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Integrated maritime education and its suitability for technically advanced ships

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INTEGRATED MARITIME EDUCATION AND ITS SUITABILITY FOR TECHNICALLY ADVANCED SHIPS

by

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

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1.2 INTRODUCTION.

World is advancing technologically every day.During the past decade technology applied in the maritime industry has advanced at a rapid rate.With the current recession all the ship owners tried to cut down the running cost of their vessels operations in order to survive in a competitive market.This led to the introduction of highly advanced technology to maritime use.With this introduction came the requirement of operators for this high tech equipment.Ship owners expect more work out of less number of personnel in order to cut down costs.This calls for highly intelligent and broadly trained personnel.To meet this challenge the maritime Education System has to be reviewed (periodically) in order to produce a new generation of operators for this highly advanced collection of technology.

Many countries tried different methods to meet this challenge.Some countries upgraded their present system and other countries adopted a revolutionised system called Integrated Maritime Education System where an attempt is made to produce personnel for the future requirements for vessels to be built in the 1990's and beyond in way of replacing the present system of training Navigating Officers and Engineering officers separately which is as some experts call a waste of resources and energy and replacing with a person who is trained enough to understand, operate and maintain above machinery effectively and safely.

In this paper an attempt is made to explore the latest develdpements in technology applied or to be applied on board with present day technology and its effect on education and training , and examines suitability of integrated maritime education for wider acceptance partially or totally by other maritime nations.

1.3 ABSTRACT

INTEGRATED MARITIME EDUCATION AND IT'S SUITABILITY FOR TECHNICALLY ADVANCED SHIPS.

In the first chapter a brief discription of shipping geography, trade, ports and types of ships available today and in future is given.

In the chapter under the heading of "The Influence of Modern Technology on Maritime Operations" the influence of modern technology in the fields of Communication, Navigation, Cargo Operations, Propulsion and Maintenance is given in order to highlight the degree of automation that is introduced which does not require highly trained personnel due to improved reliabality of equipment.

In the chapter under the heading of "The Impact of Modernized maritime Operations on E & T of Shipboard Personnel." I have highlighted the motive for integrating and the integration concept for officers and ratings.In this chapter I have argued out the wisdom to educate officers broadly on both the disciplines rather than narrowly training personnel on each discipline.

Next chapter gives a brief outline of integrated Maritime Education as practiced in many leading maritime countries.

In the last chapter as a conclusion an outline of a Integrated Maritime Education System is given with comments on some aspects of Maritime Education.

INTEGRATED MARITIME EDUCATION AND IT'S SUITABILITY FOR TECHNICALLY ADVANCED SHIPS.

2 WORLD SHIPPING PRESENT AND FUTURE.

2.1 SHIPPING GEOGRAPHY.

Recorded history indicates shipping was florishing in the China Sea some 3000 years ago.Although so far nobody has done an indepth study of maritime history in the eastern world, records indicate Chinese merchants dominating the maritime world and travelling to countries in the east and west.Records indicate during the era of Buddha ie 600 BC the Shipping in the Indian sub continent was dominant. The western history indicates Maritime industry being dominant in the Middle East where Arabs and Romans dominated the maritime trade during the same period of time.

Around 1500 AD the trade had shifted to Europe and Europeans were dominating the Maritime Trade.During 1800s the Europeans were fighting each other for the monopoly of the shipping which mainly contributed to both the world wars.After the wars the Europeon dominance was reduced and was taken over by Americans and now it is drifting towards Japan /China.
If we look back , shipping has a tendency of shifting towards west in a cycle and it can be safely assumed the future shipping will be centered in the eastern region.The Eastern Nations should be geared up in time to benefit from this Westerly shifting of center of shipping.

2.2 TRADE.

During the colonial time the super powers at that time dominated the world trade by self imposed rules and by the power of guns.1800 the British had the monopoly of Opium ,Tea ,Spices and Silk trade (to and) from the East and profitted unreasonably sometimes getting a profit margin as much as 600 percent per voyage.Passenger and Slave trade was florishing due to immigration to and from newly acquired colonies.

With the replacing of British Navigation Act and the introduction of steam and iron ships the trade in the free world increased.After the second world war upon obtaining freedom,the then colonies also entered the profitable shipping which required basically no high technology at that time and this led to competition and many unfair trade practices which resulted in many countries turning to protectionism.Today except for a few countries all countries practice protectionism one way or the other inorder to protect their trade and shipping at the expence of world trade.

Today many countries are getting self sufficient in food supplies,turning to produce manufactured products instead of exporting raw materials and importing finished products.With these and introduction of container ships together with the current economic recession came the surplus tonnage in the world market.Many ship owners were forced to scrap their older uneconomical ships and some went bankrupt.Today the economists are crossing their fingers for an upward trend in world trade in the future. Trade and shipping has changed from basically raw materials to mostly finished products.Also from labour incentive break bulk to labour saving palletising and containarisation and in many instances from general purpose ships to special purpose ships such as car carriers and refrigerated ships etc.

With the introduction of containers which revolutionised the trade makes cargo officer onboard less important.Ship officers nowadays do not have time to calculate loading related calculations and prepare loading plans as done before due to the fact their port time is so short,and hence much work is done ashore prior to ships arrival at the berth.In many instances the ship officers have a vague idea what the cargo is on board.This is vastly different from the times when the master had to even purchase the suitable cargo for onward carriage.

Today one shipper may load a container on one vessel,but before it reaches the consignee that particular container would have travelled by sea after being transhipped from may be two ports,by river on a barge, by land on a railway wagon and at last may be to a another consignee who has purchased the consignement from the original consignee while the cargo was in transit.Main thing is all these things can be done on a single Bill Of Lading without involving much paper work.

- Economics of Scale. impact on shipping. & comperative advantage of cheap labour manpower.

future - Multi model Transport. -

- Local (Regional economic trade agreement.) will give new shape & dimention to shipping. & trade patterns.

- IMO, convention, strict port control (Balthayam FOC. & open registration) may make it have its impact on developing countries in many ways.

2.3 SHIPS TODAY AND IN THE FUTURE.

Our ancestors started shipping by making rafts out of reed and paddling with oars.With the development of technology these boats grew in size and sails were introduced.With the introduction of sails better and faster ships were introduced which resulted in an upward trend in world trade.With the production of steam engines and iron ships they grew in size and their seaworthiness increased.Steam engines were replaced by more economical internal combustion engines.With the oil crises in the 1970's ship owners were looking for more economical propulsion systems.Various types of alternate propulsion systems were tested.Although nuclear power was thought to be quite promising it cannot be used commercially due to political reasons.

The Soviet Union intends to build nuclear powered container ships / Soviet Shipping / for their arctic domestic service where refueling problems and the required high power to plough through thick ice justify use of nuclear propulsion. Improved sail power and solar power are promising alternatives.Already a few large vessels are equipped with modern versions of sails as auxilary power which is controlled by computer assisted systems in which case no additional labour is required.

Use of solar power is still limited to small vessels due to technical problems.

Other alternative fuels which give promising hope for the shipowners are synthetic fuels,methyl alcohol,pulverized coal/oil slurries,hydrogen and ammonia./21/.

Experimental trials are being conducted on electro-magnetic propulsion and super conducter power plants which can be housed in the bush of a conventional propeller.
With the improvement of technology new types of trade were introduced which required new types of specially designed ships.With the coal came the colliers and discovery of oil introduced oil tankers.To carry petroleum gas, gas carriers were needed.General cargo vessels gave way to container carriers.

In the following page a list of specialised ships is given to indicate the extent of specialization of merchant ships.

TYPES OF SHIPS AT SEA.

Typical Manning Scales

Barge Carriers(BACO & CONDOCK-LASH)
Bulk Carriers
Conventional General Cargo
Container Ship
Cruise Passenger Carriers
Chemical Carriers
Cross Channel Ferries
Car Carriers (CACA)
Container RO/RO Vessel(CONRO)
Car Passenger Ship (CAPA)
Fishing Trawlers
Fishing Factory Vessels
Freezer Cargo Vessel
Fruit Carriers
Hydrofoil Vessels
Hovercraft Vessels
Ice Breaking Vessels
Live Stock Carriers
Liquid Petroleum Gas Tankers
Liquid Natural Gas Tankers
Modern Multipurpose Vessels
Module Sea Lighter
Ore Bulk Oil Carriers
Oceanagraphic Survey Vessels
Ocean Minning Vessels
Passenger Car Ship
RO/RO Vessels
Special Heavy Lift Carriers

2.4 PORTS

In the early ages many ports were mere sheltered anchorages and the cargo was loaded/unloaded by manual labour at the anchorages and brought ashore by barges.This in turn was improved and ships were able to come alongside man made jetties giving a faster turn around for ships.With the improvement of technology discharging and loading by manual labour was assisted by cranes and other mechanical aids.

With the introduction of larger ships the ports had to be made larger and deeper by dredging or new deep water ports had to be constructed , together with service facilities such as bunkers and repair. Specialised berths such as oil berths , container berths ,RO - RO berths and berths for dry bulk cargo were required to cater for various types of ships and ports had to be competitive in their service in order to attract trade.

Efforts are being made to simplify the lenghtly documentation procedures in order to standarize them.Many countries have computerized their total operation procedure to be more efficient and serve the customers better.

Presently new harbours are being built to cater for special types of customer requirements and the old and uneconomical ones are converted or abandoned. Manual labour was gradually replaced by automated or mechanical methods of cargo handling.

Cargo types have changed and that requires trained personal to handle them.Some times the entire harbour infrastructure had to be changed in order to cater for different types of cargo and ships.

3 THE INFLUENCE OF MODERN TECHNOLOGY ON SHIPBOARD OPERATIONS.

3.1 INTRODUCTION AND SUMMARY.

In this chapter it is attempted to look in to the advance of automation which is or can be introduced for shipboard use today,in order to reduce present day crews's work load.
But it should be made clear that implementation of this technology will run in to difficulties from the following quarters.

1. Safety standards , regulations and conventions (National & International)
2. Minimum safe manning levels as laid down by authorities.
3. Reliability and cost of automation.
4. Public reaction, especially from the marine community.
5. Politics.

So what can be expected on board ships of the future will be a compromise between above items ,and different countries will adopt different standards of automation in their ships.
The most important development in the communications sector is communications via satellite and UHF , which may be expected to permit direct contact with ships at all times and in all parts of the world. It will also be possible to have on-line links between on-board computer systems and computer systems ashore.

Another sector within which development is required is that of internal communications onboard ship.The larger the ships and the smaller the crews , the greater is the problem of maintaining the necessary internal liasion. The following problem area are among those comprised in the communication sector: external long distance communications , telex , emergency traffic monitoring ;automatic communications between computers on board and ashore , local external communications , internal communications , communication for education and entertainment.

The bridge computer has the task of fulfilling the functions related to "look out " , navigation and manouevering. For the first mentioned function it will require a variety of input and indicating apparatus such as radar , radar warner , echo sounder ,detectors , transponder systems and radio. Incoming information will be collected by computer to produce a relatively complete picture of the environment , which will be displayed for the operator in an ergometrically correct manner.

The navigation part of the computer will be designed to calculate , on the basis of information from the position recording equipment ,the likely position of the vessel and the course which must be steerd at any given moment. Input will be from the following equipment ; compass , log , hyperbolic system ,satellite navigation system , inertial navigation system , radar ,etc. The navigation program will also utilize information from the "look-out" side , as above.

The manoeuvering portion of the bridge program will handle steering of the ship and determine a suitable engine power setting.

The program must take into account a number of factors such as voyage programs , regulations , dynamics , decisions , routeing , hull stresses , etc. The bridge computer probably constitutes the most important component from the security aspect. It may therefore be found suitable to divide bridge functions between two computers: one for the operational side and one for the monitoring aspects.

The engine room computer has the job of handling data collection and processing , state monitoring , regulating , sequential and logic systems ,general supervision and security systems. In this context , it is desirable to make a distinction between operation and supervision. This leads to a choice in the engine room between systems comprising two computers , or one computer and a more conventional system;or , as a third alternative , letting the central computer take care of supervision.

For cargo handling , the following tasks are involved: collection and processing of readings , state control , stress calculations ,bunker operations , ballast ,stability , trim , cargo planning , sequential control of cargo operations , tank cleaning and cargo administration.
The cargo handling system will vary greatly in design and construction according to applications, ie type of ship , cargo , ports , frequency of cargo handling operations , trade etc.

In certain cases, mooring is a critical operation in crew work. It requires a great deal of labour and , furthermore, is a relatively dangerous and demanding procedure since huge forces and inertias are involved. There are excellent opportunities to control the process with computing machinery and , with the aid of predictions , to achieve mooring in a practical way. The best results can probably be achieved if there is also special equipment on shore which can work in conjunction with that on board.

As regard to deck automation (meaning systems for the controlling and supervision of the mooring of the ship) , the following tasks are involved: readings from sonar-doppler ,forces in mooring lines , alignment of lines , length of cable , length of mooring lines , wind , current , manoeuvering of winches , anchors , bow thruster , active rudder , main machinary , radar and supervision.

Two kinds of security system are required: one to protect the vessel and her crew , and the other to protect the environment. In the first case it is necessary to sense the level of awareness of the operator and fire and gas escapes and to control systems for the extinguishing of fire and ventilation of gas , as well as to monitor hull stresses. For the protection of the environment , the primary requirement concerns the detection of leakages and the prevention of oil escapes.

If an acute emergency situation arises , it should be possible to transmit the ship's position automatically via communications radio.

The system parts listed above are at various stages of development at present.As regards the bridge portion , well developed anti collision and position determining systems are already available. There is also a powerful commercial interest in the further development of these systems.The same applies , by and large , to the engine room computer system, much of the basic work is already done and guidelines for further work have been clearly formulated by classification societies ,authorities, shipbuilders and owners.The cargo handling side is less well developed so far , and much remains to be done. As regards computer assistance for port approach and mooring ,practically very little has been done so far other than concept of Vessel Traffic Systems(COST 301), and this still represents a large virgin field of work. In the communications field , little effort has yet been made to achieve an integrated system, although various components of a system are begining to be distinguished. Automation of security systems has not been tried at all , though this is a requirement which should be regarded as very urgent.

For the further work of technical development , it would be interesting to place greater accent on those sectors which at present are less well developed. It should be an urgent task , not only to clarify the technical problems , but also to examine the various problems associated with the different sectors and to establish targets for the equipment which should be installed in ships./20/

Electronic class? may revolutionise the knowledge & manning requirements. It will also help accident investigation etc

3.2 COMMUNICATIONS.

With the development of radio communication the part of the activity involving the master diminished and was mostly transferred to shore-based management.Shore management could instruct the Master where the ship should proceed next depending on market and trade.Up to recently the radio communications required specialised operators and could be interuppted by weather conditions and limited by the global position of the vessel.

During the past decade satellite communication became popular and has come to such a level of reliability that the system could replace the radio officer without reducing the effectiveness of communications and safety.The operational procedure is such that any intelligent person onboard can communicate with anybody who is connected by telephone just by dialing the necessary codes and number as in any telephone connection.

As illustrated in (ILL 1-2)automatic receiving of information will be on a round the clock basis without any interference from weather or atmospheric conditions due to satellites using frequencies which are less affected by the atmosphere. Just by dialing the necessary code numbers a very secure telephone line immune to any eavesdropping by competitors can be secured.

Transmitting and Receiving of Telexes will be fully automated without the requirement to have a highly specialised operator.
The NAVTEX receiver selects the area of operation from the information received from the onboard computer or manual input and prints out all the weather messages , Navigational warnings , Distress messages , and even Chart Correction messages which feeds directly into data base of the Electronic Chart on board.

The shore management can obtain vessel's data including position ,speed ,E.T.A. next port ,engine condition ,cargo loaded position and any other information instantaneously by just entering onboard computer without bothering the ship's crew. This even has the possibility to transfer the ship's entire operation to shore based stations by remote control.
In the Global Maritime Distress and Safety System (GMDSS) the ships position will be continuously fed to the system memory and in any emergency situation a distress message can be activated by just pressing a button or jettisoning a float free Emergency Position Indicating Radio Beacon (EPIRB) which instantly alerts shore stations placed at convenient positions around the globe.The lifeboat radio also will be fed with this information automatically.
Standard C system is a satellite communication system which can give all the above mentioned facilities except voice communication at a greatly reduced cost and of compact size (size of a shoe box)

With all this automation technology in onboard communications the role of conventional radio officer has to be changed to the role of Electronic officer to maintain above mentioned electronic equipment in the whole shipboard system, and to carry out any small repairs which he is capable to handle at sea without expensive fault diagnoise computers. Already some administrations (Singapore and United Kingdom -1987) allows vessels to proceed to sea without a qualified radio operator provided the ship is fitted with Satellite Communication system which satisfies the authorities.

