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World Maritime University Malmö, Sweden



# THE VIRTUAL CLASSROOM AFLOAT - MARITIME EDUCATION AND TRAINING IN THE 21<sup>ST</sup> CENTURY: AN INVESTIGATION INTO THE FEASIBILITY AND PRACTICABILITY OF DISTANCE LEARNING VIA THE SATELLITE COMMUNICATIONS SYSTEM

By

## **DENNIS G. TAN** Republic of the Philippines

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

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## ABSTRACT

This paper is an investigation into the current trends and developments in ship/bridge design and onboard communications systems, computers, Information Technology (IT) and telecommunications, particularly satellite communications. It also examined selected researches/experiences into the onboard learning environment by some companies or organisations. It explored some of the current distance learning methodologies and the associated technologies used in their delivery both ashore and afloat. This was for the purpose of assessing the technical feasibility and financial viability of establishing a Distance Learning Programme for the Filipino seafarers who comprise 20% of the world's manning supply. The study endeavoured to make a detailed cost estimate of the resources necessary such as financial, material, human and other resources in establishing and running such a programme. A cost-benefit analysis was made between a conventional training programme vis-à-vis one delivered via distance learning. To further determine its viability and practicability, a pioneering survey of the Filipino seafarers was made to gauge their readiness and receptiveness to new approaches to MET, i.e. distance learning. It was also a means to find out if they possess the attributes contributory to their potential success as distance learners.

This new approach to MET is geared towards solving the current dilemma the country is facing now. That is, meeting both the qualitative requirements of IMO/STCW'95 and satisfying the quantitative demands of the shipping industry to avert a potential international manning crisis.

Finally, it recommended the establishment of a Distance Learning Programme noting the pros and cons of such an undertaking and the recommendations to make distance learning a viable and a practical option for seafarers at sea.

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# LIST OF ABBREVIATIONS

ABS	American Bureau of Shipping
AI	Artificial Intelligence
API	Applications Programming Interface
ARIES	ATM Research and Industrial Enterprise Study
ARPA	Automatic Radar Plotting Aid
ARPA	Advanced Research Projects Agency
ATM	Asynchronous Transfer Mode
BPS	Bits Per Second
BPSK	Binary Phase Shift Keying
CAD	Computer Aided Design
CAL	Computer Aided Learning
CALL	Computer Aided Language Learning
CBT	Computer Based Training
CD-I	Interactive CD
CES	Coast Earth Station
CHED	Commission on Higher Education
СМС	Common Messaging Call
СМС	Computer Mediated Communication
COLREG	Collision Regulation
COW	Crude Oil Washing
CPU	Central Processing Unit
DAMA	Demand Assigned Multiple Access
DGON	Deutsche Gesellshaft fur Ortung und Navigation
D.L.	Distance Learning
DOLE	Department of Labour and Employment
DPI	Dot Per Inch
DSS	Decision Support System
DTH	Direct to Home TV

ECDIS	Electronic Chart Display and Information System
EIRP	Equivalent Isotropic Radiated Power
EMET	Enhancing Maritime Education and Training
FDMA	Frequency Division Multiple Access
FSS	Fixed Satellite Services
GEO	Geo-stationary Earth Orbit
GMDSS	Global Maritime Distress and Safety System
GPS	Global Positioning System
HDTV	High Definition Television
HEO	High Earth Orbit
HSD	High Speed Data
IBS	Integrated Bridge System
ICO	Intermediate Circular Orbit
IGS	Inert Gas System
INMARSAT	International Maritime Satellite Organisation
INS	Integrated Navigation System
IP	Internet Protocol
ISDN	Integrated Switched Digital Network
ISM	International Ship Management Code
ISP	Internet Service Provider
Kbps	Kilobit per second
LAN	Local Area Network
LCD	Liquid Crystal Display
LEO	Low Earth Orbit
LES	Land Earth Station
MARAD	Maritime Administration
MARINA	Maritime Industry Authority
MARS/VRS	Maritime Surface/Subsurface Virtual Reality Simulator System
MEO	Medium Earth Orbit
MET	Maritime Education and Training

MNC	Multinational Corporation
MTC	Maritime Training Council
NACOS	Navigation Control System
NMD	Norwegian Maritime Directorate
NMP	National Maritime Polytechnic
OOW	Officer-of-the-Watch
OOWA	Overseas Workers Welfare Administration
PC	Personal Computer
PRC	Professional Regulation Commission
PRN	Pseudo Random Noise Code
PSDN	Packet Switched Data Network
PSK	Phase Shift Keying
QPSK	Quaternary Phase Shift Keying
ROM	Read Only Memory
Satcom	Satellite Communication
SCC	Ship Control Centre
SDK	Software Developers Kit
SES	Ship Earth Station
SHOPSY	Ship Operation System
SIA	Satellite Industry Association
STCW	Standards of Training Certification and Watchkeeping
TC	Technical Co-operation
ТСР	Transmission Control Protocol
3-D	Three Dimension
TDMA	Time Division Multiple Access
TFT	Thin Film Transistor
TNA	Training Needs Analysis
UTP	Unshielded Twisted Pair
VCR	Video Cassette Recorder
V-SAT	Very Small Aperture Terminal

# **Chapter 1**

# Introduction

## 1.1 General Introduction

In 1895 Guglielmo Marconi launched a communications revolution in the field of wireless communication that continues to this day. This was widely embraced by the global maritime community, particularly the seafarers, which was rendered incommunicado by virtue of the tyranny of distance and technological limitations onboard at that time.

The development and growth of wireless communications eventually paved the way for mobile communications. Man, being both mobile and a communicator, is attuned to this form of communications, more than any other technique as it imitates the way people communicate naturally.

The mobile and isolated nature of ships spending about 80% of their time on the high seas thousands of miles away make it a pressing necessity to establish communications links with their head offices, as well as family and friends, ashore. This necessity engendered the concept and transformation of the modern ship into a floating office, which is now the recurring theme in maritime software development.

Onboard computing systems are no longer limited to stand-alone engineering and navigational applications. The growing number of ships with Local Area Network (LAN) onboard reflects the widely recognised need for vessels to become integral parts of shipping companies' computing and communications networks. This has resulted in ships being transformed into 'virtual' floating branch offices. As shore-based businesses depend upon the smooth flow of data through their head offices to branch office computer networks, so now do ships.

For ships at sea, the obvious way to bridge the gap is via satellite communications. The explosive development of sophisticated satellite technology was heralded by the launching of Sputnik 1 on the 4th of October 1957. It was stimulated by the desire to reach and exploit 'space'. The impact of that technology now touches people's individual daily lives at every turn, whether it be communications, computers, or even education (Sweeting, 1991). In tandem with the global computer revolution and Information Technology (IT), it is transforming the concept of conventional/ traditional education in general, and maritime education in particular, in quite dramatic ways.

Now satellites are increasingly becoming the fundamental resource for worldwide communications and business transactions as well as in education, albeit to a lesser degree. These 'extra terrestrial relays' are providing global links for making people and industries more efficient, more informed, and more secure.

Satellites, more than any other telecommunications technology, are capable of providing ubiquitous coverage anywhere on earth. The satellite industry has been heralded as the undeniable success story of the Space Age.

This space age technology currently provides ships with the capability to access

almost any information onboard. This sets new and exciting opportunities and trends for onboard learning.

This paper endeavours to explore the breadth and depth of the technological impact on the maritime environment in general and maritime education and training in particular.

### 1.2 Background of the Study

The Philippines has a long and proud tradition of being a maritime nation, spanning centuries from the floating 'barangays' of pre-Hispanic times through the historic galleons which traversed the Manila-Acapulco route.

It is an archipelagic country of 7,100 islands. If the 200-mile Exclusive Economic Zone is to be included, stipulated by the UN Convention on the Law of the Sea, the Philippines will have a maritime area of some 57,800 square nautical miles.

Manila is dubbed as the 'manning capital of the world'. This is because the Philippines is the main source of maritime manpower for the world fleet. In fact, it is often said that one out of every five seafarers is a Filipino. As of 1994, a total of 154,376 Filipino seamen were deployed on board foreign ships. By 1997 the number of registered Filipino seafarers had grown to 437,880 (IMO, TC 47/12/1). It is roughly estimated that some 300,000 of them are active. Together, these seafarers brought in US \$2.940 billion in 1994 alone! Thus, there is no telling as to the enormity of its economic contribution to the country.

The impact brought about by the STCW'95 caused drastic changes in the MET system of the Philippines. In its effort to comply with the Convention's stringent

requirements and finally make it to IMO's White List, a number of maritime schools and training centres had been closed. Out of the 150 or so schools offering maritime courses only a handful survived. There are only nine schools and training centres that are accredited at the moment, though this is expected to increase up to a dozen later. Paradoxically however, due to the drastic changes and draconian measures taken by the Philippine MET authorities, its primacy as a maritime manpower is threatened. Losing that status and failing to make it to the White List would have grave economic repercussions. It could also trigger a global manning crisis in the shipping community. With only nine (maybe a dozen later) maritime schools meeting the standards, how can the Philippines meet the manpower demands of the industry? Is it a question then of quantity versus quality? The emphasis now on competency-based training further aggravates the problem as it implies fewer students per class. With certificates of competency to be revalidated/renewed every five years, the necessity of taking up refresher program and the Commission on Higher Education (CHED) and Professional Regulation Commission's (PRC) Continuing Professional Education (CPE) requirements, how will the country's MET respond? Is there a way to meet the quantitative requirements of the industry without compromising the qualitative demands of international regulatory bodies such as the IMO?

This paper proposes to explore and examine the current developments and trends in the maritime technological environment, advances in computers and associated information technology (IT), satellite communications, the various methods of distance learning employing such technology as a probable solution to this problem. It will also evaluate the costs/benefits, merits and demerits of this mode of learning and make recommendations as to its feasibility and practicability of being applied in the Philippines.

## 1.3 Importance of the Study

Noting the fact that the Philippines does not have any form of distance learning programme in its maritime education and training system, this study is of particular significance to the country. The findings of this study will enable the country's MET to evaluate and assess the viability and practicability of establishing a first-of-its-kind distance learning programme using cutting-edge educational technology. It may also be of benefit to institutions in other developing countries that wish to establish a similar programme. Once successfully implemented, this D.L. programme for seafarers at sea utilising computers, IT and satellite communications system could serve as a model for them to follow.

## 1.4 Purpose of the Study

This research/study has the following specific objectives:

- 1. To examine the current developments and trends in:
  - a) modern ships' design and shipboard communications facilities
  - b) computers and information technology (IT)
  - c) satellite communications and data transfer
- 2. To investigate the various distance learning methods being used presently which utilise modern technology.
- 3. To examine the current trends in management/administrative practices in MET and other institutions employing distance learning.
- 4. To identify the hardware/software, manpower and other resources necessary in setting up distance learning programme via satcom.

- 5. To determine the approximate cost involved in establishing and operating/running such a programme.
- 6. To review, analyse and evaluate the significance and implications of the findings of selected researches, etc. made regarding onboard learning.
- 7. To evaluate the pros and cons of D.L. via satcom and its viability and practicability in the developing countries.
- 8. To make proposals and recommendations for new approaches to MET in the Philippines by harnessing the potential of state-of-the-art technologies.

## 1.5 <u>Research Methodology</u>

This research paper undertook an extensive literature search dealing with satellite technology such as INMARSAT, Iridium, ICO, Globalstar and other existing and emerging satellite communications systems. A review of publications, periodicals, magazines, dissertations dealing with distance learning, computers and IT, and ship's design was undertaken. Books, conferences and symposia proceedings, etc. relative to the subject were also studied. Contacts with selected, but strategically located, institutions from the United States of America, Australia, Japan, United Kingdom were attempted in the hope of eliciting answers to the queries posited by the author. The queries pertained to their organisational structure, human, material, technological and other resources used as well as the management/administrative system they implement. Difficulties were however encountered, as a number of them did not respond. This was further aggravated by the limited time available for research and beat the deadline for submission of this dissertation.

Communication with various maritime related companies or organisations dealing with technologies utilised in distance education such as INMARSAT, MARINTEK, Seagull, FUMAR, COMWEB, Satpool, Consafe, etc. were also made in the hope that their technical expertise could shed light on the investigations made by the author.

The author also made an informal interview with his course professor, some visiting professors to WMU of various nationalities and other experts to elucidate on certain matters he wished to be clarified.

In addition, the author also browsed the Internet and the World Wide Web and visited a number of web sites for information he could not readily find elsewhere. E-mail was often resorted to in contacting organisations/companies/institutions, etc. possessing the knowledge, information or expertise relative to his research.

The last, but not the least, the author, with the help of his institution, the National Maritime Polytechnic, conducted a pioneering survey for the Filipino seafarers, most of whom were officers in which a number of them were occupying senior/ management level positions. There were 574 respondents. The sampling could be considered purposive as it has chosen only Filipino seafarers who are mainly officers. On the other hand, it was also random sampling as the questionnaires were administered to any seafarer they encounter in Manila and in the training site in Tacloban City. To a certain degree, the sampling could be considered accidental as it was administered to the seafarers who happened to be there at NMP's training complex in Tacloban City and its extension office in Manila.

The survey aimed to find out the seafarers' receptiveness, willingness, and readiness to new approaches to MET, i.e. distance learning. It also aimed to find out if the Filipino seafarers in general, posses the attitudes and attributes that will ensure their success in distance studies.

### 1.6 Scope and Delimitation

This paper focuses only on the existing technologies currently available onboard particularly in the field of computers, Information Technology and telecommunications, including satellite communications. While it covers distance learning methodologies applied onboard as well as ashore, it does not include details in the actual design of distance study materials, though they may be mentioned in passing. It does however introduce and discuss some concepts in the aspect of delivery of distance learning and the associated technologies. Though some technical matters are mentioned, it is not intended to be a technical textbook on satellite communications nor on distance learning. In most cases, it limits its applications mainly to Filipino seafarers and the Philippine maritime environment. It may however also apply to other developing countries under similar circumstances.

The aspect of profitability in establishing the programme is beyond the scope and intent of this study. It does however make sufficient comparison of the costs and benefits between running a conventional simulator course (i.e. ARPA) vis-à-vis one delivered via distance learning.

This paper, as the title implies, focuses its attention mainly on the feasibility and practicability of implementing distance learning onboard vessels manned fully or partly by Filipino officers and crew administered by a shore-based institution in the Philippines, such as the National Maritime Polytechnic (NMP).

# Chapter 2

## An Overview of Technology in the Maritime Environment

## 2.1 Ship Design and Bridge Systems: Developments and Trends

The genesis of modern ship design was an evolution rather than a revolution or an outright creation. Everard (1997) said that this evolutionary process could sometimes go by for years without major change, then it leaps forward. The main design concept is focused on the bridge and its attendant equipment being the hub of the ship's navigation, operation and control. For decades innovations in ship design were relatively static. It hardly progressed from the steamboat prototype, except with some occasional step innovations, until recently.

In 1974 the DGON (Deutsche Gesellshaft fur Ortung und Navigation) published a study stating that shipowners, shipyards, and navigators were of differing view as to the operational benefits of the installations in ship bridges of seagoing ships 'due to the complete lack of applicable standards for the location, the maintenance and the handling and use of the numerous appliances', (Froese, 1978).

The advent of the Code of Practice for Ship Design was perhaps a great relief to this crying need. This was a welcome development, which somehow spurred certain innovations.

## 2.1.1 Optimal Bridge Design – The Sietas Bridge

A research proposal for the 'Optimal Bridge Design on Merchant Vessels' was presented to the German Minister of Transport in 1971 by the DGON for possible funding. In the design, according to this study, the naval architect should take into consideration the following:

- ergonomic aspects
- separation of the command, navigation and safety workstations
- ease of handling of all equipment at the different workstations from correctly designed chairs
- position appropriate instruments into groups
- instrument standardisation
- ergonomically designed lighting and illumination dials, display coding, interpolation of displayed values, labelling of instruments and control panels, minimum size of legends, size and shape of instruments, shape and colour of knobs, wheels, levers, switches, etc.

In most respects, the design of ship bridges was influenced by the evolution and eventual revolution in computers and information technology (IT). Attesting to this fact was the joint research project of Hamburg University Department of Naval Architecture, the German Shipowners' Federation and the Fachhochschule Hamburg entitled 'The Ship's Bridge as an Information and Decision System', (Froese, 1978).

The impact of Information Technology on bridge design, navigation equipment development and bridge training is reflected in one of the specific foci into the operational design of ships initiated by the Nautical Institute and supported by the Royal Institution of Naval Architects on 'Ship Control and Navigation'. IT interacts with the deck officer's primary function - the navigation of the ship. Navigation, consequently, is at the heart of an automated ship, (Wright, 1997).

The DGON study produced the Sietas 'optimal bridges' where the bridge equipment configuration is typically E-shape, similar to today's INS and IBS systems, (see Figure 1). The design is claimed to have the following benefits:

- the ship can be manoeuvred safely, particularly during unmanned engine room operation
- the officer on duty is able to manoeuvre the ship from either a sitting or standing position
- the working area is clearly divided into separate command, navigation and radio workstations
- the 360° arc of vision has minimal obstruction
- the basic design is adaptable to ships of different sizes and types of service

There were three basic functional arrangements under the Sietas bridge model designed for a) One-man manning, b) Two-man manning, and c) Three-man manning with the master/OOW, pilot and the helmsman standing at the after end of the middle console, (see Figure 1 a, b, c below).



**Figure 1. Sietas Bridge Model** 

The special requirements of conning faster and bigger container ships brought the necessity for Hapag-Lloyd, the biggest German liner company, to reconsider a new revised bridge design introduced in 1977 on four 33,000 grt. North Atlantic container ships.

## 2.1.2 MV Stuttgart Express Model

Froese (1978) noted that 'whereas the Sietas bridge was a yard design, the Hapag-Lloyd's bridge was developed by the managers and seafaring personnel of a shipping



Figure 2. Bridge of M/V Stuttgart Express

**Source: Modified from Froese (1978)** 

company'. Its basic idea was different and one-man manning was never considered as the aim was greater safety and reduced workload on the navigator.

In this model (see Figure 2 above), typified by the bridge plan of MV Stuttgart Express, the wheelhouse is clearly divided into four workstations: command, navigation, radar and safety and cargo control.

The command console, occupying nearly half of the forward bulkhead, contains all the important controls for the engine, the steering system, external and internal communication, as well as echo sounder and the Doppler log. The chair for the helmsman is adjustable.

For containers, which were the ones considered in the above designs, it was not possible to have a protruding wheelhouse due to loss of container storage space and risk to damage to the bridge during loading and unloading. Tankers do not have this kind of problem and so this design concept was carried out.

### 2.1.3 The Tanker Bridge Model

As with Sietas bridge design, the so-called 'Tanker Bridge' has provision for One Man Manning. In this design, the command workstation consists of a chair installed in the middle of the projecting part of the bridge deck with all the necessary controls readily accessible from this point (see Figure 3).

Ned-Lloyd of the Netherlands has also developed a projecting bridge design for a container ship of over 4,000 TEU. In this case, however, the wheelhouse protrudes on the starboard half thus avoiding obstruction of its forward view as well as minimising wastage of container storage space (see Appendix 1).

The first three designs mentioned above are by no means exclusively a German idea.

### **Figure 3. Tanker Bridge Model**



Source: Modified from Froese (1978)

Froese (1978) was quick to point out that 'similar bridge designs have been in existence since the early seventies, when the Scandinavians began to take an interest in this aspect of ship design'. No doubt other countries have made their contributions as well.

In another paper, Froese (1991) mentioned the German 'ship of the future' research which concluded in 1986 and was succeeded by another research project called 'ship operation system (SHOPSY)'. Following the client-server concept, it aimed at the development of computer networks and the utilisation of applications running on optional workstations and the decision support systems (DSS).

After a thorough task analysis, implicit in the concept of bridge design is its ability to support bridge task performance. Hardware is no longer the sole consideration. The design of information displays should be taken into account too, such as the kind of information required, when and where will it be displayed, in what form and how it is perceived by the user/operator. This is something obviously considered in the SHOPSY design.

But today, with the added impetus of technological advances, much of the changes are governed by legislation, says W. D. Everard (1997). Noteworthy also is the significant influence of oil company requirements in the tanker sector.

Further, Everard (1997) noted that 'the other main "step change" in the design of the bridge evolved from the automation of the engine room'. Vessels built in 1997 have the capability to start/stop the main engine from the bridge as well as paralleling and changing over generators and comprehensively monitoring the alarm and operational status of engine room machinery. Current trends show that with the change in cargo control operations, such as the Saab cargo system, the bridge is fast becoming the focal point of the ship, whether at sea or in port.

## Everard (1997) stated that:

Psychologically, the design and layout of the bridge plays an important role in the operation of the vessel and if a considered and practical approach is given to the ergonomics and aesthetics of this workplace the differences in personnel performance can be measurable with both ship's staff and company enjoying the benefits.

### 2.2 The Path Towards Bridge Integration: From INS to IBS

As developments and trends in ship bridge designs are followed it becomes increasingly apparent that they lead towards the path of integration. With integrated navigation, there are clear benefits. It allows for the use of data, information controls, and displays for an intelligent performance of safe, economic, and precise navigation, with simple manoeuvring control during the voyage and decreased workload for the navigators, due to an efficient man-machine interface, and with automatically recorded and documented planning and progress reports, (STN Atlas, 1999). With the implementation in July 1, 1998 of the ISM Code and its emphasis on documentation, this automated documentation system is quite a much welcome benefit.

But prior to a full bridge integration, there are three levels of Integrated Navigation Systems (INS) leading ultimately to a fully Integrated Bridge System (IBS) as per IMO definitions. These are:

- INS (A) This is essentially the sensing category, the lowest level of integration. It provides basic navigation information such as heading, speed, time, position and depth. Indications of integrity are clearly marked. It applies a Consistent Common Reference System.
- **INS (B)** This is the **decision** category. Referring to Figure 4 it could be seen that it incorporates all the capabilities of INS (A). But over and above it the system is also capable of automatic, continuous, graphical indication of basic navigational information in relation to the planned route and known and detected hazards.
- **INS (C)** Other than incorporating the capabilities of INS-A and B, the system is also capable controlling the ship. It is the **action** category.

In general, INS typically consists of three elements: sensors, displays and controls. 'Sensors will gather information from GPS, gyro, log, weather sensors, radar scanners and the autopilot. The displays usually include two radars, an electronic chart, and a conning display on which all the ship's position, heading, rudder and engine data will be shown. The control element



## Figure 4. INS and Integrated Bridge System (IBS) Concept

Source: STN ATLAS (1999)

comprises the controls of the key navigation instruments themselves together with a basic steering stand from which rudder and revs can be adjusted.

• **IBS** - This is the most comprehensive type of integration. *Compuship* quoting IMO's definition defined it as 'a combination of systems which are interconnected in order to allow centralised access to sensor information or command/control from workstations, with the aim of increasing safe and efficient ship's management by suitably qualified personnel', (*Compuship*, December 1998/January 1999). It incorporates passage execution, communications, loading/unloading and cargo

monitoring, safety and security, management operations and machinery control.

According to Andy Norris, chairman of the IEC's technical committee, the body that develops many of the IMO's functional requirements, 'Most manufacturers now have packages that are similar in many respects, although they may look different'. Noteworthy also is the fact that the 'leading manufacturers' offerings are even superficially similar in appearance: standing-height consoles arranged in a soft "E" shape with the steering stand forming the centre horizontal of the E is a typical arrangement', (*Compuship*, December 1998/January 1999). They may differ only in the man/machine interface and some extra features.

With the long-winded genesis of electronic charts now ended (IMO, Nav. 44), several manufacturers have launched new products that raise the level of integration to ever dizzying heights. UK's Kelvin Hughes is one of them. It has developed a collision avoidance advice system which is part of a 'near future' integrated bridge system. 'It integrates data from the electronic chart display and ARPA to give the mariner detailed advice on what action to take to avoid impending collision situations. If the navigator opts for a certain course of action, the advice system will be able to assess and explain to him what the consequences will be', said *Compuship* (December 1998/January 1999).

Litton's Innovation bridge series, on the other hand, is trying to elevate the level of integration aiming for a future in which more, not less, information is available on the bridge. The new integration environment Litton has created 'integrates inputs from ARPA, ECDIS, autoplilot, GPS, gyrocompass, speed log, echo sounder, engine monitoring systems and other IT systems', *Compuship* (Decemeber 1998/January 1999), added.

With so much information available on the bridge, the challenge now is how to

manage this information and minimise the risk of 'information overload'. Norcontrol is trying to grapple with this challenge by introducing its 'Bridgeline' IBS. 'Our philosophy with the integrated bridge', says its VP for sales and marketing, Leif Pederson, 'is to give the operator all the information he needs to perform a particular function from any workstation on the bridge - but only the relevant information and nothing more', *Compuship* (December 1998/January 1999).

'What the leading manufacturers see just over the horizon', says *Compuship* (Decemeber 1998/January 1999), 'is a time when the availability of so much more data, from many different sources, will bring a demand from shipowners for effective ways to manage and use that information'. The next generation of IBS, according to Norris, will see communications functions integrated within the system and controlled from the different workstations. *Compuship* (December 1998/January 1999) foresees future systems wherein outgoing as well as incoming data could be sensibly integrated. It said,

Owners will increasingly want operational data sent ashore for analysis. Systems for ballast and bilge control, tank soundings, machinery control, fire detection and alarms, diagnostics, condition monitoring, cargo monitoring, stress measurement and many more all generate data. Integrating them with the navigational information that is traditionally the preserve of the bridge will give superintendents ashore new opportunities for effective fleet monitoring and management.

## 2.3 Towards A Fully Integrated Ship: Developments and Trends

Current developments and trends in bridge designs bring us to the next logical progression from the integrated bridge to the penultimate full integration of the whole ship. Many manufacturers are already setting their sights in this direction. In fact the German company, STN Atlas, has already supplied complete, turn-key integrated packages that include electric propulsion, power generation and management, machinery control, alarms, navigation and communication equipment, *(Compuship*, December 1998/January 1999). Its NACOS range of products described as 'integrated navigation command systems' and its SCCs (Ship Control Centres) embrace automated communication, engine control and ship management functions. Its top-of-the-line Atlas NACOS 65-3 (see Figure 5) is among the most advanced product in the industry. Referring to Figure 5 makes it obvious that it incorporates a host of functions such as a common workstation technology for Chartpilot, Multipilot and Conningpilot, and central alarm management. It incorporates echo sounder, EM-log, Doppler log, gyrocompass, position sensor, wind sensor, and electronic chart system. The system is even connected to a CD-ROM and a printer, which facilitates documentation and recording of vital information.



#### Figure 5. ATLAS NACOS 65-3

Source: STN ATLAS (1999)

The aforementioned advances in ship design and automation, which led ultimately to integration, had been driven by the desire to cut costs by reducing to the lowest safe manning level and the reduction of installation and maintenance costs by simplifying and minimising interconnections, (Sperry Marine Inc./Honeywell Limited, 1995).

## 2.4 Local Area Network (LAN) Onboard

One key to making bridge integration technology feasible is the availability of powerful, affordable computer hardware. Computers are indispensable in the process of distributing, displaying, correlating and interpreting and logging shipboard data and information. As the number of communicating devices increased, parallel to the information explosion on the bridge, the number of interconnecting wires increased dramatically causing a logistical nightmare and maintenance headache. With the introduction of local area networks (LAN) onboard, these problems brought about by advanced technology have been greatly alleviated. LANs facilitate file transfer and data exchange among the various equipment and components, which make higher levels of bridge automation and integration possible. They are the high-speed communications systems designed to allow many computers to simultaneously communicate with one another. It is the 'glue' that binds all these hosts of various component functions.

The token-ring LAN architecture, originally developed by IBM, was chosen by the University of Virginia's Computer Networks Laboratory, following a 6-month study, as the most suitable for replacing shipboard point-to-point wiring based on reliability, performance, adherence to standards and cost as the evaluation criteria. Incidentally, the US SAFENET committee also adopted the token-ring architecture as the standard for Navy ships. This subsequently became the IEEE standard (802.5), eventually internationally agreed standard, 8802/5, and as an ISO (Sperry/Honeywell, 1995).

SeaNET is an application of the IEEE 802.5 Token Ring Network Standard. It gives high-speed data distribution and highly reliable transfer. SeaNET is a central integrating element of integrated bridge systems.

The token ring architecture and SeaNET's real-time interface provide a distributed network that can guarantee deterministic access to the network for all devices. With it files can be transferred from any network node to any other node at speeds comparable to the speeds that files can be written to a hard disk. Data log files can be moved from the VMS Command Station to the NWS for transfer to removable media such as floppy disk or optical disk (CD) or even to the SATCOM, if fitted, for transmission to home office.

### Muirhead (1998) noted that:

The increasing installation of Local Area Networks (LANs) on ships reflects the slow but growing realisation by some ship managers that the linking of the total ship to the company LAN ashore can increase interaction between both and lead to improved efficiency, safety and cost-effectiveness.

In the ship's case, however, the use of Internet, e-mail and data transfer services will be dependent on the satellite link of the communications network architecture.

With this technology, combining shipboard LAN and satcom, it is easy to figure out other applications such as onboard training and education. With the now becoming ubiquitous presence of computers onboard and the availability of shipboard LANs becoming more commonplace, the metamorphosis of dual-role ships as floating offices and as virtual classrooms afloat is not only a possibility but an emerging reality. This development and other trends would usher in a new era of truly global maritime education through the avenue of distance learning via the satellite communications system.

## 2.5 Advances in Computers and Information Technology (IT)

## 2.5.1 The Evolution of Computer Technology - A Brief History

It has been said that necessity is the mother of all inventions. So likewise the computer was born out of some pressing necessity. In this case it was the census of a growing population in 1890. Herman Hollerith reduced the processing time of census information from over ten years to three years by inventing a machine that stored data printed as holes punched on cards. He then manufactured his invention and later merged with another company, which gave birth to the once monolithic giant in the computer industry, IBM (International Business Machines).

