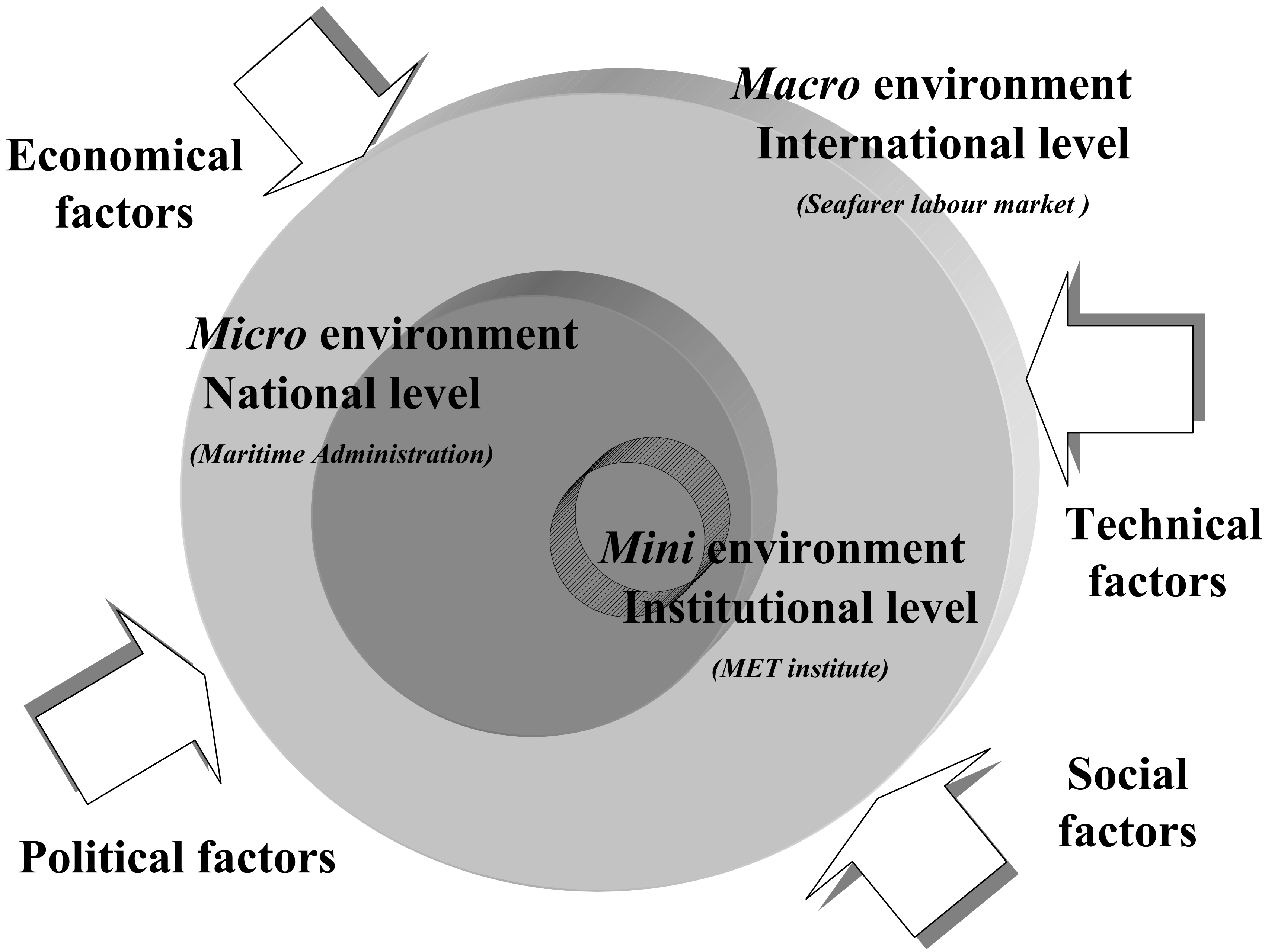
Major European and Far East shipyards





Source: Drewry Shipping Consultants, 1995

Appendix 14
Levels affecting MET model



Appendix 8

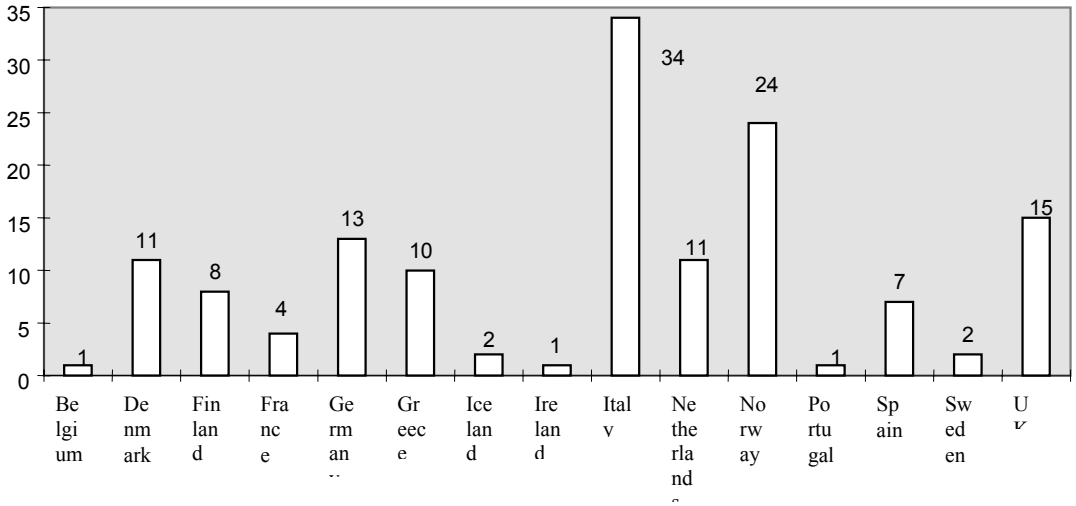
Authorities responsible for MET

Country	Authority	Ministry
Belgium	Belgian Maritime Inspection	Education
Denmark	Danish Maritime Authority	Business and Industry
Finland	Board of Navigation	Education
France	Ministere de léquipment,du logement,des transportes et du tourisme	Equipment, housing, transport and tourism
Germany	Maritime Transport Division	Transport
Greece		Merchant Marine + Education
Iceland	Maritime Administration	Education + Transport
Ireland	Department of the Marine	Education
Italy	Maritime Administration	Public Instruction
Netherlands		Education + Transport
Norway	National Maritime Directorate	Education, research and church affairs
Portugal	Directorate General of Ports, Navigation and Maritime Transport	Education
Spain	Directorate of Merchant Marine	Education
Sweden	National Maritime Administration	Education + Transport
UK	Marine Safety Agency	Education and Employment