INMARSAT ROLE

INMARSAT Equipment	Capability	Availability
Standard-A SES	General communications (voice, telex, data, facsimile)	Operational now
	Distress priority	Operational now
	Automatic distress message generator	Operational now
	Group call (receive) (voice, telex, data, facsimile)	Operational now
Standard-C SES	General communications (message only) (telex, data, digital facsimile)	Sea trials 1987, operational 1987, global coverage 1988
	Distress priority	
	Distress message generator	
	Receipt of SafetyNET and FleetNet group transmissions	
Enhanced Group Call (EGC) SES	Receipt of SafetyNET and FleetNET group transmissions	Sea trials early 1987, available late 1987
L-Band EPIRB	Distress alerting	Pre-operational test and demonstration 1986

ILL. 01
SOURCE INMARSAT

INMARSAT

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FACT SHEET

April 1986

ENHANCED GROUP CALL SYSTEM
SYSTEM CHARACTERISTICS, APPLICATIONS, USERS

CHARACTERISTICS

- Global coverage
- Compatible with international alphabets and languages
- Robust and reliable
- User message selection
- Unattended operation
- Automatic suppression of previously received messages
- Low cost receiver with omnidirectional antenna
- Low power consumption, battery or mains.
- All ships addressable
- Mandatory "ALL SHIPS" reception.
- Fixed areas
- Variable/temporary areas (circular/rectangular)
- Closed/open user groups
- Unaffected by atmospheric conditions
- Information transmitted and received at 600 bits/sec.
- All digital system
- Compatible with all INMARSAT SES standards or stand alone .
- Operates through high integrity network
- Offered by internationally owned and commercially managed satellite organization

APPLICATIONS

- Shore-to-ship distress alerts
- Storm warnings
- Coastal warnings in non-NAVTEX areas
- Commercial subscription services
- Navigational warnings
- Weather forecasts
- Market/price information
- News services

USERS

- Search and Rescue Authorities
- Meteorological Authorities
- National Maritime Authorities
- Fleet owners
- Data base providers
- Navarea Coordinators
- Port and Harbour Authorities
- Coast Guards
- News organizations
- Commodity brokers

INMARSAT

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FACT SHEET

May 1986

FUTURE GLOBAL MARITIME DISTRESS AND SAFETY SYSTEM

EQUIPMENT COSTS (US dollars)

(IMO estimate* - April 1986)

Existing Ships Already Fitted with Modern Equipment

Additional Equipment Required for:	A. Ship Equipped with Satellite Communications	B. Ship Equipped with HF Radio Installation
VHF DSC receiver	400	400
DSC Processor	1,800	1,800
DSC control	2,000	2,000
NAVTEX receiver	1,000	1,000
Satellite EPIRB**	1,000	1,000
SAR transponder**	1,000	1,000
Portable VHF (two sets)	1,100	1,100
MF DSC receiver	400	400
DSC processor	1,000	1,000
MF/HF DSC receiver		2,100
Radiotelex processor		3,600
Printer and keyboard		2,000
TOTAL:	9,700	17,400

* Average price +/- 30%

** Figures are maximum in range $500 - $1,000

ILL. 03

New Ships

Optional configurations

Equipment Required	Standard-C SES (Messages/Data)	MF/HF Radio	Standard-A SES (Voice/Data)
VHF equipment	1,300	1,300	1,300
VHF DSC receiver	400	400	400
DSC processor	1,800	1,800	1,800
DSC control	2,000	2,000	2,000
NAVTEX receiver*	1,000	1,000	1,000
Satellite EPIRB*	1,000	1,000	1,000
SAR transponder	1,000	1,000	1,000
Portable VHF (two sets)	1,100	1,100	1,100
MF equipment	6,000	6,000	6,000
MF DSC receiver	400	400	400
DSC processor	1,000	1,000	1,000
MF/HF equipment		3,400	
MF/HF DSC receiver		2,100	
Radiotelex processor		3,600	
Printer and keyboard		2,000	
Standard-C SES**	5,000		
Standard-A SES			30,000
TOTAL	22,000	28,100	47,000

*Figures are maximum in range $500 - $1,000

**Price not estimated by IMO. Figure represents Inmarsat's expectations at today's prices.

3.3 NAVIGATION.

In implementing integrated ship operations the first thing that comes in to anyones mind is Navigation.How the integratedely trained officers can manage the safe navigation of the vessel especially in a congested Channel.When training integrated officers it is obvious the level of knowledge on navigation these officers having will be lower compared to the level of officers who are specialised in navigating as at present.In order to offset this inbalance the ship designers have to compensate with automation which is feasible today at a lower cost, and training institutes have to use better methods of training such as simulators etc.

The days of navigating officer waiting with the sextant and chronometer in order to get a glimpse of celestial bodies are past.The accuracy of 4 nm required by I.M.O. for ocean navigation can hardly be achieved by astronomical sights alone and so astronomical navigation is already obsolete. We have conventional electronic navigational aids such as Radio Direction Finders , Decca Navigators , Loran , Omega , and not so conventional Transit Satellite Navigation.

In future Satellite Navigation systems will offset most of the disadvantages regarding accuracy and availability we had to cope with.With Navstar system with its own 18 satellites operational prior to 1992 to give 24 hour coverage boast an accuracy of 10 meters (for civil use 100meters) and updates the position every 2 minutes in any weather condition.This is obviously better than any conventional navigation position fixing that can be obtained by any expert navigator. This Navstar fix can be made available to any suitably trained person who can operate a basic computer.

This position fixing can be made more accurate (reduce errors) and reliable by integrating above mentioned conventional position fixing methods plus navigational aids such as Radar,bottom and side scanning sonar equipments by a central computer.

The position thus obtained can be plotted manually on a conventional paper chart or can be plotted automatically by a automatic chart table which uses conventional paper charts.If we go further the position can be automatically displayed on a electronic chart screen.Latest developments on electronic charts indicates the ability to be integrated to radar picture which gives ARPA capabilities on the same screen.Electronic charts can be updated automatically by a correction disc and information supplied via Satellite communication which corrects them automatically.The need to refer to tide tables and light lists will be no longer required since this information can be obtained direct from the chart screen which can be programmed to give the actual depth available depending on the time.

Voyages can be planned prehand by ship officers or by shore based Ship Routeing organisations and fed to the onboard computer periodically.Planned track and track made good will be indicated on the display which can be adjusted manually if necessary by the Masteror officer on watch.

Collision avoidance can be aided by the Automated Radar Plotting Aid (ARPA) or can be designated to the computers to take necessary avoiding action in order to avoid close quarter situations.At present up to about 20 targets can be plotted individually by the computer and necessary information such as course , speed ,CPA , TCPA , predicted situation if any alteration of course or speed by own ship and many more can be obtained by the officer on watch at a moment's notice relieving him from the tedious task of manual plotting.

In collision avoidence Radar if any target comes within a pre determined range it gives a visible warning to the officer on watch who has to take necessary action within a pre set time.If no avoiding action is taken by the o.o.w. an audible warning will be given with relays to Master and could be programmed to take necessary action with rudder(s) and propeller(s) to avoid close quarter situations.

(This of course had been the subject of discussions weather this can be allowed in practice)

Auto pilots are so common nowadays navigators tend to treat confidently.Even close quarter situations are handled on the auto pilot rather than changing to manual steering as previously done.It won't be long before vessels navigating narrow channels and even entering or leaving harbours without a human helmsman at the wheel.There are ships exsisting today whose auto pilot and engine controlls can be programmed to respond to oral order of the Master or Duty officer.

In adaptive auto pilots or track controllers such as SEAMASTER 2000 and BIRJUZA the optimum course keeping is ensured by means of digital PID controller. Input data is obtainable from the gyro compass , remote magnetic compass , and rate of turn gyro and other means as shown in ILL 8-9 . Feedback gains are adjustable in accordance with optimum values computed.

In the process of normal operation a Navigator derives proper values of ship's parameters from the tables attached and feeds them into the computer.

Whereupon feedback gains are calculated and transfered to the controller automatically. The course between each set of (adjustment) waypoints is calculated and displayed as a reference for course keeping. Co-ordinates of way points as well as lane widths are inserted in advance into the computer according to the voyage plan. If in the process of course keeping the vessel approaches given lane margin , an audible alarm is given. /27/.

In this type of auto pilots the course can be steered very much more accurately than human control and are more suitable for operations where very high accuracy in steering is required such as ferry route between Stockholm and Helsinki. Of course the future navigators should be taught the limitations of the equipment so they will be aware of the dangers.

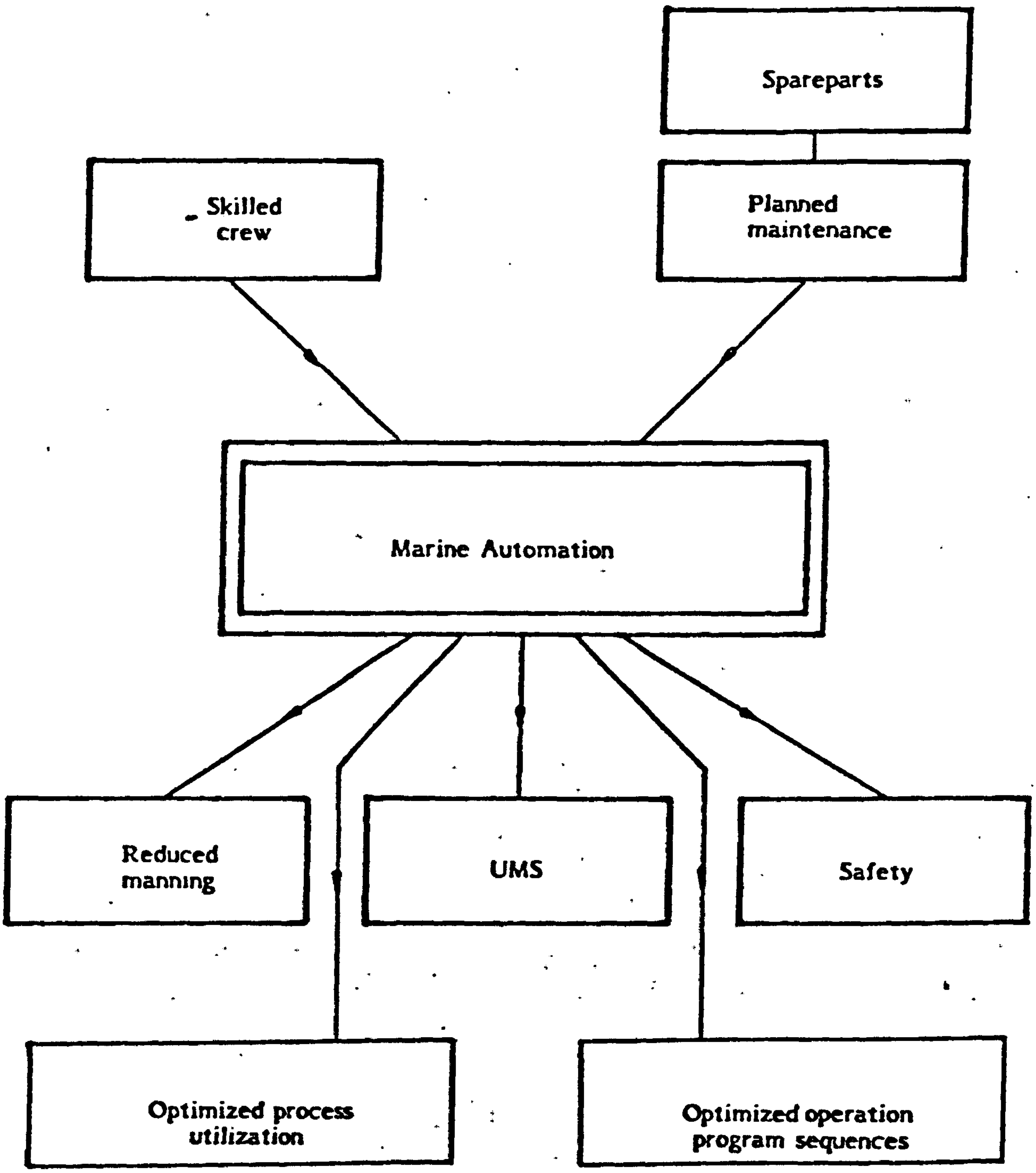
Present technology also has the capability of controlling vessels entering or leaving a certain harbour safely even without employing a pilot by using the system known as Vessel Traffic Management System where vessel's movement will be monitored by shore based Radar System and using V.H.F. radio communication to instruct the vessel.
In the VTS system the Radar pictures from several strategically located Radars are processed by a central computer to give an overall picture without any shadow sectors. The computer monitors the movement of all moving targets and operator can have all the information of that vessel just by requesting to show on the screen.
The VTS operator can give information to masters and pilots about the movement of his vessel or other vessels in the vicinity. In many ports the authorities use VTS system to guide vessels along waterways , specially in restricted visibility.
The tedious task of recording all actions taken on the bridge will be taken over by the data logger, which will be introduced in the future. Already Lloyd's have given specifications of the data logger.(Black Box). This will be usefull in casualty investigations also.

As illustrated in (ILL 9) the whole action of the bridge under normal and few abnormal conditions can be left to be handled by automation which gives the officer on watch extra time to engage in other necessary action where automation cannot handle and for important decision making. It can be safely said today the reliability of the machinary is very high but present day these machinery are relatively costly.With the popularising of automation these equipment will be available at a reduced rate which can be afforded by any ship owner.

Another factor looked in by the designers is the design of the bridge.Presently the round of action by the O.O.W. is WINDOW , RADAR , CHART . With the present rate of the ships getting broader the Navigational bridges are getting bigger making the distance that OOW has to travel those three positions great.This could be crucial at an critical situation.Illustration (12-14) shows some new ideas of ideal bridge design applied by Naval Architects inorder to get a better use of the equipment on the bridge by the OOW.These designs are taking the shape of aircraft cookpits where all the instruments are within the reach of pilot the who is seated.

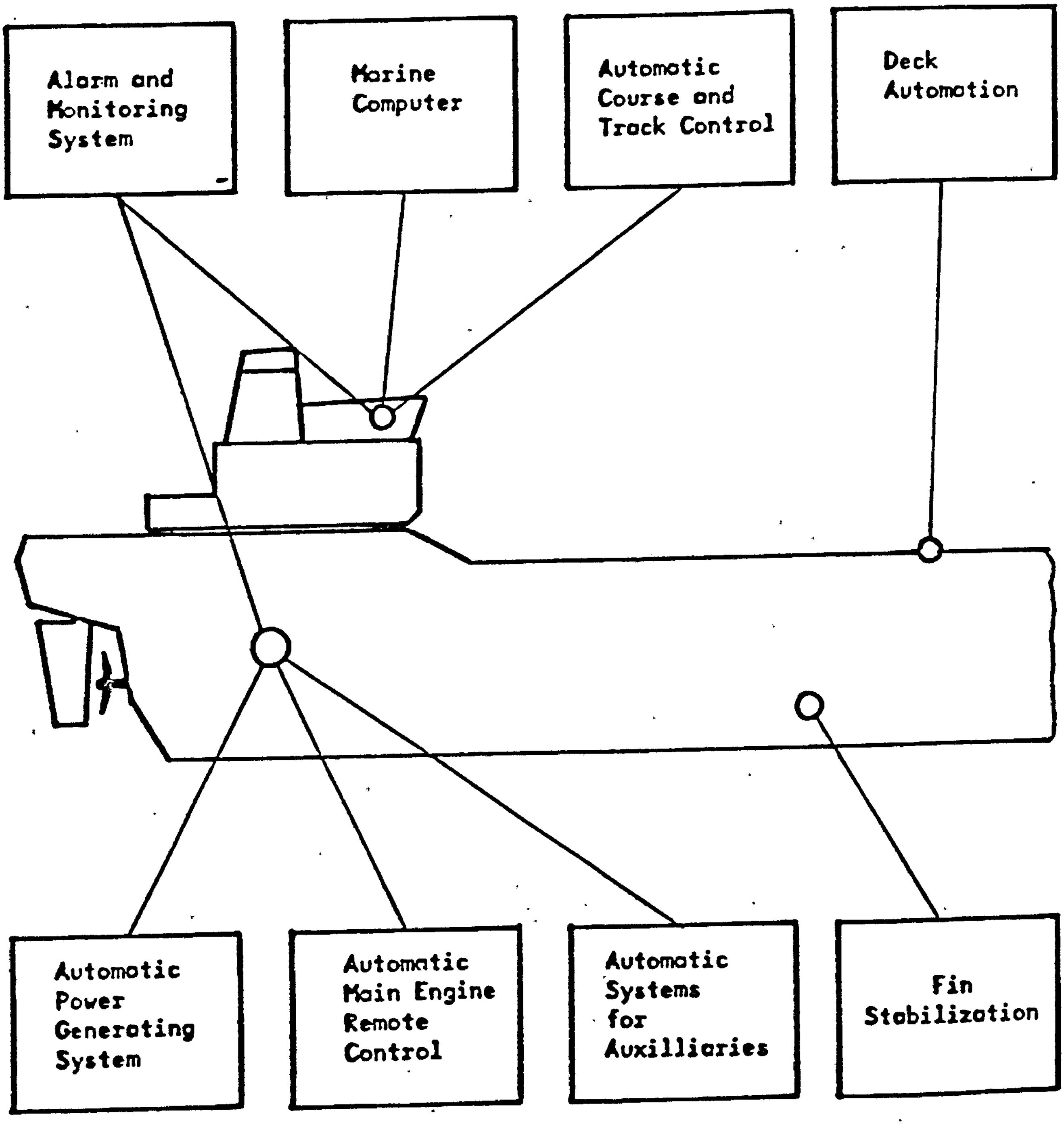
In the extreme case the whole ship can be controlled remotely from outside the vessel ie from a mother ship where few other ships will be travelling in a convoy or from a shore based control station using satellite to transfer data to and from onboard computer.At least this concept is feasible with todays technology for deep sea part of the navigation.

Presently this is in the experimental stage and Japanese researchers are expecting to sail the first experimental "INTELLIGENT SHIP" as early as 1988.It wont be long before researchers in the west specially Germans , British and French will be confident enough to sent their experimental fully automated ships to shipping lanes of the world with just a token crew who are just standing by for any failure in the system.