ENIAC was the first general-purpose electronic digital computer. It was introduced in 1945. This mainframe computer, the size of a building, occupied 3000 cubic feet of space, weighed 30 tons and contained 18,000 vacuum tubes. This machine was only capable of doing simple addition, subtraction, multiplication, and division. However, it did the job in a programmed sequence, (Forcier, 1996).

The size of the original computers was significantly reduced with the replacement of vacuum tubes with transistors in 1951. It shrank from the size of a building to the size of a room. Later it reduced further to cabinet size.

1975 onwards with the introduction of the integrated circuit or microchip, brought another further reduction in computer size. Apple and Radio Shack microcomputers were among the foremost exponents of this generation of computers called hobby kits.

The year 1982, dubbed as 'The Year of the Computer' by *Time* magazine, beckoned as a New World created by a technological upheaval that was bringing computers to millions. The personal computer was not only smaller (desktop size or smaller) but

also capable of performing more complex tasks. It served as a high-powered calculator, a word processor, a means of generating graphics from tabular information, and much more.

1993 gave birth to Apple's laptop Mackintosh PowerBook 540. In marked contrast to its massive ancestor, ENIAC, weighing 30 tons and occupying 3000 cubic feet, it weighed only about seven pounds and occupied less than one-seventh cubic foot of space. But amazingly, this diminutive offspring had 3000 times greater memory than its gigantic ancestor (36 MB against a paltry 12K) and is 100,000 times more reliable, (Forcier, 1996).

A few years later, ever smaller and more powerful versions came into being. Notebooks are now superseding laptops. Toshiba even developed a smaller version nearly half the size of notebooks with similar capabilities and aptly called it *Libretto*. Today, the market is flooded with even smaller handheld PCs otherwise known as palmtops. Philips' Velo 500, for instance, weighs less than 500 grams. While it can never replace the desktop PC as some notebooks can, its on-the-move convenience coupled with a low-price affordability makes it a very attractive option. Its '75mhz RISC processor and 16MB onboard memory along with Windows CE and bundled "pocket" versions of Microsoft Word, Excel, PowerPoint and other popular productivity and communications applications make the Velo 500 the world's most powerful handheld PC. With an optional low-power modem it can be used with GSM mobile phone to access e-mail, receive faxes or even surf the web[!]', (Newsweek, November 30, 1998).

Possession of miniaturised yet sophisticated computers, like the Velo 500, make them fantastically powerful tools in the hands of lecturers on the go.

On the other hand, Dell's Inspiron 7000 has 300 MHz Pentium II, 3-D surround sound and a 15-inch active matrix display (the equivalent of 17-inch CRT monitor).
What is amazing with this notebook computer is its 3-D graphics accelerator. 'This means you can play Direct 3-D supported games ... in blazing 3-D glory [!]', (Newsweek, November 30, 1998). What do products of this sort then portend? Well, it is obvious, using it in 3-D simulation akin to virtual reality for marine applications will deliver a powerful wallop in its pedagogical impact.

# 2.5.2 Advances in Information Technology (IT)

Technology has always been the driving force behind most of any modern day progress. Terpstra, (1991, p. 134) defined technology as 'a system of ordered information concerning the relationship of humans to the material environment from which they appropriate resources and transform them into socially desirable products.' Looking back at the trends of human history, one could see how the role of changing technology influenced every trend and shift in human activities. 'The recent 'shifts', Terpstra added, 'correlate with technological control of data generation and its processing into information.'

This 'control, generation and processing' of data is what Information Technology (IT) is all about. IT provides data to aid in decision making. But data has to be transformed into information before it becomes a vital tool in decision making. It is communications that turns business data into information.

'IT', says Patrick Slesinger, (1998), 'is, in most cases, now the only way that companies can compete in this ever faster moving world. No longer can companies afford for IT to be treated as a "back room" activity or for IT strategy not to be a Board level concern'.

Muirhead (1998) pointed out that: 'The main catalysts for change in the past two decades has been the growing power of the computer and the spread of a global information [super]highway called the Internet'. Fairplay's Marine Computing Guide, (1998) defines the Internet as 'a nexus of interconnecting networks that use

standard data protocols to exchange information with one another'. It had its origins in the late 1960s, when the US Department of Defence Advanced Research Projects Agency (ARPA) developed packet switching techniques for transferring data between computers. By 1973 the first rudiments of the Internet, then called ARPAnet, had been created. A major impetus brought about by the introduction of a standard protocol called TCP/IP (Transmission Control Protocol/Internet Protocol) in 1972 caused the rapid expansion of the Internet. But only since 1993 did it begin to

Table 1 Micro-chip Growth								
Chip	Year	MHz	No.Transistors	Memory	Data Type			
8008	1972	0.5-0.8	3000	16K	8			
8085	1976	3-8	6500	64K	8			
8088	1979	5-10	29,000	1 Mb	8/16			
80286	1982	10-16	130,000	16 Mb	8/16			
80386	1985	16-33	275,000	4 Gb	8/16/32			
80486	1989	25-33	1.2 million	4 Gb	8/16/32			
Pentium	1992	60,66	3.1 million	4 Gb	8/16/32			
Pentium	1994	100	4.1 million	4 Gb	8/16/32			
Pentium Pro	1995	200	7.5 million	6 Gb	16/32			
Pentium II	1997	233-400	8+ million	8.1 Gb	16/32			
Pentium III	1999	500-800		10+ Gb				
Merced IA64	2000	1000+	10+million	18+ Gb	32/64			

Source: Muirhead (1998), Methar Project

really grow exponentially. As of August 1996 there were 100,000 networks with 60 million e-mail users, (Spectrum Strategy Consultants, 1996). It is predicted to rise to some 200 million e-mail users by the year 2000. By the beginning of 1998 it was estimated that there were 90 million people with Internet access around the world and was likewise projected to grow to 200 million by the year 2000, (Davies, 1997).

This number will soar to 304 million [!] by 2002, according to Joan-Carol Brigham, an analyst with Data Corp. The foregoing figures clearly indicate the rapid expansion of the Internet being the fastest growing segment of IT development.

Parallels to these developments are improvements in the processing power of computer technology. 'At a given price it continued to double approximately every 18 months [i.e. power improvement cost reduction cycle]', observed Kinnaman and Dyrli (1996). Further they stated that: 'Computer-based telecommunications are developing at breakneck speeds and new products and services are quickly supplanted by more powerful options'. Current trends show (see Table 1 and 2) that telecommunications speed have increased and will continue to increase dramatically.

Table 2 Telecommunications Connection Speeds:									
Sample File Transmission Rates									
Service	Speed	150-page	300 Kb	475 Kb	2.4 Mb				
	(per sec.)	BOOK	PICTURE	AUDIO	VIDEO				
14.4 Modem	14.4 Kb	4.44 min.	2.78 min.	4.44 min	22.2 min.				
28.8 Modem	28.8 Kb	2.22 min.	1.39 min.	2.22min.	11.1 min.				
"56K"	56 Kb	1.14 min	42.6 sec.	1.14 min.	5.7 min.				
ISDN 64	64 Kb	1.00 min	37.5 sec.	1.00 min.	5.0 min.				
ISDN 128	128 Kb	30.0 sec.	18.8 sec.	30.0 sec.	2.5 min.				
T1	1.54 Mb	2.48 sec.	1.55 sec.	2.48 sec.	12.4 sec.				
Cable Modem	10-30 Mb	.3813 sec	.2408 sec.	.3808 sec.	1.964 sec.				
Т3	45 Mb	0.08 sec.	0.05 sec.	0.08 sec.	0.42 sec.				

Source: Odvard Egil Dyrli and Daniel E. Kinnaman, Technology and Learning, April 1996

*The Baltic* (November 1998) seems to concur with the above statement when it said, 'The IT industry itself is advancing in quantum leaps as technological and production capabilities improve to deliver systems and equipment that are ever more reliable, almost infinitely better in speed and performance and very much smaller in size.'

# 2.5.3 Imaging Technology

Enhanced image quality will be another benefit of tomorrow's office-imaging tools. Canon recently demonstrated a new microfine-droplet technology, which promises to bring ultrahigh, photo-realistic images to the colour ink-jet world. 'Within a year or so, we'll be producing printers whose output will be virtually indistinguishable from silver halide photographs at least to non professionals', says Salmon, European market-planning manager for Canon Europa (Newsweek, November 30, 1998).

On the same Newsweek issue Takyoshi Hanagata, group executive of Canon BJ Printer Products Business Group, said, 'We think bubble jet technology has the potential to rival, and possibly even surpass, colour-print speeds now offered in laser beam printers and midspeed copiers'.

Televisions and computer monitors, on the other hand, made their own technological quantum leaps in recent years too. From pure black and white display, to bright trinitron CRTs were later developed. Shortly afterwards, Sony's black trinitron was introduced to improve contrast as well as brilliance. Other manufacturers made their own innovations too along the same lines.

Computer monitors also made parallel progress from monochrome to colour VGA and now to super VGA.

For television, the screen size also grew bigger from 27 inches in the early 80's to 45 inches and even bigger to the incredibly immense size of screen measured in feet or metres today.

However, with bigger screens picture definition was compromised. So attempts were made to enhance picture clarity. But the most significant innovation pursued was the introduction of High Definition Television (HDTV). The first version was of much higher DPI and, naturally, many times clearer and 2.5 times brighter than standard TV. Pictures on this screen really come alive. They seem to ooze out of the screen so wondrously colourful and vibrantly teeming with life. You could almost touch them. However the first versions were based on old analogue technology and digital versions were later developed with further refinements. Today, delicate surgical operations via telemedicine are performed utilising these technological wonders in imaging. The advent of digital TV and Web TV allowing one to surf the Net, caused a blurring in the demarcation of what is TV and what is computer. The beauty of this technology is that it allows for the possibility of manipulating video pictures for better visual effects, which has enormous potential for pedagogical applications.

But imaging technology did not stop here. Liquid Crystal Display (LCD) screens were developed a decade or so earlier. Their viewing angle and clarity however were limited. But more and more innovations were made to refine and improve it. Today, a new generation of lightweight, flat panel LCD monitors may soon 'replace the bulky CRT in offices and homes around the world', predicts Hugh Brogan (Newsweek, November 30, 1998), general manager of Taiwan-based Philips PC Peripheral Division. Philip's new Brilliance TF15AX 15-inch monitor, for instance, is less than 18 cm deep and weighs only 5.2 Kg., a fraction of the size of a conventional 38 cm monitor. Thin-Film-Transistor, or TFT, technology made it possible. Since each picture-producing element has its own transistor, TFT-LCD flat screen monitors produce the brightest colours, the highest contrast and the fastest response time of any monitor on the market today, says Brogan (Newsweek, November 30, 1998). These TFT screens allow for wide viewing angle unlike conventional LCDs.

This technological innovation in TFT-LCD displays is just the tip of the iceberg. Newsweek, (November 30,1998) predicted that: 'State-of-the-art office displays in the 21st Century will be based on plasma technology. This is already used in banks, stock exchanges, airports and railroad stations around the world'. Plasma displays offer the potential for extremely large formats. These displays have extremely wideviewing angle of 160 degrees or more with virtually no picture distortion. They are also super lightweight and therefore ideal for unfettered deployment on office, and who knows, classroom, walls too!

Imagine the thrill of having a videoconference in a grandiose boardroom or a large auditorium utilising this imaging technology. What impact would it have on a student running a ship manoeuvring simulation displayed on a life-size wall-mounted screen right in his/her bedroom?! By any stretch of the imagination the future is replete with stupendous potential.

# 2.5.4 Networks and Connectivity

Initially computers, PC or otherwise, were stand-alone equipment. As their computing power and sophistication increased and their memory capacity expanded dramatically, coupled with the realisation of the synergetic advantages of connectivity, linkage with other computers did not only become possible but ultimately inevitable. These linkages and interconnectivity in the form of a network system linking several PC's to a file server provided extra flexibility and power. Networking started as local area network (LAN) composed of devices housed in close proximity to one another and growing into a wide area network or WAN, a network that spans great distances or covers a wide geographical area, (Forcier, 1996). Ultimately it reached the pinnacle in what is now a by-word, the Internet, the mother of all networks.

'But rapidly growing in importance now', said Darbyshire (1998), 'are the so-called "intranets", secured areas that use Internet and World Wide Web (WWW) standards and technologies for internal communication and collaboration.' On the other hand, 'Extranets', he explained, 'serve as a bridge between the public Internet and the private intranets. Extranets allow business partners [or sister universities and institutions] to link their intranets behind the protection of virtual firewalls and other security features'.

The Internet serves as a paradigm of communications possibilities inherent in distributed networks. Dyrli and Kinnaman (1996) readily pointed out that,

Computer-based telecommunications using the Internet and commercial on-line services such as America On-line, CompuServe, Prodigy and the Microsoft Network provide teachers and students with the unparalleled educational benefits of immediate access to global communications and information resources.

Institutions throughout the world are tapping in and even creating their own Web sites, with uses ranging from posting assignments to offering distance learning online and a host of other pedagogical possibilities. Via the Net students can access a range of programs for use within the curriculum without teacher involvement and student performance can be monitored from the instructor's own PC. Teacher and students alike can have access to information and databases directly from a library, CD-ROM stack or via the Internet or within the more secure 'firewalls' of the supporting institution's intranet.

'Hub technology is fast becoming the communications technique of choice by shipping companies', states *Compuship* (December 1998/January 1999). However, managing a private hub entails paying extra communication interfaces, negotiating your own deals with satcom service providers, brokering your own arrangements with the legion of value added service providers, and a lot of other hustles.

IMC, a UK-based messaging company, has solved this conundrum and is currently applying a new technique called 'Internet tunneling', which allows the creation of a 'virtual private hub'. So long as the client has a messaging server connected to the Internet, it could be linked to IMC's Super-hub gateway to this Internet connection

rather than to a dial out modem. The technique is tantamount to a direct link between the Super-hub and the IMC Super-hub gateway software that runs on the shipping company's messaging system. All the data traffic 'tunnels' through the direct link, using the secure Super-hub message protocols rather than the less trustworthy Internet.

IMC's remote Super-hub gateway software can 'Internet tunnel' via direct, leased line or a dial up connection to a local Internet Service Provider.

With myriads of technological breakthroughs and innovations in IT particularly in the World Wide Web, as one has seen, it is but logical for Dyrli and Kinnaman (1996) to say that,

Today's web ... is undergoing a technological makeover that will change it to a more truly interactive multimedia medium. Evolving standards like Sun Microsystems' Java programming language promise to bring high quality 3-D graphics, animation, on-line movies, and live two-way video and audio to the Web.

No wonder with these developments and trends Dyrli and Kinnaman (1996) foresaw that 'The rapid development of telecommunications technology, interactive networked multimedia, and "real time" applications has the potential to transform the curriculum and redefine schools'. These transformed curriculum and redefined schools are now the web-based virtual institutions embodying the new educational paradigm.

# 2.5.5 <u>New Products - Offshoot of Networking and Connectivity</u>

With networking and connectivity new products have been developed to further facilitate communication and overcome the 'tyranny of distance'. These developments and trends in IT have enormous benefit in education, particularly distance education. 'By linking office copiers, computer printers and other imaging devices to the Internet, business [and institutions too] are cutting costs and speeding the delivery of important documents including memo reports and even presentations with complicated tables and colour illustrations, (Newsweek, November 30, 1998). 'The trend nowadays', says Kevin Kern, vice president of Konica's Business Technologies digital systems solutions, 'is to move the document digitally and print locally', (Newsweek, November 30, 1998).

One notable product that does just that is Hewlett-Packard's Digital Senders. It is capable of scanning printed documents and transmit them via Internet computer networks as e-mails. In this way offices and schools alike can save enormous costs which could run up to \$60,000[!] in telephone charges and by eliminating most fax machines. 'And beyond the cost savings', says information and communication-technology consultant, Henrik Bethlehem, 'these new machines scan in colour documents at 15 pages per minute, which is much faster than the fax machines we are using today', (Newsweek, November 30, 1998).

Not to be outdone Canon developed GP215, a networked copier, printer and fax designed for workgroup environments. On the same issue of Newsweek, Graham Salmons, European marketing manager, said, 'The GP215 will know where an addressee sits and what their e-mail address is so that if you have an urgent document, you can post it from your PC desktop and the system will find the most efficient way to deliver it. If the fax line is busy', he added, 'it will automatically send it as an e-mail'.

## 2.5.6 The Trans-Oceanic Connection

Networking and interconnectivity of computer stations with each other as well as with selected input/output peripheral devices often require cabling. It often consists

of twisted pair wiring such as has been used in the telephone system. Coaxial cable and fibre-optics are now replacing this. In fact the International Herald Tribune (10/3/98) stated that,

Today there is approximately 368,000 km of fibre-optic cable on the floor of the world's seas, with a further 280,000 km due to be laid by the end of 1999. In addition 30 international telecommunications providers have established 'project oxygen', a super Internet that will link up 175 countries through 320,000 km of fibre-optic cable to handle the demands of Internet and video transmissions.

A connector or port on a computer allows data to flow between the computer and the outside world. These interface ports allow the user to connect a cable linking the computer and a peripheral device.

A modem is connected to a serial port in order to convert the digital data into analogue form to transmit over phone lines. A modem connected to the serial port of a receiving computer translates the analogue data back to digital form. Bits per second (bps) is a measure of how fast is the transfer rate. Bps is a more precise unit of measure at higher speeds than baud rates. Modems of 9,600 bps are already considered very slow by today's standards. The ISDN or Integrated Digital Service Network now offers 64/128 kilobits per second (Kbps). Muirhead (1998) pointed out that 'telephone companies using unshielded twisted pair (UTP) category 5 cabling can handle 100 BASE-T Fast Ethernet at 100 Mbps'. At present, capacities of 100 Mbps or more are being installed by Internet Service Providers (ISP). Advances in cabling and wireless technology enabled the rapid increase in bandwidth (a measure of how much and how quickly electronic communication is transported). New machines will enable the handling of data up to 50 gigabits per second.

# 2.5.7 Marine Applications Software

Muirhead (1998) stressed that: 'the most important growth in the use of IT onboard has been in integrated vessel management software. Computer application packages are interestingly being placed on ships as an integral part of the company's overall management system'. The ISM Code's requirement for documented procedures and processes on board coupled by STCW'95 Convention's requirements are engendering this trend. A Computer-based approach, as suggested by the 1998 Marine Computing Guide, seems to be the obvious and straightforward solution.

'Software developments coupled with equally rapid communications improvements, are opening up new ways of ship operating and management', Marine Computing Guide (1998). *Compuship's* Decemeber 1998/January 1999 issue showcased the ABS' (American Bureau of Shipping) 'aces in ship management software game'. It featured ten software modules, each dedicated to a key area of vessel operation and maintenance from tracking and planning surveys, inspections and maintenance work to recording the hours worked by crew members and the wages due them as a result. Modules for planned maintenance and repair, purchasing and inventory, financial reporting, crew management and crew payroll have been fully integrated.

PreMaster is a suite of Windows-based maintenance software for planned maintenance, inventory management and purchasing. There are three versions: PreMaster Ship for the ship's database for the aforementioned functions; PreMaster Office, primarily designed for a ship superintendent ashore to follow up and analyse maintenance activities performed aboard ship; and PreMaster Purchase, which imports electronic requisitions generated by PreMaster Ship and turns them into purchase order.

Likewise, Star Information Systems also consisting of three subsystems, namely Star Fleet Management System, Star Central Purchase System and Star Information Planning System offer a comprehensive package of fleet management software.

The tracking of so-called remote assets using a combination of mobile data communication technology and the World Wide Web are among the hottest services launched in the shipping industry. Webtrack from telecoms giant BT, FreigtFinder and Vessel Vision from the small UK firm, Pole Star; FleetXs from Dutch logistics specialist, Simac, offer essentially the same type of services. A remote asset, be it a ship, a truck or even a single container automatically sends data via mobile communication system to a central computer which also acts as an Internet server. This could be accessed by dialing into the server via the Internet from which data from the remote asset could be downloaded. BT's Webtrack claims to be a 'complete business solution for messaging and tracking'. It has the flexibility of being able to use a variety of data communication channels such as Inmarsat-C, GSM cellular versions and the new diminutive Inmarsat-D+ system. All tracking data are stored in a server with a wide portfolio of maps and charts. These enable the subscribers to see their remote assets plotted graphically, (*Compuship*, Decemeber 1998/January 1999).

With the aforementioned developments and trends in IT, computers and computing technology and the Internet we come to the ever growing realisation that 'The world is already becoming an information society', as Len Holder (1998) puts it. 'The new educational paradigm must therefore reflect this', he urged. As a way to adapt to these developmental changes he further admonished that 'educators and trainers alike should not anymore be cramming students heads with facts, but providing them with a framework of knowledge, plus the skills required to access information quickly and efficiently'. This is wise counsel from the president of the Nautical Institute that other maritime institutions will do well to heed.

## 2.6 Satellite Systems: Principle and Technology - A Descriptive Overview

Satellites are now the fundamental resource for worldwide communications and business transactions. The editors of the magazine Wireless World describe satellites as the 'extra-terrestrial relays' providing global links for making people and industries more efficient, more informed, and more secure.

Dr. Robert A. Nelson, (*Via Satellite*, July 1998), president of Satellite Engineering Research Corporation stated that: 'The design of a satellite communications system presents many interesting alternatives and trade-offs. The characteristics include the choice of orbit, the method of multiple access, the methods of modulation and coding, and the trade-off between power and bandwidth'. He then proceeded to described these characteristics as follows:

# 2.6.1 Orbit

Satellite systems design commences with the choice of orbit. There are four classifications of orbit based on its altitude above the earth, namely: LEO, MEO, GEO and HEO. The Low Earth Orbit's (LEO) altitude is above the atmosphere or some 1000 km. above the earth but below the first Van Allen radiation belt. MEO or Medium Earth Orbit, on the other hand, lies between the first and second Van Allen belts. The geo-stationary orbit (GEO) however is unique. It lies at 35,786 km above the earth. At this altitude satellites appear to hover over the sky relatively stationary when viewed from the earth. The fourth and last category is High Earth Orbit (HEO). It is about 20,000 km. and is above the second Van Allen Belt but below GEO.

There are two other important orbital parameters besides altitude: inclination and eccentricity. Choice of inclination could be based on the maximisation of the level of multiple satellite coverage. Elliptical orbits may be used with eccentricities designed to maximise the dwell time over a particular region.

The nature of service or the constraints of the communications link often dictate the choice of an appropriate orbit. The mobile satellite communications satellite systems amply illustrate this. For instance, the choice of LEO could be influenced by the desire to minimise power in both the satellite and the mobile handset, reduce the antenna size, minimise time delay (latency) for a two-way signal, and maximise the angle of elevation.

MEO can be an excellent compromise between LEO and GEO. It still allows for a modest size antenna and relatively low power while keeping the latency small. Its chief advantages over LEO are significantly reduced numbers of satellites required for global coverage and a considerably longer dwell time.

GEO could still be a viable alternative for mobile telephone satellites. Its primary advantage is that it allows for a system to be built on a regional basis. With only one satellite, an entire country or geographical region can be served. There is however a trade-off on this, a two-way time delay can be over half a second and is quite perceptible. But people in areas under served by terrestrial telephone system may however be able to tolerate this drawback.

# 2.6.2 Multiple Access

Multiple access refers to the method by which many users share a common satellite resource. To achieve this, three primary methods are employed, namely: Frequency Division Multiple Access (FDMA), Time Division Multiple Access (TDMA), and Code Division Multiple Access (CDMA). To these, a new method called Demand Assigned Multiple Access (DAMA) may be added.

With FDMA each user obtains a dedicated portion of the spectrum which can be used for either analogue or digital signals.

In TDMA's case, users are assigned a time slot in a repetitive time frame. At the assigned time slot the stored data bits are burst (forwarded) to the satellite occupying the entire transponder bandwidth. TDMA is inherently digital due to the fact that bits are stored during the portion of time frame not assigned to the user.

The method employed by CDMA is by modulation of the signal to be transmitted into pseudo random noise (PRN) code. The magnitude of the code rate is several orders greater than the information bit rate. In this method users share the same spectrum and the code spreads the signal over the full bandwidth available. The receiver with a replica PRN code simultaneously modulates signals from all users. By simple auto-correlation the desired signal is then obtained, while all the unwanted signals are spread over the whole bandwidth and appear as 'white noise'.

Both conceptually and in terms of hardware required, FDMA is relatively simple. Since a satellite transponder is a non-linear device, for multiple carriers, this nonlinearity generates harmonics that produce inter-modulation interference among neighbouring channels. To mitigate this effect, a reduction in input power, termed 'backoff', is necessary in order to operate in the linear portion of the transponder output vs. input power characteristics so that inter-modulation is reduced to an acceptable level. (See Figure 6. below).

As for TDMA, backoff is not necessary, which is a major advantage since at any given time a single user occupies the whole bandwidth of the transponder. Consequently its output power is greater than with FDMA. TDMA also offers more flexibility in that with relatively simple changes to software user allocation can be changed.

In contrast, CDMA offers the potential of greater capacity. Other advantages are that CDMA mitigates interference and enhances data security.





Source: Via Satellite (October 1998)

#### 2.6.3 Bandwidth

There are numerous measures of bandwidth of which 'Noise bandwidth' is one and 'Occupied bandwidth' is another. The latter is the bandwidth required for the signal to pass through a band-limited filter. In an FDMA system, it is the occupied bandwidth that determines the system capacity. The occupied bandwidth is about 1.2 times the noise bandwidth.

A third measure of bandwidth is the null-to-null bandwidth. This is the width between the zeroes of the main spectral lobe. Other measures of bandwidth, such as the half-power bandwidth, are also used.

# 2.6.4 Frequency

Nelson, (1998) empahasised that important considerations need to be taken into account in the choice of frequency such as coverage area, gain and the antenna size. The gain of an antenna increases with increasing frequency for a fixed antenna size. On the other hand, the antenna gain is determined by the area coverage. The frequency is chosen on the basis of maximising the performance of the system and exploiting the portions of the electromagnetic spectrum that are available. Thus L-band (1.6 Ghz) is used because it is the lowest practical frequency that is available.

Another factor is the availability of spectrum. Initially C-band (6/4 Ghz) was used exclusively for the fixed satellite service. Later Ku-band (14/12 Ghz) was used both because it was a frequency domain that was available to expand capacity and because the higher frequency permits the use of smaller earth terminal antennas. However, more power is required to overcome the detrimental effects of rain.

New satellite systems for broadband applications are in various stages of development. These new systems will extend the frequency domain into Ka-band (30 Ghz) and V-band (50 Ghz). However, rain attenuation increases dramatically at these frequencies. At Ka-band the wavelength is 10 mm and the attenuation is 5 dB/km for 99.95% availability, whereas for C-band (6 Ghz) the wavelength is 50 mm but the attenuation per km of path is only about 0.1 dB/km for a maximum rain rate of 22 mm/h. At Ku-band (14 Ghz), the wavelength is 21 mm and the rain attenuation is 1 dB/km under the same conditions. At V-band the wavelength is only 6 mm but the corresponding attenuation is 9 dB/km. Thus it is obvious that attenuation (loss of signal) increases with broader frequency bands.

Without mitigating techniques, such as spatial diversity and switching to lower frequencies, the availability of such transmission will be in the neighbourhood of 98 or 99 % for any reasonable attenuation allowance.

# 2.6.5 Modulation

Modulation can either be analogue or digital. In analogue signals, the range of values of a modulated parameter is continuous. In terrestrial radio systems, for instance, AM and FM channels represent amplitude and frequency modulation, respectively.

# Nelson (1998) stated that:

By far the most common form of modulation in digital communication, is M-ary phase shift keying (PSK). With this method, a digital symbol is represented by one of M phase states of a sinusoidal carrier. For binary phase shift keying (BPSK), there are two phase states, 0° and 180°, that represent a binary one or zero. With quarternary phase shift keying (QPSK), there are four phase states representing the symbols 11, 10, 01, 00. Each symbol contains two bits. A QPSK modulator may be regarded as equivalent to two BPSK modulators out of phase by 90°. For M-ary PSK, the noise bandwidth is equal to the information bit rate divided by the number of bits per symbol. Thus for uncoded BPSK modulation, the noise bandwidth is equal to the information bit rate. The null-to-null bandwidth is twice the noise bandwidth in each case.

# 2.6.6 Coding

The code rate is the ratio of information bits to the number of coded bits. There are two types of codes used: block codes and convolutional codes. In a block code a group of information bits are accepted as a block encoder and parity bits are added to form a code word.

In a convolutional code, bits are continuously added to a shift register and affect the formation of coded symbols over several bit periods. The number of bit periods that a given bit occupies the shift register is called the constraint length. The optimum method of decoding employs the Viterbi algorithm.

Coding reduces power at the expense of increased bandwidth. For example, a rate of 1/2 code doubles the required bandwidth. Thus the bandwidth of a rate 1/2 coded signal using QPSK modulation is equal to the bandwidth of an uncoded signal using BPSK modulation.

# 2.6.7 Bit Rate

The information bit rate is determined by the service or activity to be supported by the communications link. The available carrier to noise density ratio (C/N $_{\odot}$ ) provided on either uplink or downlink is determined by the transmitter equivalent isotropic radiated power (EIRP), the receiver figure of merit G/T, the free space loss, impairments due to rain, any losses, and various forms of interference. The given EIRP and G/T will determine the bit rate that the link can support.

# 2.6.8 Conclusion

'The design of a satellite communications system involves a wide variety of alternatives and trade-offs. Often a particular set of choices will reflect a particular design philosophy or experience in some other field of communication. The mobile telephony systems illustrate how different designs can be adopted to achieve similar objectives', said Nelson (1998). These various technical possibilities make it a never ending challenge to satellite engineers and continuously fascinate the satellite enthusiasts.