Source: METHAR, wp 1.1

Appendix 9

Maritime Academies in METHAR countries



Source: METHAR, wp 1.1

Appendix 10

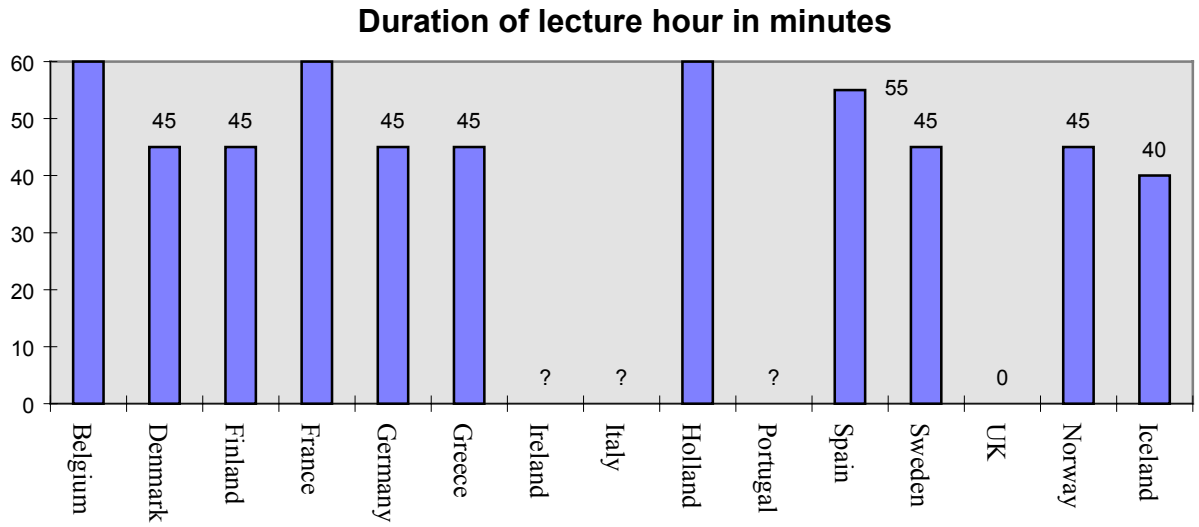
Syllabuses

Country	Master	Ch.Mate	Mate	Ch.Eng.	1st Eng.	Eng.Off.
Belgium	4 173	4 173	4 173	3 040	3 040	3 040
Denmark	3990	3990	1470	3990	3990	1470
Finland	4500	4500	3000	4000	4000	3000
France	4 229	4 229	3 259	4 229	4 229	3 259
Germany	2700	2700	2700	3340	3340	3340
Greece	0	0	3144	0	0	3144
Ireland	1680	1680	1680	3300	3300	3300
Italy	5760	5760	5760	5760	5760	5760
Holland	6 533	6 533	6 400	6 533	6 533	6 400
Portugal	3655	3655	2790	0	0	0
Spain	6 160	6 160	3 813	6 160	6 160	4 009
Sweden	2400	2400	1600	2400	2400	1600
UK	0	0	0	0	0	0
Norway	2660	2660	1330	2660	2660	1330
Iceland	4 844	4 844	3 556	4 444	3 111	1 778

Note:

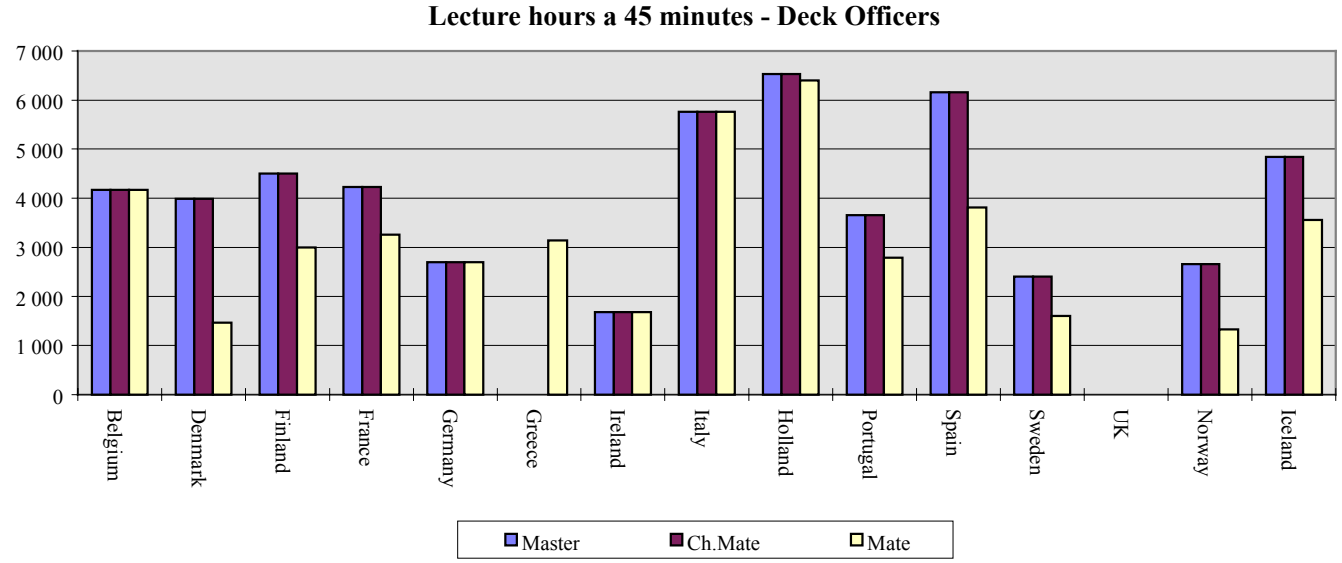
The zeros indicate that no time is given for the specific course or that the course leading to the specific competency is not conducted in the country.