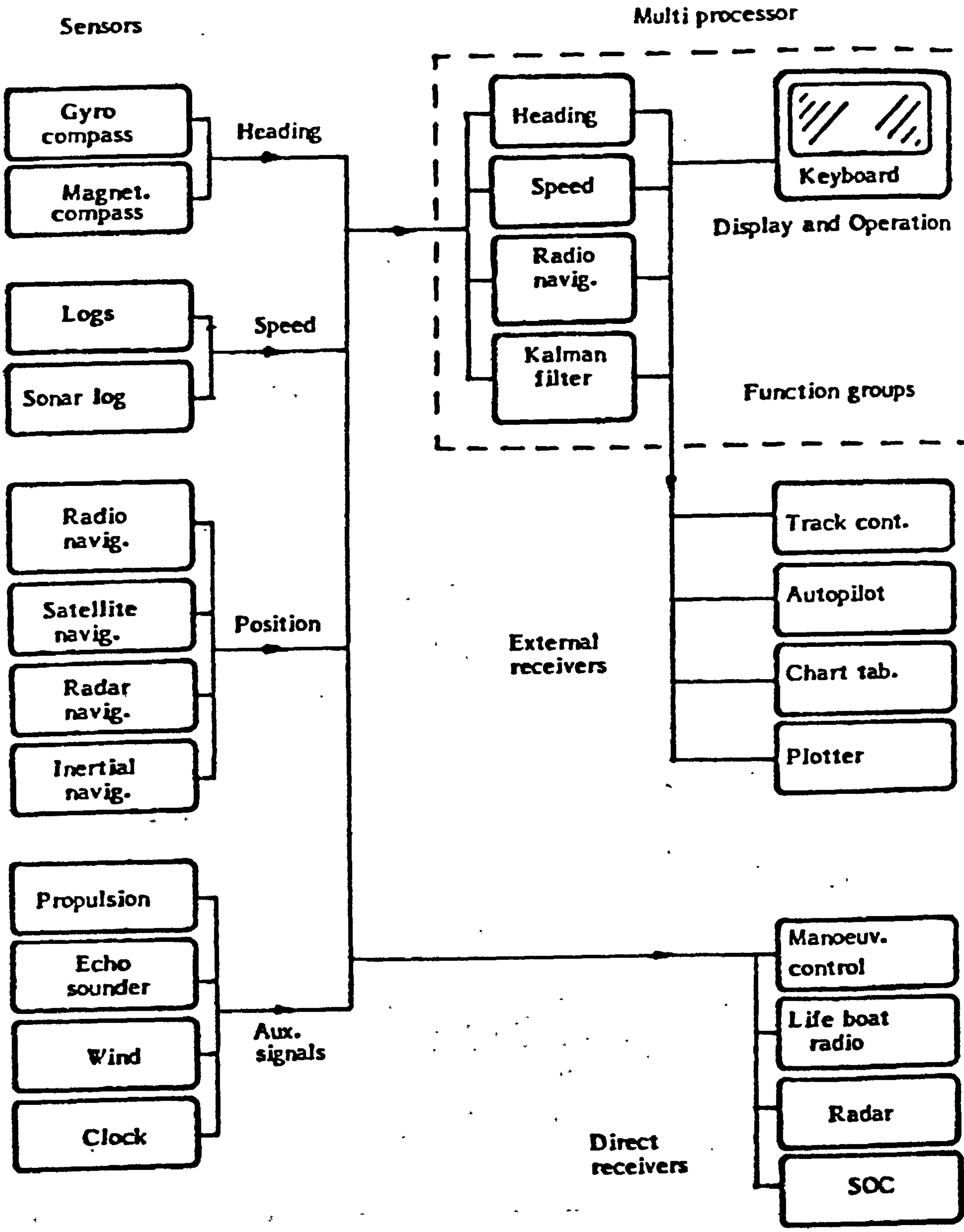
Necessities and results of marine automation

ILL. 05

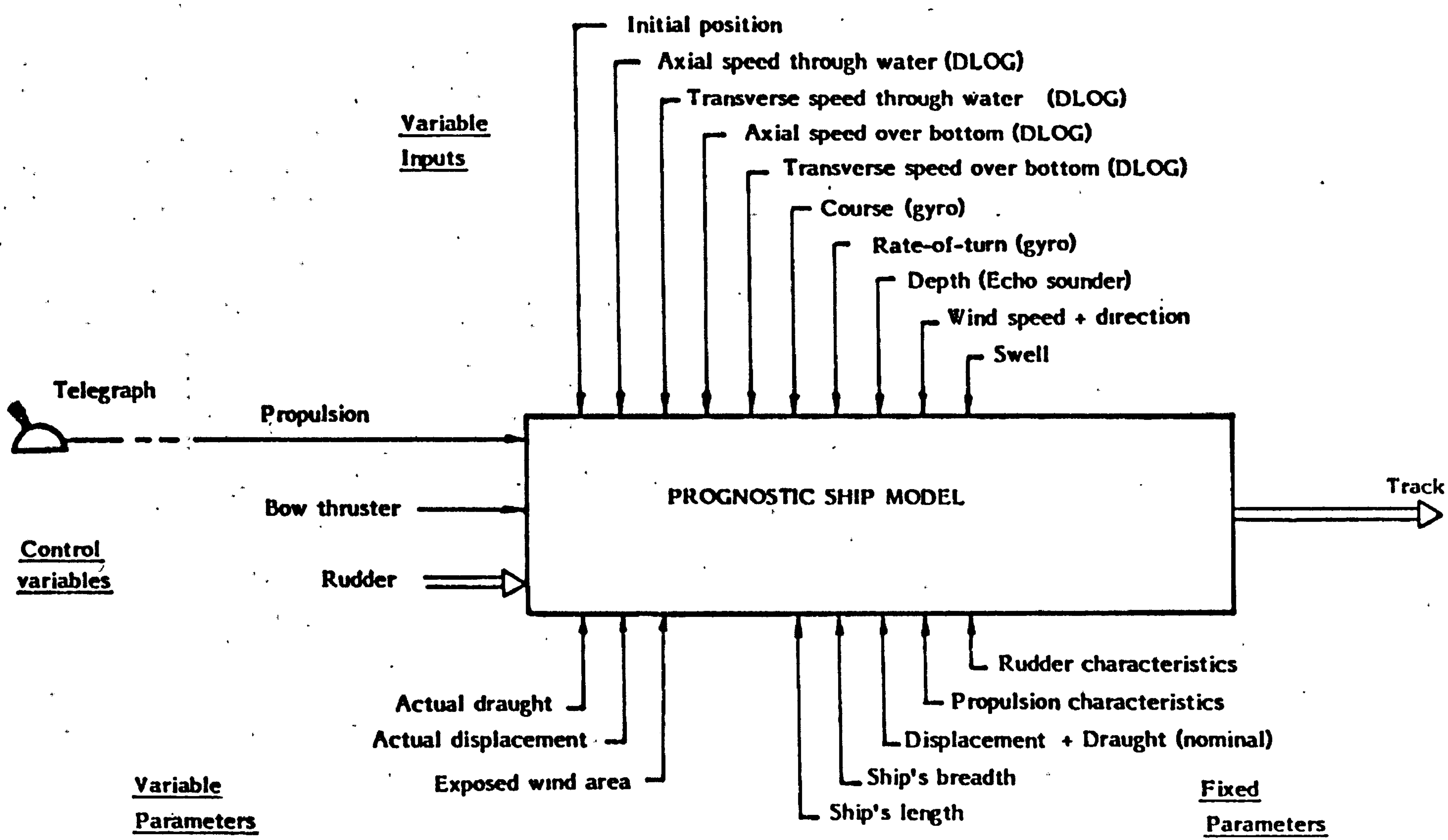


Marine Automation Systems

ILL. 06



Ingtegrated Navigation System (Teldix)
(Computer aided dead-reckoning navigation, failure minimized)



Prognostic Ship Model for Track Controller Tuning (KAE)

ILL. 08

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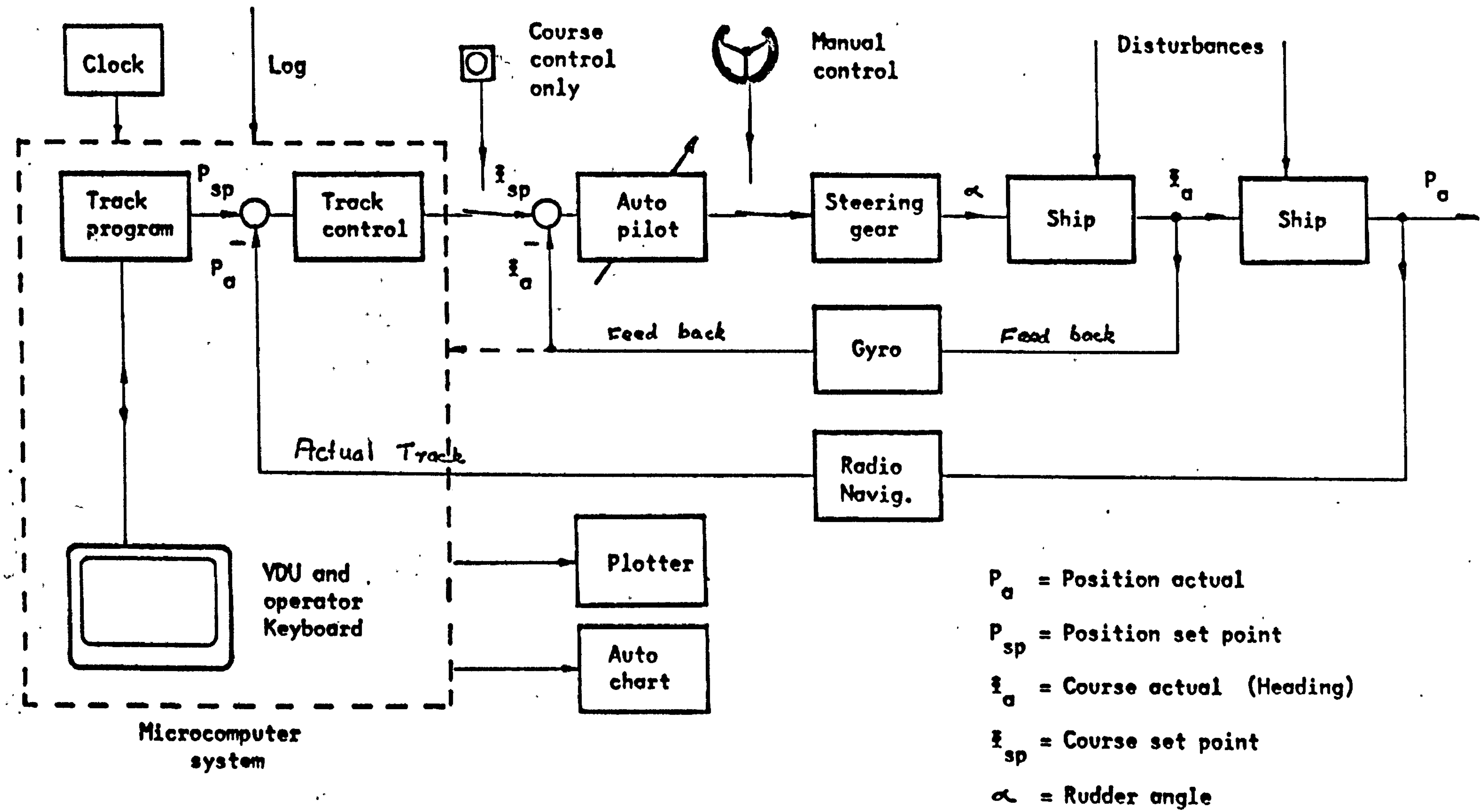


Simplified Blockdiagram of Course and Radio Track Control

ILL. 09

Flensburg
Research Institute for Ship Operation

- Navigation on a preselected track
- Closed loop control of the most significant navigation variable
- Adaptive track control for precise and economic operation
- In connection with the auto pilot (course controller) a cascade control is performed
- Route planning by means of
  - way points
  - track functions
  - manoeuvre information

  for

  - deep sea
  - coastal trade
  - estuary trading
  - high-precision track for surveying, dredging and research
- Great circle navigation
- Control of
  - main propulsion
  - bow thruster

  for track control with slow speed
- Precision of track control (only)

  < 30 meters

  under condition of heave and surge, wind velocity: 7 BF

Features of adaptive track control

ILL. 10

Functions

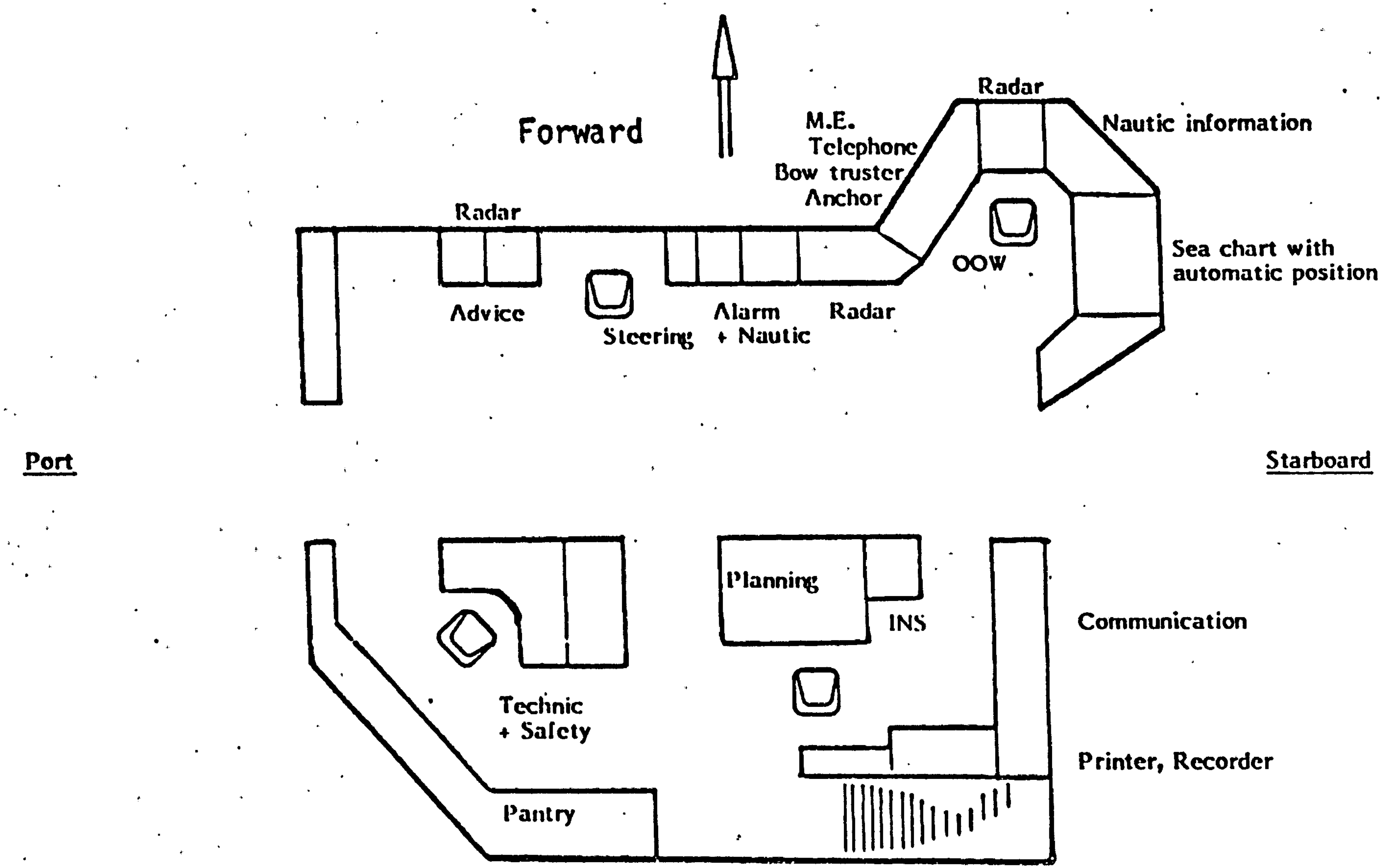
- Determination of actual ship's position from different independent radio navigation sensors, gyro an sonar Doppler log

- Route planning for long term operation in deep see by way point input and for short term manoeuvring in coastal waters by setting the selected course lines with the aid of the ARPA radar's "rubber band" function

- Automatic track control by the ARPA radar and Adaptive Radar Controlles Autopilot (ARCAP) by means of inputs from all navigational sensors and the dynamic characteristics of the individual ship. This function provides minimum track deviation