#### 2.7 Birds in Flight - Commercial Communications Satellites in Orbit

More than any other telecommunications technology, satellites are capable of providing ubiquitous coverage on a non-discriminatory basis. The satellite industry has become the undeniable commercial success story of the Space Age. Though its history had been marred by some devastating failures, recent successful launches have fired the rockets of imagination and corollary innovations fuelling its explosive development from an evolutionary pace to a revolutionary one.

A growing number of satellites is now blanketing the space providing broader coverage to almost every nook and cranny on the face of the earth. Satellites already do and will continue to provide backbone telecommunications connectivity around the world. These dramatic developments and trends have tremendous implications for seafarers both personally and, even more so, professionally.

The current capability of ships to access aboard almost any information ashore even in the high seas poses new and exciting opportunities for onboard learning. To see the breadth and depth of the technological impact on the maritime environment, and maritime education and training in particular, it is useful to take a cursive look at the satellite industry at large.

#### 2.7.1 The Big Birds - Major Players in the Satellite Industry

**INMARSAT:** The International Maritime Satellite Organisation (INMARSAT) is a global consortium with 84 member-countries. It is the only satellite system to be owned and controlled by states from the West, the Eastern Block and the Third World. It is a major component of the Global Maritime Distress and Safety System

(GMDSS). From its inception, intended to serve the maritime community, it has since evolved to become the sole provider of global mobile communications for commercial and distress and safety applications, at sea, on the air and on land. It is its GMDSS function that provided it with a *de facto* monopoly of the marine satellite industry and engendered its dominance since its establishment in 1979.

INMARSAT has three major components: the space segment, the Coast Earth Station (CES), and the Ship Earth Station (SES). The space segment is a constellation of four geo-stationary satellites some 36,000 km. above the equator. The INMARSAT 3 spacecraft utilises spot beam technology which allows reuse of the radio frequency spectrum and inter-system co-ordination. Its virtual global coverage spans four ocean regions: Atlantic Ocean Region - East (AOR-E), Atlantic Ocean Region - West (AOR-W), Pacific Ocean Region (POR), and the Indian Ocean Region (IOR).

On the other hand, the Coast Earth Station (CES) is a land-based facility providing the link between the satellite and terrestrial telecommunications networks. It consists mainly of a parabolic antenna for transmission of its own signal and for receiving signals from satellites. It has also the capability to transmit and receive signals from other land-based facilities.

The Ship Earth Station (SES) is an on-board terminal of which there are three basic types: Inmarsat-A, Inmarsat-B, and Inmarsat-C. From these three basic facilities and a number of other non-GMDSS compliant pieces of equipment, INMARSAT is capable of providing a range of services. These include direct-dial phone, telex, fax, electronic mail and data connections for maritime applications; flight-deck voice and data, automatic position and status reporting, direct-dial passenger telephone, fax and data communication from aircraft; and in-vehicle and transportable phone, fax and two-way communications, and fleet management for land transport. INMARSAT is used for disaster and emergency communications and by the media for news

reporting from areas where communications would otherwise be difficult or impossible. Systems are also available for temporary or fixed operation in areas beyond the reach of normal communications, (Wortham, 1998).

INMARSAT's dominance is not destined to remain unchallenged forever. The juggernaut of globalisation and economic liberation has forced it to tread down the path of privatisation. INMARSAT is now poised on the 'brink of a [fundamental] transformation - from an inter-governmental body with a clear mandate to provide distress and safety services into a private company with the unmistakable objective to make money for its shareholders', (*Compuship*, February 1999).

Today numerous existing and emerging satcoms are set to challenge INMARSAT and test its mettle even right on the sphere of its dominance, its distress and safety function in GMDSS. These companies are targeting the shipping industry with their global satcom services and so are outspoken about developing a distress and safety capability of some kind. In fact, SP Radio and Skanti are currently selling maritime versions of dual-feed Iridium terminals featuring a conspicuous BIG RED BUTTON for its distress alerting function, thereby encroaching what used to be the exclusive domain of INMARSAT.

The volatile world of global communications has spawned new birds for satcom in the maritime arena, as well as on many other fields. These fledglings are set to grow and fly sky-high. A number of these existing and emerging satcoms are briefly described below.

**Iridium:** Among the new and emerging challengers, Iridium is the most potent. It has successfully completed launching its 72-satellite (66 operational and 6 spares) low earth orbiting (LEO) constellation designed to provide handheld/satellite telephony services. These satellites are in polar orbits at an altitude of 780 km. The system is designed for continuous global coverage using FDMA /TDMA. Iridium

satellites are 'intelligent' with capability for extensive onboard processing which enables them to route calls through the constellation via inter-satellite links. Each satellite has an approximate capacity of 1,100 simultaneous users. With this technological capability, Iridium launched the world's first terrestrial and satellite hybrid cellphone currently on the market today.

New maritime Iridium terminals have a conspicuous big, red distress button. Pressing that big, red button will place a telephone call to the designated RCC. Iridium defined the boundaries of the 'cells' used by the system in determining the location of individual terminals on the earth's surface to coincide with the boundaries of the IMO's Search and Rescue regions. Though Iridium's GMDSS position remains unclear, the bold step it has recently taken is a clear signal to challenge INMARSAT.

**Globalstar:** Globalstar will employ a constellation of 48 LEO satellites in inclined orbits at 52° at an altitude of 1,406 km. So far it had completed launching eight satellites in low earth orbit as of July 1998. This system uses a combination of FDMA and channelised CDMA. Coverage is concentrated over the temperate regions of the earth from 70°S to 70°N. It uses a technique called spatial diversity, wherein signals received simultaneously from two satellites are combined in the receiver to mitigate losses due to blockage and multipath effects. The inclined nonpolar orbit constellation ensures that at least two satellites are visible at all times, (Nelson, 1998).

**ICO:** The acronym ICO is derived from the term 'intermediate circular orbit' which is technically synonymous with medium earth orbit, MEO. ICO is the third major challenger in the mobile telephony satellite entry. It is in many ways a successor to INMARSAT. It grew out of Inmarsat's 'Project 21' and boasts many ex-Inmarsat engineers and administrators on its staff, (*Compuship*,October/Novovember 1998). Once completed, this system will consist of 10 (plus 2 spares) MEO operational satellites at an altitude of 10,355 km. ICO has ordered 12 Hughes Space and

Communications-built satellites and intends to use four different boosters to put at least 10 of them in orbit by 2000, (*Via Satellite*, January 1999). MEO, being an excellent compromise between LEO and GEO, will enable ICO to launch fewer satellites with global coverage. The system also affords to keep the antenna to a modest size, including its power requirement while keeping the latency small. Like Iridium, it uses a combination of TDMA and FDMA. ICO is designed to support at least 4,500 telephone channels. ICO will use a new generation of pocket-sized dual mode mobile phones capable of roaming between ICO's satellite system and cellular networks worldwide.

**Intelsat**: Intelsat is an organisation with a treaty-based structure similar to INMARSAT. It is the biggest player in terms of capacity in Latin America. It has 10 spacecraft carrying two hundred eighty 36-Mhz-equivalent C-band transponders and thirty-five 36-Mhz Ku-band transponders that provide advanced communications services in the region. Its new IS 805 satellite, for instance, provides high-power C-band coverage throughout North and South America from which signals can be uplinked or downlinked throughout the Americas and Europe. 'Intelsat', says Boecke, 'provides a full array of services from telephony to television distribution, from private networking to **distance education** [author's emphasis]', (*Via Satellite*, November 1998, p.50).

Intelsat's space segment also dominates the African market, and 42 African signatories have invested \$150 million in Intelsat. The organisation handles approximately 60 to 70 percent of Africa's international telephony traffic via its satellites, (Bachabi, 1998). Of Intelsat's fleet of twenty, 12 satellites are beamed down to roughly 1000 earth stations in Africa. Six of these satellites carry Internet traffic to 40 African countries, including the '@intelsat' Internet Service which service between 64 kbps and 2 Mbps.

Via Satellite (August 1998, p. 26) said that according to Fabrice Langreney, WLL (Wireless Local Loop) project manager for Intelsat's advanced programs and

systems group, 'Senegal is scheduled to become the site for a significant test using demand assigned multiple access (DAMA) VSATs (Very Small Aperture Terminal) and digital enhanced cordless telecommunication technology (DECT) and WLL technology'. Intelsat had also conducted DAMA VSAT tests in Peru using global beams on Intelsat 603. Tapping the hemi beams from the same satellite will enable Intelsat to operate smaller dishes at higher EIRP and G/T.

**Panamasat:** The most established and by far the biggest private, commercial player in Latin America. Panamasat has five satellites serving the region. Its strategy of dealing directly with end users for end-to-end services, instead of working through signatories like Intelsat, has paid off. Now 'Panamasat', says Cynthia Boeck, editor of *Via Satellite* (November 1998, p. 52), 'is the largest operator of "hot birds" that aggregate large numbers of television networks for cable and TV distribution on a single satellite. It is also home to Latin American DTH (Direct to Home) platforms, Galaxy Latin America and Sky Latin America'. Its broadcast customers include Turner Broadcasting, Time Warner, Disney, Discovery, Viacom, and other U.S. programmers who are reaching Latin America, as well as the largest and most well-known Latin American broadcasters like Globo, Televisa, the Cisneros group, Artear and others.

**Loral Satmex:** Loral Space and Communications won an auction and acquired a 75% stake in Satelites Mexicanos (Satmex) last October 1997 in Mexico's Communications and Transport Ministry's bid to privatise its satellite operations. Satmex is transforming itself into a regional satellite operator. It is now adopting a number of more customer-oriented, commercial marketing and sales strategies. The company aims to shed its image as a state-run entity and to garner a larger share of the market outside its traditional Mexican base operations.

Satmex's asset consists of three operating satellites. An additional satellite, Satmex 5, is under construction, will provide extensive coverage of North and South

America, encompassing an area from Canada to Argentina.

**Nahuelsat:** Nahuelsat has only one satellite, Nahuel 1, which covers Latin America with special emphasis on Argentina. It has a variety of customers ranging from telephone operators, DTH operators, TV networks and VSAT network operators. It now has a customer base outside its home country covering Uruguay, Chile, Paraguay, Brazil and other countries.

**Brasilsat:** Brazil has currently 3 spacecraft and a fourth one under procurement. According to the Satellite Industry Association (SIA), the Brazilian government plans to conduct auctions for licences to provide fixed satellite services (FSS) in early 1999. This would give way for a second domestic satellite system that would compete with the current monopoly provider Embatrel and its Brasilsat system.

**Orbcomm:** Orbcomm is a forerunner of the little LEO front. It has already placed 12 satellites in orbit to form the basis of a low-data rate, store-and-forward satellite constellation.

**Teledesic:** Dubbed as the 'Internet in the Sky' is among the latest technological advances and innovations. It will use 288 satellites that will allow seafarers to roam the Internet. This further boosts the potential to provide access to distance education programs and leisure pursuits for the mariners at sea (Muirhead, 1998).

# 2.7.2 Other Birds Over the Horizon

The satellite industry is teeming with life. A host of other smaller and lesser-known companies are in the offing. They are too numerous that space will not allow mentioning them all. Some of them are listed below:

• Hispasat - provides transatlantic linkage between Spain and Latin America.

- Columbia Communications a U.S. entrepreneurial satellite operator, acquired rights to operate Intelsat 515 satellite, renamed Columbia 515.
- Loral Orion will be launching its Orion 2 satellite by mid-1999 with 38 Kuband transponders which work well with small receiving dishes for rooftop-torooftop communications. It is best suited for a variety of telecommunications services from data and Internet applications to video, including DTH. Its sought after services are Internet services, including ISP connectivity, value-added services for ISPs, IP telephony and voice services.
- Telesat Canada has technical consulting business that presides over the construction and launch of satellites for various organisations around the world. It is aggressively expanding its satellite fleet to provide coverage in North and South America. Its Anik F satellite, under construction, sets new records in size and power. The massive satellite will carry 84 transponders. Twelve C-band and sixteen Ku-band transponder will serve South America. One of its key markets is Pan-American Internet delivery and video distribution.
- New Skies A spin-off company of Intelsat in its move towards privatisation. Intelsat will transfer six satellites to New Skies.
- ECCO is a satellite mobile telephony system utilising a circular orbit constellation in the equatorial plane designed for communications in the tropical regions.
- Ellipso employs elliptical orbits to maximise coverage over the Northern Hemisphere.
- Asiasat a Hong Kong based satcom provider.
- Agila The Philippines' flying eagle operated by Mabuhay Satellite Corporation is the one and only privately owned and operated satellite in the country.

Satellite technology is continually evolving. Research and development activities are geared towards producing faster and more cost-effective means for data transmission. This has resulted in improved broader global coverage and access to the Internet, e-mail, and the World Wide Web even for seafarers at sea.

It is therefore evident from the foregoing that new satellite technology is opening up numerous opportunities for new educational approaches. One could thus conclude that never in the annals of maritime education has the optimism for its future and potential been greater. Likewise, at no other time in its history has the satellite industry been more vibrant. When the much-vaunted Iridium system finally went into operation, it heralded the advent of the world's second global mobile satellite communications network. This, among many other developments, illustrates the kind of exciting trends rife with potential waiting to be tapped by the world business community, scientific societies, educational institutions and, not the least, the maritime industry and the mariners themselves.

# Chapter 3

# **Distance Learning Methodologies**

The launching of Sputnik 1 on the 4th of October 1957 heralded the explosive development of sophisticated satellite technology stimulated by the desire to reach and exploit 'space'. The impact of that technology now touches people's individual daily lives at every turn, whether it be communications, computers, or even education, (Sweeting, 1991). This, in tandem with the global revolution in Information Technology (IT) is transforming the concept of conventional/traditional education in general, and maritime education in particular, in quite dramatic ways.

Modern ships of today are increasingly computerised. They are equipped with integrated bridge systems, sophisticated communications facilities, even a local area network (LAN) on board. 'The growing availability of computers on board ship for operational needs opens new avenues for learning and skill acquisition,' (Muirhead, 1995).

The communications revolution launched by Guglielmo Marconi in 1895 continues to this day especially in the field of wireless communication. The maritime community enthusiastically embraced this extra convenience. When the system was used to save lives at sea, it quickly earned a place in the hearts of mariners the world over. From these early devices, considered primitive by today's standards, hardly anyone foresaw the speed with which the spectacular growth of mobile communications in the latter part of the 20th century. With cost coming down and technology improving, it was only a matter of time before we cut off the umbilical cord of the telephone. Being tethered to a fixed location in order to communicate is simply not the way people have done it in the past thousands of years. Man is mobile and he is a communicator. More often than not, he is both at the same time, (Wortham, 1988).

Mobile communications, more than any other technique, imitate the way people communicate naturally. Now that the technology has developed to the point where it provides increasingly cost-effective service, a general migration from fixed to mobile services is inevitable.

The mobile and isolated nature of ships far away from land makes it a pressing necessity to establish communications links with their head offices, as well as family and friends, ashore. Due to this fact it is no wonder then that

A recurring theme in maritime software development has been the concept of the modern ship as a floating office. Onboard computing systems are no longer limited to stand-alone engineering and navigational applications. There is a widely recognised need for vessels to become integral parts of shipping companies' computing and communications networks, (Christian, 1995).

Ships are being transformed into 'virtual' floating branch offices. And, as shore-based businesses depend upon smooth flow of data through their head offices to branch office computer networks, so now do ships.

As ships spend 80% of their time on the high seas thousands of miles away, the

obvious way to bridge the gap is via satellite communications.

Legislation and commercial pressures', said David Favre of Vancouverbased Rydex Industries, 'have conspired to make it necessary for all ocean-going vessels to be an inherent part of the corporate information network, treating information as a corporate resource.

The introduction of the 1988 Amendments to the International Convention for the Safety of Life at Sea (SOLAS) 1974, making the Global Maritime Distress and Safety System (GMDSS) mandatory to all ships by 1st February 1999, is probably part of such 'conspiracy'.

GMDSS is a more efficient system for distress and safety communications at sea. The satellite communications capability offered by INMARSAT and the distress alerting capability offered by COSPAS-SARSAT play a major role in the GMDSS. But the key to the system as a whole is the fact that it is based on automated radio communications systems, both terrestrial and satellite.

Despite the fact that most of the emphasis is laid on communication for times of emergency, the creators of GMDSS also took into account and made provisions for ships' normal business needs under the functional requirement of 'general radio communications'.

This provision for general radio communications via the INMARSAT's system space segment consisting of the satellites; the Coast Earth Station (CES), a landbased facility providing links between satellite and terrestrial communications networks (consisting mainly of a parabolic antenna) and the Ship Earth Station (SES), which is an on board ship facility, provides the gateway through which distance learning could be

## facilitated.

Distance learning, by definition, is 'An instructional system in which the learner is separated from the institution organising the instruction by space and time', United Nations Educational, Scientific, and Cultural Organisation (UNESCO, 1987).

Rowntree (1992) puts it more clearly as 'learning while at a distance from one's teacher, usually with the help of pre-recorded, packaged learning "materials" '. A variety of communications medium is utilised in this mode of learning such as print, broadcast (radio or TV), microcomputers, computer networks (LAN, WAN or Internet) and satellite communications, Chou, et. al (1996) and UNESCO (1987).

'The basic characteristics in the concept of distance learning are the application of adapted teaching methods, utilised in educating students outside and away from traditional learning institution, being effected through a communications medium', (Huggins, 1998). It integrates the role of teacher, student and the current available communications technology. In this set up, a large measure of responsibility is placed on the student to learn and understand on his/her own, though with the remote support of the teacher/institution organising the programme.

Distance learning consists of professionally developed and structurally designed learning units with built-in teaching and learning mechanisms. These typically consist of a unit guide, a study guide, supplemented by a readings book. A textbook, computer software, video or audio-tapes may further support it. Teleconferencing, video conferencing and occasional on-campus attendance may be part of the total learning programme.

However, for shipboard personnel at sea direct access to the tutor is impossible but

this is no longer so now, thanks to the advances in satellite communications. A student at sea can send his/her assignment electronically, have it corrected and marked by the tutor ashore within a short period of time. Queries can have almost immediate response by fax, telex, telephone or e-mail.

With the continuing development and installation of increasingly sophisticated maritime technology demands for high levels of knowledge and skills from onboard personnel are necessary. This is further compounded by the requirements of STCW'95, which put a premium on competency based training of seafarers.

Distance learning with the mariner at sea utilising satellite technology gives seafarers access to the teacher at the institution ashore. CD-ROM and CD-I, such as the ones developed by Seagull and Videotel, provide excellent educational support.

Modern educational techniques such as computer-based training (CBT), computer aided learning (CAL), PC-based simulation, interactive CD (CD-I) are part of a comprehensive and high-tech distance learning programme which could bridge the gap between sophisticated shipboard systems and the manpower available to run them.

By distance learning methods and through satellite and computer networks medium transfer of many practical training programmes on board are now possible. This has the potential of raising the level of knowledge and skill that are appropriate to the changing needs of the workplace (Muirhead, 1995). Shipping companies and operators could thus be assured that their crews are provided with appropriate training to carry out the tasks assigned to them without ever leaving the workplace, the ship.

The availability of Inmarsat-A duplex high-speed data (HSD) allows for multimedia transmissions (video, voice, and data) to be used without interference from

atmospheric conditions.

The current generation of synchronous modems enables data to be exchanged between ships and shore at a raw transfer rate of 9,600 bits per second. This equates to 1,200 characters per second. As a typical page text of information consists of about 2,500 characters, it means transmission will only take two seconds per page. Though still rather slow, it is cost-effective enough for transmitting short messages, such as instructions regarding an assignment to be completed.

This is a very good development in favour of distance learning, which requires some kind of interaction between teacher and student from time to time.

As early as 1995, INMARSAT adapted the Lotus cc: Mail and Microsoft MS Mail email systems. It was billed as the world's first 'off the shelf' e-mail service for shipping. This is packaged as 'Satmail'. All that is required to run it is a PC with either cc: Mail or MS Mail installed and a v.34 modem on board and in the office.

The service operates initially over Inmarsat-A, Inmarsat-C and later with Imarsat-B and Inmarsat-M. This implies that companies can contact their mobiles with e-mail using the same software as they would for exchanging information with different offices in another city or country, (British Telecom, 1995).

This e-mail modem could be a cheaper alternative means of transmitting data for distance learning.

Another development, which has a bearing on distance learning, is Magnavox's Communications Integrator. It is a programmable call routeing device that optimises voice, fax and data communications integrating INMARSAT, VSAT, cellular, DSC

radio and land lines into a seamless communications system. It automatically routes out-going calls through the most cost-effective medium, based on tariff data stored in its memory, which could be updated. With this device, Magnavox claims, customers can expect savings of 30% or more. Surely, this has the potential of bringing down the cost of distance learning at sea.

Some of the difficulties associated with the Inmarsat-C data and messaging system is incompatibility. All the main land earth station (LES) systems manufacturers (ABB, Nera, Hughes, Comsat, Thrane and Thrane and NEC) have their own protocols and approaches to packaging, addressing and delivering the messaging services they supply. Mobile Earth Station (MES) manufacturers show similar divergence. INMARSAT is seeking to redress it. It is developing an Applications Programming Interface (API). This is, essentially, a messaging model for data communications. When a message is sent across either a local or wide area network or modem link, it follows a standard messaging exchange protocol, allowing the recipient's computer to understand how the transmitted data is being packaged and addressed.

INMARSAT is creating an API for Inmarsat-C satellite communication based on CMC (Common Messaging Call). Allied with this effort is the 'On Air API Software Developers Kit' or SDK. This is a 'toolbox' of communication protocols and packaging aids that includes a standard interface for all Inmarsat-C land earth station. Once the project is completed, the API will make the hardware portion of the Inmarsat-C system irrelevant. Which terminal model a ship has will no longer matter. This means that ship managers ashore will be able to exchange files with the ship in any suitably written software application.

This development augurs well with MET institutions offering distance learning to mariners aboard ship. This will further facilitate the communications flow and boost the effectiveness of distance learning programmes.

Equipping maritime institutions to handle e-mail for distance learning will substantially reduce communications costs. Savings derived from this could help recover initial installation cost for new equipment within a year or less. Captain Lars Brödje (1994), then senior adviser of INMARSAT, suggested some of the means by which savings could be generated as follows:

- using cheaper data communications instead of fax or telex
- reducing connection time by data compression
- pre-program transmission to take place during 'off peak' period
- avoiding expensive international land line charges by using local e-mail access point

Shore-based bound users, like MET institutions, traditionally have had to accept the routeing provided by the national telecommunications which decide the user charges. The user usually ends up paying substantially higher rate for messages to a vessel than the other way around. Conversely, by letting the vessel initiate the call, instead of the MET institution ashore, the cost can be reduced by 30-40%. By calling on 'off-peak hours', a further reduction could be achieved, thus reducing cost by at least 50%, (Brödje, 1994).

Effective distance learning at sea is likely to include a full range of teaching methods, teaching aids to include CAL, CBT, audio and video presentation, teleconferencing and video conferencing. However, to send and receive pictures with standard TV quality requires a data speed of several megabytes per second and is not economically feasible. The solution is to use compressed video via an INMARSAT HSD channel. Slow scan video pictures can be transmitted from a vessel to an INMARSAT CES. From the CES the signal is to be carried via an ISDN (Integrated Switch Digital
Network) connection as standard telephone line cannot handle HSD. Though compressed video is not comparable in quality with standard TV, it is often sufficient to meet the desired learning objectives at a reasonable cost.

The confluence of all these regulatory requirements (SOLAS, STCW'95), technological advances in mobile satellite communications, IT revolution and more cost-effective means of communications have conspired to make distance learning, via the INMARSAT and other satcom systems, not only technologically feasible, but also economically viable. Thus the ship could now be transformed not just into a floating branch office, but even more so as a 'virtual classroom afloat'. This then will set the trend of maritime education and training in the 21st century.

# **Chapter 4**

# Research into the Onboard Training Environment Utilising Existing and Emerging Simulation Technologies

### 4.1 Norwegian Research Project

To improve competitiveness in the highly competitive world of the latter part of the 20th Century, particularly in the shipping industry, Norway had undertaken a grand research project involving various shipping companies, training and research institutes, leading marine applications software developers, simulator manufacturers and even the Norwegian Maritime Directorate (NMD). The research project was christened 'Information Technology in Ship Operation Programme'.

The project aimed at developing new operating concepts and information systems, in close co-operation with equipment suppliers, classification societies and authorities. In particular it explored the following areas:

- Information exchange and decision support
- Qualification and training
- New and flexible organisational structures
- Extended suppliers' services and support
- Strengthening the flag state regime

• Extended classification services

For purposes of brevity and owing to the confidential nature of some of the research findings, this paper will narrow its focus on the aspect of qualification and training.

Project B2 was a sub-part of the overall research programme focusing on 'Training, Recruitment and Selection', which is incidentally its official title. The objectives of the 'Training, Recruitment and Selection' project are to develop tools for competence assessment and to implement an improved training system based on the result of individual assessment. The enhanced training system is based on the functional approach used in the revised STCW and utilises computer based training to enable employees to satisfy general and company specific competence requirements.

Under this sub-project were a number of tasks such as Improved Training System, aimed at developing an iterative company specific Competence Development System based on iterative re-training principles used in land-based industries. A prototype system where onboard use of computer-based training (CBT) modules played an important part in this task, was installed on three vessels operated by Red Band in March 1997, (MARINTEK, 1998).

The training tools used in this study were CBT modules developed by MARINTEK and Seagull. MARINTEK developed ship specific safety modules for tankers operated by Red Band and a bulk carrier belonging to T. Klaveness. Seagull on her part produced 9 modules covering safety and operation related topics. Seagull and MARINTEK collaborated with Ulstein Bergen to develop a CBT for daily maintenance of an Ulstein Bergen diesel engine. This application integrated CBT and documentation, and can be used for both training and as reference book. Most of these CBT's are available as part of Seagull's CBT 2000 system.

Bona Shipping, on the other hand, chaired a group of project participants in a task to develop ability and performance profile assessment tools. This culminated in what is called APRO (<u>A</u>bility <u>Pro</u>file) and consists of a set of seven psychological tests. To generate data for validation and normalising of test results, over 4000 persons have used the system. As an improvement of the existing Captain's Report form, a second tool, PPRO (<u>P</u>erformance <u>Pro</u>file) was developed. PPRO consists of sets of questions divided into four main topics, namely: attitude-initiative, leadership, administrative skills and professional skills. Various sets of questions were developed corresponding to different levels, from cadet to senior deck/engine officers. The system was piloted on board Bona vessels. It has two parts, a data collection part on board the vessel and the data analysis component at the shipping company's office.

With regard to Seagull's question database CES 2000, shipowners, maritime education and training centres and the Norwegian Maritime Directorate (NMD) have taken part in the validation activities. Its validation outcome was eventually utilised to improve the CES 2000 system.

The project's output resulted in the development of training tools such as the following:

- Training Supervision Basic Introduction Course a one-day course for training supervisors and instructors aimed at providing a comprehensive introduction to ISM Code and STCW Convention.
- In-service Assessor Training Course a two-day course for training supervisors and assessors covering the functions of an assessor, planning and evaluation of learning processes and in-service assessment methods.

Since both the revised STCW Convention and the ISM Code are placing greater responsibility on shipping companies to ensure that their ships are manned by qualified and competent crews, it behoves then for shipping management to focus on cost-efficient and auditable competence systems to be developed for their own benefit.

So improving the training and assessment system was an obvious solution. Where individual competence was found wanting, a company specific training system was designed to remedy the deficiency, i.e. gaps between company specific competence requirements and individual competence.

As a result MARINTEK, on behalf of Red Band, developed a cyclic company specific training system. This focused on training on the seven functions of the STCW Code on a periodic basis. A matrix was developed for each position and the corresponding mandatory and company policy training activities as shown in Table 3.

Period	1, 4, 7	2, 5, 8	3, 6, 9
Position			
Senior officer - deck	Controlling the operation/	Cargo handling	Navigation/Radio
	care		
	for persons on board		communication
Junior officer -deck	Controlling the operation/	Cargo handling	Navigation/Radio
	care		
	for persons on board		communication
Rating - deck	Controlling the operation/	Cargo handling	
	care for persons on board		
Senior officer - Eng.	Controlling the operation/	Marine	Electrical/electronic
	care for persons on board	engineering/	/control engineering
		maintenance &	
		repair	

### **Table 3. Training Matrix**

Source: MARINTEK (1998)

Relative to the above-mentioned training, different types of assessment tools were also created designed to facilitate documentation as proof that employees had met international minimum or company specific standards of competence.

Noteworthy on this training system is the extensive on-board use of CBT's. Mostly these were modules of Seagull's CBT 2000 system. The experience gained and lessons learned from this research proved the effectiveness and efficiency of CBT's for training and documentation of training outcome and the ease with which trainees' progress could be monitored.

### 4.2 <u>Onboard PC-based Simulation - The Anglo-Eastern Ship Management</u> <u>Experience</u>

The Norwegian project has parallels, albeit in a different dimension, in the experience of Anglo-Eastern Ship Management, a Hong Kong and India based international shipping company, in using PC Maritime's computer based training (CBT) simulator onboard working vessels, (Spalding, 1998).

A training needs analysis (TNA), similar to what the Norwegians did, was done by the company's marine superintendent. Based on his findings he implemented a training schedule to meet individual requirements of each crew. A PC-based simulator was utilised to enhance and record the training undertaken and the results gained.

This same superintendent carried out his various tasks including ship management and navigation audits boarding each ship in his fleet. While onboard for about two weeks, he also carried out navigation training. Out of his own initiative he developed a special training module entitled: 'The Enhanced Onboard Training Package'. He used PC Maritime's award-winning 'Officer-of-the-Watch' PC-based simulator. He then added a number of exercises on basic watchkeeping, which became more complicated as the cadets progressed.