Source: METHAR, wp 1.1



Out of 15 countries 6 countries use 45 minute lectures.
Only one country have a lecture period that is below 45 minutes.
4 neigboring countries (Spain-France-Belgium-Holland) have a lecture period longer than 45 minutes.

The following table show how many hours that the selected countries use in order to educate the three deck officer categories requireing a Certificate of Competency (CoC).



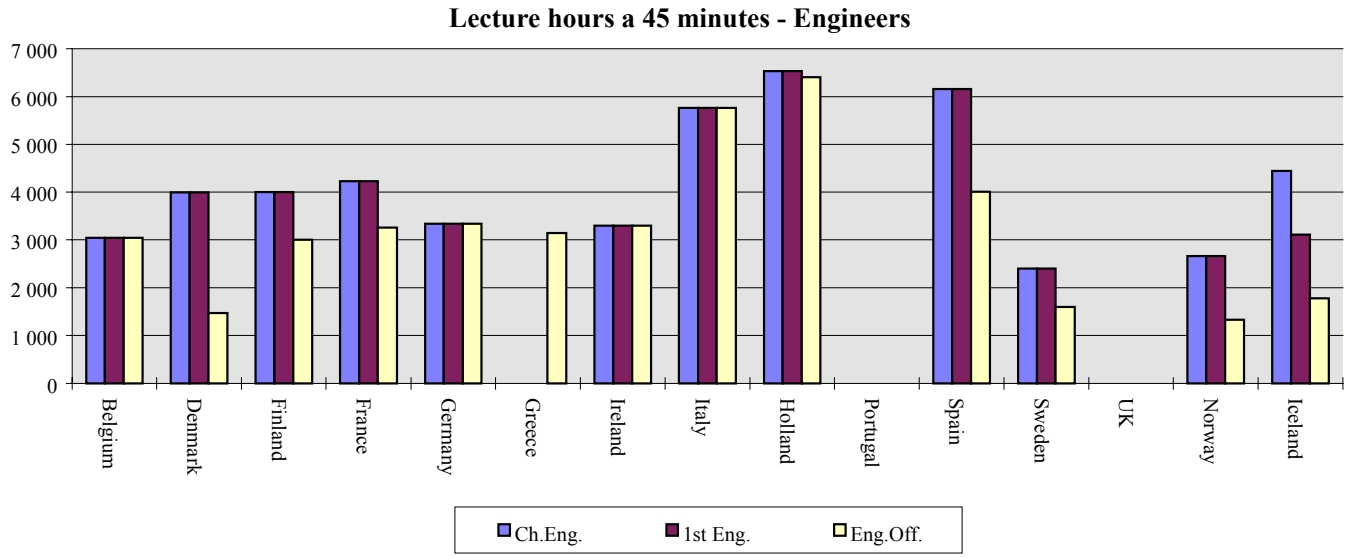
The average amount of hours with reference to this information is :

Master 3552 hours

Ch.Mate	3552 hours
Mate	2978 hours

The highest amount noted for Holland with 6533 hours for Masters and Ch..Officers and 6400 hours for Mates. The lowest amount noted for Ireland with 1680 hours for Masters and Ch..Officers and Norway for Mates with 1330 hours.