- Collision avoidance and alarms

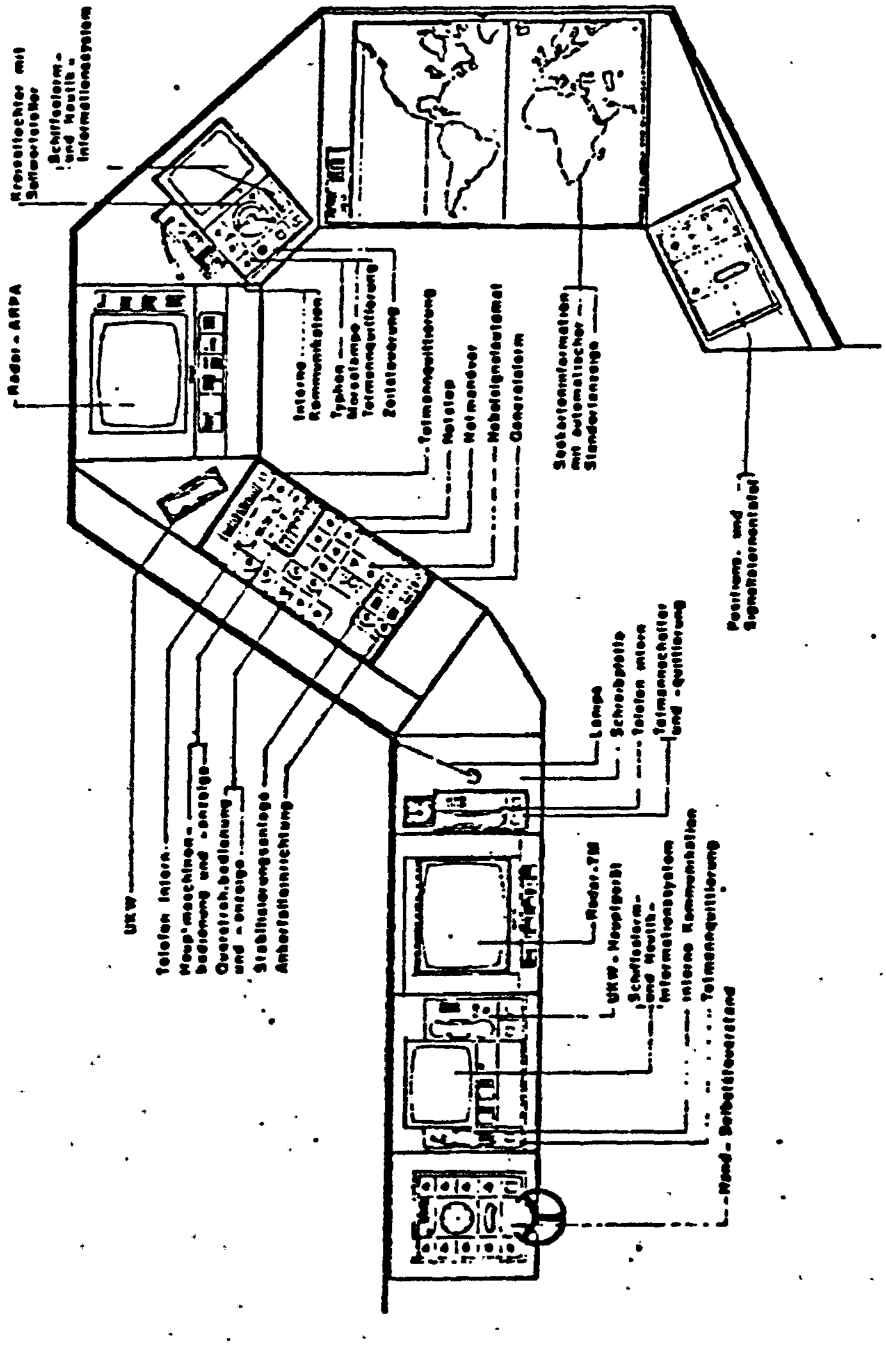
- Indication of navigational an other ship's data on the Navigation Information Display (NID)



Ship Operation Center (Task orientated)

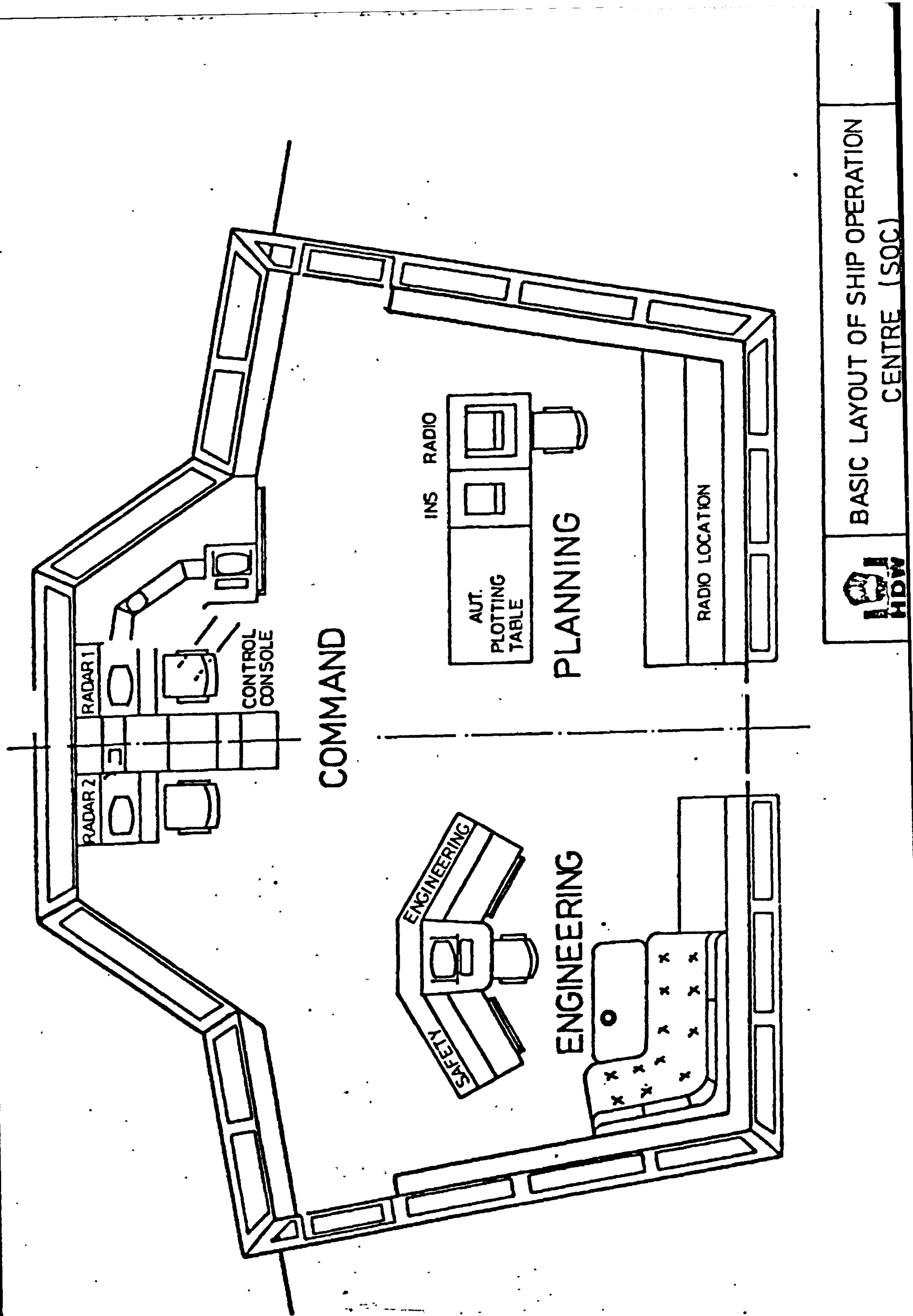
FLENSBURG RESEARCH INSTITUTE FOR SHIP OPERATION:

ILL. 12



Ship Operation Center
Task orientated

ILL. 13
SOURCE FLENSBURG RESEARCH INSTITUTE FOR SHIP OPERATION:



ILL. 14

FLENSBURG RESEARCH INSTITUTE FOR SHIP OPERATION

3.4 CARGO OPERATIONS.

In future most of the cargo transported by sea transport will be unitised such as containers and the rest will be bulk. Cargo handling will be planned by shore personnel using computers even before the ship berths at the pier.Cargo loading conditions will be monitored by the onboard computers and any overloading or over stress condition shall be indicated to the operator or necessary action can be initiated by the computer such as ballasting and transfering ballast automatically.Stability of the ship as well as the trim will be monitored by the computers continuously all the time.All the documentation will be handled by shore perssonal and will be stored in the onboard computer.

Opening and closing of hatch covers is of such stage only one person is needed for the operation,that is also for checking and to operate a lever.

It is needless to say even at present the chief officer has nothing much to do during the cargo operation .His work presently mainly consists of checking the computed loading plan which is made by the ship planner who is normally an experienced ex master or chief officer himself.

Normally he keeps himself busy due to the fact that he does not have much confidence in shore personal doing the loading operation and he likes to check all the operation himself. Once the concept of ship/shore bivalence is rooted up he will get used to qualified shore personal carrying out loading operation and build up confidence.

In the field of tanker operations still the role of chief officer is important.Here also he can be further assisted by remote controlled discharge/-load operation.Today with the availability of Simulators the tanker Chief Officer can obtain expert knowledge without the fear of creating pollution. The cargo work can be further assisted by centrally located bilge,tank sounding & ballasting system with other loading information in the cargo operations room.

3.5 MOORING AND UNMOORING OPERATION.

In this field there is not much progress in automation compared to other fields. Presently anchoring and other winch control can be handled remotely with the assistance of closed circuit video cameras with telescopic and wide angle lenses.This also can be further assisted by the following.

- By engaging shore based mooring crew (as employing rigging and lashing gangs which is done nowadays) which embarks with the pilot and dis embarks with the pilot when leaving port.To achieve this sucessfully it is important to standarize the mooring equipment so all the shore labour will be familiar with the equipment on board.

- By organising shore facilities where ship crew have only to take the mooring ropes given by the shore personal and put them on bollards and the responsibility of bringing the vessel alongside and making fast will be handled by shore personal.

- Automation of berthing such as that existing for ferry operations.

- Work such as control of mooring arrangements and the winding up and unwinding of tug lines and mooring lines (which are on drums)are treated centrally.

- Use of stronger and light weight mooring lines , so number of mooring lines handled can be kept to a minimum.

- Wider use of self tensioning winches which are integrated to sonar - dopplers so less attention can be paid to mooring lines while berthed and can be programmed to maintain the same position in order not to put strain on loading hoses in tankers and on ramps of RO-RO vessels.

- Anchor handling can be carried out from the bridge itself with the aid of high tech video cameras. It may still be necessary to have men forward to prepare anchors for anchoring. The display of anchor lights and balls and all other signals will be controlled from the bridge.

3.6 MAINTENANCE OF DECK

In this aspect also the work load of the crew will be reduced due to application of high technology and better planning.Following are a list of items which can be suggested to ease the work load of the crew.

- Deck washing machines with high water pressure.
- Minimised upper deck piping.
- High resistance hull painting and better preparation of hull plating ie shot blasting of hull plating at dry docks.
- Carrying out necessary planned maintainance using shore personal while the ship is in port or dry dock.
- Trends towards lightweight designs,such as use of light alloy metal for construction of blocks, lashing material etc, maintaining the same safe working conditions in order to facilitate easy handling.

3.7 ENGINE ROOM OPERATIONS AND MAINTENANCE.

Due to the advance of technology the unmanned engine rooms have been operational for the last 20 years.With the experience obtained in the past automation technology is at a very high standard.In future much machinery will be standarized and will be plug on/off type like in the aircraft industry where entire engines or pumps can be replaced to be repaired by shore personal after a certain number of hours of use, reducing the tasks to be handled by the crew to minimum and increasing the reliability of the machinery.Few most essential units can be left onboard as spares in case of failure.Most of the equipment as shown on ILL 15 can be conected to an automated control system which can be monitored and controlled form the central control room ie Bridge.

In any case most of the electronic equipment which will be available in future will be inrepairable on board.Other than diagnosing the faulty circuit of that equipment and replacing it with a spare circuit carried on board nothing much will be possible.

Bunkering can be handled by remote control from the central control room.

Even the ships refrigeration room for victualling can be in the form of portable container where all the required provisions can be pre loaded and the whole container placed on board requireing minimum crew.

Following are a few examples of improvements already or to be introduced on board as crew facilities.

- Simplification of system (F.O)
  In order to simplify the F.O.system an alternative plan is applied for the electric heater and F.O. treatment equipment which is the water removal type, instead of steam heating heater and F.O. purifier respectively.Consequently,both reliability and availability are improved.

- Improvement for essential equipment due to the combination of equipment (M.E. cooling system)
  For example of F.W. central cooling system,improvement in reliability and availability is accomplished although the system is more complex compared with the conventional ones.

- Dual system for essential equipment(ie number of Generator sets etc)
  Here the availability of dual or triple systems are raised tremendously compared with the availability of 0.99453 with one set of generator.

- Intencive backup system on land.
  For example for equipments such as F.O.purifiers which needs much labour in their repair and maintainance it may be better to rely upon onland maintainance applying multiple system.

Also on engine Manoeuvering

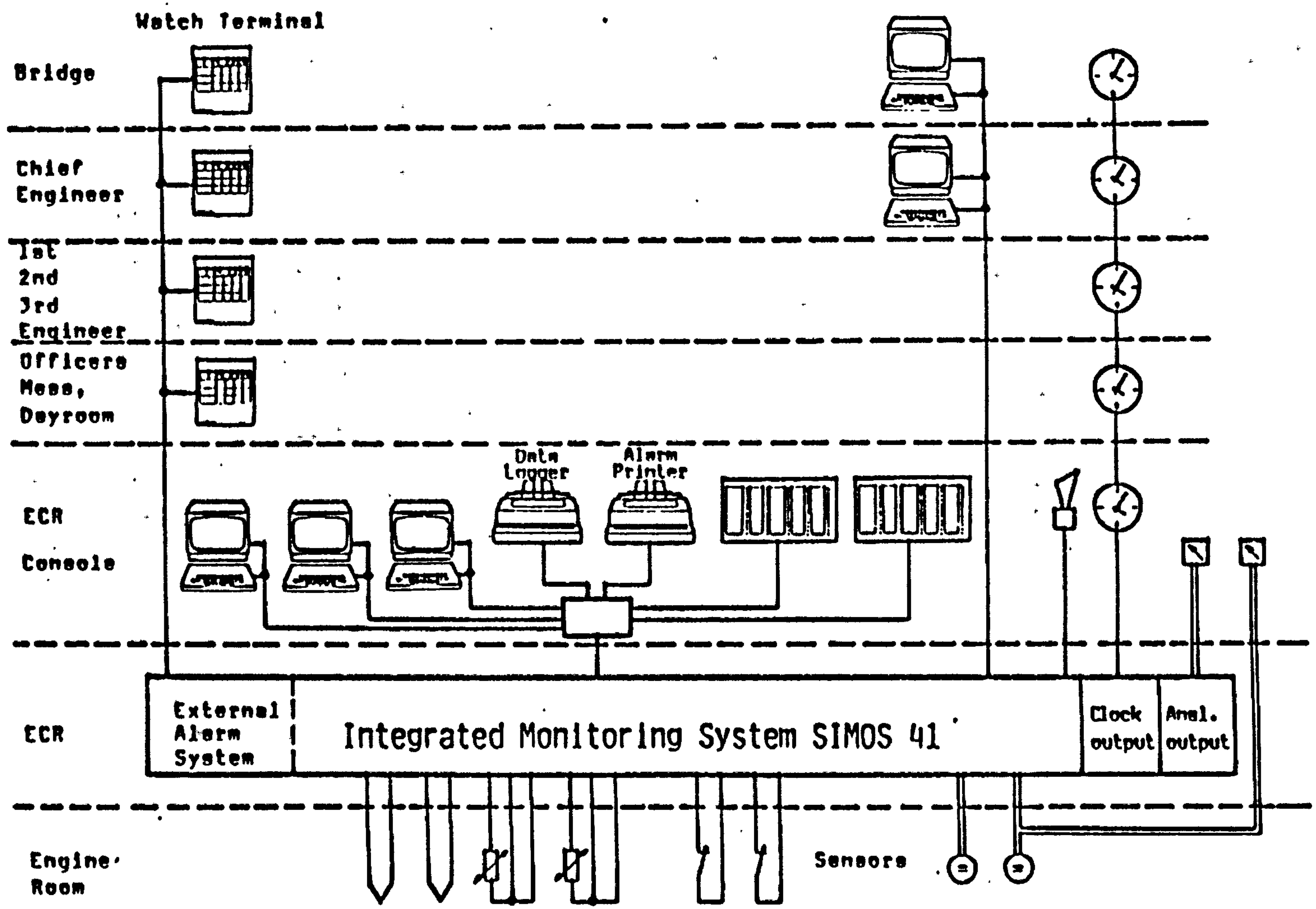
- Sequential and program control of plant mode.
- C.P.P. with shaft driven generators.
- Integrated monitoring system.
- Trend analysis for essential machinery.

On Maintenance

- A hot water heating system instead of steam system.
- Central F.W. cooling system.
- F.O.filter treatment instead of purifier system.
- Automation of bilge system and rearrangement of sludge tanks.
- Electrical/Electronic controls instead of compressed air.
- Wide maintainance space & efficient handling tools.
- Grade up of pipe material.
- Simplifying of L.O. system.
- Centralising the frequently expensive and sophisticated resourses required for repairs for better utilisation.
- Reduction in volume of man hours for maintainance on board , in consequence of the reduced importance of preventive maintenance and the trend in corrective maintenance from " as required " to " as opportunity arises ".
- Progressive extension of test functions on board , to also comprise fault finding and diagnosis in addition to present day alarm and state monitoring function.