As for the junior officers, more advanced exercises were provided. In one of these, they have to get a sweat on manoeuvring a VLCC into the harbour without tugs. This provided them with an 'experience' and an appreciation of the rigors of ship handling.

Similar to the CBT's in the Norwegian project, the logging facilities of this simulator were of particular value. Examining the simulator's performance analysis graph after an exercise enabled the superintendent to see what the students/cadets had been doing and find out deficiencies in their watchkeeping practice. Thus it makes a very valuable assessment tool as well.

Anglo-Eastern's growth from 15-20 ships to over 70 placed increased demands on their training activities so much so that they even established a training centre in one of its home bases.

Traditionally Anglo-Eastern carried out skill assessment over long periods of time by senior officers and self training by the student, from observation of his peers in line with STCW 95's emphasis on skills. This method however became increasingly difficult with the reduction of seagoing staff and quick turnaround times.

Conventional simulation in land-based facilities at maritime colleges or training centres, while effective, requires the crew over long periods to be away from the ship while attending courses.

A low-cost PC-based simulator, like the 'Officer-of-the-Watch', provides the answer to this crew-training dilemma. This simulator is intended for watchkeeping and collision avoidance. With its built-in 'expert system', which provides advice to students as well as control of the target ships, the necessity of an onboard instructor is negated.

The training programme the company has set up led Peter Cremers, Anglo Eastern's Managing Director, to comment that: 'this programme allows us to carry out on board interactive training that has been proven to improve bridge procedures and officers' performance in an efficient and cost-effective manner', (Spalding, 1997).

The OOW simulator, as attested by its Managing Director, enabled the company to meet the objectives set in the IMO Model Courses for deck officers as well as STCW 95 requirements.

With the application of modern technology, Anglo-Eastern is able to maintain a high level of training. Its marine superintendents based in Hong Kong maintained all training record books. Each trainee, ranging from cadet to master, is assessed and training materials are allocated as needed. The training they offer either comes from the stock of IMO based course materials that come with the OOW or are themselves created by the superintendents using the OOW Course Designer.

Once the training packages are prepared, Spalding (1997) explained:

The courses are then sent to specific students via satellite link and are automatically downloaded onto the ship's PC, complete with instructions and course timetables. When the course material is completed the results are sent back to Hong Kong via satellite where they are assessed and students are de-briefed and set new simulation tasks according to their needs. The results are recorded against the individual's employment records.

The above example demonstrates what can be achieved through shipboard training using PC-based simulators and CBT's. Acomarit and Northern Management are two

other companies known to have employed OOW in this type of training.

Needless to say that in the foregoing example the 'expert system' plays a pivotal role in onboard training programme. 'The "expert system", says Spalding (1997), 'is the key to the whole issue of distance learning onboard'.

#### 4.3 Advantages of Onboard Simulation and Computer Based Training (CBT)

While it is true that there is no substitute for the real thing and undoubtedly the best method of training for seafarers is still actual sea experience, nevertheless simulation, particularly onboard simulation, still offers some unique advantages. Paffett (1981) identified five of them. First, simulation saves money. A simulator, particularly PCbased simulator, is much cheaper than a ship, and far cheaper to run. Second, simulation saves time; one doesn't need hours or days in a training ship getting to the exercise area and back again afterwards. Nor does it need to divert a working ship from its normal route; the computer puts you at the right area at once. Third, with a simulator conditions are completely under control. If the instructor wants restricted visibility, a strong tidal current and two ships in a fairway he puts them there. Thus precisely designed exercises tailor made to suit the company, or even ship specific requirements, are easily attainable. Fourth, conditions are exactly repeatable. An exercise can be wound back and run again from any chosen point if necessary to drive home a particular lesson. The simulator's repeatability also allows performance of different groups under identical inputs to be compared. This makes the simulator a powerful examining and assessment tool. Fifth, the simulator, above all, is safe. Crews can be taken through exercises, which would be completely inadmissible in the real world. They can be allowed to run aground, collide with other ships without any injury except to their ego. Emergency and near disaster drills can be repeated until the correct response becomes automatic. Thus a lifetime experience of navigational crises can be compressed into a week's course.

With a PC-based simulator onboard, as Spalding (1997) had pointed out, there are added advantages. It provides ample opportunity for the seafarer/trainee to undertake training at his own pace while at sea. As for the shipowner, he can save travel costs, as he need not send his crew to a training establishment ashore. Therefore the ship's normal operation will not be hampered by the absence of some of its crew undergoing shore-based training. Neither will it be adversely affected by new, inexperienced emergency replacements onboard for those who are undertaking land-based training. Focused and structured training aimed at bridging the gap between the job performance requirements and what the seafarer can actually do, can be easily designed even right onboard the ship.

Since PC-based simulators cost only a fraction, about 1/10th or less, of their 'big brother' simulators ashore, they are cost-effective and therefore affordable to most companies.

As already mentioned before, 'simulation is the next best thing to actually doing the job, without the risk of placing a vessel, people or environment in jeopardy', said Spalding (1997).

### 4.4 Requirements for an Effective Shipboard Simulator

Simulators are not created equal. Not all can perform equally well in the same task for which they were designed. There are myriad of PC-based simulators available today and the market is flooded with them. So it is vitally important to set criteria by which these simulators will be evaluated and judged suitable or not for onboard simulation training. Spalding set these criteria as follows:

• Ease of use - It should be easy to use not just by experienced mariners, but even by the novice, the young, inexperienced cadet. The user interface should ideally be intuitive and icon-based to overcome language deficiency.

- Availability of a built-in 'expert system' to allow for effective operation without an instructor.
- Should be able to motivate and provide a stimulating learning environment for the learner. It should integrate the principles of 'discovery learning' to allow students to learn from their mistakes. It should direct the student's attention towards learning so that the simulation exercise does not degenerate into 'play'.
- Flexibility It must be capable of addressing a wide variety of training issues and various levels of competence from cadets to captain.
- Playback, Feedback and Assessment Capability It must be able to provide feedback, de-briefing and assessment reports as well as replay and review facilities.
- Cost-effectiveness It must be affordable to shipping companies with tightly controlled budgets and be effective in meeting training objectives.
- Compatibility with modest standard computers It must perform just as effectively even with inexpensive, low-end computer hardware, if possible.

The above criteria are a helpful guide in the company's choice for the most suitable type of simulator for its fleet as well as for training establishments.

One however should not be misled into thinking that only watchkeeping and bridge procedures need reinforcement at sea. There is a host of training software addressing various training and competency requirements. What is important is that they must meet, as appropriate, the seven functions set forth by Part A of STCW 95 as a minimum. This was precisely what was targeted by the Norwegian project and hoped to have been accomplished, if not exceeded. Then in addition, company and ship specific requirements could be addressed.

Other specific areas for shipboard training and practice are stability, loading and cargo stowage, engineering, bunkering, fuel separators, COLREG, passage planning,

SAR, emergency procedures, IGS-COW, tanker operation, ship management, and many more. Fortunately software developers have addressed many, if not all, of these. The Transas' Navi-trainer provides training similar to OOW. DMI's Desksim is good for passage planning as it incorporates weather routeing. Poseidon addresses many of the operational requirements of most bridge equipment like radar, Loran C, GMDSS, etc. Marine Soft, SSPA's PortSim, also addresses ship handling issues. Boxer Technologies utilises interactive multimedia based training and simulation in many areas including safety and familiarisation, laws and regulation, electronics, etc. But Seagull probably offers one of the most comprehensive sets of training packages in its CBT Onboard Library once completed. It addresses various training requirements in the area of Navigation, Cargo Handling and Stowage, Controlling the Operation of the Ship and Care of Persons, Marine Engineering, Electrical, Electronic and Control Engineering, Maintenance and Repair, Radio Communications and many others. Seagull, which benefited from its participation in the Norwegian project, aims not only compliance with the seven functions outlined by Part A of the STCW Code, but also attempts to go beyond minimum international requirements. (See Appendix 5 for a complete list of its CBT modules.)

Videotel, on the other hand, also offers a wide array of training packages, which is just as comprehensive. It offers a Safety Library, First Aid and Medical Care Onboard, Oil Tanker Training and Shipboard Management consisting of several videos, supplemented by support books. Knowing the training limitations offered by videos, which do not involve interaction, Videotel developed disks and CD-ROM versions in many of its training packages.

In employing any new or existing technology for onboard training the important thing to consider, as pointed out by Spalding (1997), is that it provides interaction between students and course material, as well as records the results of their activities.

The highly absorbing and motivating effect of employing multimedia technology incorporating sound, visual, animation, interaction, self-testing and evaluation, makes CBT tower high above in effectiveness over older types of distance learning, such as books and video.

Using CBT and PC-based simulation in training onboard, ensures that the student is assessed not only in knowledge, but more importantly, it shows how he/she applies that knowledge, which allows an instructor to gauge how well the student understands both the 'how' and 'why' of any given situation.

### 4.5 Virtual Reality (VR) - An Emerging Reality in Simulation Technology

Virtual Reality offers all the advantages of other forms of simulation without its drawbacks. Unlike the full-scale bridge simulator, it doesn't require so much space and priced only at a fraction of its cost. It inculcates intuitive understanding of situational awareness. It allows discovery learning principle to be applied and provides an interactive training environment. The system has a built-in capability for lesson planning, exercise control and monitoring. It offers some degree of flexibility too. It could be used separately, link to a network or in conjunction with a full bridge simulator, thus saving installation cost. As an evaluation tool, it has automatic recording and assessment capability, thus relieving the teacher of this tedious and time-consuming task. Consequently, it saves him time and effort to devote to other more demanding tasks.

The Canadian Navy's desire to improve training performance while reducing cost brought about the development of a low cost, high performance bridge and ship handling simulator which could be used by a number of trainees simultaneously. This is embodied by its Maritime Surface/Subsurface Virtual Reality System (MARS/VRS). The system is the convergence of four technologies, namely: high fidelity 3-D imaging, voice recognition, speech synthesis and artificial intelligence (AI).

Speech synthesis allows interfacing of the OOW with surrogate bridge personnel while voice recognition enables the trainee to control the ship by verbal engine and helm orders using proper vocabulary and syntax. This also ensures that trainees are only able to use standard orders and reports.

Among its advantages, states Eades (1997), are that it is 'portable, inexpensive and highly flexible; many training tasks can be undertaken simply by software selection. Its cheapness and compactness enable provisioning on a "one-per-trainee" basis with the result that an entire class can be trained simultaneously, thus increasing the concentration of training opportunity'.

The head-mounted VR visor offers high resolution, high contrast, and large angle images allowing for the entire hemisphere surrounding the observer to be displayed. This, coupled with high fidelity 3-D graphics display and Sensurround sound, provides a surrealistic immersive training environment conducive for learning. With it, the training scenario becomes so absorbing as there are no real-world distractions. Thus trainee attention is fully concentrated. Unlike CBT and PC-based simulation, it doesn't make the trainee a mere spectator from the outside looking in with very little role to play. VR puts the trainee right in the simulated environment, and he becomes very much a part of every piece of action. This is what makes VR simulation more effective than any other forms of simulation.

Its effectiveness was proven when it was subjected to a 'proof-of-concept' trial. 'The conclusion of this evaluation', says Eades (1997), 'indicated that the trainees who benefited from simulator time obtained better results than those who were denied it, obtaining scores of 25-30% improvement'.

Eades (1997) said that the introduction of Virtual Reality simulator by the Canadian Navy for OOW training demonstrated the fact that a significant part of training ashore can be done practically, and obtain potentially better overall results. This finding is corroborated by studies made by the US National Research Council that 'there is strong evidence to suggest that, for new trainees, up to 40 hours structured simulation training can effectively substitute for as much as the initial 30 days training at sea'.

There are, of course, other areas that VR can simulate other than navigation, ship handling and watchkeeping. In fact, as of 1997, Canada had future plans for helicopter operations from ship and marine platforms, engine room and systems training and operation, fire fighting training in enclosed spaces and damage control and stability management, all using VR as a training medium.

VR's ready availability, both ashore and afloat, provide the means to develop and maintain skills at high level of proficiency, to checkout newly qualified personnel and to undertake rehearsal training before an event. This is highly beneficial when adverse conditions are likely to be encountered and test the adequacy of plans before execution. As such, it offers an extremely effective and cheap risk management tool of significant operational benefit, (Eades, 1997).

With this 'significant operational benefit' there is a strong likelihood that in the foreseeable future Virtual Reality will emerge as an onboard training reality.

### Chapter 5

# Setting Up Distance Learning Programme Utilising Satcom Technology: Resources and Costs Involved

### 5.1 Definition of Requirements

Before coming to grips with the economics of setting up a distance learning programme utilising satcom technology, it would be helpful to first consider the institutional needs, its aims, goals and objectives. What does the institution want? What are the requirements that will help achieve these wants and needs? Focusing on technology instead of on functionality is setting one's sight in the wrong direction. Technology is only a tool, a means to make an end and not the end itself.

Cagulada (1996) pointed out that the Philippine's primacy as the world's biggest supplier of seafarers is being threatened by the growing share in the development of international seafarers by other countries in Eastern Europe and Asia, particularly China. The employability of seafarers depends largely on the quality of education they have acquired and the effectiveness of training that they have undergone pursuant to the requirements of STCW'95. If the country remains complacent about the present level of competence of its seafarers, it may lose out to other countries in the global labour market competition.

The Philippines has to respond to the challenges in the global maritime environment by maintaining a viable supply of well-trained mariners. To achieve that, however, will require new approaches to maritime education and training. This new MET approach should be one that affords high quality output to a great number of seafarers. In other words, it must be something that meets both the quantitative and qualitative requirements of the industry and international regulatory authorities, particularly the IMO.

This new approach to MET in the Philippines could be the establishment of a Distance Learning Programme. Distance learning employing state-of-the-art telecommunications technology, IT and satellite communications system will enable the Philippine MET to train a great number of seafarers even while they are at sea without sacrificing quality.

Incidentally, the National Maritime Polytechnic (NMP), being the country's only government owned maritime training centre, with a more complete array of sophisticated equipment and simulators for both marine engineers and navigators, is most likely to spearhead in this endeavour. In fact, Leonardo Quisumbing, then Secretary of the Department of Labour and Employment (DOLE), in his address to the 2nd LSM Manning and Shipping Conference held in Manila in 1996, made NMP part of his central strategy to meet the challenges of the STCW'95. That strategy included the expansion of NMP facilities to Luzon and Mindanao for the provision of quality training to cater to the growing needs of the industry and bring it closer to its clientele. The rationale of the expansion of NMP's facilities is the corollary extension of its training capabilities.

In the same vein, the setting up of a Distance Learning Centre in NMP will definitely expand and improve its training capabilities. It can maximise its training output with relatively minimal input. The NMP must also meet the technological challenges posed by developments of the 21st Century.

Such requirements will necessitate the acquisition of a classroom not solely dedicated to distance learning. It should rather be one that supports distance learning and many other functions. To optimise its efficiency and maximise its functionality and its return of investment, an ultra-modern 21st Century classroom should be multipurpose and multifunctional. It should be designed to support teaching a range of subjects from Maritime English, Cargo Handling, Stowage and Stability, Ship Management, Maritime Law, Marine Engineering, Medical Training, to Computer Aided Design (CAD), etc. It should also be user-friendly to both computer literate students and the relatively novice.

This classroom must be able to support a variety of needs such as the following:

- General Purpose Classroom
- Computer Lab
- Computer-Aided Language Learning (CALL) Lab
- Computer-Based Training (CBT)
- Video Conference Room
- Multimedia-Based Classroom
- Lecture and Presentation Room
- Internet Web-Based Learning Centre
- Curriculum Design and Production Room
- Administrative Meeting Room
- Distance Learning Centre

The above list is by no means exhaustive. More functions and uses could be added depending upon the limits of one's imagination and the needs of the institution. Ideally this classroom should, of course, be multi-modal distance learning instruction capable. It should be flexible enough to support either or both site-to-site and site-to-multi-site distance learning programmes. It must be a computer supported, multimedia-based distance learning centre. It must be capable of supporting every multimedia communication for both short-distance, where students and teacher are

within the same classroom, and long-distance learning, where students could be thousands of miles apart somewhere in the middle of the Atlantic, Pacific or Indian Ocean, or virtually anywhere on earth. It must have the possibility of linking with other similarly equipped classroom(s) anywhere in the world. It should be able to provide an interactive environment regardless of the distance. It must support 3-way interaction, that is: teacher to student(s), student to student(s), and student(s) to teacher. 'Classroom-to-classroom communication' should be possible. That is, faceto-face and screen-to-screen communications with students at a remote site and an instructor or team of instructors in a distance learning centre in another location.

Since many of NMP's target students (seafarers) could be in different time zones at any time, it is desirable to have the capability for both synchronous (for face-to-face teaching or for remotely situated land-based students within the same or similar time zones) and asynchronous links, mainly for those onboard ship sailing in a completely different time zone. This is a feature that will allow a teacher to provide face-to-face instruction which could be transmitted in real time (synchronous) to another remote learning centre or even to ships at sea operating in the same or similar time zones. In addition, the same lecture/presentation could be recorded simultaneously and be transmitted at a later time (asynchronous) suitable to students onboard ships plying in opposite or nearly opposite time zones.

The classroom must support any computer platform: PC, Mac, Sun, etc. and work even without CPU, only monitors. Integration of any data or videoconferencing systems or any multimedia peripheral must be made possible. A migration path for integrating old and new equipment, analogue and digital with any emerging or future technologies should be provided. In that case the distance learning/multipurpose facility will not become easily outdated, at the same time large savings could be generated from the ability to use older and existing equipment and facilities instead of buying new ones. An ideal 21st century classroom should have the facility to automatically record both teacher presentation and student work to be re-used later when developing case studies, curricula or student portfolios or even transmitted via satellite in an asynchronous mode to help and guide students at sea.

A creative packaging of various communication media should allow for a multimodal approach to didactical communication. It should allow for different forms of communications links for the delivery of knowledge and information. This linkage could be digital or analogue, wired or wireless, (e.g. ISDN, fibre, ATM, T1, etc.) including ordinary telephone lines. Thus the instructor will not be tied up to a single type of connection. He or she will have the freedom and the liberty to choose the medium dictated by the place where he or she is connecting and the topic he or she is teaching. During the course of the class, he or she will have the flexibility to shift from one connection to another as the need arises.

One must not however forget that it is not only technology that is important, but even more so are the people who run and manage such technology. An important consideration would be that they must be empowered to control such technology instead of being controlled by it. This will only be possible if these people are properly equipped with appropriate knowledge, skills and attitudes required to handle the job. This drives home the point of the importance of training, that is, training the right people to run and manage such a high-tech enterprise. Teacher in-service training and professional development in the aspect of educational technology is the single most critical element in this ultra-modern educational environment. Teachers and school administrators must learn how to manage their technologists and technologies rather than being managed by them. Therefore a vital component of any installation package employing such technologies should include training. Without training it would be tantamount to building a super high-tech 'car' (classroom) without providing a training programme for the driver (teacher).

### 5.2 Distance Learning Network Design Architecture

Having defined the functional requirements of an ultra-modern, multipurpose and multifunctional classroom capable of supporting distance learning, it is now logical to explore various distance learning network designs' architecture. This then can provide NMP with a more concrete basis with which to assess and evaluate their suitability. As noted by R.Adm. McMullen of Texas A&M University, the technology associated with distance learning is the same technology that is used in an 'electronic classroom'.



Figure 7. WMU Computer Lab

Source: Betril Wagner (1999)

In that case then the World Maritime University's Computer Lab can serve as a fine model and provide some basis in the equipment/facilities needed and costs involved. After all, McMullen (1999) noted that once one has established an electronic teaching/learning environment, he or she is only a small step away from projecting that outside the walls of the building. Figure 7 above shows WMU's Language Lab allowing one to visualise and scrutinise its functions and capabilities.

This design architecture shows a capability for video/desktop conferencing, document viewing and projection into the instructor and students' PC as well as into a wide screen. The electronic white board allows what is written on it to be shown on the PC screen and even print a hard copy. Video could also be shown into a large TV and transmitted into a remotely located TV linked to the Lab. It has other capabilities not obvious from the diagram. However this network shows only a single external connection via ISDN. This configuration may make it capable of supporting distance learning to PC's with Internet connection but not necessarily to ships at sea unless it has an extra satellite link.

A more complex and sophisticated infrastructure is the so-called Ed21 - Knowledge Web School as shown in Figure 8. This configuration is suitable for a large, complex and truly global school system consisting of several multipurpose and multifunctional classrooms which could be contiguous to each other or situated hundreds or thousands of miles apart. It has linkages with several organisations outside the local school system. But building such a system would be too costly and beyond the reach of the average institution particularly in developing countries.

Another model configuration is a modification from the original COMWEB Multipurpose and Multifunctional 21<sup>st</sup> Century Classroom. It is a little simpler than the Ed21-Knowledge Web. The beauty of this model is that it could be built in a modular manner forming the basic web then into more sophisticated configuration such as the one shown in Figure 8. Since its installation could be phased in, this



Source: COMWEB (1998)

becomes more likely to be affordable to smaller institutions such as the NMP. Referring to Figure 9, modified from the original COMWEB Multipurpose and Multifunctional 21<sup>st</sup> Century Classroom, one could see its multiple capabilities meeting the functional requirements mentioned previously. It has ISDN, satellite, fibre optics as well as ordinary telephone lines. The classroom has a video conferencing capability. It can record simultaneously classroom activities, and com-

### Figure 9. Proposed NMP Multipurpose and Multifunctional Classroom



With the Ship as the Virtual Classroom Afloat

Source: Modified from COMWEB Multifunctional and Multipurpose 21<sup>st</sup> Century Classroom (1998)

press and decompress data/video to be transmitted in either synchronous or asynchronous mode. The system capability basically meets all the required functionality stipulated previously.

Another model worth considering is International Datacasting shown in Figure 10. This could easily be adopted for distance learning. It is capable of both synchronous and asynchronous transmission, which could be suitable for NMP's purpose. Video transmission could be of very high quality with its MPEG 2 and high bandwidth satellite. The satellite utilised here however is unlikely to be INMARSAT as its transmission rate is from 258 Kbps to 400 Mbps. This will therefore make it not suitable for distance learning at sea until such time when higher bandwidths are widely available onboard. If, instead, V-SAT is used it may prove useful for onboard distance learning, albeit only to a limited number of seafarers. This is because of V-SAT's expensive hardware limiting its availability mostly to cruise liners and some super tankers and other well-equipped modern ships.



**Figure 10. International Datacasting** 

Source: Via Satellite, p. 52 (August 1998)

With several configurations explored, including those which were not shown, the most suitable distance learning network design architecture, which meets NMP's needs and requirements, appears to be the Multipurpose and Multifunctional 21st Century Classroom of COMWEB. It may not necessarily be the best system in the world, but there is no doubt that it is the one system that fulfils all the functional requirements of what was visualised as an ultra-modern classroom that supports

Distance Learning while serving other functions and purposes for the institution (NMP).

### 5.3 Specific Hardware and Costs Involve

COMWEB and ROBOTEL appear to meet similar functionality based on NMP's requirements. Table 4 and Table 5 show comparative pricing systems. These figures then provide a more concrete idea of what it involves and the corresponding costs in setting up an ultra-modern multipurpose and multifunctional electronic classroom.

While Table 5 (Robotel's SmartClass 2000) lists additional more high-tech options, such as touch screen control, the figures quoted are much higher than COMWEB's. Technology need not be the primary driving force in one's choice. One should not get carried away with the glitz and glamour of the high-tech, high touch mentality in vogue and fashionable today. Rather, he or she should focus on the functionality and less on technologies.

With the quoted figures below, which mainly involve the hardware installations, it would then be relatively easy to project the approximate total cost of implementing a distance learning programme by adding the cost of designing and production of a course or curriculum, plus the remuneration of the people involved, utilities, peripheral equipment/devices, and other miscellaneous expenses.

The prices quoted in Table 4 and Table 5 include only the basic facilities for an electronic classroom capable of eventually supporting distance learning. There are additional peripheral equipment and facilities involved if it has to reach potential students beyond the confines of the four corners of the classroom.

Equipment List	ID Code	Qty.	Unit	Total
			Price	Cost
Main Control Box (System Hub)	MCC-390VKM	1	\$3,550	\$3,550
Touch-sensitive Control Panel				
Handheld Wireless Remote Control				
Projector and RS0232 Ports				
			4.450	4.450
Auxiliary System Controllers	MCC-391VKS	1	4,450	4,450
(Multimedia Sub-system)				
SVGA Video In/Video Out (800x600)				
(900rr(00) (Digital Challe)				
(autou) (Digital Chaik) Video Switch/Amplifier				
video Switch/Ampliner				
Extension Box (Coupler)	MCC-190VKS	21	650	13 650
Standard Cable Sets				10,000
Muting + Keyboard/Mouse Locking				
Keyboard/Mouse Remote Control				
Student Call Button				
COMWEB Mics and Earphones (as				
required)				
Mounting Brackets				
Whiteboard, Digitising 3" x 4"	MCC-BOARD	1	2,050	2,050
Pivoting Desktop Camera PAL/220V	MCC-Camera2	1	1,295	1,295
HiRez Document Camera w/Zoom	MCC-Camera1	1	3,675	3,675
PAL/220V				
		DUE		¢20 (70
	AMOUNT DUE: \$28			\$28,670

# Table 4. COMWEB Price Quotation for a Typical Multipurpose Room

Source: COMWEB (1998)

Qty	Part #	Description	Unit Cost	Price	
2	38-805001-01	SC2000 Control Unit	\$1,574	\$3,148	
4	38-805002-01	SC2000 Junction Box	383	1,532	
32	38-805003-01	SC2000 Interface, w/ Keyboard/	412	13,184	
		mouse w/ cable up to 15' on average			
3	38-805012-01	Additional Power Supply	246	738	
32	38-805005-01	Headsets with Microphones	71	2,272	
30	38-805004-01	Student Terminal w/ audio, testing,	318	9,540	
		teamwork			
2	38-805010-01	Basic Response Terminal for	143	286	
		Instructor Audio			
2	38-805007-01	SmartClass Testing Software	360	720	
2	38-805013-01	SC2000 Classroom Installation	1,140	2,280	
Total Investment = \$33,700					
	OPEN MARKET ITEMS				
32	SC2000KMA	HP9000-715-50 Keyboard/mouse	150	4,800	
		adapters			
1	SC2000Y	SC2000 Y-Room Connector	815	815	
		Distributor ##			
2	SC2000YC	SC2000YC-Room Connector Device	270	540	
		##			
Total Investment with Open Market Items = \$39,855					
Additional Option					
2	Open Market	Upgrade to Touch Screen Control Unit	5,000	10,000	
Overall Total Investment Including Open Market Items + Option =				\$49,855	

# Table 5. SmartClass 2000 Proposal

### Source: ROBOTEL (1998)

# 5.4 Web-based Training Solution

Table 6. Projected Basic Ownership Cost					
	Allen	Assymetrix	Docent	Macro-media	Micro-Medium
	Communication				
Hardware (166-M	Ihz Pentium MMX with	128 MB of RAM)			
Content Creation	\$900	\$900	\$900	\$900	\$900
System					
Web server	\$900	\$900	\$900	\$900	\$900
Database server	\$900	\$900	\$900	\$900	\$900
Software					
Course Manage-	\$1,750	\$19,600(1)	\$100,000(2)	\$35,000	\$395(3)
ment tool					
Content-creation	\$2,990(4)	\$1,095(5)	\$149(6)	\$3,498(7)	\$976
tool					
Network operating	\$1,618	\$1,618	\$1,618	\$1,618	\$1,618
system (8)					
Database software	\$1,399	\$1,399	\$1,399	\$1,399	\$1,399
(9)					
Installation					
Installation	\$3,600	\$4,000(11)	\$0	\$4,000	\$0
consultant					
1 hr. of database	\$36	\$36	\$36	\$36	\$0
administrator's					
time					
1hr.of web-	\$0	\$26	\$26	\$36	<b>\$</b> 0
master's time					
Maintenance	ſ	ſ	1	ſ	r
1 database	\$0	\$864	\$864	\$864	\$0
administra-tor at 2					
nrs.					
/III0.	£0.	8624	\$634	\$624	£0.
tor at 2 brs	20	3024	5024	3024	30
/mo for1 yr					
Training					
Resic training	\$995(12)	\$0	\$1.500	\$2.000	\$600
Tachnical support	\$7711(13)	\$3 435(14)	\$1,500	\$2,000	\$000
based on business	\$711(15)	\$5,455(14)	310,000	\$7,700(13)	30
hr. support for 1					
vear					
Total cost	\$15,799	\$35.397	\$118,916	\$59.465	\$5,894
Evaluation Score:	Excellent	Very good	Poor	Good	Excellent

Source: InfoWorld Media Group Inc.(1998)

### Remarks on the above numerical notations:

- (1) Assymetrix Librarian 6.01
- (2) Docent 2.0
- (3) Cost of Performance Pack Suite, which is used to transfer data from FTP site to database
- (4) Designer's Edge 2.0 Pro costs \$2,495; Net Synergy 1.0 costs \$495
- (5) Assymetrix ToolBook II Assistant 6.1a
- (6) Microsoft FrontPage 98
- (7) Authorware 5 Attain costs \$2,699; Dreamweaver Attain costs \$799; and Pathware 3 Attain Essential costs \$35,000 per server
- (8) Microsoft Windows NT Server 4.0 at \$809 per copy
- (9) Microsoft SQL Server 6.5
- (10) Microsoft Access 97
- (11) Cost of Jump Start program; includes set up, training and testing
- (12) Cost of training on Designer's Edge 2.0 is included in the price of installation
- (13) 15% of the purchase price
- (14) 15% of Librarian, plus technical support for Assymetrix ToolBox II Assistant6.1a at \$495
- (15) 20 % of the price list; includes maintenance and upgrades.