The same study for Engineers give the following table

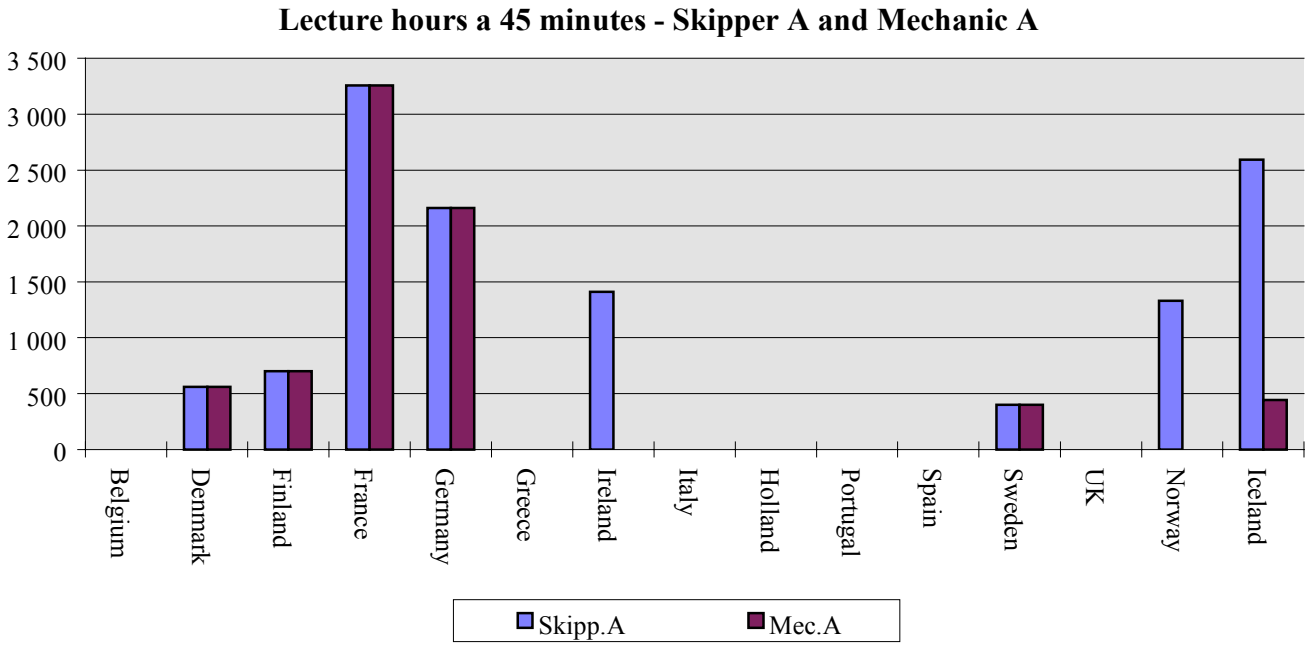


The average amount of hours with reference to this information is :

Ch.Eng	3324 hours
1st Eng.	3235 hours
Eng.Off.	2762 hours

The highest amount noted for Holland with 6533 hours for Ch.Engineers and 1st Engineers and 6400 hours for Eng.Officers. The lowest amount noted for Sweden with 2400 hours for Ch.Engineers and 1st Engineers and Norway for Enginer Officers with 1330 hours.

CoC´s for limited trade appears to be very scattered when it comes to hours needed to obtain this competency. For practical reasons therefore only the Skipper A and Mec.A have been taken up for comparison.



The variations here is quite remarkable. The table quite tells for itself.

An observation is that the amount of hours spent on the Skippers is equal as the hours spent to educate a Mechanic.