- Increased centralisation of all test functions on board through the use of computers.
- Carefully selected range of replacement units in line with test philosophy and maintenance on " as occation arises " basis.
- Increased requirements regarding repair equipment and rules for maintenance on shore (principally maintenance of equipment and overhaul). /2/

SIEMENS



E 473

Automation on Ships
SIMOS 41 System Overview

ILL. 15

Signal	Disturbance group	Generator breaker OPEN	Diesel Stop	Further automatic operation blocked	Start-up command to standby set
Generator current $\geq$ 85 %, 30 sec; $\geq$100 %, 20 sec					●
System voltage / System current $\leq$95 %, 10 sec	1				●
Fuel admission $\geq$ 110 %, 5 sec					●
Cooling water temperature > 85°C	2*	●	●	●	●
Lubricating oil temperature >110°C		×	×	×	×
Exhaust temperature max.		●	●	●	●
Generator winding temperature max.		×	×	×	×
Lubricating oil pressure min.	3	●	●	●	●
Reverse power $\geq$ 6 %, 3 sec		●	●	●	●
Overspeed		●	●	●	●
System voltage / System frequency $\leq$ 85 %, 5 sec		●	●	●	
Underload shutdown 10 min		×	×		
Busbar short-circuit		●			

● Standard function
× Optional function
* Generator breaker cut-off and diesel stop order delayed

ILL. 16

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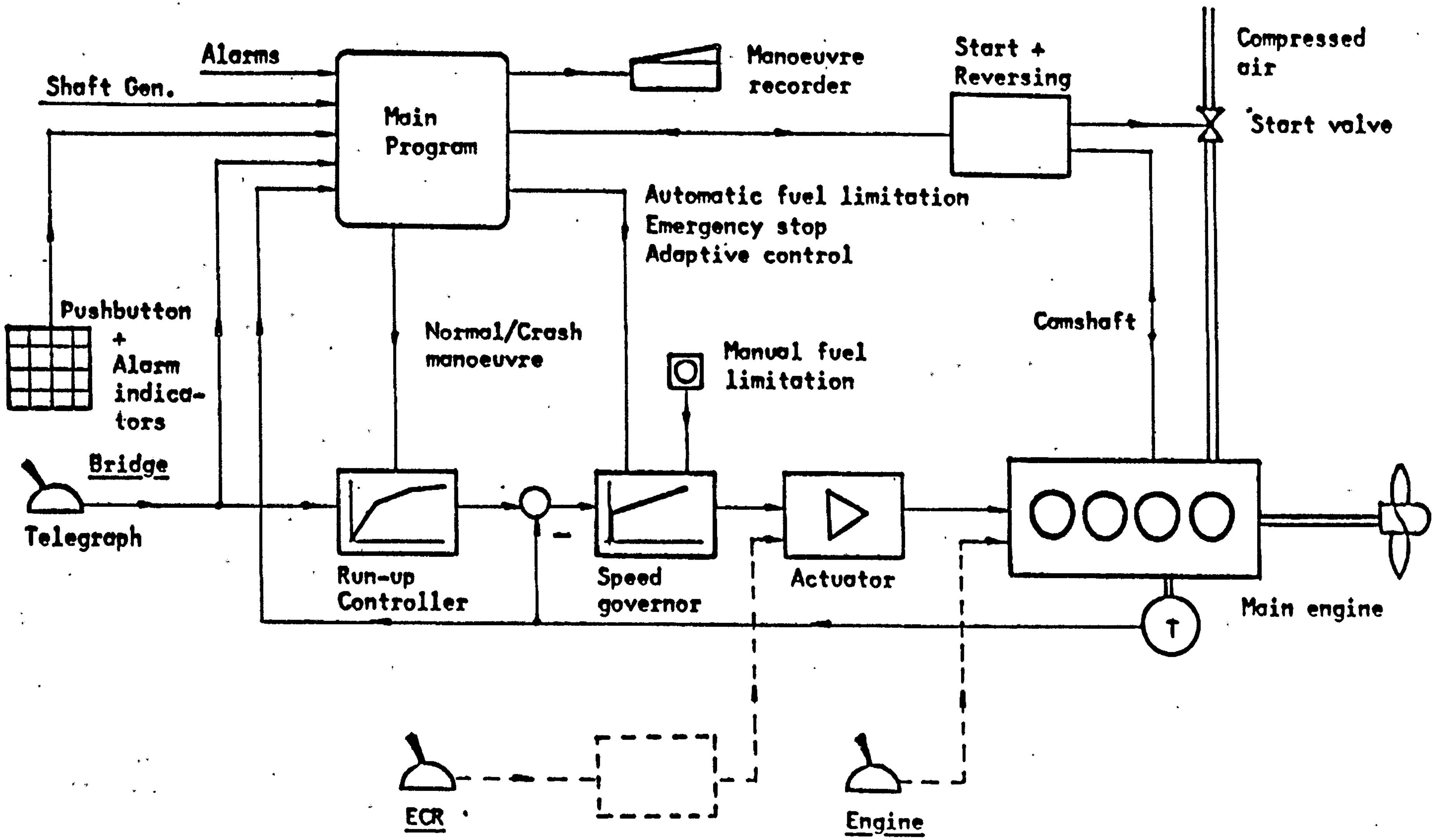
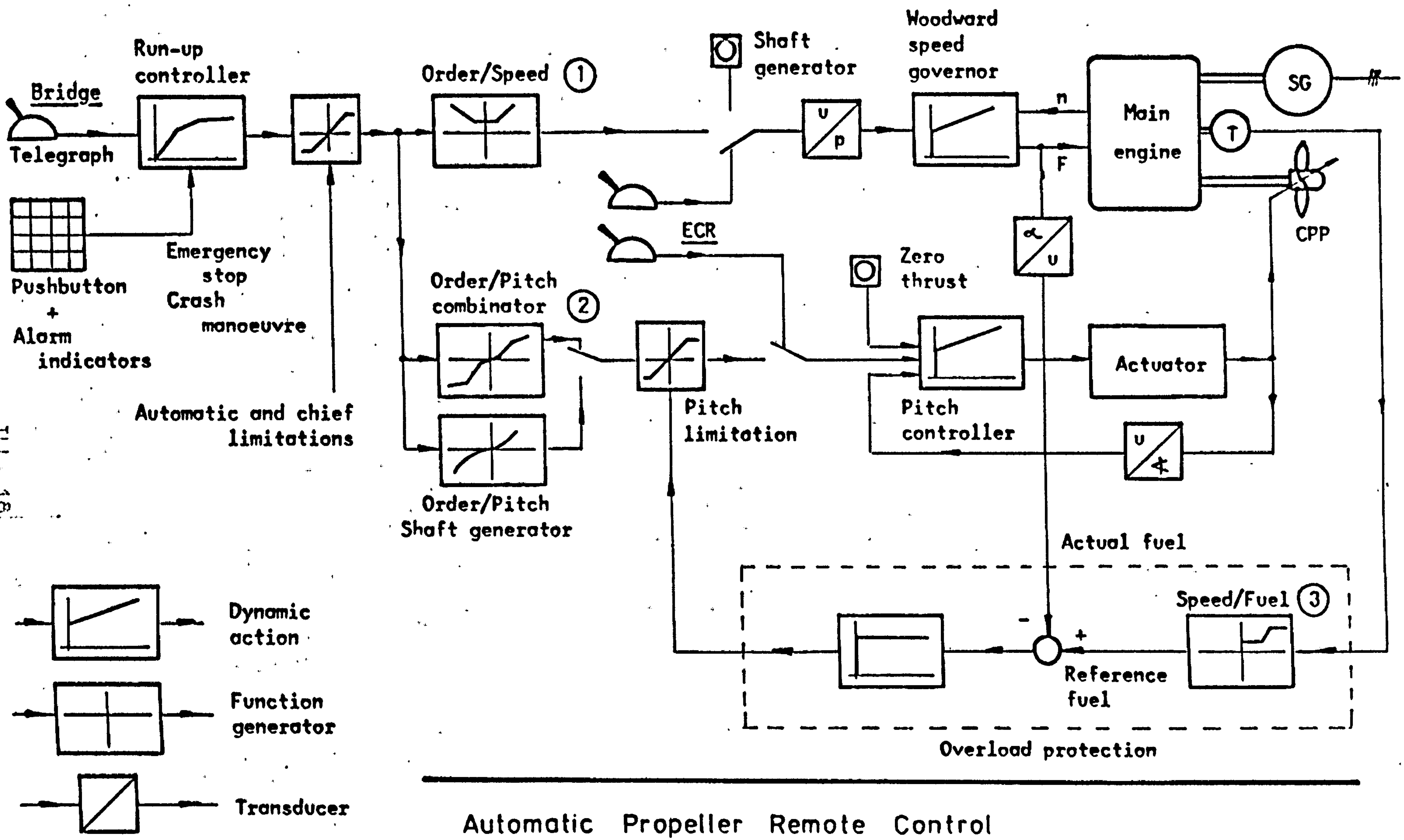


Electronic Main Engine Remote Control (MAN)

ILL. 17

Research Institute for Ship Operation Flensburg



Automatic Propeller Remote Control

ILL. 18

Availability of Diesel Propulsion System for Conventional and Reduced-Crew Vessel (FAULT TREE METHOD)

	Conventional vessel		Proposed reduced-crew vessel	
Propulsion plant (Sea going)	(34.1/0.62)	.99450	(19.6/0.35)	.99449
OR				
– Main engine	(13/0.67)	.998063	(13/0.54)	.997598
– Remote control device	(0.04/0.2)	.999980	(0.04/0.16)	.999975
– Auxiliaries	(21.1/0.59)	.996436	(6.52/0.21)	.996905
OR				
– FO system	(1.04/0.46)	.999774	(1.11/0.242)	.999542
– LO system	(1.45/0.32)	.999547	(0.78/0.18)	.999567
– Crosshead LO system	(0.0061/0.33)	.999998	(0.0061/0.23)	.999997
– Jacketcooling FW system	(0.76/0.50)	.999848	(0.34/0.17)	.999800
– Piston cooling FW system	(0.76/0.50	.999848	(0.50/0.18)	.999727
– FOV cooling system	(0.031/0.18)	.999983	(0.031/0.15)	.999979
– FW cooling system		-	(0.50/0.20)	.999745
– SW cooling system	(0.18/0.33)	.999945	(0.14/0.26)	.999946
– Air system	(0.134/0.27)	.999950	(0.134/0.20)	.999933
– Exh gas system	(0.05/0.2)	.999975	(0.05/0.16)	.999969
– Cyl oil system	(0.025/0.17)	.999985	(0.025/0.14)	.999982
– Shafting	(0.12/0.025)	.999520	(0.16/0.024)	.999334
– Starting air system	(0.0092/0.34)	.999997	(0.0092/0.27)	.999997
– Control air system	(0.51/0.40)	.999896		-
– Power supply system	(12.1/5.24)	.999769	(2.1/0.85)	.999752
– Steam, feed water system	(3.95/0.25)	.998422	(0.63/0.21)	.999684

Note : (λ/μ), Availability λ : Failure rate (10^{-4}) 1/hr

μ : Recovery rate 1/hr

SOURCE: REDUCED CREWS AND FUTURE SHIP SYSTEMS

BY: T. OTONARI

Availability of Electric Generator System

Availability of one generator set = 0.99453

(Failure rate = 11.0×10^{-4}/hr, Recovery rate = 0.2/hr)

		During sea going service	During full load
Generator with 100% capacity (one for standby)	2 sets	0.999970	0.999970
Generator with 50% capacity (two for standby at sea going service, and one for standby at full load)	3 sets	0.999999	0.999880

Effects of Land Service for Purifier System

(No maintenance and repair on board)

Failure rate for one purifier system = 4.0×10^{-4}/hr

Time between maintenance/ repair	2 sets installed		3 sets installed	
	Availa-bility	Probability of system failure times/yr	Availa-bility	Probability of system failure times/yr
1 voyage (750 hrs)	0.96306	0.442	0.99640	0.043
2 voyages (1500 hrs)	0.87809	0.731	0.97688	0.139
3 voyages (2250 hrs)	0.77248	0.910	0.93714	0.251

SOURCE: REDUCED CREWS AND FUTURE SHIP SYSTEMS

BY: T. OTONARY

ILL. 20

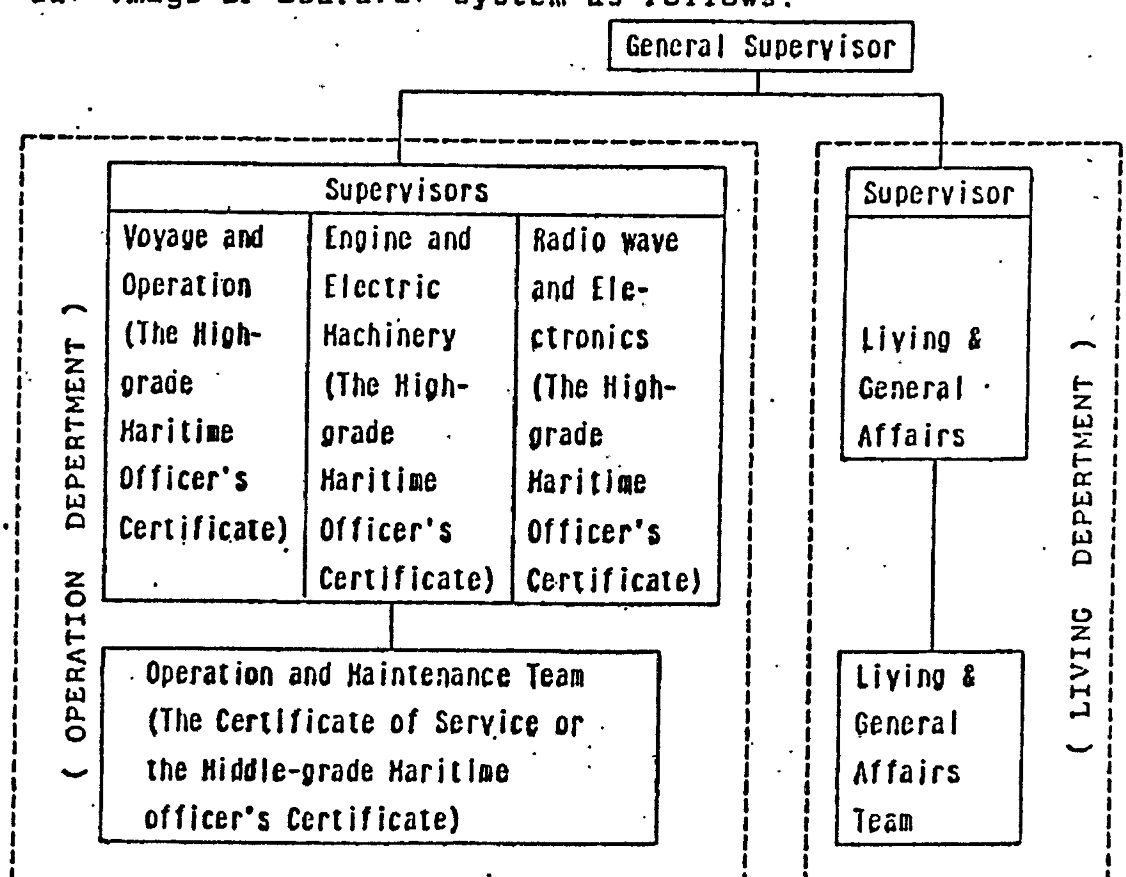
3.8 ON ORGANIZATION ON BOARD.

With the introduction of advanced technology, the work on board has changed considerably.The trend was to reduce the number of crew on board.

With the reduction of crew from over 80 in the early days of this century to about 20 - 18 as at the present stage the need to change the traditional organization on board in order to maintain the same efficiency was felt.

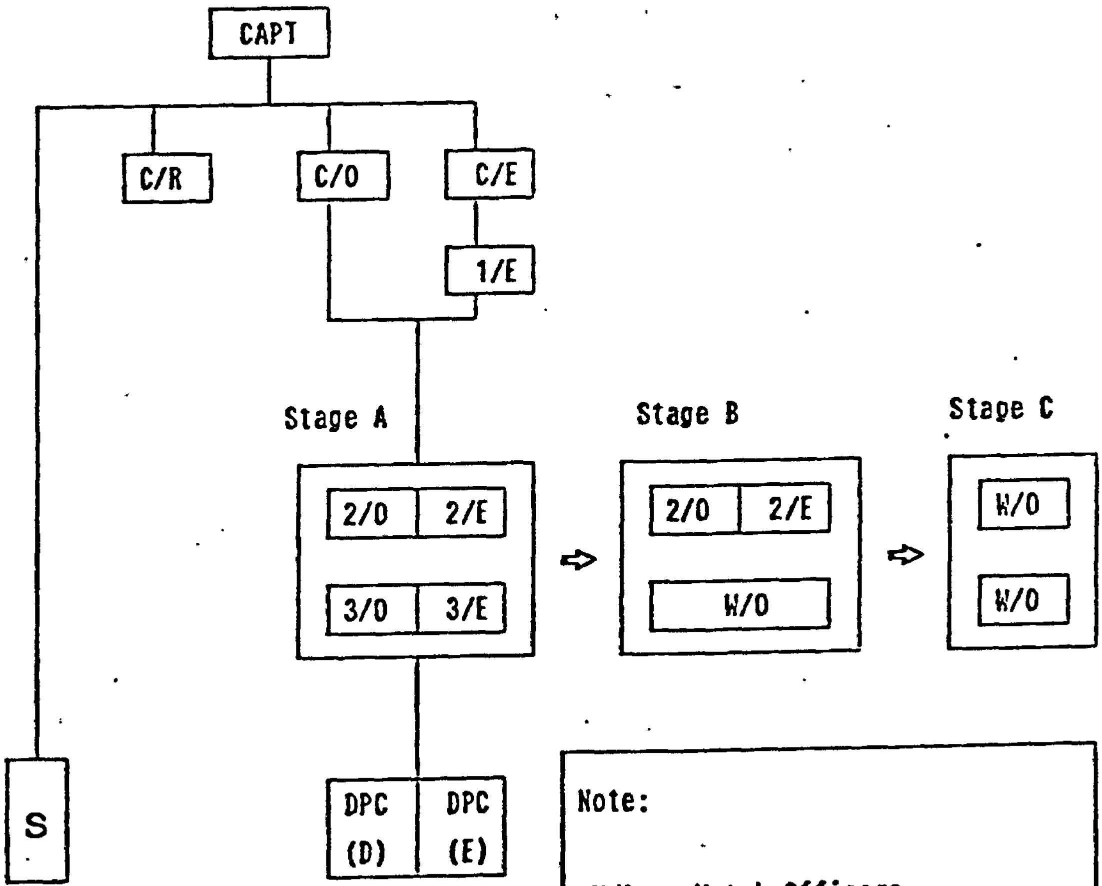
The Japanese Government and Ship owners association were first on conducting a study on this field which is followed by Norwegians and other European countries.