#### Source: InfoWorld Media Group Inc. (1998)

A web-based training solution could be another less costly alternative. However, since it is software-based, it may have limited compatibility with some facilities. Besides, it partly meets only the requirements set forth in Section 5.1. It has however enormous potential in terms of cost-effectiveness in conducting distance learning for seafarers ashore, right in their own homes. It may not be entirely suitable for seafarers at sea, though.

Table 6 above shows the projected costs of basic ownership based on calculations of a 500-student implementation. It excludes courseware designing, which varies wide-

ly depending on the complexity of the training.

#### 5.5 Marine Applications Software and Videos Needed

For the most part, the intended training programme will be using CBT packages from Seagull, and in some cases from MARINTEK. PC Maritime's OOW, DMI's DeskSim and other marine applications software will also be considered depending on the type of training offered. Videos mainly from Videotel will be used in conjunction with some CBT packages. In due time, the institution will try to develop its own tailor-made CBT scheme and training videos.

Incidentally, only prices for Seagull's CBT modules are available. As per information in its brochure, a price tag of NOK 625 (about \$73.50) per module for one-year subscription period is the basis for cost projections. This does not however include shipping and handling of the CBT modules contained in a CD.

### 5.6 Additional Facilities Required and Costs Involved

It should be noted that distance education has several enabling infrastructure technologies. These include T1-based technology, ISDN, Internet/Intranet, Asynchronous Transfer Mode (ATM) as well as satellite. One's choice should consider certain advantages/disadvantages. Primarily cost, both fixed and variable, should be taken into account. In the technical aspect, bandwidth and latency should be considered too. It is also important to consider learning styles of students, i.e. symmetric and asymmetric learning, which must be reflected in the syllabus/curriculum.

Videos mainly from Videotel and some other producers, as well as films locally produced by NMP may be utilised from time to time. In addition to the core facilities, if transmission of video via satellite is being considered, such as those produced by Videotel as well as NMP's locally produced films, compression/decompression device or CODEC such as H.320/H323/ATM may have to be included. This will require, in turn, video input and output sources such as cameras, VCR, microphones, monitors, document camera, etc. COMWEB already included many of these (see Table 4). In the USA, according to Walt Magnussen (1999), the cost of a room including CODEC like H.320 run on dedicated 128 or 384 Kbps lines, for instance, costs a staggering \$55,000! If one opts for H.323 run over Internet the cost will nose dive down to \$300-\$8,000. For ATM converted to ATM cells providing high quality video and low latency also costs \$55,000 like the H.320.

A minimum of two 26" multi-system televisions or bigger may be needed in the multipurpose classroom. Each will cost roughly between \$800 and \$1,200.

Since maritime communications will almost invariably involve satellite, Inmarsat SES will definitely be necessary. This entails obviously additional cost. The lowest priced terminal in the INMARSAT alphabet is Inmarsat-C. It costs \$10,000. Its big brothers, Inmarsat-A and Inmarsat-B, are priced from \$25,000 to \$30,000. An upgrade to HSD will require an additional \$5,000 for Inmarsat B but \$10,000 for Inmarsat-A. Iridium terminals are already available in the market but the author has difficulty getting their price tag. But it is reasonable to guess that they must be within a similar price range. For high quality video transmission V-SAT, available in some cruise liners, would be more suitable for receiving high quality video. In that respect it is much better than Inmarsat, which is capable of receiving only slow scan video. However, V-SAT is priced very expensively at \$100,000 as of 1996, (Brödje, 1996).

For Computer Aided Instruction (CAI), a Web server costing \$10,000 plus Web development tools costing an additional \$2,000 will be needed. At least 12 computer units will be necessary in the multimedia laboratory. Each may cost between \$1,500 to \$2,000 for Pentium I with 32 MB of RAM and at least 1-Gigabyte hard disk capacity. A reliable Internet line is also required. As for streamed video a streaming

video is worth \$10,000 to \$50,000. In addition, streamed video development tools will cost an extra \$500 to \$2,000. Likewise, a reliable Internet connection is also necessary.

From the technical point of view, the types of communication lines should also be considered. Dedicated ISDN, T1 or ATM lines offer the advantage of continuous availability whenever they are needed. However, this advantage of 'always being there' means wastage when not needed. An alternative is a packet-based connection like the Internet/Intranet. This allows for the carriage of all traffic, voice, video, and data. Unfortunately, with the Internet/Intranet it is difficult to control delay. It is a gross misconception to think that placing things in the Internet is 'free'. There is no such thing as 'free lunch', as they used to say. There is always a trade off in terms of compromised capabilities.

### 5.7 Types of Communications Lines and Costs Involved

A T1 dedicated connection line runs at 1.544 million bits per second (medium speed). It is very reliable and has wide availability practically anywhere. In the State of Texas the connection line costs \$800 per month. This line supports H.320 on video channel and H.323 of data channel.

ISDN, on the other hand, is a digital telephone line. It is easy, one simply has to call the other end. It runs at multiples of 128 Kbps. Fixed cost for access lines is \$55 per month, per end variable cost for utilisation, \$30 to \$90 per hour. It is available almost anywhere.

Internet/Intranet is also available almost anywhere. In case of dedicated access for small institutions via T1, for instance, it will cost as low as \$620 a month. For DS-3 (45 million bit per second), suitable for a large institution, it could go as high as \$23,000 per month. Dial-up access for individuals costs \$20 to \$50 per month.

While Internet/Intranet offers the advantage of all application being shared by everyone, it doesn't give anyone any assurance of his 'slice of the pie'.

In the foregoing, it was amply demonstrated that there are many tools that can be used for distance learning which consequently also involve a variety of costs. 'The important thing', advised Magnussen (1999), 'is to pick the right tool for the application. Decision should be based upon fact, not perception'.

### 5.8 Human Resources Necessary and Approximate Costs Involved

A research by Dr. Larry Lippke (COMWEB, 1998) into Distance Learning universities and colleges in North America showed that instructor/tutor salaries account for the highest percentage of distance learning costs and expenditures (31.72 %). In 1997 this even accounted for 37.21% of total costs. This only goes to show that personnel cost, instructor/tutor remuneration, is one aspect of distance learning expenditure that should not be overlooked.

The number of tutors and other human resources involved are obviously one determining factor in this aspect of expenditure. So if one has to cut down expenses on this recurring and continuing cost, the barest minimum of personnel should be considered. It is probably best to only have a core of permanent personnel involved in distance learning. To achieve this, temporary or contractual employees or even tapping the services of private specialised companies/organisations may be considered when there is much work to be done or when no internal expertise is available. Outside experts have to be employed occasionally when necessary.

The distance learning activity proposed to be established by the National Maritime Polytechnic (NMP) would not be a special purpose school, but rather it will be a programme to be offered as a sideline activity or, more appropriately, as a parallel activity. That is, parallel to the existing conventional courses offered by NMP. The same courses taught in classrooms the conventional way will also be offered via distance learning.

### 5.9 Functions, Activities Involved and the Organisational Framework Required

To set up a distance learning programme will require academic and administrative staff to develop course materials using audio/video tape, CBT modules, PC-based simulation and other study materials. It must provide advisory and two-way, or even three-way, didactic communication with the students on-board or ashore utilising telephone, fax, telex, e-mail and other means available whichever is appropriate and more cost-effective. Counselling/tutoring, giving and correcting assignments, examining, and issuing certificates are other concerns for this organisation. It will be an extension department of NMP rather than a separate entity. It will provide distance study opportunities for its own extra-mural and on-campus students. It will cater for the training needs of the Filipino seafaring community. With modest resources, it will attempt to produce study materials with far-reaching parallelism with residential study.

Having known the activities and functions involved, there is now a sound basis to determine the kind of expertise needed and the number of personnel necessary in setting up distance learning. Obviously a head of department is needed. An assistant may not be necessary if the department is small. But a system analyst and some programmers are indispensable. Tutors trained in the delivery of distance learning are absolutely essential. They may even need to learn to design courses utilising computers and Information Technology. Their number should be proportional to the number of students. A maximum ratio of 1:50 is proposed.

A graphic artist might be necessary. A mass communication and audio and video technician is also essential. Clerical personnel may be required from time to time but not on a permanent basis. An electronic communications technician or engineer is

necessary to maintain the high-tech facilities used in the delivery of distance learning. The first year of operation may require a consultant to advise and help oversee the setting up and implementation of the distance learning programme. Since NMP already has a registrar, there is no need to have another one. An on-line enrolment system may have to be adopted to facilitate this tedious process. Likewise, NMP's existing research division could also lend a hand to do researches relative to distance learning and other related subjects. Hence there is no need to duplicate its function. To save on extra remuneration costs, some under-utilised personnel/staff from other divisions may be 'borrowed' temporarily in times of peak activity. These 'borrowed' personnel/staff may be paid special remuneration in the form of an honorarium or overtime pay as appropriate. To better visualise its organisational set up a proposed organisational chart is shown in Figure 11.



#### Figure 11. Distance Learning Department Organisational Chart

With a minimum of five tutors doubling as course designers at the same time, an average salary of about \$1,500 under this special scheme may be paid to each. This amount may look ridiculous by western standards, but this is actually favourable for
the economic viability of implementing the programme. The Department Head could also work as a tutor/course designer to save on labour costs. An extra compensation should be given to him or her, of course, for the extra work. The System Analyst if 'borrowed' from another department/division of NMP, and not working permanently in the D.L. Department, will have to be paid an honorarium on top of his/her regular salary commensurate to his/her salary grade. The same is true with the programmers and other specialists involved if they are working on a temporary basis. Local government rules and guidelines have to be followed if such apply. This section will not dwell on rules and guidelines regarding finances and the legality of such proposed scheme under Philippine law. It is beyond the scope of this paper. The point here is simply to make a more concrete basis of the approximate costs involved in setting up a distance learning programme.

#### 5.10 Summary of Cost Estimate in Setting up a Distance Learning Programme

Having examined a variety of facilities that could be utilised for distance learning and their respective costs, the institution will be able to figure out the approximate total costs based on the admixture and combination of hardware/software chosen including human resources. These are shown in Table 7.

The cost estimate in Table 7 purposely excluded the cost of TV and VCR necessary and the 12 computer units needed as these are already installed in NMP. A variety of options and financial projections will be proposed in the next chapter to examine and explore the practicality and financial viability of this proposed undertaking.

Tal	ple 7. Cost Estimate of Setting Up and Implementing a Distance Learning Programm	ne
Capital Outlay	Basic COMWEB equipment/facilities	\$ 28,670.00
	Shipping charges (estimated at 5% of equipment cost)	1,433.50
	Installation cost (estimated at 15% of equipment cost)	4,300.50
	Training costs: a) core maintenance personnel	2,867.00
	(estimated at 10% of equipment cost)	
	b) core teaching staff /tutors	2,867.00
	(estimated at 10% of equipment cost)	
	Inmarsat-B terminal (1 unit)	25,000.00
	High Speed Data (HSD) channel (additional option)	5,000.00
	Inmarsat-C (1 unit)	10,000.00
	H.323 run over Internet (cost of room including CODEC)	8,000.00
	Web Server	10,000.00
	Web development tools	2,000.00
	Streamed video server	10,000.00
	Streamed video development tools	2,000.00
	Sub-total =	\$ 112,138.00
Common/Recur-	Material component:	
ring Costs:	Seagull CBT module annual subscription fee (NOK 625 or about \$ 76.22 at	38,109.76
	\$1:8.2 NOK)	
	Other supporting materials	5,000.00
	Sub-total =	43,109.76
	Service component:	
	Tutor renumeration (\$1,500/month X 5 persons)	90,000.00
	Dept. Head and Tutor (additional compensation/year)	6,000.00
	System Analyst and programmers, graphic artist, audio/video specialists, etc.	10,000.00
	Support staff (as needed)	5,000.00
	Advertising	5,000.00
	Consultant/advisory service (at \$5.000/mo)	60,000.00
	Utilities and miscellaneous expenses	5.000.00
	Sub-total =	\$181.000.00
	Satellite transmission costs via Inm-B (9.6 Khits during off-neak periods) At	7.680.00
	\$1.28 per 5 Kbit of data per message x 12 messages/year x 500 students	.,
	(64 Kbit/sec. HSD.) At \$2.17 per 5 Kbytes (1 A4 size page) x 24 messages/year x	
	500 students	13,020.00
	<i>Fax</i> at \$4.53/37 Kbits x 12 messages/year x 500 students	27,180.00
	Sub-total =	47.880.00
Others:	T1 dedicated access for small institutions (\$620.00 <i>cost per month</i> )	7440.00
	ATM average <i>cost/month</i> , \$ 8,000.00 x 12	96,000.00
	ISDN fixed cost for access line <i>per month</i> \$55.00 x 12	660.00
	Variable cost for utilisation <i>per hour</i> \$30.00 at 1hr./day x 365 days x 500 students	10,950.00
	Sub-total =	\$115,050.00
	Total Estimated Cost	\$612,196.76
		,

From the forgoing estimates, the findings of the study by Dr. Larry Lippke is further corroborated noting the service cost for the human resources involved to be 45%, i.e. \$271,000 out of the total estimate of \$602,196.76. So from this, it could be concluded that the greatest expense involved, particularly the recurring costs, is not so much in the hardware but in the service component particularly if the services of a foreign consultant are to be utilised.

# Chapter 6

# STCW '95 and the Philippines: Challenges and Opportunities for New Technology, Methods and Approaches

#### 6.1 Impact of STCW '95 on the Philippine MET System

Of all IMO conventions, the STCW '95 is probably the one that has the most farreaching impact on the Philippine MET system as well as on its Maritime Administration (MARAD). The coming into force of the Convention (STCW'95) exposed the weaknesses of the fragmented and diffused organisational and administrative structure of the Philippine MARAD. There are seven different departments (ministries) involved with a total of thirteen agencies under them. This makes it rather unwieldy to manage and administer causing a lack of focus and unity of purpose among the agencies involved. The overlapping and duplicating functions of the various agencies naturally led into inter-agency bickering and bureaucratic rambling resulting in so much confusion in the country as to which government entity is the Administration. This was one of the major obstacles causing so much delay in its STCW compliance and implementation. This problem had caused so much concern in the international maritime community considering the standing that the Philippines has as the primary provider of maritime manpower.

This concern was highlighted by the visit of no less than the Secretary General of

IMO, William O' Neil, to the then President of the Republic of the Philippines, Fidel Ramos. This was followed up by the visit of the Rector of the World Maritime University, Dr. Karl Laubstein. Covert as well as overt pressures exerted by the maritime industry, both local and abroad, brought the government to the grim realisation that it has to act decisively. It has to bow to these pressures for its own good to avert a catastrophic disaster in the manning sector and the subsequent loss of millions of dollars in annual remittances from its seafarers.

Against this backdrop, the President of the Republic finally stepped in to settle the dispute among the agencies locked in a mortal combat to gain primacy and dominance over the others. The issuance of Executive Order 396 cleared the way for the controversies by designating MARINA (Maritime Industry Authority) as administrator and lead agency for STCW implementation. The other agencies involved, such as the Maritime Training Council (MTC) and the Philippine Coast Guard (PCG), were given vital roles to play under the leadership of MARINA towards its realisation. This set-up, along with the clear delineation of functions and better co-ordination among the various agencies involved, smoothened the flow of the measures taken towards STCW compliance. This concerted effort culminated in the timely submission to the IMO of the country's communication of information pursuant to Article IV of the STCW '95 relative to the compliance of the said convention prior to the deadline of 1<sup>st</sup> August 1998 in its bid to be included in the 'White List'.

One of the measures the Philippines has taken was the issuance by the Maritime Training Council of Memorandum Circular No. 10 mandating the use of IMO Model Courses as the standard to follow for maritime training centres all over the country. On its part, the Commission on Higher Education (CHED) launched its EMET (Enhancing Maritime Education and Training) programme to rationalise the curricula for maritime education and realign it with the STCW Convention certification system. Later, MTC and CHED, the two agencies charged with MET system

implementation, made a collaborated effort to eradicate sub-standard schools and training centres in the country. As a result, out of about 150 or so maritime schools and training centres only six initially survived. This later increased to nine institutions and is believed to reach up to a dozen schools later. These are institutions considered to be centres of excellence or at least meeting the required equipment and facilities and having qualified and competent teaching staff to implement the curricula designed by CHED or the IMO Model Courses, in the case of training centres. Track records of maritime schools were also scrutinised to check the proof of their performance in terms of passing rate in the Licensure Board Examination administered by the Professional Regulation Commission (PRC), the country's examining body. Otherwise, if a school has not produced a single graduate passing the exam for watchkeeping officer within a three-year period, it will be slated for closure or at least not be permitted anymore to admit new entrants until the problem has been rectified.

To ensure that it has a valid and reliable examination system, the Professional Regulation Commission, had come up with a new and updated Certification and Examination System, a project assisted by the IMO/Norway Co-operation Programme.

With regards to national legislation, the outdated Presidential Decree (P.D.) No. 97, otherwise known as the Philippine Merchant Marine Officers Law, was superseded by R.A. 8544 to make it more relevant and attuned to the new requirements of the Convention on Standards of Training Certification and Watchkeeping, 1978, as amended.

These are some of the measures the country has taken to ensure compliance. Among the actions taken, perhaps none was as drastic as the draconian measure taken by both CHED and MTC resulting in the closure of many of the bad and ugly schools so that only the good ones remain. Ironically, however, this drastic action will eventually lead to the reduction of the number of seafarers the Philippines can supply to the world fleet. This is a paradox that the country is facing now. How will it be able to meet the qualitative requirements of the 1995 amendments of the STCW and at the same time meet the quantitative demands of the maritime industry? Is it a question then of quantity versus quality? Does the country have to sacrifice quantity in the name of quality, or is there a middle ground to meet both? The current emphasis on competency-based training implies fewer students per class. With certificates of competency to be revalidated every five years and the CHED's and PRC's requirements for Continuing Professional Education (CPE) further exacerbate the problem considering the country's greatly diminished training capability due to the axing of over a hundred maritime schools.

These then are the issues and concerns this paper wishes to address and redress through the establishment of a Distance Learning Centre within the realm of the National Maritime Polytechnic (NMP) training and administrative structure. With D.L. utilising advanced telecommunications and Information Technology, including satcom, NMP hopes to meet the so-called middle ground thus addressing both the quantitative and qualitative requirements without compromising one or the other. The next challenge then is to explore the feasibility and practicability of putting up such a system. These are the things this chapter wishes to address.

## 6.2 <u>Presentation, Analysis and Interpretation of Data from the NMP Survey of</u> <u>Filipino Seafarers</u>

#### 6.2.1 Presentation and Analysis of Data

The following is the result of the pioneering survey conducted by the author in his home country with the assistance of the research department (PRPD) of the National Maritime Polytechnic (NMP), the institution where the author works. The questionnaire was designed to gauge the extent of the readiness and receptiveness of the Filipino seafarers, both at the operational and management level, for new approaches to MET, i.e. distance learning. The table showing the summary of responses has been split into two due to the non-homogenous nature of the questions. The full questionnaire is in Appendix 3. Table 8-a grouped together the questions answerable by 'Yes' or 'No', while Table 8-b are those questions with four or five options, including some open-ended questions.

No	Questions		%	No	%	Remarks
1	Do you have any experience using computers?	224	39	304	53.6	46 No response
3	Does your ship have computers onboard?	407	77.1	100	18.9	21 No response
4	Do you have access to a computer onboard?	117	52.2	96	42.9	11No response
7	Do you have access to a computer at home?	45	16	220	78	17No response
11	Onboard the ship, do you still find time to read for pleasure or to study?	230	86.8	34	12.8	1 No response
13	Are you interested in upgrading your knowledge and skills relative to STCW '95 requirements and your personal and professional growth?	253	95.8	10	3.8	1 No response
15	Are you interested in learning and developing new knowledge and skills in your own <i>time</i> ?	253	93.4	15	5.5	3 No response
16	Are you interested in learning and developing new knowledge and skills in your own <i>place</i> ?	233	86	15	5.5	5 No response
17	Are you interested in learning and developing new knowledge and skills in your own <i>pace</i> ?	225	88.9	20	7.9	8 No response
18	Would like to enrol in such a learning/ study programme that allows you to learn at your own <i>time, place and pace</i> ?	233	92.1	12	4.7	8 No response

#### Table 8-a. Summary of Responses to Questionnaire (Y/N)

#### Note: Percentages are based on the total responses to a particular question only

No	Abbreviated Questions	Responses	Remarks
2	Computer skill		Respondents
-	Very good	11	were
	Good	69	allowed
	Fair	114	to tick as
	Poor	28	many as
	No response	20	annronriate
5	System configuration of onboard computers	2	uppropriate
5	Stand-alone	96	
	Local Area Network (LAN)	58	
	No response	70	
6	Onboard computer used for:	70	
0	Ship/cargo related activities	127	
	Communications	246	
	Communications     Training	240	
	• Hanning	64	
	• Others	80	
0	No response	25	
0	Frequency of computer use onboard or at nome:	10	
	• Everyday of almost daily	19	
	Weekly or during weekend	14	
	• Once or twice a month	5	_
	Very rarely	6	
	No response	1	
9	Average time spent on computer per day:		1
	• Less than 2 hours	24	
	• 2 to 4 hours	14	
	• 4 to 6 hours	3	
	More than 6 hours	3	
	No response	1	
12	Length of time spent in reading/studying daily:		- <b>1</b>
	Less than 2 hours	148	
	• 2 to 4 hours	77	
	• 4 to 6 hours	2	
	More than 6 hours	1	
	No response	2	
14	Preferred learning programme		
	Regular classroom instruction	156	
	Tutorial	21	
	Self-study	51	
	Internet-based	10	
	Others	5	
	No response	10	
19	Maximum amount willing to pay per course		
	• \$200 or less	195	* response
	<ul> <li>More than \$200 but less than \$300</li> </ul>	25	not indicated
	• More than \$300 but less than \$400	2	in the
	More than \$400	2	questionnaire
	* Free or paid by sponsor	2	1
	No response	27	
20	Intended time indicated when to enrol		-
	• As soon as possible	78	
	Any time this year (1999)	40	
<u> </u>	• Any time by the year 2000	89	
	Other intended time	25	

# Table 8-b Summary of Responses to Questionnaire (Multiple Options)

There were a total of 574 respondents to the questionnaire, however not all respondents answered each question nor do they have to. It is due to the nature of the questionnaire, which requires some questions to be skipped depending upon whether they responded 'Yes' or 'No' to some of the items. This means that the number of respondents per question is not consistent. This is further compounded by the fact that some questions allow for multiple responses and that some did not respond to certain questions at all.

Among those surveyed only 39% have experience using computers while 53% do not have any. Among those with computer experience, 86% have varying degree of skills from the very good down to those having fair ability, which comprise the majority. A few of those with experience using computer, 12.5 %, rated their skill as poor.

As far as availability of computers is concerned, a good 77.1% of the respondents indicated that their ships have computers onboard while only 18.9% have none. This finding seem to corroborate with the findings of the Nautical Institute (NI) in the survey it conducted for its members indicating a high percentage of 88% (out of over 200 respondents) who were using PC-based technology on-board, (Matthews, 1999, p.63). Among those whose ships have computers, 42.9% are stand-alone (in contrast with 76% from NI survey) and 25.9% (compared with 43% in the NI study) even have a local area network onboard. These onboard computers, consistent with the findings of the NI, were mainly used for ship/cargo related activities (74.4%), communications (42.9%) and training (14.6%). For those whose ships have computers onboard, a slight majority of 52.2% have access to them. Unfortunately 42.9% are not granted access even if a computer is available onboard. This is rather alarming not only for distance learning application, but also to the morale and well being of the crew, the human factor. Being cut off from a communications facility when one is available constitutes a kind of psychological and emotional torture and not so subtle way of discrimination. Frequent contact with family and friends ashore is crucial to keeping morale high and putting officers and crew at the peak of their performance.

As far as availability of computers at home is concerned, only 16% have, while the majority, 78%, do not have. Among those responding to the question, 86.8% still find time to read for pleasure or study onboard. Of these, 64.3% comprising the vast majority, spend two hours or less reading/studying. Practically, a third (33.5%) read or study for 2 to 4 hours daily. Less than 1% spend as much as 4 to 6 hours or more a day.

Among those with access to a computer whether onboard or at home, 42.2% use it on a daily basis while 31.1% use it once a week or on a weekly basis. The rest use it only once or twice a month and some of them rarely touch their computers. The majority (53.3%) of those using the computer daily spends less than 2 hours on average. However 31.1% use them for 2 to 4 hours daily. Some 13.3% however use the computer for 4 to 6 hours or more.

As far as interest in upgrading their knowledge and skill relative to STCW '95 requirements, as well as for their personal and professional development, an overwhelming 95.8 % responded 'yes'. Quite understandably, 61.7 % of them still preferred to learn the conventional way via regular classroom instruction. A few, 8.3%, preferred tutorial, and interestingly 20.2% wanted to learn by self-study, while a measly 4% prefers Internet-based learning. Still even fewer, 2%, prefer other forms of learning programme. Of those interested in developing new knowledge and skill, 93.4% prefer to do it in their own time, 86% wanted to do it right in the convenience of their own place and 88.9% wanted the flexibility of learning at their own pace. When asked whether they would like to enrol in a study programme that provides the flexibility, ease and convenience of learning in their own time, 77.1% are willing to pay a fee of \$200 or less per course. About 10% are even willing to pay as much as \$200 to

\$300. In the extreme end of the spectrum, a little less than 2% are willing to pay between \$300 to \$400 or even more, these are probably the people in the senior officers' category. Two respondents suggested the training to be free or paid by a sponsor. There were 27 who did not answer the question. Among the respondents willing to enrol in a flexible and convenient learning programme, 17.2% signified their eagerness to enrol this year, 1999. There were 38.4% who wanted to enrol by the year 2000, others, 33.6%, were eager to enrol as soon as possible. The rest, about 11%, preferred to enrol at some other time.

#### 6.2.2 Interpretation of Data

If the responses are taken as representative of the entire population, though percentage-wise only 39% of the total respondents have experience using computers, this could be a positive indication of the number of seafarers possessing the skills needed to facilitate distance learning of the kind conceived by the author. Since there were 437,880 registered Filipino seafarers as of 1997 (IMO, TC 47/12/1), 193,300 of whom were deployed overseas in 1998, the corresponding figure then could be considerably large. In the Philippines it is roughly estimated that about 300,000 are actively engaged in the seafaring profession. If this latter figure is taken as basis, this means roughly 117,000 (39% of 300,000) seafarers are ready for D.L. Even if only those with fair or better computer skills are considered, that still leaves some 100,620 (86% of 117,000) possessing the necessary skill to profit from modern D.L. techniques.

On the other hand, the rest (53.6%) may have to undergo training first in computer literacy and other aspects of IT prior to benefiting the ease, convenience and flexibility that distance learning offers. That is, as far as the form of distance learning the author has envisaged is concerned.

Of those surveyed, 77.1% indicated that their ships have computers, of which about

26% even have LAN onboard. This development and trend is a positive indication that the great number of Filipino seafarers can benefit from distance learning provided they are all allowed access to computers and other communications facilities onboard. The fact that only 16% have access to a computer at home seems to signal that most are not ready yet for web-based or Internet-based training solution to D.L. for seafarers ashore. Besides, it will not be cost-effective for a training institution such as NMP to use that mode of delivering D.L. when it is obvious that it will not benefit from the economy of scale, which is one of the main contentions for opting such a solution. This option should however remain open to accommodate future considerations of the growing availability of computers in the home of seafarers who are the *de facto* new emerging middle class in the country.

It is noteworthy that 14.6% indicated that their onboard computers were used for training purposes. This is a clear indication of the growing awareness of some ship owners of the importance of STCW '95 and the ISM Code and the vital role human factors play in the safety and efficient operation of ships. This augurs well for the prospect of establishing distance learning onboard.

Considering that 73.3% of those who use computers do it on daily or weekly basis and that 84.4% spend from less than two hours to 2-4 hours daily on average, coupled with the fact that 86.8% still find time to read or study onboard make it obvious that they have the right attitude and habits conducive for distance learning. With 95.8% signifying their interest to upgrade their knowledge and skill relative to the requirements of STCW '95 further reinforces the proof of their desire to develop themselves professionally given the means and opportunity. Though only 26.1% prefer self-study, Internet-based or other forms of learning compared to 61.7% who still prefer learning through regular classroom instruction, yet 93.4% are interested in learning and developing skills in their own time, 86% in their own place and 88.9% prefer learning in their own pace. These are actually the types of learning more attuned to the modern mode of D.L. techniques. In fact, an overwhelming 92.1% signified their interest to enrol and pay a fee of \$200 or less, others are even willing to pay higher. On top of that 89.2% are eager to enrol this year, by the year 2000 or any time soon.

Thus with the foregoing analysis and interpretation of data based on the result of the survey, it could be concluded positively that the Filipino seafarers are willing to develop their knowledge and skills pursuant to the requirements of the STCW '95 Convention as well as for their own professional growth. Further, it could be concluded that a good majority of those already possessing the skills necessary to benefit from the flexibility, ease and convenience that D.L. offers generally possess the qualities, habits and aptitude to succeed in distance learning.

#### 6.3 Technical Feasibility and Capability

The influence of computers and impact of Information Technology on modern bridge design is clearly demonstrated in the trend towards integration. Today more and more ships have Integrated Bridge System (IBS). The growing use of computers onboard for communication and marine applications is now becoming the norm. Presently some 3000 ships currently use ship management applications.

Many ships today even have Local Area Network (LAN) onboard (26% from author's survey and 43% in the NI study). Coupled with the explosive growth of INMARSAT installations onboard, being a GMDSS requirement, satcom technology is proliferating explosively. In fact, Mr. Patraiko told *LSM* (March 1999 issue, p.64) that:

The use of PCs aboard ships is accelerating at a tremendous rate. Many companies who started with single, stand-alone systems in the early 1980s, have now developed complex and sophisticated systems, incorporating Local Area Networks (LANs) on ships designed and

built with fibre optic connections, and often linked to Wide Area Networks (WAN's) through satellite communication.

Due to tremendous competition and greater demand for higher bandwidth applications, both from offshore and the maritime industry, INMARSAT is expanding and value-adding its range of services to include e-mail and web-browsing on board. Currently, its development thrust is on bandwidth flexibility. Its 'Horizons' project to develop 'bandwidth-on-demand' has been given the funding it needs and the M4 global mobile office solution is entering the marketing phase.

As of end of June 1998 (*Compuship*, June/July1998), less than 4,500 Inmarsat-B terminals have been commissioned. However there are now over 17,000 Inmarsat-A installations. But for Inmarsat-C, a massive base of over 32,000 terminals has already been installed out of a total of 50,000 shipboard units, (*Compuship*, November 1998). 'Everyone of these is Internet-enabled now, without the need for any additional software', said Phil van Bergen, INMARSAT's maritime marketing manager. Now, 'All shipowners need to do', he added, 'is implement e-mail to eliminate the relatively high cost of telex and fax', (*Compuship*, June/July 1998, p. 15).

But for NMP, to be able to send information to a particular ship or group of ships, it should obtain an INMARSAT Mobile Number (IMN) for each ship (listed in the INMARSAT Directory) and the INMARSAT Ocean Regional Access Code. It has to register also as an authorised FleetNET information provider to be able to transmit to a group of ships in a fleet. In turn the participating ships of a fleet should register with a FleetNET service and have stored in their SES an EGC Network Identification Code (ENID). Only these SES then with stored ENID code will receive the broadcast from the institution.

Inmarsat-C's wide availability (50,000 units) and compatibility with the Packet

Switched Data Network (PSDN) using X.25 protocol makes it virtually accessible by anybody with a PC and modem. It thus makes Inmarsat-C a highly viable option to reach more students at sea than its big brothers.

INMARSAT, using packet-switched data technique, has now made web-browsing on board possible. Internet e-mail, of which there are currently 2,500 users utilising a specialist maritime communications hub, is fast becoming an every day occurrence. Over the old analogue system of Inmarsat-A a technique called 'spoofing', which imitates packet switching, may bring web browsing to fruition. Spoofing makes it possible to set-up and drops a call in an instant. Van Bergen explains: 'You dial up the web, download the page you want and the connection is dropped instantly. Then when you press the button for the next page, it re-establishes the call in the blink of an eye and you download the page.' These new technology onboard (i.e. e-mail and web browsing) will not only make distance learning via satcom a technical possibility but also a tantalising reality.

Another viable alternative to ordinary commercial shipping is VSAT (Very Small Aperture Terminal). Its operational mode is similar to INMARSAT. These satellites are primarily used for television broadcasting or fixed communications. It is operated by organisations such as Intelsat, Eutelsat, Panamasat and Orion. Currently, Orbit, a terminal manufacturer, is working with a number of service providers who are about to bring VSAT services to the shipping market. Once widely available onboard, this could be a better alternative to INMARSAT being more suitable for bandwidth hungry applications such as live video transmission and remotely controlled simulation from institutions ashore.

Fuelled by new technology and the explosive growth in data communications for remote vessel management applications and the industry's bandwidth hungry requirement, significant changes in VSAT services during the next 18 months is bound to happen, announced Orbit's David Rowe, (*Compuship*, December 1998/ January 1999).

Actually, VSAT services have already made significant impact in the cruise and offshore industry where demand for high-volume data communication exists. In fact Telenor, an INMARSAT signatory, has been offering VSAT services called Norsat Sealink since 1992, providing link between ship and shore. 'Shipowners', claims its sales manager, Tommy Dybad, (*Compuship*, December 1998/January 1999, p. 17) 'get a seamless connection, dynamic bandwidth, broad global coverage, multi-channel management and numerous value-added services such as television and radio broadcasts, as well as telephone access at terrestrial network prices.'

Presently, a number of Scandinavian shipping companies are now using Norsat for all their communications. VSAT's biggest advantage, says Dybvad, is that: 'Users have unlimited access, up to their bandwidths capacity, for a set subscription. No matter how much they use, they know their communication costs.'

'More recently, there has been a continuing migration of both land and offshore operations from INMARSAT to VSAT in those regions where domestic or regional C and Ku-band coverage is available. However, INMARSAT remains the mainstay of the oil field mobile and portable communications solution due to its global coverage, low hardware costs and usage-based service.' said, Wayne Rentfro, Comsat Mobile Systems' manager of energy sales, (*Via Satellite*, August 1998, p.50).

In the mid 1990's, Project Aries (ATM Research and Industrial Enterprise Study), commissioned by the American Petroleum Institute, etc. successfully developed advanced satcom technology utilising very high speed data via ATM over the NASA ACTS Ka-band satellite. This demonstrated the potential benefits of wideband services, (*Via Satellite*, August 1998).

Relative to the growing availability of wideband satcom services, Sea-Tel launched two new shipboard systems designed for use across a wide range of frequencies from L-band (1.5 Ghz) to Ka-band (20-30 Ghz). It claims that its new systems will enable larger dishes required by Ka-band systems to be used aboardship at sea. The stabilisation and tracking technology in its new 96 and 97 system now make Ka-band communications at sea a realistic proposition for the first time. Robert Matthews, Sea-Tel chairman, predicted that Ka-band would soon be the preferred carrier for high-speed data applications such as video, video conferencing, Internet access and high-speed file transfers.

The combination of the growing availability of computer technology onboardship, IT, shipboard LAN and existing and emerging satellite services such as INMARSAT, Iridium, ICO, or Teledesic, allowing seafarers to roam the Internet, leave no doubt as to the technical capability and viability of setting up distance learning on board via satcom.

The resurgence of VSAT and its increasing installation onboard and the emergence of broadband satellite communications (L-band, C-band, up to the Ka-band) in the shipping industry hold a very tantalising promise for the future of distance learning onboard.

#### 6.4 Financial Viability and Sustainability

Based on the calculations from Table 7 of Chapter 5 the following estimates and projections are made. Below, Table 9 makes a comparative estimate of the costs involved in the first year of operation. A projection from the second up to the third year or beyond is made with the assumption that enrolment will continually increase as a result of the distance learning programme gaining more popularity and with additional courses being offered.

Table 9. Financial Projections Considering Dropout R	ates
First Year of Operation with 500 Enrolees and 10 tutors	
Capital outlay	\$112,138.00
Material component	43,109.76
Service component	271,000.00
INMARSAT transmission cost	47,880.00
Others	115,050.00
Total calculated operational cost <i>including</i> capital outlay:	\$589,177.76
Average cost per student at: NO dropout	\$1,178.36
<b>15%</b> dropout rate (425 remaining students)	\$1,386.30
<b>25%</b> dropout rate (375 remaining students)	1,571.14
<b>50%</b> dropout rate (250 remaining students)	2,356.51
First Year of Operation with 1000 Students and 20 tutors	
Capital outlay	\$112,138.00
Material component	81,219.51
Service component <i>including</i> consultant	451,000.00
INMARSAT transmission cost	95,760.00
Others	<u>126,000.00</u>
Total calculated operational cost including capital outlay:	\$866,117.51
Average cost per student at: NO dropout	\$866.12
<b>15%</b> dropout rate (850 remaining students)	\$1,018.96
<b>25%</b> dropout rate (750 remaining students)	1,154.82
<b>50%</b> dropout rate (500 remaining students)	1,732.24
First year of Operation with 1,500 Students and 30 Tutors	¢110.100.00
Capital outlay	\$112,138.00
Material component	119,329.28
Service component including consultant	631,000.00
INMARSAT transmission cost	143,640.00
Others	<u>136,950.00</u>
Total calculated operational cost including capital outlay:	\$1,143,057.28
	<b>6-</b> ( <b>0</b> ) (
Average cost per student at : <i>NO dropout</i>	\$762.04
<b>15%</b> dropout rate (1,2/5 remaining students)	896.52
<b>25%</b> dropout rate (1,125 remaining students)	1,016.05
<b>50%</b> dropout rate (750 remaining students)	1.524.10

Table 10. Second Year of Operation with 500 Enrolees and 10 tutors			
Capital outlay	None		
Material component	43,109.76		
Service component <i>without</i> consultant	211,000.00		
INMARSAT transmission cost	47,880.00		
Others	115,050.00		
Total calculated operational cost <i>less</i> consultant <i>and</i> capital outlay:	\$417,039.76		
Average cost per student at: NO dropout	\$834.10		
<b>15%</b> dropout rate (425 remaining students)	\$981.27		
<b>25%</b> dropout rate (375 remaining students)	1,112.11		
<b>50%</b> dropout rate (250 remaining students)	1,668.16		
Second Year of Operation with 1000 Enrolees and 20 Tutors			
Capital outlay	None		
Material component	81,219.51		
Service component <i>without</i> consultant	391,000.00		
INMARSAT transmission cost	95,760.00		
Others	126,000.00		
Total calculated operational cost <i>less</i> consultant <i>and</i> capital outlay:	\$693,979.51		
Average cost per student at: NO dropout	\$693.98		
<b>15%</b> dropout rate (850 remaining students)	\$816.45		
<b>25%</b> dropout rate (750 remaining students)	925.31		
<b>50%</b> dropout rate (500 remaining students)	1,387.96		
Second Year of Operation with 1,500 Enrolees with 15 Tutors			
Capital outlay	None		
Material component	119,329.28		
Service component <i>without</i> consultant	571,000.00		
INMARSAT transmission cost	143,640.00		
Others	136,950.00		
Total calculated operational cost <i>less</i> consultant and capital outlay:	\$970,919.28		
Average cost per student at: NO dropout	\$647.28		
<b>15%</b> dropout rate (1,275 remaining students)	\$761.51		
<b>25%</b> dropout rate (1,125 remaining students)	863.04		
<b>50%</b> dropout rate (750 remaining students)	1,294.56		

The above estimates of projected costs do not take into account inflationary fluctuations and other variable economic factors. It assumes a relatively static economic environment reflective of the relatively stable situation in the country after

Table 11. Third Year of Operation with 2000 Enrolees and 40 tutol		
Capital outlay	None	
Material component	157,439.04	
Service component without consultant	751,000.00	
INMARSAT transmission cost	191,520.00	
Others	147,900.00	
Total calculated operational cost <i>less</i> consultant and capital outlay:	\$1,247,859.00	
Average cost per student at: NO dropout	\$623.93	
<b>15%</b> dropout rate (1,700 remaining students)	\$734.03	
<b>25%</b> dropout rate (1,500 remaining students)	831.91	
<b>50%</b> dropout rate (1,000 remaining students)	1,247.86	
Second Year of Operation with 3,500 Enrolees and 70 Tutors	1	
Capital outlay	None	
Material component	271,768.32	
Service component <i>without</i> consultant	1,291,000.00	
INMARSAT transmission cost	335,160.00	
Others	<u>180,750.00</u>	
Total cost of operation <i>less</i> capital outlay and consultant fee:	\$2,078,678.32	
Average cost per student at: NO dropout	\$593.91	
<b>15%</b> dropout rate (2,975 remaining students)	\$698.72	
<b>25%</b> dropout rate (2,625 remaining students)	791.88	
<b>50%</b> dropout rate (1,750 remaining students)	1,187.82	
Second Year of Operation with 5,000 Enrolees and 100 Tutors		
Capital outlay	None	
Material component	386,097.56	
Service component <i>without</i> consultant	1,831,000.00	
INMARSAT transmission cost	478,880.00	
Others	<u>213,600.00</u>	
Total cost of operation <i>less</i> capital outlay and consultant fee:	\$2,909,577.56	
Average cost per student at: NO dropout	\$581.92	
<b>15%</b> dropout rate (4,250 remaining students)	684.61	
<b>25%</b> dropout rate (3,750 remaining students)	775.89	
<b>50%</b> dropout rate (2,500 remaining students)	1,163.83	

the economic turmoil that plagued most of Asia. It does so also for the sake of simplicity and brevity. An analysis of the data in Table 9 shows that assuming an initial enrolment of 500 students without any drop-out, an average cost per student per course amounting to \$1,178.76 will be I incurred due to large investment in the capital outlay for the equipment and facilities and the employment of a foreign con-

Table 12. Third Year of Operation or Beyond with 10,000 Enrolees and 200 Tutor		
Capital outlay	None	
Material component	767,195.12	
Service component without consultant	3,631,000.00	
INMARSAT transmission cost	957,600.00	
Others	323,100.00	
Total cost of operation <i>less</i> capital outlay and consultant fee:	\$5,678,895.12	
Average cost per student at: NO dropout	\$567.89	
15% dropout rate (8,500 remaining students)	668.11	
<b>25%</b> dropout rate (7,500 remaining students)	757.19	
<b>50%</b> dropout rate ( 5,000 remaining students)	1,135.78	

sultant.

Doubling the enrolment to 1000 will bring down the average cost by 26.5% per student or \$866.12. Tripling the enrolment to 1,500 will bring down the average cost per trainee by 35.4% or \$762.04. Comparing the average cost per student with capital outlay and consultant fee against one without, assuming an enrolment of 500 students and no drop-out, gives a cost difference of 29.2% or \$1,178.76 against \$834.10. On the second year of operation and onwards, when capital outlay and consultant fee are out of the picture, successive increases in enrolment and corresponding decrease of average cost per student are shown in Table 13. From those figures, it is obvious that there is only a slight decrease in the average cost per student despite of the relatively significant increase in enrolment. This situation is due to the fact that for every increase in student population there is a significant corresponding increase in the training inputs such as additional tutors, increased volume and frequency of satellite transmission and in the number of CBT modules to be distributed on a one-to-one ratio to each student. This incurs a considerable cost as each CBT module is leased on an annual basis. Dropouts increase the cost per student significantly. For every dropout of 15%, at least in the first year of operation, there is a corresponding increase in the average cost per student of 17.6%. With 25% dropout the increase will be 33.3%. Obviously, with 50% dropout the average cost per trainee will double.

From the financial projections and analysis made below, it could be concluded that it will necessitate both cost-cutting and revenue-raising measures to make distance learning onboard utilising satcom, not only technically feasible but also financially viable and affordable to most seafarers.



# Table 13. Enrolment Increase andCorresponding Decrease in Average Cost Per Student

### 6.4.1 Cost-Cutting and Other Measures to Ensure Affordability

To lower the capital cost NMP has to utilise its existing computers and facilities in the establishment of its multipurpose and multifunctional electronic classroom supporting distance learning. At present NMP has 32 workstations with Intel 80486 processor and 26 desktop and 6 laptop with Pentium chips. At least 12 (+1 for the teacher) of these Pentium desktop could be utilised solely for training purposes, either for short or long distance learning. Existing multi-system 26-inch TVs and multi-system VHS videocassette recorders could be utilised too.

Maximisation of the use of the multipurpose electronic classroom should be optimised to make it more productive, efficient and cost-effective. Its video conferencing capability should be used for board meetings when the head of the institution and other key NMP officials cannot be physically present at the meeting place (usually in Manila or other remote location) due to some constraints. Conversely, when the board members cannot come to NMP's training complex in Tacloban City (about 300 miles south of Manila) a video conference could be arranged instead. It will save NMP from paying expensive airfares and hotel accommodations, not to mention savings in terms of precious time.

The facility should also be used for Stowage Planning, Trim and Stability calculation classes utilising special computer software. It should be utilised too as a Computer Aided Language Lab (CALL) to teach Maritime English. PC-based ship manoeuvring and other forms of simulation including oil, chemical and gas tanker operation are other suitable applications. It should also be utilised as a computer lab in teaching computer literacy and associated IT's. NMP's Curriculum Development Committee should make use of it too for designing and developing high quality course materials.

NMP's Inmarsat-A and C simulators could be refurbished to be used for actual satellite transmission so that it only has to purchase an Inmarsat-B. To save on transmission cost it has to be registered as an authorised FleetNET information provider to be able to transmit to a group of ships in a fleet.

Another economical approach to data transmission is to make use of data compression techniques utilising computer-based software, a computer terminal, modem and the Inmarsat system (A,B,C or M). This is of particular value when

sending large amount of files to students at sea. Participating ships would only need a PC with appropriate file transfer software and a data modem of 9,600 bits per second or higher using a V32 protocol.

Pre-programming transmission to take place during off-peak periods is another economical way of sending messages. The use of e-mail instead of by telex or fax is another cheaper alternative to shore-to-ship and ship-to-shore communication. Brödje (1994) pointed out that the cost of transmitting an e-mail containing the same amount of information is only a fraction compared to telex or fax. This is not to mention that this method of message transfer is less sensitive to interference.

With Internet e-mail already available and web-browsing now possible onboardship via INMARSAT using packet-switched data technique, a cheaper alternative to the expensive HSD is now an option. With packet-switched data the user is charged only for the data he/she downloads. This technique may lend credence to making distance learning utilising satcom not only technically feasible but also commercially viable.

Using a call routeing device such as Magnavox's Communications Integrator will optimise voice, fax and data communications integrating INMARSAT, VSAT, cellular, DSC radio and landlines into a seamless communications system. As much as 30% savings could be generated by automatically routeing out-going calls through the most cost-effective medium, based on tariff data stored in its memory.

Installing a Hewlett-Packard's Digital Senders could help minimise costs as it is capable of scanning printed documents and transmit them via Internet computer networks as e-mails. The company claims savings of up to \$60,000 could be made in telephone charges and by eliminating fax machines, (Newsweek, November 30, 1998).

Installing VSAT, instead of INMARSAT, could also save cost of transmission. 'The

advantage', according to David Rowe (*Via Satellite*?), is that: 'With VSAT, you are only charged for the amount of bandwidth you are using.' Whereas 'With INMARSAT, you work to a fixed cost per minute, and you are limited in the bandwidth you can use.' The problem with VSAT, however, is the prohibitively high cost of its hardware.

Another measure to significantly cut cost is to encourage sharing of CBT module with other seafarer-students boarding the same ship and enrolled in the same course. If two or more students share the same CBT module, it will bring down the material cost to about 50% or more thus further reducing overall training cost.

A better way would have been to lease and use only one CBT module to be transmitted on demand, synchronously or asynchronously, via satellite to students at sea who wish to access it, similar to a system in a network where one server provides data and information to all who need. In that case, it would have been more efficient to run a simulation from an institution ashore to assess the knowledge and skill of a student at sea. Supervising and monitoring students' exercises and assignments would have been more efficient and interesting. However, current available bandwidth onboard via the INMARSAT (up to 64 Kbps) is not sufficient to handle such enormous volume of data. VSAT, with its higher bandwidth, may provide some glimmer of hope. But it is really the emergence of Ku- and Ka-band satcom in the shipping industry that really holds the promise. Soon, as predicted by Robert Matthews, Sea-Tel chairman, it will be the preferred carrier for high-speed data applications, Internet access and high-speed file transfers onboard.

These are some of the cost-cutting measures NMP has to do to make distance learning onboard an economically viable proposition.

#### 6.4.2 <u>Revenue-Generating Measures to Help Finance Training Cost</u>

The cost cutting measures above, if implemented, could generate large savings but may not be enough to bring average cost per trainee down to \$200, which is the amount indicated by the survey Filipino seafarers are willing to pay. Therefore measures should be taken to ensure seafarers could afford the cost of training.

Since Filipino seafarers bring in over 400 million dollars to the country in annual remittances, it is just right and proper that the government should give them something in return. Subsidising the cost of training by the government, including those via distance learning would go a long way.

Enhancing and value-adding of existing OWWA (Overseas Workers Welfare Administration) scholarship fund should be initiated to ensure more seafarers are properly trained within a year to meet STCW '95 requirements.

Company sponsorship should be encouraged. Many of the big companies of high repute are doing this. The rest however still need to initiate such a policy, after all they are the ones who benefit from having well-trained, competent and efficient mariners to safely manage and operate their ships and prevent marine pollution, (ISM Code, Preamble 1). Secondary legislation may have to be made to strengthen the operationalisation of the STCW '95 and ISM Code (6.2, 6.5) to ensure that each ship is manned with qualified, certificated, and medically fit seafarers and the necessary training are identified and provided. That would then guarantee that shipping companies take the responsibility of training their seafarers in recognised training centres/institutions.

For the not-so-rich companies, a 50-50 split in the payment of training fees could be arranged between them and the seafarers. For the smaller and relatively cash-strapped companies, a study-now-pay-later scheme may be appropriate. In this case

the shipowner may provide the full payment to the training institution to be refunded by the seafarer later. Payment could be made through salary deduction spread through, say, a one-year period to cushion its financial impact on the poor mariner.

Carlos Salinas, President, Philippine Transmarine Carrier, Inc. and incidentally member of WMU's board of governors, proposed the establishment of a private training fund, during the very first LSM Manning and Shipping Conference for STCW '95 held in Manila. The fund should come from the shipowners/employers/ manning agencies themselves and administered by them. This will ensure that there is always money available to finance the training of seafarers without imposing any financial burden on them. The only obligation seafarers may have is in terms of providing safe and efficient service to the shipping industry.

Some kind of seafarers' scholarship foundation may have to be set up to help defray training expenses. Considering the fact that there are about 300,000 active Filipino seafarers, requiring them to contribute 1 dollar per month will generate funds of as much as \$3,600,000 annually! The foundation should be preferably managed by the seafarers themselves. People with expertise in managing foundations of this sort should assist them. Responsible government officials may help oversee the foundation particularly those involved in maritime related activities.

Requesting technical assistance from IMO is another viable proposition. This could be in the form of financial assistance to shoulder fully or partly the capital cost in establishing distance learning. The other component is the provision of a distance teaching expert to oversee the setting up and operation of the D.L. programmes at least in its first year of operation. This will also help defray NMP from paying high consultancy fee when a foreign expert is employed.

Grants may be requested from countries with keen interest in employing Filipino seafarers such as Japan and Norway. These countries may donate either equipment or

expertise's, again helping NMP defray the initial capital cost.

NMP may have to negotiate with INMARSAT service providers, manufacturers of satcom facilities, computers and other equipment utilised for distance learning to have a donation or a 'soft' (long-term, low or no interest) loan.

These ideas, if implemented, will ensure the affordability of distance learning at sea and the economic feasibility and financial viability of the proposed project.

#### 6.5 Comparative Analysis of Conventional Course vis-à-vis Distance Learning

Table 14 below illustrates the costs and benefits between a conventional ARPA course vis-à-vis one delivered via distance learning. The conventional programme utilises a four own ship Radar/ARPA simulator (estimated to cost \$2,000,000). Each ownship is fully equipped with a complete array of navigational equipment and supporting facilities necessary for the simulation. The simulator is housed in a room about 250 square metres in size and fully air-conditioned.

The figures given are based on the assumption that students stay in the training complex for seven days (1 day before + 5 days training + 1 day after). The costs involved are either direct or indirect expenses incurred by the trainee, the NMP or sponsoring company. The operation and maintenance cost is derived from the Pre-Feasibility Study of NMP's Expansion and Upgrading of Training Facilities, (NEDA-NMP, 1995) valued at 31,341,000 pesos (\$1,205,423.10 at the time at 1:26 exchange rate). It includes salaries and other benefits of both training and administrative personnel. Dividing it by the number of courses offered by NMP will enable one to derive the average maintenance cost per course (e.g. ARPA). The course assumes a total of 500 students trained annually. Food expense is estimated at 200 pesos (\$5.26) a day for seven days converted to dollars based on the exchange rate of 1:38. Accommodation is estimated at 100 (\$2.63) pesos a day multiplied by

seven days. The students do not actually pay this amount but this is the estimated expense incurred by NMP in maintaining each dormitory accommodation. Travel by air is presumed being the most convenient and round-trip airfare is estimated at 3,000 pesos (\$78.95). The distance covered is based from Manila to Tacloban City, which is about 300 miles. The author considers it as the average distance enrolees will travel considering that Tacloban City, NMP's location, is at the central part of the Philippines, (see map in Appendix 4).

The seafarers' travel expenses from the ship, which could be from any port in the world, back to Manila is purposely excluded here.

The calculated income loss is equivalent to one-month shipboard pay of a 2nd Mate based on the POEA (Philippine Overseas Employment Administration) rate equivalent to \$1,500. But in a better paying company it could be just the salary of a 3rd Mate. That is why this value is chosen considering that a number of NMP trainees are in this rank category, though there are many of senior rank who enrol on the course as well. This is based on the fact that seafarers will loss their income for a month while on training since they normally undergo training while on vacation for a month or two after a one year stint at sea.

The subsidy for D.L. students is based on the calculation of average cost per student of \$1,178.36 (from Table 9) for the first year of operation without any dropout less the suggested training fee of \$200.00 based on the survey response conducted by the author.

From the figures shown in Table 14 below, it is clear that a regular ARPA training incurs an aggregate cost of \$2,918,691.02 against a minuscule benefit amounting to only \$26,315.79, thereby incurring a negative difference of \$2,892,375.23. As for distance learning, the total cost is \$906,219.76 compared to a total benefit of \$917,105.25 thus gaining a net benefit of \$10,885.49. Though the amount is small, it

is a clear indication of the positive benefit and advantage of distance learning over the conventional simulator-based face to face instruction. The above data included the cost of training facilities and equipment and a number of indirect costs for the first year of operation. The lower cost in distance learning, though the tuition fee is much higher, is attributed to the fact that the seafarers remain employed while studying.

C O S T		BENEFIT	
Conventional	Distance	Conventional Distance	
	Learning		Learning
Capital Outlay: \$2,000,000.00	None		
Operation & Maint: 40,180.77	417,039.76		
70% Subsidy: 61,405.00	\$489,180.00	Training Fee:	Training Fee
(6666.7 pesos x 70% = 4666.69 /38 = <b>\$122.81</b>	(\$978.36	\$26,315.79	\$100,000.00
<b>per stud</b> . x 500)	subsidy/student)	2000 pesos/38=5\$2.63	(\$200/students x 500)
Income lost: 750,000.00	None		Income Earned
(2/M salary/month = \$1,500 x 500 stud.)			\$750,000.00
Travel Cost: 39,473.68	None		Travel savings:
(3000 pesos/38=\$78.95 x500 students)			\$39,473.68
Food: 8,421.05	None		Food savings:
(200 pesos/day/38=\$5.26x7d x 500 students.)			\$18,421.05
Accommodation: 9,210.52	None		Accommodation
			savings:
			\$ 9,210.52
Total: 2, 918,691.02	\$906,219.76	\$26,315.79	\$ 917,105.25
(\$2,892,375.23)			\$10,885.49
Net loss			Net Benefit

 Table 14. ARPA Cost-Benefit Analysis Case I - With Capital Outlay and

 Consultant

A second table on cost-benefit analysis is shown below (see Table 15) extending to the second year of operation where capital cost and consultant fee are out of the picture. The same assumptions are made here as in the first case with some exceptions. In the second case, the subsidy for each D.L. student is derived by subtracting the training fee of \$200.00 from the average cost per trainee of \$834.10 on the second year of operation (see Table 10).

C O S T		BEN	EFIT
Conventional	Dist. Learning	Conventional	Dist. Learning
Capital Outlay: None	None		
Oper. & Maint:\$ 40,180.77	\$417,039.76		
Subsidy: \$61,405.00	\$317,050	Training Fee:	Training Fee
(6666.7 pesos x 70% = 4666.69 /38	(\$634.10	\$26,315.79	\$200/p \$100,000
= <b>122.81 per stud</b> . x 500)	subsidy/student)	(2000 pesos/38=\$52.63)	(\$ 834.10 average cost/ student)
Income lost: \$750,000.00	None		Income Earned
(2/M salary/month = \$1,500 x 500 student)			\$750,000.00
Travel Cost: \$ 39,473.68	None		Travel savings:
(3000 pesos/38=\$78.95 x500 students)			\$ 39,473.68
Food: \$ 18,421.05	None		Food savings:
(200 pesos/day/38=\$5.26x7d x 500 stud.)			18,421.05
Accommodation: \$	None		Accommodation
9,210.52			savings: 9,210.52
Total: \$ 918,691.02	\$734,089.76	\$26,315.79	\$ 917,105.25
(892,375.23)			\$183,015.49
Net loss			Net Benefit

Table 15. ARPA Cost-Benefit Analysis Case 2 - Capital and Consultant
Excluded

Based on Table 15 above, a similar conclusion could be drawn in that distance learning accrues more benefit than conventional ARPA training having a net benefit of \$183,015.49 against a net loss of \$892,375.23 for the conventional course. While the conventional training programme offers a much lower tuition fee of \$52.63 against \$200.00 for distance learning, it has much higher accrued indirect cost due to the seafarer's loss of income while on training and other indirect training related expenses. In contrast, distance learning students are privileged in not having had to forego occupational earnings during their time of study, which on-campus/site trainees must do. Unlike shore-based learners, it is physically impossible for seafarers to study part-time alongside their jobs while at sea except through distance learning.

Holmberg (1989), on the case studies he made on the subject concluded that: 'There can be no doubt that distance education, as applied to large student bodies, is characterised by very favourable cost-benefit relations provided that the distance-teaching element consistently predominates. In some cases', he elaborated, 'it is the use of sophisticated and costly media and technology that detracts from the cost-benefit relations, but this does not change the overall picture of distance education as economical.' Though distance learning onboard via satellite is quite expensive, it still boils down to the fact that the overall picture is nevertheless favourable if the conventional course's indirect costs are considered.

Besides the economic benefit of open and distance education, there are other nonmonetary and unquantifiable benefits as well. Open and distance learning increases educational opportunities through liberal admission policies, through using more than one mass medium to communicate with learners, and by bringing resources to the learner rather than expecting the learner to come to the resources. It is the ease, convenience and flexibility of learning at one's own time, pace and place that make distance learning attractive particularly to mature, busy people who are tied up with their work.