The Japanese study was initiated as early as April 1977 and in May of 1980 they prepared a hypothetical Image of Seafarer system as follows.



SOURCE /28/

A Hypothetical Image of Seafarer in a Transitional Process



Note:

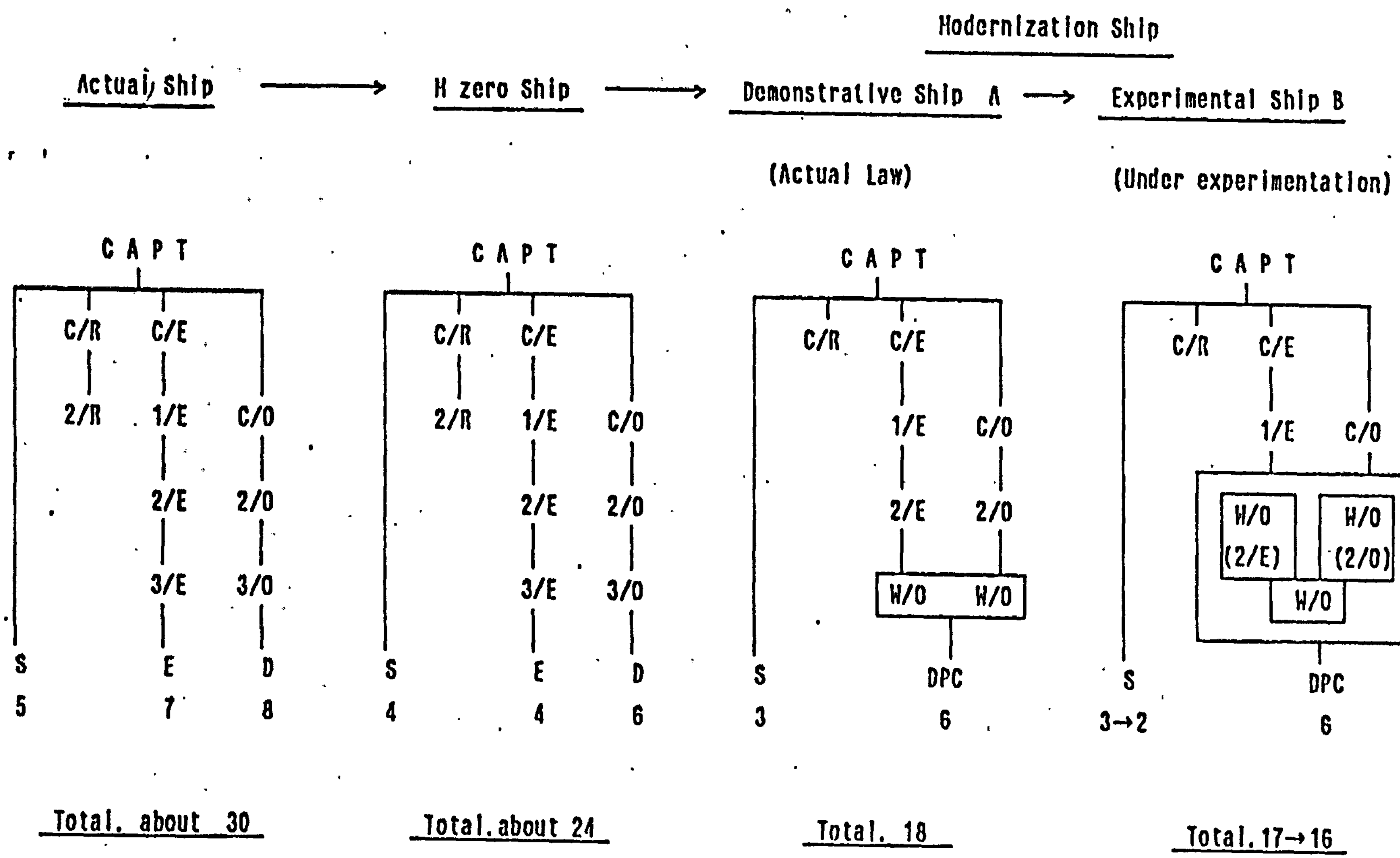
W/O: Watch Officers (provisional title) mean navigational and engineering officers after they acquired competency of watch keeping in both fields.

DPC: Dual Purpose Crews (provisional title) mean ratings having technical skills in both deck and engine departments in addition to their speciality.

ILL. 21

SOURCE /28/

TRANSITION OF MANNING SCALE



ILL. 22

SOURCE /28/

a) The General Supervisor

He corresponds to the present captain to the post of which supervisors of the operation department provided with experience , competancy and insight will promote.

b) The Supervisors of the Operation Department.

As techniques needed for the operation of vessels are divided in to some special fields , supervisors are selected from each of those fields as the experts in respective fields.(one from each field.)

c) The Operation and Maintenance Team.

This will serve under supervisors (a) and (b) to perform operation and maintenance of the vessel. The formation of the team needs not to be in the current vertical structure , and to provide flexibility in personal formation to meet various duties aboard the vessel.

As shown in the next page the transition will be made in three stages.
At stage A the deck crews and the engineering crews are replaced with dual purpose crews.
At stage B , both the Third officer and Third Engineer are replaced by watch officers.
Finally both the Second officer and Second engineer will be replaced.

At the present stage , a demonstration experiment is being conducted to extend the stage A experiment with 18 member crew to a still wider range of ship types ; and the stage B experiment is being promoted to carry the experiment a step further to manning by highly trained crews of 17 and 16 members. Stage C is to start by early 1987 & decided by then depending upon results of Stage A and B. /23/

The Japanese Government has set up guide lines as to the equipments which should be carried on these "Advanced Ships".
Page(35 to 37) will show these conditions.

REQUIREMENT OF " M ZERO SHIP ".

Following are to be fitted.

(01) Remote control of propulsion machinery and alarm devices for propulsion machinery and its direct auxiliaries , to be fitted on the navigation bridge.

(02) Automatic start system of stand by pumps of L.O. pump , F.O. supply pump and cooling water pump for propulsion machinery.

(03) Safe guard system of propulsion machinery for excessed revolution and loss of L.O. pressure.

(04) Automatic temperature control system of fuel oil , lub oil and cooling water for propulsion machinery.

(05) Automatic control system of electric generating and and distributing units.

(06) Safe guard system of electric generating units.

(07) Automatic temperature control system of lub oil and cooling water for electric generator's motor.

(08) Shielded fuel oil injecting pipe of main diesel engine.

(09) Automatic fire detecting devices in engine room.

(10) Alarm device for machinery in engine room , to be fitted in engineer's cabins.

EQUIPMENT OF EXPERIMENTAL SHIP.

(1) Stage A Ship

In addition to the requirement of "M ZERO SHIP" the following to be fitted.

(a) Remote control system of injecting pipe of fuel oil tank (except for the ship which is not necessary this system as situation of the pipe.)

(b) Remote controlled level gauge and high level alarm of fuel oil tanks (except for tanks are in engine room)

(c) Automatic data logging device of main propulsion machinary.

(d) Navigation by satellite system.

(e) Automatic steering system.

(f) Remote control device of mooring winches placed on bow and stern.

(g) Remote control system of liquid cargo handling on the ship carrying liquid cargo in bulk.

(h) Remote control system of ballast handling on the ship necessiated to adjust heel and/or trim by ballast water during cargo handling.

(i) Power driven devices of side port and ramp way for cargo handling , power driven steel hatch cower handling devices. (Pontoon type excluded)

(j) Maritime satellite communication system.

(2) Stage B Ship

In addition to stage A ship ,following are to be fitted.

(a) Central engine monitoring system on ship's bridge.
(b) Automatic radar plotting aids.
(c) Effective monitoring system of reefer container for container ship.
(d) Fire-wire winch and one-man hose crane or derrick for tanker.
(e) Automatic deck cleaning system for ore and coal bulker.

(3) Stage C Ship

In addition to the stage A and B ship equipments the following are required.

(a) Improved catering arrangements.
(b) Placement of monitors of essential equipment including monitoring of pollution on the bridge wings.

Collisions and the Circumstances

Several analyses show very clearly that by far the most important contributing factor to collisions is human fallibility. A glance at the 'Statistics of Casualties to Commercial Vessels' elaborated by the United States Coast Guard shows that personal faults contribute in up to 88 % of all collision cases.

Statistical Summary of Casualties to Commercial Vessels

1 October 1977 to 30 September 1978 Fiscal Year 1978	Collisions, crossing meeting and overtaking	Collisions while anchored, docking or undocking	Collisions, fog	Collisions with piers and bridges	Collisions, all others
Number of casualties	309	253	1	618	347
Number of vessels involved	834	688	2	1 244	585
Number of inspected vessels involved	230	186	1	356	174
Number of uninspected vessels involved	604	502	1	888	411
PRIMARY CAUSE					
Personnel fault:					
Pilots-State	16	18	...	30	5
Pilots Federal	5	2	...	20	2
Licensed officer-Documented seaman	140	118	1	369	118
Unlicensed-Undocumented persons	76	31	...	26	42
All others	16	19	...	32	12
Calculated risk					
Restricted manoeuvring room	1	1	...	2	5
Storms-adverse weather	6	8	...	30	22
Unusual currents	...	...	...	7	3
Sheer, suction, bank cushion	9	1	...	3	1
Depth of water less than expected	...	2	...	...	5
Failure of equipment	19	37	...	53	21
Unseaworthy-lack of maintenance	1	...	...	2	...
Floating debris-submerged object	1	...	...	9	76
Inadequate tug assistance	1	2	...	8	2
Fault on part of other vessel or person	566	437	1	642	244
Unknown-insufficient information	16	12	...	11	24

SOURCE: SHIP CASUALTIES – AN ANALYSIS OF CAUSES AND CIRCUMSTANCES:
BY. R. ROTHER

ILL. 23

3.9 CONCLUSION

As I mentioned earlier the adoption to new automation is time taking.To the old mariner nothing is better than the old system or own sense,and approval for any change has to go through old mariners who are in administrative positions. If unfortunately they are old fashioned the problem will be more difficult.

But one has to face reality. Automation makes life easier,economical to operate and we have achieved a standard where automation can substitute much of the work carried out by humans to a very high degree of reliability.The argument is that automation can fail.Well ,every human can fail.As shown in the illustration 23 we can see that most of the fatal accidents happened during the past few years, a high percentage is due to human failure.In automation the machinary will not get much fatigue due to overwork , personal problems, sea sickness nor get drunk like humans do.Automation needs proper care and little maintenance.

But it should be kept in mind , as automation leads to fewer people on board and human failure of one of the few has consequences reverse proportional to the number of personnel ; because the importance of decisions is higher, control over other humans is less, and correction capacity will also be less. When introducing automation and thus reduction of crew , the naval architects and owners should not forget the psychological strain the limited crew will suffer. This strain will be very critical specially the crews from eastern regions who are more accustomed to community life. Shorter voyage time , better recreational facilities ,better recruitment procedures, better facilities to contact families via telephones may ease this situation. To a successful bivalence of Deck and Engineering officers and crew the introduction of automation is vital.Otherwise they will not be able to handle the workload with a small crew. In other words introduction of automation on board may facilitate bivalence of crew.

In the developing countries it will take time to realise the importance of introducing latest technology in their shipping activities.So it will face stiff opposition if it is tried to introduce bivalence of officers in the immediate future.But these countries also should be prepared to introduce this system at the earliest opportunity.In my view it will take at least another 15 years before the degree of automation on shipboard operation of many of the developing countries will come to a standard which justify introduction of bivalence of Deck and Engineer officers.But 15 years is not too long for shipping and also taking in to account the fact it will take minimum of atleast 10 years to produce a competent master from a young recruit.

So these countries should start now to gain experience and try to retain them for their vessels.

Another point is in about 10 years time the "Technically Advanced Ships" of today which are designed for bivalently trained operators will be available in the second hand market,and if ship owners of the developing countries wish to operate them they should have ship crews who are trained to handled them efficiently.

It is my sugestion for the Developing countries to work on introduction of high technology in their shipping activities specially on shipboard operations and benifit from many advantages coming from it.

4 THE IMPACT OF MODERNISED MARITIME OPERATIONS ON EDUCATION AND TRAINING OF SHIPBOARD PERSONNEL.

4.1 INTRODUCTION.

What kind of tasks will these advanced vessels pose?. There will be a shift towards jobs of a more supervisory type , which under normal conditions do not require a very high degree of specialised technical training but , on the other hand , good knowledge of the system to enable the supervisor - the operator - to comprehend the significance of various test functions , and to manage switchovers in the event of breakdown or malfunction etc.

The worker himself must also be able to act as a supplementary part of the system as a whole.The maintenance situations in ships will be largely determined by factors such as trade ,type of vessel , cargo , service facilities in ports , regularity etc. A shift may be anticipated , however , from cost based maintainance to maintainance which is necessary to meet various safety requirements. Maintainance duties which remain in the ship will be necessary supplement to the possibly frequently monotonous work of routine monitoring.

Well trained staff need varied tasks , which are both meaningful and conductive to personal development.Work on board ship will therefore be characterized by intermittent maximum efforts on the part of the individual , interspersed with opportunities for quieter occupations. The job will be both meaningful and require individual development.

The new form of organization of ships will be based on teamwork.The present hierarchical structure with sharp distinction between various groups of personnel will disappear. So will also the concept of officers and crew. The kind of organization which at present known as " Partially self controlling groups " will , in a developed form , be the basis of future organisation : a development which also comprises concepts such as " Cockpit Organization etc ". The personnel will be offered training and development opportunities that will permit everyone who can meet the given requirements to advance to masters grade as a matter of course.Well developed relief systems will be one of the cornerstones of future recruitment and personnel policy in a system based upon a balance between work , leisure and training.

A very important factor in development is the future training pattern for sea going personnel.Education will probably be not merely a part of carrier process ,but also an end itself.In other words , the individual will regard education as attractive and personality developing , not merely in the context of his work but also for himself.The link with other branches of education offered by society will be distinct and logical. To train one's self for shipboard duties alone will be a thing in the past. A dynamic attitude to education will have replaced the more static orientation of the present day.

Many developed country ship owners' associations have prepared a plan with a view to changing the present form of organization involving vertical ability structure , to one featuring a wide horizontal ability structure. The transformation is motivated by the improved and extended shore organisation , the increase of automation on board and the reliability of system components.
It is intended that , parallel with the development towards the new organization ,the size of the crew will be gradually reduced. The new organization will also require new training. The changeover will be made in stages.The present crew is in excess of twenty , but progressive reduction will be made , first to twenty , then via 19 and 15 to the final aim , a crew of less than ten men?.The Norwegians are talking about six !.
This reduction will be commenced as soon as permitted by law and collective agreements./20/

4.1 THE JOB ANALYSIS OF CREW.

The characteristics of ship handling are very different between ocean passage and coastal navigation including manoeuvring in and out of harbours;usually the maximum number of crew are needed in case of manoeuvring in and out of harbours.On the other hand,in case of navigation in open sea,it is not unusual that only two or three men control her.
Mr.Thomas Mara carried out a comprehensive study of job analysis of sea fareres and following subchapter is prepared with the assistance of parts of his report which is supplemented by Mr.Une Shoji and Mr.Nomoto Kensaku.

4.1.1.NAVIGATION IN OPEN SEA.

a.Captain's Work.

Direct navigation work is about 10-15% in all working hour.It is mainly the position fix,weather checking and deciding the ship's course.The remaining majority of his task is management work,for example,management of ship operation,-Personnel management and miscellaneous clerical works.It seems that 50% of his work can be replaced by supporting team on land.

b.Work of Navigating Officer on Watch.

He is responsible for the safety of navigation and normally his main job is to keep watch.He should avoid a collision with other ships,for others in distress and maintain the given course and engine RPM.But they say,"we do not see any ship for several days in open sea,specially on the North Pacific route." Regarding in this case their main work is only to keep the course and maintaining the navigation equipments.Therefore,their work can be reduced if the position keeping system were automated.

In the event of an alarm on navigation,power plant or cargo system the watchkeeper must have sufficient knowledge and skills to respond appropriately.

His job analysis is as follows:

Handling wheel and maneuvering	1%
Identification of location of own vessel	10%
Lookout or watch	65%
Others-preparation of documents etc	remainder

/2/

c.Work of Helmsman.

He is a companion who shares the mental and manual problems of the navigation officer rather than his actual work that is to set the steering or autopilot as navigating officer tells him and act as lookout when necessary.If the engine control is put in the wheel house and the engineer on watch is located there,this function of the helmsman can be replaced by the engineer , provided that the engineer is trained to steer , which does not take much effort. Rules of the road do not require extra lookout during daytime in good visibility.

d.Works of Navigation Ratings.

His work is to check,inspect and to maintain the navigational equipments on day duty for safe navigation.As mean time between failures of most equipments(engine remote control console,radar, steering gear and etc) are now 2500-5500 hrs,- their work become less than the past and number of staff can be decreased.

e.Works of Engineers.

Engine reliability has been increased rapidly in recent years.According to promotion of the M-0 (M-Zero) ships,now it is not necessary to watch the engine on day and night(24 hrs).Moreover,- works of engineers on day duty differ from that in the past.That is,the maintaining work becomes just to check and inspect the machinary.Therefore,the works become small.