## 6.6 <u>Pros and Cons of High-Tech Distance Learning Utilising Satcom and Other</u> <u>Technologies in Developing Countries</u>

#### 6.6.1 The Pros and Concomitant Advantages

Advanced telecommunications and IT, including satellite communications, have revolutionised the way distance learning is being delivered and administered. The new technologies now allow for a powerful combination of highly interactive standalone material with two-way asynchronous communication between teacher and students. New technologies also offer the promise of any course delivered at any time, anywhere, the promise of truly international courses, fully inter-cultural, with student and teachers drawn from all over the world.

The concept of socio-cultural theory conveniently called community of practice (Lave 1988, Rogoff 1990) refers to the fact that most people learn best not by receiving lectures but rather by engaging collectively in practice, with the assistance of teachers and peers. With Computer-Mediated Communication (CMC), the development of communities of practice is facilitated. It brings learners into more direct contact and communication with each other, whether in a classroom or across the globe. Synchronous electronic discussion on a LAN, WAN or Internet germinate and sprout into communities of practice when students exchange e-mails write assignments with their classmates or engage in group projects with long distance partners (Kern, 1996, Janda 1995, Warschauer 1995). CMC thus engenders collaborative learning as spoused by the socio-cultural theory.

Another concept advanced by socio-cultural theorists is that of situated learning. This emphasises the importance of having students 'carry out talks and solve problems in an environment that reflects the multiple uses to which their knowledge will be put in the future' (Collins, Brown, and Newman 1989). Hence learning *in situ* in an onboard environment will put learning in the proper (real or actual) context essential

in the transfer of knowledge to new domains. Therefore distance learning onboard ship is well suited to the concept of situated learning.

Distance learning does promise greater learning effectiveness, more learner-centred approaches, and better quality of instruction. Technology also offers the possibility of delivering training right into the workplace by embedding training in computer applications, by enabling just-in-time or on-demand training, and by bringing specialists from anywhere in the world into conferences and meetings.

In the case of computer-mediated communication (CMC), students and lecturers communicating via e-mail, electronic chat rooms and bulletin boards are encouraged to research library resources electronically. Thus providing them access to a variety of informations globally further enriching the learning process.

Sellinger (1995); Verduir and Clark (1991); Nielsen et al. (1991) demonstrated that videoconferencing, coupled with associated technologies like document cameras, has enhanced the social interaction that is often essential to success in distance learning.

Voicemail is another resource that facilitates distance learning. Short lectures and responses to study questions are being recorded in voicemail systems for students to access when the need arises. These new electronic/digital ways of communication with people and accessory information are seen to offer opportunities for a caring environment highly essential for the success of distance learning. Because after all, as Lentell (1994) said, '...however splendid the printed texts, and however refined the quality measurement tools [in distance education], it is the relationship between the tutor and the learner that determines success or failure'. It is this 'caring' environment facilitated by modern technology that enhances/strengthens this relationship.

#### 6.6.2 The Cons and Accompanying Disadvantages

While high technology offers a number of advantages very favourable to the learning environment, it is by no means a perfect solution. There are certain limitations, and even disadvantages, associated with the use of technologies in distance learning. Crock et al (1994, p.17) raised the issue of IT use in distance learning becoming 'seduced by the presentation capabilities of related technologies at the expense of the genuine needs of the end user'. Another problem identified is the fact that for students to experience learning/education via information technologies requires them first to possess or have access to the requisite technologies at their end (Davison, 1996). Onboard, access to the ship's computer system and satcom could be a problem. As a matter of fact, 42.9% of those Filipino seafarers surveyed indicated not having access to the facility despite of its availability. Hence acquisition or access to technological hardware and support systems should get it all to work well, before they could begin to worry about how to use it to their advantage.

The move to computer-based learning raises major issues of access and student support for distance learners. (This is also the case for Filipino seafarers of which only 16% have computers at home as per survey result conducted by the author). Thus a university using a particular IT, warned Davison, might be the very antithesis of empathy and contribute to less access and success in higher education for those who fail to meet the requisite technological hardware and associated skills necessary. As has been pointed out, the promise of new technologies does not necessarily lead to open learning, nor does it guarantee that technology will be used in these ways. 'Without careful management and design', Bates (1997) sternly warned, 'it can lead to a widening gap in access between rich and poor, it can lead to cultural imperialism, the "Americanisation" of curriculum; it can lead to the destruction of public education systems by powerful multinational corporations (MNC's)', if allowed to happen.
On-line distance learning premised on user-pays-for-time-on-line can result in less use and less use contribute to a lack of success. With the present trend of distance learning becoming increasingly electronic-based; students will be less and less buying more time 'on-line' instead, (Floridi, 1995).

'Success in higher education via IT', says Davison (1996), 'requires being skilled in their use and being willing to use them'. Distance students using IT have to devote considerable amount of time in learning how to use it and using it to facilitate their distance studies. Accessing and manipulating information electronically seems to 'eat' time at a rate we are often not aware of and so the personal costs will be more than financial, with the less technologically skilled and/or inclined doubly disadvantaged. Such disadvantage may provide the right condition to drop out of studying altogether.

Another consideration is that, given the often selfish and demanding nature of studying, family members of distance learning students, particularly in developing countries, might feel a bit peeved that so much money is going towards studying. This is because technology is often very expensive, particularly new ones. Thus distance learning utilising high technology may impose a financial burden on the part of the student and his family.

For institutions using telephone, especially satphone, for tutorials, its use could be limited because of cost, technical difficulties and/or lack of confidence, depending on to whom the call is being made.

The use of IT in distance learning presents a problem not only to students but also to the tutors/teaching staff. The very same IT skills required of students is also expected of the teaching staff, perhaps even to a much higher level. They too have to be encouraged to use the technology to help students learn better even if it means giving up on the familiar. In the developing world, the lack of communication infrastructure presents a serious hindrance in the delivery of distance learning employing such technologies.

The interaction between learner and a real teacher can be substituted only to a certain extent by learning materials. Learners are always capable of generating ideas that cannot be adequately anticipated by machine-based learning.

Compared with campus-based students with access to a computer lab, distance learners have far greater obstacles to overcome. Distance students need access to a computer, and not just any computer; it must have CD-ROMs and Internet connection plus a satellite link, in the case of seafarers at sea. It requires the acquisition of a workstation costing several thousand dollars. A modem of sufficient speed is also necessary to allow downloading of needed information even through plane, old telephone line.

Present satcom technology commonly available onboard has limited bandwidth thus restricting, if not preventing, the author from implementing the concept of distance learning he originally has in mind. That is, employing remotely controlled simulation undertaken by a student at sea from an institution ashore and transmitting full motion video material (e.g. Videotel) via satellite. INMARSAT is only capable of handling slow-scan video as the standard TV quality picture will require data speed of several megabytes per second.

These are some of the limitations distance learning via satcom utilising computers and Information Technology institutions should consider prior to establishing any D.L. programme utilising such technologies.

# **Chapter 7**

### Summary, Conclusion and Recommendations

### 7.1 Summary

From the preceding chapters it is clearly seen how the computer revolution and the added impetus of developments in Information Technology have had dramatic impact on bridge design, navigation equipment development and bridge training. This trend eventually led to full bridge integration.

The availability of powerful, affordable computer hardware has made bridge integration technologically feasible. Computers play a central role in the processing, distributing, displaying, correlating and interpreting and logging of shipboard data and information.

Onboard computing systems are no longer limited to stand-alone engineering and navigational applications. The increasing installation of LAN on ships reflect the growing realisation by some ship owners that the linking of the total ship to the company LAN ashore can increase interaction between both and lead to improved efficiency, safety and cost-effectiveness.

The LAN onboard facilitates file transfer and data exchange among the various equipment and components. It also allows many computers to simultaneously communicate with one another.

The widely recognised need for vessels to become an integral part of shipping companies' computing and communications network has led to the recurring theme in marine software development to the concept of transforming the modern ship into a floating office.

This, in turn, led to a tremendous rate in the growth of computers aboard ships. In fact, many companies that started with single, stand-alone systems in the early 1980s have now developed complex and sophisticated systems, incorporating Local Area Networks (LANs). Some ships have even been designed and built with fibre optic connections, and often linked to Wide Area Networks (WAN's) through satellite communication.

Meanwhile, research and development activities in satcom technology geared towards producing faster and more cost-effective means of data transmission are continually evolving. This has resulted in a growing number of satellites now blanketing the space providing broader coverage to almost every nook and cranny on the face of the earth. Foremost among these is the advent of Iridium heralding the world's second global mobile satellite communications network. Never in history has the satellite industry been so vibrant.

INMARSAT, on its part, has expanded and value-added the range of services it offers. It now includes Internet e-mail as a built-in capability in its SES. The packetswitched data technique it has developed now allows the surfing of the World Wide Web even by seafarers at sea. This could even soon be possible also with the old analogue system over Inmarsat-A using a technique called 'spoofing', which imitates packet switching.

The current capability of ships to access aboard almost any information ashore even in the high seas poses new and exciting opportunities for onboard learning. The resurgence of VSAT installation onboard and the emergence of broadband satellite communications (C-band, Ku-band, up to the Ka-band) in the shipping industry hold a very tantalising promise for the future of interactive synchronous/asynchronous distance learning onboard.

Modern educational techniques utilising computer based training (CBT), computer aided learning (CAL), PC-based simulation, interactive CD (CD-I) are part of a comprehensive high-tech distance learning programme that could bridge the gap between sophisticated shipboard systems and the manpower available to run them.

Relative to this, the Norwegian research project called Information Technology in Ship Operation Programme, particularly the sub-project regarding 'Training, Recruitment and Selection', led to the development and extensive use of CBT onboard. It also included the development of different types of assessment tools designed to facilitate documentation showing proof that their seafarers had met international requirements.

This research project proved the effectiveness and efficiency of CBT's for training and documentation of training outcome and the ease with which trainees' progress could be monitored.

Similarly, the Anglo-Eastern Ship Management experience demonstrated that a PCbased simulation training programme with built-in expert system, such as PC Maritime's Officer-of-the-Watch, is the key to the whole issue of distance learning onboard. The programme allowed the company to carry out onboard interactive training that has led to improved bridge procedures and officers' performance in an efficient and cost-effective manner.

The use of satellite communication in the transmission of training packages, including instructions and course timetables, which were automatically downloaded

onto the ship's PC, provided an excellent example of the efficient and effective use of modern telecommunications in the assessment of completed material and debriefing on the results of the training tasks performed by the trainees onboard.

In another but related development, the Canadian Navy's desire to improve training performance while reducing costs brought about the development of a low cost, high performance bridge and ship handling simulator which could be used by a number of trainees simultaneously. Its MARS Virtual Reality System embodies this.

VR's ready availability, both ashore and afloat, provide the means to develop and maintain skills at high level of proficiency, to checkout newly qualified personnel and to undertake rehearsal training before an event. This is highly beneficial when adverse conditions are likely to be encountered and test the adequacy of plans before execution. As such, it offers an extremely effective and cheap risk management tool of significant operational benefit.

With this 'significant operational benefit' there is a strong likelihood that in the foreseeable future Virtual Reality will emerge as an onboard training reality.

In the establishment of a distance learning programme, among the various technologies explored, it was decided that a multipurpose and multifunctional electronic classroom that supports distance learning is the most suitable relative to the NMP's aims and goals. This multipurpose classroom could support a range of subjects. It is capable of delivering multi-modal distance learning instruction. It is also flexible enough to support either or both site-to-site and site-to-multi-site distance learning programmes in either synchronous or asynchronous transmission mode (ATM).

The establishment and operation of such a programme was found to cost approximately \$602,196.76, if existing computers at NMP and other equipment and

facilities are to be utilised. This is rather expensive considering the fact that the country has suffered about 40% currency devaluation during the recent Asian crisis plunging the peso down to 43 against the dollar and now has settled at about 38 pesos to the dollar.

However, if both of the proposed cost-cutting and revenue measures are implemented the economic viability and financial sustainability of the project could be assured.

The comparative analysis of the costs and benefits between a conventional ARPA course vis-à-vis an ARPA course delivered via distance learning medium revealed the great discrepancy in tuition fee in favour of the conventional course. However, if most, if not all, of the indirect costs particularly loss of income is considered, etc. distance learning offers a much more favourable cost-benefit relation.

### 7.2 Conclusion

It is therefore evident from the foregoing that satellite technology along with IT and telecommunications technology is opening up numerous opportunities for new educational approaches. Never in the annals of maritime education has the optimism for its future potential been greater. It has demonstrated clearly the technical feasibility and economic viability of establishing distance learning utilising satellite communications system.

Legislation (e.g. STCW'95, ISM Code and SOLAS) and commercial pressures (i.e. multinational crew, demand for short, task related courses, reduction of crew) have conspired to make it necessary for distance learning to become a viable alternative to effective training of seafarers at sea.

With the now becoming ubiquitous presence of computers onboard and the availability of shipboard LAN and satellite communications systems becoming more

commonplace, the metamorphosis of dual role ships as floating offices and virtual classrooms afloat is not only a possibility but an emerging reality.

### 7.3 <u>Recommendations</u>

In the light of the foregoing, the following recommendations are made:

- Adopt a new approach to MET in the Philippines by establishing a Distance Learning Programme employing state-of-the-art telecommunications technology, IT and satellite communication (satcom) system to enable the Philippine MET to train a great number of seafarers while they are at sea without sacrificing quality.
- 2. NMP, being government-owned and the most technologically equipped maritime training centre in the country, should spearhead this pioneering endeavour.
- 3. Implement phased-in installation of the multipurpose and multifunctional classroom supporting distance learning.
- 4. Implement cost-cutting and other measures to ensure affordability in establishing and running distance learning utilising satcom and IT such as the following:
  - Utilise NMPs existing computers and facilities in the establishment of its multipurpose and multifunctional electronic classroom supporting distance learning to lower the capital cost.
  - Maximise the use of the multipurpose electronic classroom by utilising it for videoconferencing (e.g. board meetings to save travel cost, accommodation, etc.), as a Computer Aided Language Lab (CALL) to teach Maritime English, as computer lab for teaching computer literacy and Information Technology,

for PC-based simulation for deck, marine engineering and other courses, for Curriculum Development to develop high quality course material, and other applications and uses to make it more productive, efficient and cost-effective.

- Refurbish and upgrade NMP's Inmarsat-A and C simulators for actual satellite transmission to save on transmission cost and register as an authorised FleetNET information provider to be able to transmit to a group of ships in a fleet.
- Acquire the necessary facilities (hardware/software) to make use of data compression techniques.
- Pre-program transmission of messages, etc. to students at sea during off-peak periods.
- Use of e-mail instead of telex or fax as a cheaper alternative to shore-to-ship and ship-to-shore communication.
- Explore other effective ways of using Internet e-mail and web-browsing onboardship via INMARSAT, using packet-switched data technique as a cheaper alternative to the expensive HSD, to lend credence in making distance learning utilising satcom not only technically feasible but also commercially viable
- Use cost-saving devices such as Magnavox's Communications Integrator, a call routeing device, and Hewlett-Packard's Digital Senders to help minimise overall operational costs.
- Explore the possibility of using VSAT and other emerging wideband satellites (i.e. Ku-band and Ka-band) instead of, or in conjunction with, INMARSAT,

for utilisation of high-speed data applications, Internet access, high-speed file transfers onboard, remotely controlled simulation from the institution ashore, full motion, TV quality video to enhance the effectiveness of its future D.L. programmes. (Weigh and consider the advantages/disadvantages of such a plan by conducting a comparative analysis and comprehensive feasibility study on the matter.)

- Encourage sharing of CBT module with other seafarer-students boarding the same ship and enrolled in the same course by offering them some discount in the tuition fee as an incentive.
- 5. Implement revenue-generating measures to help finance training cost as follows:
  - Subsidise the cost of training, including those via distance learning.
  - Initiate enhancing and adding value to the existing Overseas Workers Welfare Administration (OWWA) scholarship fund to ensure that more seafarers are properly trained within a year to meet STCW '95 requirements.
  - Encourage company sponsorship for the training of the seafarers they employ, after all they are the ones who benefit from having well-trained, competent and efficient mariners to safely manage and operate their ships and prevent marine pollution.
  - The Philippine government should enact a secondary legislation to strengthen the operationalisation of the STCW '95 and ISM Code (6.2, 6.5) to ensure that shipping companies take the responsibility and support the training of their seafarers in recognised training centres/institutions.

- Institute a 50-50 split in the payment of training fees between the seafarers and the not-so-rich companies or a study-now-pay-later scheme for smaller and relatively cash-strapped companies in which the shipowner may provide the full payment of training cost to be refunded in full by the seafarer later on a staggered basis through salary deduction spread through, say, a one-year period to cushion its financial impact on the poor mariner.
- Establish a private training fund from the shipowners/employers/manning companies to be organised and administered by them. This will ensure that there is always money available to finance the training of seafarers without imposing any financial burden on them. It will also ensure that they have sufficient supply of well-trained and competent seafarers to safely and efficiently man their ships.
- Set up some kind of a seafarer scholarship foundation to help defray training expense by requiring active Filipino seafarers (numbering about 300,000) to contribute 1 dollar per month to generate funds. The foundation should be preferably organised and managed by the seafarers themselves. They may have to be assisted by people with expertise in organising and managing foundations with responsible government officials helping to oversee it.
- Request technical assistance from IMO either financially to help shoulder fully or partly the capital cost in establishing distance learning or through the provision of a distance teaching expert to oversee the setting up and operation of the D.L. programmes for the first year of operation.
- Request for grants from countries with keen interest in employing Filipino seafarers, such as Japan and Norway, by letting them donate either equipment or expertise.

- Initiate negotiations with INMARSAT service providers, manufacturers of satcom facilities, computers and other equipment utilised for distance learning to invest in NMP through a 'donation' or a 'soft' loan (long-term, low or no interest loan).
- 5. Formally request permission from the missions for seamen, in areas frequented by Filipino seafarers, to provide them ample opportunity for the use of their computer facilities in activities relative to distance learning.
- 6. Promote and encourage utilisation of cyber coffees as a venue for on-line distance learning when access onboard is not possible and when computer facilities are not available in the mission for seamen at a particular port of call.
- 7. Include training of D.L. teaching staff as part of the package in the purchase of hardware/software in establishing a distance learning programme.
- 9. Develop in-house D.L. training materials when capable.
- Negotiate with shipowners/managers to allow access onboard of computer facilities and satcom for those seafarers enrolled in a distance learning programme.
- 11. Pilot test the training programme with sufficient number of people to check its effectiveness, etc. prior to full implementation.
- 12. Include distance learning programme in the overall quality standard system being installed in the National Maritime Polytechnic organisational structure.

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### **APPENDIX 3**

### Questionnaire

## **World Maritime University**

Malmö, Sweden

WMU was established in 1983 by the International Maritime Organisation, a United Nations specialised agency. Our mission is to serve the global maritime community as a centre of excellence and IMO's apex institution for high-level maritime education and training.



Q U E S T I O N NA I R E

For the **dissertation** entitled:

### The Virtual Classroom Afloat -- Maritime Education and Training in the 21<sup>st</sup> Century: An Investigation into the Feasibility and Practicability of Distance Learning via the Satellite Communications System

Name:	(optional)	Civil Status: Single
Age:		Married
Present PRC Marine Licence	•	Others
Actual Position on Board:		
Number of Years at Sea:		
Present Company:		
Nature of Trade: Domestic	Foreign	

**Instructions**: Please *tick* (check) on the appropriate box below corresponding to your answer. Be assured that your answers will be treated with utmost confidentiality.

- 1. Do you have any experience using computers? (If **no**, go to question 3) Yes No
- 2. How good is your computer skill?a) Very Good b) Good c) Fair d) Poor
- 3. Does your ship have computers onboard? (If **no**, go to question 7) Yes No

- 4. Do you have access to a computer **on board**? Yes No
- 5. What kind of system configuration do your onboard computers have? Stand alone Local Area Network
- 5. How is your onboard computer used? (Tick as many as appropriate)
  - a) For ship/cargo-related activities
  - b) For communications
  - c) For training
  - d) Others, please specify:
- 6. Do you have access to a computer **at home**? (If **no**, go to question 11) Yes No
- 7. How often do you use a computer onboard or at home?
  - a) Everyday or almost daily
  - b) Weekly or during weekends
  - c) Once or twice a month
  - d) Very rarely
- 9. How much time per day on average, do you spend on a computer?
  - a) Less than 2 hours
  - b) 2 to 4 hours
  - c) 4 to 6 hours
  - d) More than 6 hours
- 10. What do you use the computer for? (Tick as many as appropriate)
  - a) Personal/job-related computing and record keeping
    - b) For games and entertainment
    - c) For study and research
    - d) Others please specify:
- 11. Onboard the ship, after your regular work such as standing on watch, etc., do you still find time to read for pleasure or to study? (If no, go to question 13) Yes No
- 12. How long do you spend time reading/studying on a daily basis?
  - a) Less than 2 hours
  - b) 2 to 4 hours
  - c) 4 to 6 hours
  - d) More than 6 hours
- 13. Are you interested in upgrading your knowledge and skills relative to STCW '95 requirements and for your personal and professional growth? (If **no**, you need not answer the rest of the questions)

Yes No

- 14. Which kind of learning programme do you prefer?
  - a) Regular classroom instruction
  - b) Tutorial
  - c) Self-study
  - d) Internet based
  - e) Others, please specify \_\_\_\_\_
- 15. Are you interested in learning and developing new knowledge and skills in your **own time**? (i.e. no regular class schedule)

Yes No

- 16. Are you interested in learning and developing new knowledge and skills at your own place? (i.e. onboard or at home)Yes
- 17. Are you interested in learning and developing new knowledge and skills at your own pace? (i.e. your own learning speed)Yes
- 18. Would you like to enrol in such a learning/study programme that allows you to learn at your own *time*, *place*, and *pace* if one exists and is available in the Philippines?

Yes No

- 19. How much is the *maximum* amount you would be willing to pay <u>*per course*</u> for a good training package that will allow you to meet STCW'95 requirements while onboard ship *or* at home on vacation?
  - a) US \$200 or less
  - b) More than US \$200 to less than US \$300
  - c) More than US \$300 to less than US \$400
  - d) More than US \$400
- 20. When would you like to enrol for one of the STCW '95 courses that allows you to study and learn at your *own time*, *place* and *pace*, if such is available in the Philippines?
  - a) As soon as possible
  - b) Any time this year (1999)
  - c) Any time by the year 2000
  - d) Other intended time, please specify:
  - e) No intention at all

- End -



# **Onboard Library**



andling vage	Controlling Operation of Ship, & Care,	
Manne Properties	OP: Ship Gases Safety	C S
Stability	Sot Safety	F S)
iquid Cargo Properties	SM: Equipment.	Sep
Gas Tanker Fam.	Structure Safety Conditions	Fue Eff
HAZMAT - MDG Code	Proc. Hullo Machineny	Pro Syste
COW	Fire fighting Fixed Fire Equipment	S B
ODME Operation	Fire Prevent MARPOL & Fighting	Com
Inerting	SOLAS Toxicity & Hazards	T Ch
Crisis anagement	First Aid Life Saving	Inst Air S
o/Ro Pass- nger Safety	Medical Aid	Refrig
nvironment Model		En Perfo





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No ship manager can survive these days if he does not consider carefully the onboard training needs of his fleet. There is a growing weight of regulation requiring onboard training. Some of the most important are:-

- The International Safety Management (ISM) Code, now adopted as part of SOLAS.
- ISO 9000 Series "Quality Systems"
- Class Notations eg SEP (Safety & Environment Protection Det norske Veritas).
- Code of Ship Management Standards of the International • Ship Manager's Association (ISMA).
- ILO Conventions & Recommendations (147 and others).
- Various Charter Party clauses. •
- Port State Control (becoming worldwide).
- SOLAS Amendments & Revisions. •
- **European Union Directives** •
- MARPOL Amendments and other national pollution prevention laws such as OPA'90.
- Special programs such as Sea Carriers Initiative Program and "Hazmat" regulations.
- Drug & Alcohol enforcement regulations.
- IMO International Convention on Standards of Training, Certification and Watchkeeping for Seafarers (STCW 1995)

#### **Videotel Can Help**

For over 20 years and with the active support of many organisations (including the IMO), Videotel Marine International Ltd. has been producing training packages - films, videos, books and computer programs specially for the shipping industry.

In the past 5 years we have introduced a safety library rental scheme. This has proven immensely popular. Currently there are over 400 client companies participating with their fleets in the scheme.

#### A Proven Scheme

The scheme allows flexible access to Videotel's extensive catalogue of over 300 safety and technical training videos and computer programs. Choose from the catalogue the packages best suited to your fleet training needs. These will be provided to the ships in your fleet in specially designed carrying and storage cases. We call this the "Videotel Safety Library" scheme.

#### Why it Works

The details of the rental scheme have been carefully worked out to provide the best possible service to your ships in support of your program of onboard training. It works because seafarers will watch videos, making training onboard more acceptable and more motivational. A video is one of the most effective aids a trainer can have and computer based training is appropriate for one-to-one training and professional advancement. With a "Videotel Safety Library" on board your ships, officers and crew will have access to up-to-date knowledge and experience of some of the world's leading experts who work with Videotel's production teams. They are drawn from the IMO, ISF/ICS, Intertanko, SIGTTO, The Nautical Institute, the Institute of Marine Engineers and many many others.

#### ISM and STCW 95

Using the "Videotel Safety Library" will ensure compliance with the ISM Code, particularly clause 5 and will provide materials required to undertake approved training as required by STCW'95.





Videos

Disks



Attendance forms

Certificate

#### **Basic Terms of the Videotel Rental Lib**

- Twenty training packages chosen from a catalogue of over 300, which can be expande
- Packages updated and exchanged without extra charge.
- A minimum rental period of two years.

Ships supplied with "Videotel Safety Libraries" are registered on Videotel's database wh organisations.

#### Amongst the training packages most frequently requested are:-

- 1. **Fire Prevention**
- **Basic Fire Fighting** 2.
- Command & Control Part 1 3. 4.
- Command & Control Part 2

#### Solas Chapter III Series

- Solas Chapter III: 5. Part 1 - Preparing for Abandonment
- Solas Chapter III: 6. Part 2 - Abandonment by Lifeboat
- Solas Chapter III:
- Part 3 Abandonment by Liferaft 8. Solas Chapter III:
- Part 4 Techniques of Survival 9 Solas Chapter III:
- Part 5 Amendments and Updates
- Personal Safety Onboard Ship Series 10. The Shipboard Management Role
- Personal Safety
   Personal Safety
- Engine Room 13. Personal Safety

#### Others

- 14. Fighting Pollut 15. Bridge Watchk
- 16. Entering into I
- 17. Port State Cont
- 18. Drugs Way O

**APPENDIX 7** Additional Special Libraries



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**CD-Roms** 



# First Aid and Medical Care Onboard Series

**VIDEOTEL** 

- A Matter of Life & Death
- **Dealing with Shock**
- Dealing with the Unexpected •
- Bone & Muscle Injuries •
- Oxygen for the Brain-Maintaining the Supply •
- After Care of Shock •
- Moving Casualties & Dealing with Other Problem
- Fractures, Dislocations & Sprains •
- PLUS 

  Cold Water Casualty
  - Transmissible Diseases



Support Books



Training and Assessment On Board book

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addition of a Supplementary Library.

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19. Shipping Casualty Emergency

Response 20. Port State Control

The selection need not be limited to 20 packages, a supplementary library can be used to add 10 packages making a total of 30. Additional special libraries can be used to meetspecialist needs.

# **Oil Tanker Training**

TANKER TRAINING

- Shipboard Oil Spill Contingency Planning
- **Crude Oil Washing Operations** •
- Operation & Maintenance of Inert Gas Systems •
- Over & Under Pressurisation of Tanks •
- Personal Safety on Tankers •
- Pumping Cargo 1 •
- Pumping Cargo 2 .
- Tank Cleaning
- **Heating Cargo** ۲
- Measuring Cargo ۲

Note: These packages plus manuals form Videotel's approved Petroleum Tanker Safety Course



# **Shipboard Management**

- Management on Board
- Looking Ahead
- Managing Resources On Board

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- Teamwork on Board
  - Working with Individuals
  - Communication

- PHIS . Quality Management - An Introduction The ISM Code
  - **The Claim Game Series**

  - Part 1- Legal Responsibility & Loss Prevention Rights, Duties & their Understanding
  - Part 2 The Master Under Pressure

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	Stratos	4.25	SingTel	3.93	Station 12	3.85 3.93	MVS	3.95 4.15	VSNL MVS	3.70	MVS	3.95	OTE	3.65	OTE	3.65	OTE	3.65	OTE	3.65
ORE	VSNL	3.70	CTE	3.65	VSNL	3.30	SingTel	3.23	SingTel	3.23	SinoTel	3 22	SingTol	3.85	telenor	3.85	Telenor	3.85	Telenor	3.85
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	Stratos	4.15	SingTel	3.85	Station 12	3.85	Telenor	3.95	S VSNL	3.70	MVS	3.95	OTE	3.65	OTE	3.65	OTE	3.65	OTE	3.65
OR	Korsa T'com	3.62	Korea T'com	3.62	VSNL	3.30	SinnTel	3 23	SingTel	3.30	Automotive	4.15	Silvienor	3.85	lelenor	3.85	Telenor	3.85	<b>iele</b> nor	3.85
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TO TA TROM ORW ITLANTIC OCEAN IEGION WEST) ORE ATLANTIC OCEAN IEGION EAST]	ARGEN SERVICE PROVIDER Station 12 Telstra BT Telenor OTE Station 12 Telstra	4.15 TINA COST US\$ 1.18 1.20 1.24 1.24 1.24 1.00 1.18 1.20	CYPR SERVICE PROVIDER Letenor Tance Trom Tance Trom Tance Trom Tance To Tance To Tan	3.85 COST US 0.92 0.95 0.95 0.95 0.67 0.80 0.92	Zetenor ONIE GREE SERVICE FHOVIDER Telenor Telenor Tomotil Station 12 Int Telecom UTE decom Italia	3.85 3.85 CE COST US\$ 0.92 0.95 0.95 0.62 0.62 0.62	HONG KON HONG KON HONG KON SERVICE PROVIDER Station 12 Telenor CITE Station 12 Telenor	3.62 3.95 MAT G SAR COST US\$ 1.18 1.20 1.24 1.24 1.24 1.00 1.18	KDD Cores T'com JAPA JAPA JAPA JAPA JAPA JAPA SERVICE HOVIDER KDD Suition 12 Talstra 8T KDD Secon Italia	3.51 3.62 <b>RS</b> <b>USS</b> 0.84 1.18 1.20 1.24 0.84 0.97	SingTel MVS AT-C CO KORE ERVICE Sotion 12 Ielstra Stalenor Liscom Italia OTE	3.23 3.95 MIMI A COST US\$ 1.18 1.20 1.24 1.24 1.24 0.97 1.00	NETHERL NETHERL HERVICE HOVIDER Henor Henor Hobil Station 12 Link Telecom OTE	3.62 3.65 ON ANDS COST US\$ 0.92 0.95 0.95 0.95 0.95 0.95 0.80	NORW SERVICE FROVIDER Telenor Trince T'com T-Mobil BT Diff Telecom	3.62 3.65 AY COST US\$ 0.92 0.95 0.95 0.95 0.62 0.80	UK SERVICE PROVIDER Telenor Tance T'com T-Mobil BT Tefk Telecom OTE	3.62 3.65 COST US\$ 0.92 0.95 0.95 0.95 0.95 0.62 0.80	USA USA USA USA USA USA USA USA USA USA	3.62 3.65 COST US\$ 0.95 0.96 1.07 1.20 0.80 0.95
TO TA ROM ILLANTIC OCEAN EGION WEST) ORE ATLANTIC OCEAN EGION EAST)	ARGEN SERVICE PROVIDER Station 12 Telenor OTE Station 12 Telenor DTE Station 12 Teletra BT	4.15 TINA COST US\$ 1.18 1.20 1.24 1.24 1.00 1.18 1.20 1.24	CYPR BERVICE PROVIDER Fetenor Telenor Tance Tcom TAMobil Station 12 fark Telecom OTE Telenor Telenor	3.85 COST US 0.92 0.95 0.95 0.95 0.67 0.82 0.92	Zetenor ONIE GREE SERVICE FROVIDER Telenor Tomos Trom Tomos Trom Tomos Trom Tomos Trom Tomos Trom Tomos Trom Telecom DTE effectom Italia Telenor	3.82 3.85 CE COST US\$ 0.92 0.95 0.95 0.95 0.62 0.62 0.68 0.68 0.87 0.92	HONG KON HONG KON SERVICE PROVIDER Station 12 Telstra BT Telenor OTE Station 12 Telstra BT Telstra BT	3.62 3.95 MAT G SAR COST USS 1.18 1.20 1.24 1.24 1.00 1.18 1.20 1.24	Corea T'com COREA T'com JAPA JAPA JAPA JAPA JAPA Service HOVIDER KDD Suttion 12 Talstra 8T KDD Mecom Italia OTE Striion 12	3.51 3.62 <b>RS4</b> <b>COST</b> <b>US\$</b> 0.84 1.18 1.20 1.24 0.84 0.97 1.00 1.18	SingTel MVS AT-C CO KORE ERVICE Sotion 12 Ielstra BT Selenor Telstra OTE Station 12 Telstra OTE Station 12	3.23 3.95 MIMI A COST US\$ 1.18 1.20 1.24 1.24 1.24 0.97 1.00 1.18 1.20	NETHERL NETHERL NETHERL Henor Henor Hobil Station 12 Link Telecom TE Mose Tcom Telecom Telecom Telecom Telecom Telecom Telecom Telecom Telecom	3.62 3.65 ON COST US\$ 0.92 0.95 0.95 0.95 0.62 0.80 0.80 0.82	NORW SERVICE HOVIDER Telenor Trince T'com T-Mobil BT UNK Telecom CTE Mecom Italia	3.62 3.65 AY COST US\$ 0.95 0.95 0.95 0.95 0.95 0.95 0.80 0.80 0.87	UK SERVICE FROVIDER Telenor Tance T'com T-Mobil BT Teffic Telecom OTE Telecom Italia	3.62 3.65 <b>COST</b> <b>US\$</b> 0.92 0.95 0.95 0.95 0.95 0.80 0.87	USA USA USA USA USA USA USA USA USA USA	3.62 3.65 COST US\$ 0.95 0.95 1.07 1.20 0.80 0.95 0.95
O TA ROM DRW EGION WEST) RE TLANTIC OCEAN EGION EAST) DR	ARGEN SERVICE PROVIDER Station 12 Telenor OTE Station 12 Teletra BT Station 12 Station 12	4.15 TINA COST US\$ 1.18 1.20 1.24 1.24 1.24 1.24 1.20 1.18 1.20 1.24 1.20	CYPR BERVICE PROVIDER Jetenor Tamboli Station 12 Tark Telecom OTE Telenor Telenor	3.85 COST US 0.92 0.95 0.95 0.95 0.95 0.95 0.92 0.92	Telenor ONIE GREE SERVICE FROVIDER Telenor Tomos Trom Trimos Tom Trimos Tale Station 12 Derk Telecom OTE effecom Italia Telenor Telenor	3.82 3.85 CE COST US\$ 0.92 0.95 0.95 0.95 0.62 0.62 0.62 0.62 0.87 0.92 0.92	AUTO HONG KON SERVICE PROVIDER Station 12 Telstra BT Telenor OTE Station 12 Telstra BT Station 12 Telstra BT	3.62 3.95 MAT G SAR COST US\$ 1.18 1.20 1.24 1.24 1.00 1.24 1.18 1.20 1.24 0.79	Corea T'com Corea T'com JAPA JAPA JAPA JAPA SERVICE HOVIDER KDD Station 12 Talstra BT KDD Mecom Italia SOTE Station 12 Station 12	3.51 3.62 <b>RS</b> /2 <b>COST</b> <b>US\$</b> 0.84 1.18 1.20 1.24 0.84 0.97 1.00 1.18 0.84	KORE KORE KORE ERVICE NOVIDER Sation 12 Ielstra BT Bienor Kore Station 12 Ielstra OTE Station 12 Core Station 12 Station 12 Core Station 12 Core Station 12 Station 12 Core Station 12 Core St	3.23 3.95 MIMI A COST US\$ 1.18 1.20 1.24 1.24 1.24 1.24 1.24 1.20 1.18 1.20 0.70	NETHERL NETHERL Henor Henor Hobil Henor Hobil Hation 12 Urk Telecom OTE Henor Calecom Italia Falenor Simotal	3.62 3.65 ON ANDS COST US\$ 0.92 0.95 0.95 0.95 0.95 0.95 0.80 0.80 0.87 0.92	NORW SERVICE HOVIDER Telenor Timos T'com T-Mobil BT Dirk Telecom S. OTE Mescom Italia Telenor	3.62 3.65 AY COST US\$ 0.92 0.95 0.95 0.95 0.95 0.80 0.87 0.92	UK SERVICE FROVIDER Télenor T-Mobil BT Terk Telecom OTE Telenor Telenor	3.62 3.65 COST US\$ 0.92 0.95 0.95 0.95 0.95 0.95 0.87 0.92	USA USA SERVICE FROVIDER Station 12 Telenor BT Telstra OTE UTE Telecom Station 12 Telenor	3.62 3.65 <b>COST</b> <b>US\$</b> 0.95 0.96 1.07 1.20 0.80 0.95 0.95 0.95 0.96
O TA ROM DRW EGION WEST) RE TLANTIC OCEAN EGION EAST) DR ACIFIC OCEAN STION)	ARGEN SERVICE THOVIDER Station 12 Telstra BT Telenor OTE Station 12 Telstra BT Station 12 Telstra BT	4.15 TINA COST US\$ 1.18 1.20 1.24 1.24 1.00 1.18 1.20 1.24 1.20 1.24	CYPR BERVICE PROVIDER Jetenor Fance T'com T-Mobil Station 12 Tark Telecom OTE Telenor Telenor Fance T'com Telenor Fance T'com	3.85 COST US 0.92 0.95 0.95 0.95 0.67 0.82 0.92 0.92 0.92 0.95	Telenor ONIE GREE SERVICE FROVIDER Telenor Tomos Trom Trimos Trom Trimos Trom DTE elecom Italia Telenor Telenor Telenor Telenor Telenor	3.85 3.85 <b>CE</b> <b>COST</b> <b>US\$</b> 0.92 0.95 0.95 0.95 0.62 0.68 0.68 0.87 0.92 0.92	AUTO HONG KON SERVICE PROVIDER Station 12 Telstra BT Telenor OTE Station 12 Telstra BT SingTel Station 12	3.62 3.95 <b>MAT</b> <b>G SAR</b> <b>COST</b> <b>US\$</b> 1.18 1.20 1.24 1.24 1.00 1.24 1.20 1.24 0.79 1.18	KDD Cores T'com JAPA JAPA JAPA SERVICE HOVIDER KDD Suttion 12 Talstra 80 KDD Station 12 KDD Station 12 Station 12 Station 12	3.51 3.62 RS/4 N COST US\$ 0.84 1.18 1.20 1.24 0.84 0.97 1.00 1.18 0.84 0.95	KORE KORE KORE ERVICE NOVIDER Sation 12 Ielstra BT Belenor Licom Italia OTE Station 12 Station 12 Core Telecom SingTel	3.23 3.95 MIMI A COST US\$ 1.18 1.24 1.24 1.24 1.24 1.24 1.20 0.97 1.00 1.18 1.20 0.70 0.79	NETHERL NETHERL HERVICE HOVIDER Henor Hobil Hation 12 Urk Telecom OTE Helenor SingTel Telenor	3.62 3.65 ON ANDS COST US\$ 0.92 0.95 0.95 0.95 0.95 0.95 0.95 0.92 0.92	NORW SERVICE Telenor Telenor Telenor T-Mobil BT UK Telecom Telenor Telenor SingTel Telenor	3.62 3.65 AY COST US\$ 0.92 0.95 0.95 0.95 0.95 0.80 0.80 0.80 0.87 0.92 0.92	UK SERVICE FROVIDER Télenor T-Mobil BT Telenor SingTel Telenor	3.62 3.65 0.92 0.95 0.95 0.95 0.95 0.95 0.87 0.92 0.87 0.92 0.92 0.92	USA USA SERVICE HOVIDER Station 12 Telenor BT Telstra OTE UTE Telecom Station 12 Cielenor Station 12 Cielenor Station 12	3.62 3.65 COST US\$ 0.95 0.96 1.07 1.20 0.80 0.95 0.95 0.95 0.95 0.96 0.96
O TA ROM ORW EGION WEST) RE TLANTIC OCEAN EGION EAST) DR ACIFIC OCEAN EGION)	ARGEN SERVICE THOVIDER Station 12 Telstra BT Telenor OTE Station 12 Telstra BT Station 12 Telstra BT Station 12 Telstra BT Telenor	4.15 TINA COST US\$ 1.18 1.20 1.24 1.24 1.20 1.24 1.20 1.24 1.20 1.24 1.20 1.24	CYPR SERVICE PROVIDER Jetenor France T'com T-Mobil Station 12 Tark Telecom OTE Telenor France T'com T-Mobil SinaTel	3.85 COST US 0.92 0.95 0.95 0.95 0.92 0.92 0.92 0.92 0.95 0.95	CREE SERVICE SERVICE PHOVIDER Telenor Telenor Totom TTMobil Station 12 Derk Telecom OTE effector Italia Telenor Telenor Tance T'com T-Mobil Ing Tielecom	3.85 3.85 <b>CE</b> <b>COST</b> <b>US\$</b> 0.92 0.95 0.95 0.95 0.62 0.68 0.68 0.87 0.92 0.92 0.92 0.95 0.95 0.95	AUTOL HONG KON SERVICE PROVIDER Station 12 Telstra BT Telenor OTE Station 12 Telstra BT SingTel Station 12 Telstra Telstra Telstra Telstra Telstra Telstra	3.62 3.95 MAT G SAR COST US\$ 1.18 1.20 1.24 1.24 1.20 1.18 1.20 1.14 1.20 1.18 1.20 1.24 1.24 1.20 1.18 1.20 1.24 1.24	KDD Cores T'com JAPA JAPA SERVICE HOVIDER KDD Sution 12 Taistra 8T KDD Station 12 Station 12 Station 12 SingTel Station 12	3.51 3.62 RS/4 N COST US\$ 0.84 1.18 1.20 1.24 0.84 0.95 1.18 0.84 0.95 1.18	KORE KORE ERVICE NOVIDER Sation 12 Ielstra BT Belenor Lecom Italia OTE Station 12 Ielstra Cores Telecom SingTel Station 12	3.23 3.95 M M M COST US\$ 1.18 1.20 1.24 0.97 1.00 1.18 1.20 1.24 0.97 1.00 1.18 1.20 0.70 0.79 1.18	NETHERL NETHERL HERVICE HOVIDER Henor Hobil Station 12 Urk Telecom OTE Helenor SingTel Telenor SingTel Telenor	3.62 3.65 <b>ON</b> <b>ANDS</b> <b>COST</b> <b>US\$</b> 0.95 0.95 0.95 0.95 0.80 0.87 0.92 0.92 0.92 0.92 0.92 0.92 0.92	NORW SERVICE HOVIDER Telenor Telenor T-Mobil BT Unit Telecom Tolecom Italia Telenor SingTel Telenor Telenor Telenor Telenor	3.62 3.65 AY COST US\$ 0.92 0.95 0.95 0.95 0.95 0.80 0.80 0.80 0.82 0.92 0.92 0.92 0.92 0.92 0.92 0.92	UK SERVICE FROVIDER Télenor Timos T'com Timos T'com Timos T'com Timos T'com Telenor Telenor Tralenor Tralenor France T'com	3.62 3.65 0.92 0.95 0.95 0.95 0.87 0.92 0.80 0.87 0.92 0.80 0.87 0.92 0.92 0.95	USA DIE USA SERVICE HOVIDER Station 12 Telenor BT Telstra OTE UTE Telenor Station 12 Telenor Station 12 Telenor	3.62 3.65 COST US\$ 0.95 0.96 1.07 1.20 0.80 0.95 0.95 0.95 0.96 0.79 0.95 0.96
O TA ROM ORW EGION WEST) RE TLANTIC OCEAN EGION EAST) DR ACIFIC OCEAN EGION) R	ARGEN SERVICE TROVIDER Station 12 Telenor OTE Station 12 Telenor Station 12 Telestra BT Station 12 Telestra BT Telenor	4.15 TINA COST US\$ 1.18 1.20 1.24 1.00 1.18 1.20 1.24 1.18 1.20 1.24 1.24 1.24 1.24 1.24 1.24 1.24 1.24	CYPR SERVICE PROVIDER Jetenor Trance T'com Tambo Ji Station 12 Statistion 12 Statistio	3.85 COST US 0.92 0.95 0.95 0.95 0.92 0.92 0.92 0.92 0.92 0.95 0.95 0.95 0.95 0.95 0.95 0.95 0.95 0.92 0.92 0.92 0.92 0.92 0.95 0.67	CREE SERVICE SERVICE PHOVIDER Telenor Common Tomon Station 12 Der Telecom DTE Secon Italia Telenor Telenor Tance T'com T-Mobil Sing Telecom	3.85 3.85 CE COST US\$ 0.92 0.95 0.95 0.95 0.62 0.68 0.87 0.92 0.92 0.95 0.92 0.95 0.95 0.95 0.95 0.95 0.95 0.95	HONG KON HONG KON SERVICE PROVIDER Station 12 Telenor OTE Station 12 Telenor OTE Station 12 Telestra BT SingTel Station 12 Telstra Telenor SingTel	3.62 3.95 WAT G SAR COST US\$ 1.18 1.20 1.24 1.24 1.20 1.18 1.20 1.24 0.79 1.18 1.20 1.24 0.79 1.18	KDD Cores T'com JAPA JAPA SERVICE HOVIDER KDD Sution 12 Taistra 8T KDD Station 12 Taistra 8T KDD Station 12 Station 12 Station 12 SingTel Station 12 Telstra	3.51 3.62 RS54 N COST US\$ 0.84 1.18 1.20 0.84 0.97 1.00 1.18 1.24 0.84 0.95 1.18 1.20	SingTel MVS AT-C CO KORE ERVICE Setvice Setvice Setvice Setvice Setvice Setvice Setvice Setvice Setvice Setvice Setvice Setvice Setvice Setvice Setvice Setvice Setvice Signel Setvice Setvice Signel Setvice Setvice Setvice Signel Setvice Setvice Setvice Setvice Signel Setvice Setvice Setvice Setvice Setvice Signel Setvice Setvice Setvice Setvice Setvice Signel Setvice Setvice Setvice Setvice Setvice Setvice Setvice Signel Setvice Setvi	3.23 3.95 M M M COST US\$ 1.18 1.20 1.24 0.97 1.00 1.18 1.20 1.24 0.97 1.00 1.18 1.20 0.70 0.79 1.18 1.20	NETHERL NETHERL HERVICE HOVIDER Henor Hobil Station 12 Urk Telecom OTE SingTel Telenor SingTel Telenor Timce T'com Timos T'com	3.62 3.65 <b>ON</b> <b>ANDS</b> <b>COST</b> <b>US\$</b> 0.95 0.95 0.95 0.87 0.92 0.92 0.95 0.95 0.95 0.95	NORW SERVICE Telenor Telenor Telenor Telenor Telenor Telenor Telenor SingTel Telenor SingTel Telenor Telenor Telenor Telenor Telenor Telenor	3.62 3.65 <b>AY</b> <b>COST</b> <b>US\$</b> 0.95 0.95 0.80 0.87 0.80 0.87 0.92 0.92 0.95 0.92 0.95 0.95 0.95	UK SERVICE FROVIDER Télenor Timos T'com Timos T'com Timos T'com Timos T'com Telenor SingTel Telenor Tranes T'com Timos T'com Timos T'com	3.62 3.65 0.92 0.95 0.95 0.95 0.62 0.80 0.87 0.92 0.92 0.92 0.95 0.95 0.95	USA DIE USA DIE USA DERVICE HOVIDER DIA Telenor BT Telestra OTE UTE Telenor Station 12 Telenor Station 12 Telenor Station 12 Telenor BT SingTel Station 12 Telenor BT	3.62 3.65 COST US\$ 0.95 0.96 1.07 1.20 0.80 0.95 0.95 0.95 0.96 0.79 0.95 0.96 1.07
D TA ROM ORW EGION WEST) ILANTIC OCEAN EGION EAST) OR ACIFIC OCEAN EGION) IR PDIAN OCEAN	ARGEN SERVICE TROVIDER Station 12 Telstra BT Telenor OTE Station 12 Telstra BT Station 12 Telstra BT Telenor OTE VSNL	4.15 TINA COST US\$ 1.18 1.20 1.24 1.00 1.24 1.18 1.20 1.24 1.18 1.20 1.24 1.18 1.20 1.24 1.00 1.08 1.008 1.008	CYPR SERVICE PROVIDER Jetenor Tance T'com Tance T'com OTE Telenor Telenor Telenor France T'com T-Mobil SingTel Unit Telecom OTE	3.85 COST US 0.92 0.95 0.95 0.95 0.95 0.92 0.92 0.92 0.92 0.95 0.95 0.95 0.95 0.95 0.95 0.95 0.95 0.95 0.92 0.92 0.92 0.92 0.92 0.92 0.92 0.92 0.92 0.95 0.80 0.95 0.95 0.95 0.80 0.80 0.80 0.95 0.80 0.85 0.80 0.85 0.	CREE CREE SERVICE SERVICE PROVIDER Telenor Telenor Telenor Telenor Telenor Telenor Telenor Telenor Telenor Tance T'com T-Mobil Static Telecom CTE Com Com Com Com Com Com Com Com	3.85 3.85 CE COST US\$ 0.92 0.95 0.95 0.95 0.95 0.62 0.68 0.87 0.92 0.95 0.92 0.95 0.95 0.95 0.95 0.95 0.95 0.95 0.95	HONG KON HONG KON SERVICE PROVIDER Station 12 Telstra BT Telenor OTE Station 12 Telstra BT SingTel Station 12 Telstra Telenor SingTel - OTE	3.62 3.95 WAT G SAR COST US\$ 1.18 1.20 1.24 1.24 1.24 1.24 1.24 1.24 0.79 1.18 1.20 1.24 0.79 1.18 1.20 1.24	KDD Cores T'com JAPA JAPA SERVICE HOVIDER KDD Station 12 Telstra Station 12 SingTel Station 12 CEStra Station 12 SingTel Station 12 Telstra KDD SingTel Station 12	3.51 3.62 RS54 N COST USS 0.84 1.18 1.20 0.84 0.97 1.00 1.18 1.24 0.95 1.18 1.20 0.84 0.95	SingTel MVS AT-C CO KORE ERVICE Setvice Setvice Setvice Setvice Setvice Setvice Setvice Setvice Setvice Setvice Setvice Setvice Setvice Signel Setvice SingTel Setvice SingTel Setvice SingTel Setvice Setvice SingTel Setvice Setvice Setvice SingTel Setvice Setvice Setvice Setvice Setvice Setvice Setvice Setvice Setvice Setvice SingTel Setvice	3.23 3.95 M M M COST US\$ 1.18 1.20 1.24 0.97 1.00 1.18 1.20 0.70 0.79 1.18 1.20 0.70 0.79 1.18 1.20 0.70 0.79	NETHERL NETHERL NETHERL Henor Henor Hobil Station 12 Urk Telecom SingTel Telenor SingTel Telenor Timce T'com Timce T'com Timce T'com Timce T'com	3.62 3.65 3.65 <b>ANDS</b> <b>COST</b> <b>US\$</b> 0.95 0.95 0.95 0.95 0.92 0.95 0.92 0.92 0.95 0.92 0.92 0.92 0.92 0.95 0.92 0.95 0.92	NORW SERVICE Telenor Telenor Telenor Telenor Telenor Telenor Telenor SingTel Telenor	3.62 3.65 <b>AY</b> <b>COST</b> <b>US\$</b> 0.92 0.95 0.95 0.80 0.87 0.80 0.87 0.92 0.92 0.92 0.95 0.92 0.92 0.95 0.92 0.95 0.92	UK SERVICE FROVIDER Télenor Tance T'com Tance T'com Tance T'com Telenor SingTel Telenor Telenor SingTel Telenor Trance T'com Tance T'com Tance T'com	3.62 3.65 3.65 0.95 0.95 0.95 0.95 0.80 0.87 0.92 0.92 0.92 0.92 0.95 0.95 0.95 0.95 0.95 0.95 0.95 0.95	USA DIE USA DIE USA DERVICE HOVIDER DIA Telenor BT Telestra OTE OTE Telenor Station 12 Telenor SingTel SingTel SingTel SingTel	3.62 3.65 COST US\$ 0.95 0.96 1.07 1.20 0.80 0.95 0.95 0.95 0.96 0.95 0.96 0.79 0.95 0.96 1.07 0.79
TO TA TROM NORW ITLANTIC OCEAN IEGION WEST) OR ATLANTIC OCEAN IEGION EAST) OR PACIFIC OCEAN IEGION) DR NDIAN OCEAN EGION)	ARGEN SERVICE PROVIDER Station 12 Telstra BT Telenor OTE Station 12 Telstra BT Station 12 Telstra BT Telenor OTE VSNL Station 12 Telstra	4.15 TINA COST US\$ 1.18 1.20 1.24 1.00 1.18 1.20 1.24 1.18 1.20 1.24 1.18 1.20 1.24 1.18 1.20 1.24 1.18 1.20 1.24 1.18 1.20 1.24 1.18 1.20 1.24 1.18 1.20 1.24 1.00 1.24 1.00 1	CYPR SERVICE PROVIDER Jetenor Tance T'com Tance T'com Tetenor Sete Danmark Tetenor Sete Danmark Tetenor France T'com T-Mobil SingTel Dark Telecom OTE Tetenor Tetenor	3.85 COST US 0.92 0.95 0.95 0.95 0.95 0.95 0.95 0.95 0.95 0.95 0.95 0.95 0.95 0.95 0.95 0.95 0.95 0.92 0.92 0.92 0.92 0.92 0.92 0.92 0.92 0.92 0.92 0.92 0.92 0.95	CREE CREE SERVICE SERVICE PROVIDER Telenor Telenor Totom Tation 12 Dark Telecom Telenor Tatice T'com Telenor Tatice T'com Telecom Tatice T'com Tatice T'co	3.85 3.85 3.85 CE COST US\$ 0.92 0.95 0.95 0.95 0.95 0.92 0.95 0.92 0.95 0.92 0.92 0.95 0.95 0.95 0.95 0.95 0.95 0.95 0.95	MVS AUTOL HONG KOW SERVICE PROVIDER Station 12 Telstra BT Telenor OTE Station 12 Telstra BT SingTel Station 12 Telstra Telenor SingTel OTE VSNL	3.62 3.95 WAT G SAR COST US\$ 1.18 1.20 1.24 1.20 1.12 1.20 1.24 0.79 1.18 1.20 1.24 0.79 1.18 1.20 1.24 0.79 1.18 1.20 1.24 0.79 1.00 1.24	KDD Coree T'com JAPA JAPA SERVICE HOVIDER KDD Suttion 12 Telstra ST KDD SingTel Station 12 Telstra KDD SingTel Station 12 Telstra KDD	3.51 3.62 RS54 0.84 1.18 1.20 0.84 0.97 1.00 1.18 1.24 0.95 1.18 1.20 0.84 0.95 1.18 1.20 0.95 0.97	SingTel MVS AT-C CO KORE ERVICE Setton 12 Ielstra BT Belenor Licom Italia OTE Station 12 Telstra Cores Telecom SingTel Station 12 Telstra District 12 Telstra District 12 Telstra District 12 Telstra District 12 Telstra District 12 Telstra	3.23 3.95 M M M COST US\$ 1.18 1.20 1.24 0.97 1.00 1.18 1.20 0.70 0.79 1.18 1.20 0.70 0.79 1.18 1.20 0.70 0.79 0.97	NETHERL NETHERL HERVICE HOVIDER Henor Hobil Station 12 Urk Telecom SingTel Telenor SingTel Telenor Timos T'com T-Mobil Urk Telecom T-Mobil Urk Telecom T-Mobil Urk Telecom	3.62 3.65 3.65 <b>ANDS</b> <b>COST</b> <b>US\$</b> 0.95 0.95 0.95 0.95 0.92 0.95 0.95 0.92 0.95 0.95 0.92 0.95 0.92 0.95 0.92 0.95 0.92 0.95 0.92 0.95 0.92 0.95 0.92 0.95 0.95 0.95 0.92 0.95 0.95 0.95 0.95 0.95 0.95 0.95 0.95	NORW SERVICE Telenor Telenor Telenor Telenor Telenor Telenor SingTel Telenor SingTel Telenor SingTel Telenor Telenor SingTel Telenor SingTel Telenor SingTel Telenor SingTel Telenor SingTel Telenor SingTel Telenor SingTel Telenor SingTel OTE	3.62 3.65 <b>AY</b> <b>COST</b> <b>US\$</b> 0.92 0.95 0.95 0.80 0.87 0.92 0.92 0.92 0.92 0.95 0.92 0.95 0.95 0.95 0.95 0.95 0.95 0.95 0.95	UK SERVICE PROVIDER Telenor T-Mobil BT Telenor Telenor Telenor Telenor Telenor Trance Tcom Trance Tcom Trance Tcom T-Mobil Turk Telecom Sing	3.62 3.65 3.65 0.95 0.95 0.95 0.95 0.95 0.95 0.80 0.87 0.92 0.99 0.92 0.95 0.95 0.95 0.95 0.95 0.95 0.95 0.95	USA DIE USA DIE USA DERVICE HOVIDER Station 12 Telenor BT Telstra OTE UT Telenor Station 12 Telenor Station 12 Telenor SingTel Station 12 Telenor BT SingTel Station 12 Telenor BT SingTel Station 12 Telenor BT	3.62 3.65 0.95 0.95 0.96 1.07 1.20 0.80 0.95 0.95 0.96 0.95 0.96 0.95 0.96 0.95 0.96 0.95 0.96 0.95 0.96 0.95 0.96 0.95 0.96 0.95 0.95 0.95 0.95 0.95 0.95 0.95 0.95

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Here's how it works: first choose the Ocean region from which you wish to initiate

your call. The Ocean Regions are listed in the left hand column. The read across the table until you come to a point directly beneath the country to which you want to place your call. At that point, you will find the four

cheapest Inmarsat service providers for that call - according to their published tariffs - in descending order. So, if you want place a call via Inm-B from the Indian Ocean Region to a your office in, say Cyprus, your cheapest options are going to be VSNL, Korea Telecom, OTE and Telenor. Of course, you may be able to get cheaper prices through volume discounts and special deals, but these prices give you a benchmark that puts your own deals into their perspective.

In this issue we compare the prices for two contrasting satcom services. With the focus of this issue firmly on GMDSS, it is

interesting to look at Inmarset C as a viable option for everyday communications. For shortersmessages, it certainly has a role to play. And every immarsat C terminal can have an internet email eddress, which makes it even more attractive as a communications option.

But the communication method of choice for nearly all newbuildings today is Inm-B, so once we bring you a snapshot of the best prices in the market for that service. Prices here are really tumbling, with cheapest matching some Mini-M prices. It is also worth noting that, across the board, lameB

prices are considerably cheaper than the best tariffs we've seen published for iridium service, which average around the US\$7-8.00. mark.

The table show prices in US dollars. Although this table reflected the most accurate information at the time of going to press, some tariffs may have changed since publication. Alignment inclusive of LES and land line charges and are based on the last tariffs known at the

date of issue of this table. All rates are indicative and liable to vary depending on currency fluctuations and / or tariff changes. Tariff Check is prepared in conjunction with Sait-Radio Holland