4.1.2.NAVIGATION IN COASTAL WATERS.

a.Captain's Work.

He has to keep the safe navigation all the time;keeping the ship from collision and maintaining accurate course and making the right decision.
Normally he is only required on the bridge in case of difficulties experienced by the officer on watch or approaching busy or critical areas. For this work he needs much information:other

ships' movements,buoys' position,radar informations,rpm, course informations and so on.In short,his main work is information processing and decision making.

b.Navigation Officer's Work.

He has to carry out duties mentioned in the above column when he is the sole officer on watch. When the captain or pilot is on the bridge he has to give information to captain or pilot. For this work he observes other ships' movements,-buoys' positions and gathers other information in various ways.Also he commands rpm and anchoring following captain's or pilot's order. Moreover,he plots movements of other vessels on the plotting charts and by monitoring the radar from time to time.

c.Helmsman's Work.

He has to keep the course and put the rudder as the captain or pilot tells him.It is manual control. Ships with adaptive auto pilots his actual work starts a short time before entering a port or leaving. Adaptive auto pilots can handle steering and alteration of courses better and more reliable than human handling.

d.Works of Navigating Ratings.

They must work at bow and stern as officers' assistants in addition to lookout duties when required.Especially,on manoeuvring in and out of harbour their work is very important.For these atleast 3 men are needed.

e.Works of Engineers.

They operate the machinary following the Captain's or Pilot's orders.In the mean time they monitors operation of other auxliary machinary. Especially , while "Stand by Engine",they must do various kinds of engine handling. 3-4 men are needed.

4.3 THE MOTIVES OF THE INTEGRATION OF SHIP CREW.

The development of technology has lead to considerable changes in shipping over the years.Therefore the field of activity of the crew on board changes as a result of efficient automation and improvement of reliability of the equipment on ships.The monitoring of engine room by modern control devices makes it possible to reduce the crew considerably.These developments lead to unmanned engine room and a reduction of the labour in the engine department.

On deck this development is not so evident,although modern hatchcovers,mooring winches, cranes,autopilots and modern navigational equipment in this department facilitate work.Furthermore we have to take in to consideration the development of such modern transport technologies which make lower demands on the crew; or transfer the supervision of cargo operations and handling to shore based management.This development results in the use of more and more technical devices by the crew.

A general view about the last 100 years shows, that more and more technical knowledge is necessary to operate a modern ship./1/

By going through statistics on collisions and groundings and other on board casualties (ILL 23) it is evident about 88% of the causes are due to human failure.If so, by reducing crew from on board service as far as possible and replacing with more reliable machinery we can expect a reduction of casualties due to human failure.Today asking for onboard reliability of 0.999 is reasonable. With the competition from the developing countries in the shipping field together with ever rising operational costs the ship owners in the developed countries naturally looks for ways of reducing operational costs.Capital costs and fuel costs are beyond any ship owners control.Developed country ship owners tried to take the advantage of advanced technology in which they are ahead of than developping countries.They tried to replace the man by machines which are more efficient and becomming more and more reliable.With the reduction of crew comes the problem of having to cope up with the following considerations.

- The safety at sea in critical situations.
- The occurance of peak strains at irregular intervals of labour in different department of the crew.

The solution is Dual Purpose Training.
It has been observed that with the improved reliability with the systems and equipment and by introducing systems such as EXPERT SYSTEM where a micro computer can be programed by experts in the field to assist/ instruct the crew to carry out necessary operations.In case the crew require expert advice to carry out an operation they have the expert advice by the touch of keys on the computer.There goes the requirement to have highly qualified engineers or deck officers on board to carry out operations where a intelligent person with broad knowledge on both aspects of the trade can perform satisfactory job as well as a highly qualified engineer or a deck officer.

It should be stated the whole aspect of ship board operation cannot be programmed for the automated or expert system. These blackholes should be identified and they should be picked up for special consideration for the training.
With the availability of advanced simulators which can simulate near real time situations. The time and money spent on training can be considerably reduced. In other words considerable part of the practical experience obtained by the old mariners by serving a few years on board vessels can be available to new trainees with few weeks of simulator training at a lesser time scale , cost and risk.

Nowadays operations on board are becoming more technical, the deck officers will require more technical knowledge. On the other hand engine operations are becoming more and more supervisory operations ,it is no more required for marine engineers to have very high technical knowledge. This way the distinction between two disciplines are diminishing.

With this bivalence a ship will have enough personel who are trained enough to cope with almost any situations to be expected on board.
With the bivalence comes the availability of officers rather than waiting for a navigator or a engineer as happens at present. This benefits both crew and ship owner.

In this competitive world of shipping the developped world shipping can stay ahead due to taking the advantage of high technology which gives them an efficient and low cost operation.

In the developing countries many people argue whether it is necessary to employ high technology in shipping operations due to the fact of having excess man power.

I would like to stress that the introduction of high technology does not substantially reduce man power requirment in a particular organization as a whole.It may be possible to shift man power requirment from one department to another department in the same organization.In shipping it may be possible to shift manpower requirement from the high cost ship board operation to low cost operation ashore.

Even in the developing countries though comparatively lower than the developed country operation the manning cost is a substaintial part of the operational cost.The fuel costs and capital costs are the same for every body.

So if the developing countries wish to remain alive in the shipping world it is important to employ modern technology in the shipping operations specially in the ship board operation.

With the introduction of high technology on board we require operators who are trained enough to operate this machinery.In all countries importance must be given to training officers and crew on the understanding and operation of high technological equipment. In the developing countries there is an excess of highly intelligent young people who are eager to make a carreer at sea.They should be encouraged.

Many developed countries who are active in the marine fields have found bivalence of ship crew takes care of many problems they can foresee in the manning of their vessels.It is obvious from the fact that countries like France , USA , Nethar-lands,Japan , England ,West Germany (crew only) , have introduced training of bivalent officers and crew and this concept is gaining acceptance and popularity.In France the bivalence is such popula-rity they are scrapping conventional training of navigators and engineers separately.Many other countries are waiting cautiously to inplement this system in their maritime training.

By discussing with various organizations involved in bivalently trained officers specially the French who has at least 11 years experience with bivalent-ly trained officers it was evident they are well received on vessels as well as ashore due to their broader knowledge,easy communication and flexibili-ty of employment.

Many institutions believe the bivalence will get wider acceptance by shipowners , specially by those who wish or obliged to operate their ships with high salary crews from developed countries.

ADVANTAGES AND DISADVANTAGES OF BIVALENCE.

ADVANTAGES :

(01). Better understanding of the ship as a total system.

(02). Better understanding between the disciplines on board.

(03). Basic technical skills will be held in all times by all officers.

(04). More flexible deployment of officers becoms possible.This will allow a reduction in the number of officers kept in reserve and a wider distribution of duties to reduce the likelihood of fatigue.

(05). Better understanding of the ship's working environment.

(06). Greater interest through wider variations in work content.

(07). Better skill fit with integrated ship system.

(08). Rational step for ships with new technology.

(09). Compatible with international convention STCW.

(10). National scheme does not inhibit use of personnel in single discipline by individual companies.

(11). Pending development of dual training the conversion of existing watch keepers to dual role is possible to a certain extent.

(12). Overcome some problems of mismatch with shore employment for deck officers.

DISADVANTAGES:

(01). Need for rationalization of depth of theoretical treatment for specialist subjects.

(02). Need for rationalization orextension of periods of practical training.

(03). Need to provide an onboard work regime to keep all skills active.

(04). One skill may lapse and need to be recertified if insufficient ships operate a dual certificate system.

(05). A national scheme requires collective agreement.

(06). Need to overcome some prejudices from existing traditional trained incumbents.

Generally speaking ,this practice seems a desirable development for the present advanced technology and high labour cost fleet, which is in tune with the need to operate modern technology to best advantage and reflects a growing view of questioning the necessity and desirability of the traditional strict demarcation between deck and engine against the trend towardsmodern high technology shipping./36-37/

4.4 INTEGRATION CONCEPT FOR RATINGS.

The integration concept for ratings is not new and is widely accepted in many shipping lines in the developed and developing countries alike.There also the wide use of automation in cargo and mooring operation has enabled highly specialised men to be replaced by broadly trained personnel.

Due to the same reasons as indicated in chapter 4-2 page (54) we require to have personal available for any emergency and peak labour incentive work.But having separate crew on both departments is a waste of manpower and is uneconomical.

Employing general purpose crew , greater understanding is required between deck and engine departments if any distinction is maintained.Ship management team should discuss the priorities and work accordingly in order to avoid conflicts.

It can be safely assumed wider use of general purpose crew will be seen in future ships.Many countries including developing countries have turned to training general purpose crew ; due to the demand by ship owners..

Countries currently training general purpose ratings are

Australia, Denmark, Netherlands,Soviet Union , Sri Lanka ,West Germany.

4.5 INTEGRATION CONCEPT FOR OFFICERS.

We have to consider that a bivalence is common also by ship's officers,so the navigating officers observe radio communication.On small ships The navigating officers hold the certificate of competancy as Mechanist and the technical officer fulfil the duty of an electrical engineer at the same time.

Nobody should expect bivalence to be a new quality,as an unexpected result of scientific revolution during the last decades.The new quality is merely, that these possibilities are also seen on big modern ships.

The origin of this development is based on the reliability of the further rationalisation and therefore also for reducing the crews.On ships equipped with a temporarily unmanned engine room, the number of the necessary crew is determined through the work required for maintainance and repair,the qualification of the crew men through the level of the work needed.In shore based industry the production on the basis of automated systems is more and more done by lower qualified personnel and chief engineer is required in major repairs only./1/.(Experience shows even at present, some of the chief engineers hardly go down to the engine room , unless in a case of emergency; and manages via readings received by engine log book and by telephone).

This concept can be applied in the onboard operation also where most of the work will be automated. One feature of bivalence is there will be no two departments of officers such as engine or deck.The same officer who perform 4 hours of bridge watch will perform 4 hours of engine watch keeping. In case of engine breakdown all the officers will be available for work except officer on bridge and vice versa.

This way we require only 6 watch keeping officers plus one Master who is also a bivalently trained officer.

Another approach is to maintain two departments as at present, but the officers will be bivalently trained officers and for example say this voyage one perform as a 2 nd engineer and next voyage he himself can perform as Chief officer, thus increasing the availability of officers rather than waiting for a navigating officer for the job or vice versa.

It should be accepted that bivalently trained officers will have a lower degree of specialised knowledge and his experience is more heterogeneous.

When the concept of integration of ships officers was first brought up, France which took up first in this concept experimented by trying to make Navigators out of engineers and engineers out of Navigators. This obviously failed due to the fact among other things mariners are stubborn by nature to accept a change , specially seasoned mariners.

Then they experimented catching them young and fresh. They took a batch of young men who were highly qualified in high school standard on the mathematics field and introduced to Navigation and Engineering field in the same time. This approach was well taken up by the students. Ship owners were highly satisfied with their ability and flexibility and they were communicating better than before.

One disadvantage the ship owners found out later was due to the above reasons they were well accepted on shore and most of these trained personnel were lost to shore based operations as superintendents and managers.Now the French are introducing lower standard in qualification in their C2NM certificate (for near continental trade) hoping to retain them at sea.

4.6 SHIP SHORE BIVALENCE.

By introducing more automation onboard we are hoping to transfer somr part of shipboard personnel to shore.

If we are to benefit from these personnel they should be trained more on the shore aspect of the operation such as ship business , maritime law , Organization and management of agencies etc.

In the past many of the maritime related operations such as operations-manager of shipping companies,-port authorities, stevedoring companies etc were carried out by retired mariners.Unfortunately they lacked knowledge about the shore part of the operations initially and learned them by mostly trial and error,costing shipowners a substaintial amount. Only a very few followed separate management courses prior to taking responsibilities. Another aspect is , although the contents in syllabus of Masters and Chief engineers were comparable to contents for BSc degree awarded by universities, upto recently the certificate of competancy lacked the official recognition by the educational authorities , resulting difficulties in finding a suitable job ashore when the mariners want to come ashore for good.This led to frustration in the mariners mind.

In general a seaman spends about 8 - 10 years at sea. Comparing it to the fact that a legal working time in most of the countries is from 35 - 40 years it means that the seaman are educated for only one fourth of their carrier.The task of marine education should therefore be not only to create a fully qualified seaman , capable of running the engine and guiding the ship , but to give him a possibility for a trouble free employment on land , but still in the shipping industry./22/

The argument is , can a single person learn all the subjects and still be a good seafarer.

My point is as I mentioned earlier with the advance of automation in the shipping industry , and teaching methods , we can pay less attention to some parts of the curriculums which does not require indepth study and concentrate on subjects which are considered important to todays standards.

If a person wants to specialise on a specific subject at a latter date he can always do as done today.But the point is all personal should be introduced to important aspects of maritime operations at the early stages of the education which will ensure better communication and thus smoother operations.

4.7 THE QUALITY OF THE THEORETICAL AND PRACTICAL TRAINING BY A BIVALENTLY TRAINED OFFICER.

I will place in front that in general it is possible to organize the training of marine officers in such a way that they are able to fulfil their duties in Navigation and in Engine operations too;there by the requirement of the IMO's convention on STCW can be taught for Navigating officers as well as Engineers.The question if so is, how far can we go?.Should we stop at watch keeping level and let them decide which discipline they want to specialize or can we carry on up to highest qualification ie to Master level.

The bivalence in the training of ship's officers who acquire a certificate as a Navigating officer and Technical officer too requires new considerations relating to the topics of education.

The optimum to be aimed at we find between the full training in both branches and the training in both branches as for the necessary minimum;which comply with the topics of the the International Convention on Standard of Training , Certification and Watchkeeping (1978).

By going through the syllabus of Navigating officers and Engineering officers it is evident at least 40% of the lessons are used for the basic training which is nearly the same for Navigating and Engineering officers.

The bivalent officer has to study the special topics of both , thus he has to accept an extension of theoritical education by 50% ie from 36 months to 54 months./1/. In another approach it may be possible to drop out selected topics from the syllabuses which can be reliably substituted due to the introduction of automation on board application and new teaching techniques.

For example in the past much of the navigation syllabus is reserved for training to refer tables, calculations , and plotting. But with the high entry standard , the students are better conversant with calculations etc. We can subsitute most of the time spent on teaching calculations for other important subjects and leave the calculations to computers which are so common nowadays.

Same applies to cargo work syllabus where most of the individual commodities are being phased out from the shipping scene in favour of containers and other specialised cargo vessels. Time spent on teaching carriage of individual commodities can be reduced to bare basic factors. In my view only the basic principles should be teached to students , and if a person comes across a difficult individual commodity he can always get the information by referance or from the shipper himself.

In the propulsion operation also for example much of the time spent on steam propulsion can be omitted due to the fact only very few steam propelled ships are available today. If a operator needs to work on a vessel with steam turbines such as cargo pumps on a tanker he can always follow a separate short course on steam propulsion as done today such as tanker operation course etc.

Unfortunately it is very difficult to quantitify the time which can be saved due to the fact this depends upon the amount of technology which the individual country administrations are wishing to introduce to their maritime operation & education. In my view all students should be given minimum and basic princilples in order for them to carry out their job satisfactorily and safely.Any special knowledge required due to the nature of individual ship or cargo being carried could be given to them by special short course which are becoming popular nowadays.

Due to the fact most of the vessels cargo of today and future will be of specialised nature it will be impossible to train a person for all type of vessels and cargoes. As I stated earlier only the principles should be given at the shore based maritime educational institutions and specialisation can be given as and when required.

Experience shows most of the theoritical knowledge we were given during our cadetship time were not used even after many years at sea. So why should the students be burdened with information which they are unlikely to use may be in their whole carreer.It is better to use that time to introduce the students to other aspects of maritime operations which will be useful to himself as well as to the whole industry.

This way we can train future seafarers in a horizontal hierarchy than in a vertical hierarchy who will be more useful for the industry. It is not my intension to say that most of what was taught to former recruits are useless. We may be able to drop out few topics which are outdated and few topics can be separated as a special additional course for those who will be needing them.

We should use new methods of teaching which a student can be given more knowledge at a shorter time such as audio visual, simulator and computer aided instructions.

Part of practical training can be substituted by shore based simulators where near real time situation can be simulated and the trainees can be given better understanding at a shorter time and at a lower cost.

As in the shore application of automation in the production technology, in the shipping also with the introduction of reliable automation and systems such as Expert systems on board which gives a lower qualified personnel access to highly technical information and trouble soothing approach and availability of instant communication with a shore based technical department where an expert engineer will be available or can contact directly even the manufacturer raises the question whether it is necessary to employ a highly paid expert for onboard operation.

Another approach is as in the aircraft industry the inclusion of redundancy on vital equipment makes it possible to have lower qualified personnel on board.This of course depends upon the economy of having redundancy versus the cost benefit obtained from lower manning scale.

Presently with the automation in production, and mass production the cost of most equipment is becoming cheaper where the cost of manning is ever rising.Also most of the equipment is required to have built in redundancy by various international

conventions.
Another aspect is with the improvement of technology comes the introduction of semiconducters in the machinery and today some of the electronic equipment have self diagnoise system where a less qualified personnel will be able to identify the faulty part of the machinery and replace it.It is hardly possible to repair a printed circuit onboard even with a highly qualified engineer onboard, without the aid of highly expensive fault diagnosise equipment which is uneconomical to install on board.
With these comes the question whether it is necessary to employ or train maritime officers to a high level in one discipline where their knowledge will not be put in to practice on board and same work can be carried out safely as before by a person with the aid of high technological equipment who is less qualified in one discipline , but broadly trained for both disciplines as a operator.

By introducing bivalently trained officers we are introducing personnel trained to perform shipboard operation on a vessel of a high degree of automation and at the same time to ensure there will be personnel available to cope with any emergency situation that can be foreseen.

At the same time it helps the shipowners to cut their expences in order to survive.

5. SELECTION OF EXISTING , PARTLY AND FULLY INTEGRATED MARITIME EDUCATION SYSTEMS.

INTRODUCTION.

In this chapter an attempt is made to look in to the maritime education and training of countries already experimenting on Dual Maritime Education for Ship Officers.

It was attempted to present the information in a standard form so an evaluation can be made much more easily.

It is expected to find a common apporoach to the implementation of dual purpose maritime education which can be used by both developed and developing countries alike.

It is understood West Germany who had been having Integrated Maritime Education for coastal trade will be extending this facility to foreign going class as well,commencing from the coming year.

5.1 THE INTEGRATED MARITIME EDUCATION IN NETHERLANDS.

The dual purpose education system started in the Netherlands as far back as 1976.
First of which where it offered students a two or three year course; depending on entrant's diploma level, after which sucessful candidates acquired an apprentice's certificate as deck officer (BS) or marine engineer (BM).
After one year service at sea apprentices returned to school for a limited period and applied for examination by the Government examination board inorder to obtain a watch keeping certificate as mate or marine engineer.Junior officers having obtained legally required seatime would exchange ship for school and further examination for higher certification.
In 1976 a one year follow up course introduced for interested apprentices , which can be considered as begining of dual purpose maritime officers in Netherlands.There students begin their carrier and first complete shore education in one discipline , and if wishing, follow the follow up course for dual purpose officers. At sea they should have 50/50 sea service on each discipline and should keep a diary.At the end of 18 months sea service they get both S3 and A certificates. After that they should choose their career for higher certificates. (From 1976 - 1981 , 95 dual purpose officers entered the Dutch merchant marine.)
This type of follow up course was continued during the period of change of the Nautical Education system from a two year course to a four year course which was fully implemented in Holland by 1982.The

third year of this four year course was spent at sea; a diary was kept by students which was reviewed by Ministry of Transport and the school.
Diary plus a succesful final examination at the end of the fourth year offered students a third mate's or an "A" certificate as engineer.
Officers acquired higher certification through sea time and no further examination was required other than a Radar Navigator course for applicants for a Masters certificate.
Due to syllabus enhancement of both 4 four year courses it proved impossible to squeeze required professional knowledge in to one year.Fortunately the sandwich system was , and still is in operation and successful examinees went through a six months course for third mate (S3) or marine engineer plus another 6 months spent at sea writing a thesis on the other discipline and applied for examination by the government examination board.Started in 1982 the courses have produced 165 dual purposes officers till date.
In the new system which was introduced as a experimental basis the students will have integrated maritime education for first 2 + 1 years and can choose which discipline to specialise in the fourth year.He gets a watch keeping certificate on both discipline plus HVE diploma.
He gets his higher certificates by completing required sea time and no further examination is required as for mono disciplined officers.
Presently all other types of courses are being systematically phased out and in a few years time only the dual purpose education is expected to survive in Netherland's maritime colleges./19/

5.1.1.ENTRANCE REQUIREMENTS:

Procession of at least H.A.V.O. leaving certificate- Should pass physical , eye sight , and oral tests for deck officers.

5.1.2.FROM BEGINING OF STUDIES TO MASTER MARINER.

Students are expected to gather knowledge , acquaintance and ability in a four year process , during which period all items of the job profile will be lectured supported by necessary theory at substantial level.
In order to amalgamate training of deck officers and marine engineers into that of the dual purpose officer , distinction were made between items which

- are part of the examination programme.
- are part of subjects lectured in the final year but do not necessarily have to be examined.
- are concluded at the end of the students year at sea.
- are concluded in first and second scholastic year.

A rough division of subjects over first and second year is as follows.

	1 st	2 nd
1. General subjects	15 %	10 %
2. Exact sciences	35 %	12 %
3. Professional subjects	18 %	26 %
4. Navigation/Seamanship	15 %	26 %
5. Marine engineering	17 %	26 %

The aim of the third year , which all students spend at sea is :

- to gain experience in ships' operations as it occurs on ship(s) he is on as a trainee. - to compare his theoritical knowledge with the daily practice aboard ship. - to support and supplement his theoritical knowledge with the daily practice aboard ship. - to prepare him for his future job as dual purpose officer.

This year of industrial experience has a very important double function.

a) in a very definite manner it is part of the tutorial process.

b) it offers the trainee the possibility to acquire sea time for future watch keeping certification.

The dual purpose officer should be employable within the total shipboard operation as a watchkeeping officer and for this reason major part of the trainee's shipboard service must be aimed at acquiring operational skills and it is of utmost importance that his attention is drawn to imminent occurences aboard ship irrespective if it be on deck, bridge , or in the engine room.
Frequently deck , bridge and engine room watches should be stood as a supernumary , preferably in maximum periods of a week,depending on special circumstances that may occur.

Due to the versality of ship's operations this will call for extreme involvement of trainee's shipboard mentor as well as other staff.

Competence and expertise of Dutch officers offers the ship side possibility to check activities and instructions to be carried out by the trainee.This can most effectively be done with the aid of a "Trainee's Work Book". Besides a check list of operational skills this work book will contain a limited number of items on which the trainee has to report to the institute.

Before begining of the fourth year trainee forward their work books to their school where it is reviewed by MOT and the institute.Should it be considered insufficient on a limited number of items concerning operational abilities ,after final examination extra sea time may be ordered.

In the fourth and final year of their study, specialisation is introduced so the students must make a choice between Navigation or Marine engineering for future highest certification , after legally required seatime (thus experience) and an updating course.

5.1.4.TIME TABLE FOR DUAL PURPOSE OFFICERS.(PER WK).

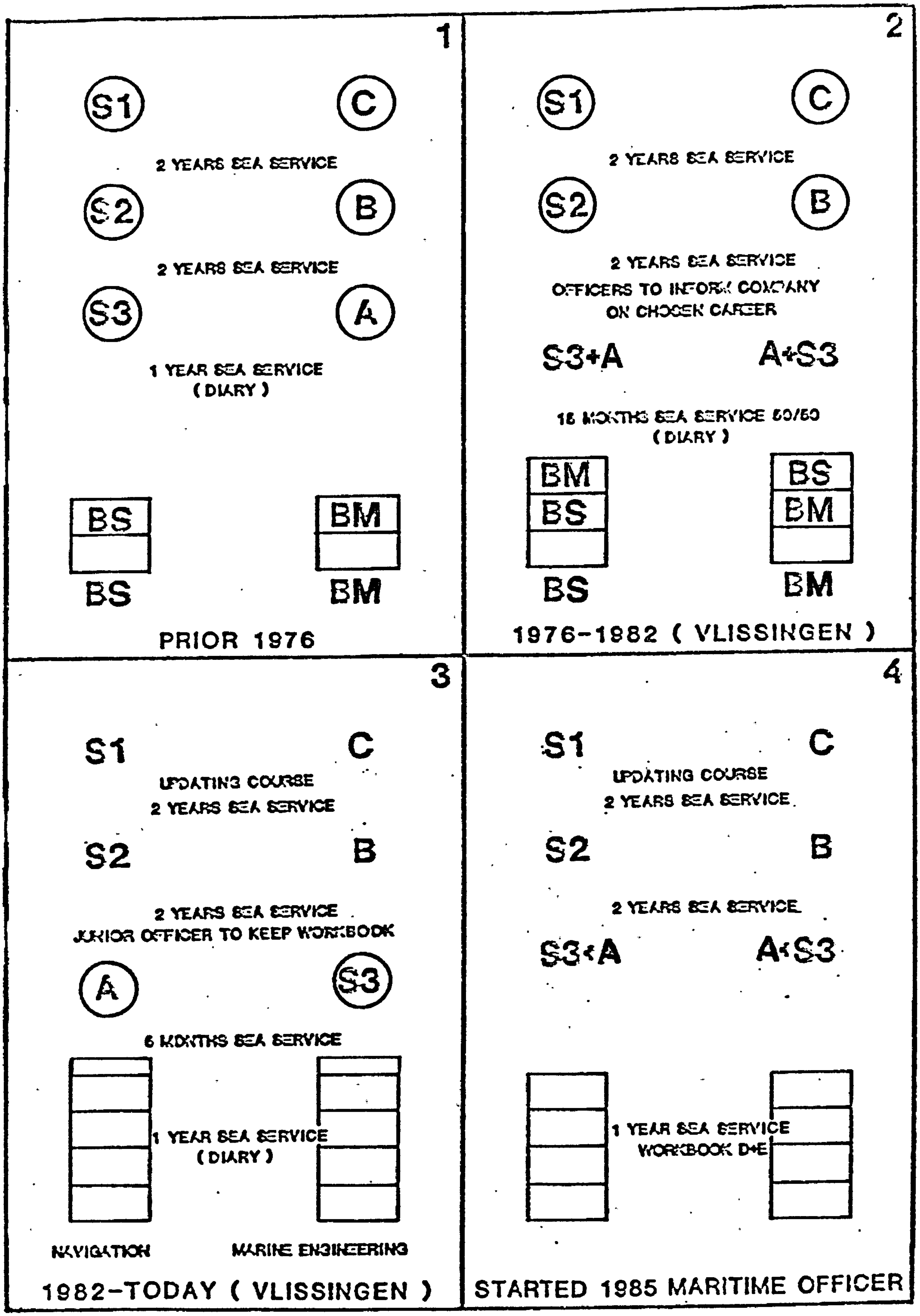
	1 st y.	2 nd y.
Dutch language	1	-
Engilish language	1	1
Shipmasters Business	1	-
Management	1	1
Pre sea and First aid	1	1
Mathematics	4	1
Physics	6	2
Computer science	2	1
Automation	3	3
Electrical engineering	2	4
Ship construction	1	1
Radio telephony	-	0.5
Manoeuvering		
Meteorology		
Practical exercises		
Navigation		
Navigational instruments & systems		
Passage planning		
Cargo handling		
Rules of the road	5	9
Practical engineering		
Workshop practice		
Propulsion systems		
Auxiliary systems	6	9
TOTAL	34 hrs	34 hrs

TIME TABLE FOR DUAL PURPOSE OFFICERS (PER WEEK)

FORTH YEAR.

Part 1	Nav	Mar Eng.
Health and First aid	1	1
Automation	2	2
Ship Construction	1	1
Manoeuvering	1	1
Meteorology , Oceanography	1	1
Practical work machinary and electrical Engineering	2	2
Part 2		
Navigation, Instruments & Systems.		
Passage Planning		
Cargo Handling		
Rules of the road	10	4
Propulsion Systems		
Auxilary systems		
Electrical engineering	4	10
Part 3		
Thesis	3	3
Additional Subjects	3	3
TOTAL	28	28 Hrs

EVOLUTION OF DUAL PURPOSE OFFICER EDUCATION



ILL. 24 SOURCE /19/

5.2. THE INTEGRATED MARITIME EDUCATION IN ENGLAND.

The dual purpose licensing of deck and engine officers is being tried as a experimental basis at the Plymouth Polytechnic under the auspices of Shell Tankers (UK) Ltd.

Here also the students are recruited from higher standard which is required for award of HND on Maritime Technology.

Their professional out come will be

Class 4 (Deck) certificate of competency

Class 4 (Engine) certificate of competency.

Also they will be exempted from part A of class 2 (engine) and section 1 of part B of class 2 (engine) certificate of competency.

After completing the course the students should choose their future career and proceed for their senior qualification as existing today.

Three maritime colleges other than Plymouth are offering an OND marine technology as a two year full time course commencing in September 1986 , and it is expected to recruit from this course on to HND marine technology from 1988 onwards.

The OND marine technology contains engine , deck and common studies.

The course structure of HND level is designed to obtain HND qualification within the 3.5 year time scale of the program.

5.2.1. ENTRANCE REQUIREMENTS.

GENERAL EDUCATION REQUIREMENTS.

- G.C.E. (O.L) credits in Mathematics , Physical science and English.
- G.C.E. (A.L) Minimum grade E in Mathematics or Physical science plus one more subject.

PHYSICAL AND PSYCHOLOGICAL REQUIREMENTS.

Minimum age 18+
Medical test for fitness ,eye sight , speech impediment and mental infirmity.

PRACTICAL REQUIREMENTS.

None.

5.2.2. SHORE BASED EDUCATION AND TRAINING.

Students will follow a pattern of,

- Academic studies in classroom and laboratory.
- Application in simulated industrial conditions in Workshops and Navigation Simulator.
- Observe study and practice at sea during the two sea phases.

This pattern will be followed in two stages.
Stage 1.

- One academic year of study during which time the students will develop the basic knowledge and skills needed for deck and engine operations.A period of sea service and workshop practice when the skills introduced in the first acadamic year will put in to practice and monitored by guided studies assesment and supervision of workshop activities.

Stage 2.

On return from sea there will be a 31 week period of acadamic study when students will develop the skills needed to be able to undertake supervised watchkeeping.A period of supervised watchkeeping at sea when the students will put their skills in to practice in a controlled environment.

After returning for a further two terms of study the students will complete studies for the HND and obtain professional qualifications.

Specific practical skill will be transferred on short courses ie Fire fighting, Sea Survival,First aid and Radio telephony.
Students will be motivated by having in view the prospect of applying skills during the sea and workshop phases.The student will observe work learned in college being applied at sea and will take part in operations at sea where processes taught in college are being put in to practice.
At the end of the course the student will have the task of obtaining first professional qualification to enable him to put knowledge in to practice.

CONTROLLED SEA SERVICE.

Students will go to sea for a period of 15 months over a period of approximately 18 calender months in two phases. During this period they will (1) Complete 220 hours of distance learning as part of the scheme. (2) Complete specified tasks as laid out in the Deck and Engine Cadet record books. (3) Undertake supervised deck and Engine watchkeeping.

NON CONTROLLED SEA SERVICE.

This will be as in the regular system where Master and Chief Engineer gives certificate for watch keeping.

5.2.3. ASSESSMENTS AND CERTIFICATION.

INTERNAL ASSESSMENT.

On completion of the first year of acadamic study the students will be required to have passed all the essential designated units before being recomended to proceed with dual purpose training.
Students who fail to pass all units during the first academic year will be considered for progress along a route leading to qualification in only one of the disiplines ie Deck or Engineering.
During the workshop and industrial experience phase,assignments will be required to be submitted in order to monitor the success of the student in carrying out the application of work done during the first academic year.The assignments will form part of the assesment of the appropriate units.
In order to obtain a HND in engineering (Marine Technology) the students will have to complete all the designed units during all phases of the course.Because of the nature of sea service it will not be possible to identify a sub group of units which would merit the award of HND by part time study.
The subjects which directly give exemption from certain engineering examination requirements of the Dept. of Transport will require written examination approved to a national standard. The final examination score will make a substantial contribution to the final marks.
It is understood the final examination for award of certificate of competency will be handled by the Polytechnic itself.

5.2.4. SYLLABUS

	Total			Hours
	1st	2nd	3rd	4th
		years		
Mathematics/Computing	72		36	
General studies	72			
Marine operations	36			
Marine transportation	36	60		
Coastal navigation	36	25		
Meteorology	36	30	29	72
Engineering drawing	108			
Applied heat	117		55	60
Applied mechanics	90			
Process and material	27			
Marine Engineering Principle	27			
Marine Operations		60	58	
Ocean and offshore navigation	36	25	29	48
Electronic principles			44	
Project			58	30
Naval Architecture			58	36
Electronic navigation system			58	60
Shipboard operations			29	72
Ship construction/stability			15	24
Coastal passage planning			29	48
Control Engineering				30
Marine electrotechnology	135			
Work shop	204	210	288	138
Total	828		534	504

5.3 THE INTEGRATED MARITIME EDUCATION IN FRANCE.

The maritime education is carried out almost exclusively in institutions and until recently on training ships operated by the central government or under the direct control of the state. It is provided free of cost to trainees and scholarships and study grants are also available. Shipowners contribute to the financing of training by means of annual apprenticeship assesment amounting to 0.4 percent of the aggregate salaries paid by all shipping companies per annum. in addition, certain ship owners provide scholarship to active seafareres enrolled in training courses.
Development of training schemes are carried out by a Commitee for Professional Maritime Training who makes recommendations with respect to the training conducted by the different training institutions, the training methods employed , the level of certificate, diplomas or certificates which they provide ,the examinations carried out ,the recruitment of administrative and teaching personnel and trainees, and all other padagogic questions relating to the training of all categories of seafareres. The comittee is composed of representatives of the government ,shipowners, seafareres, and certain persons specially qualified in maritime training./32-33/
The bivalent programme was introduced in 1966 but it was not widely accepted by the maritime community until 1974.Before 1966 the classes were conducted in the traditional monovalent way.

After the 1967 reform education was carried out in two levels.

LEVEL I : It is the highest level corresponding with the stream for Captains 1st class of the merchant navy;(C1NM); it's main characteristic is a dual formation for bridge and machines; the officers can either work on the bridge or in the engine room.

LEVEL II : The formation was given in two separate streams, either bridge or engine room, and from there they can reach the dual formation for bridge and machines. they are

Bridge Officer (OCQ)

Technical Officer (OT) and both can become Captain 2nd class of the merchant navy-(For vessels upto 8000 hp); and then have the dual function of bridge and engine room officer.

After 1974 the level II was dropped completely and only level I was conducted in all schools in France. At the end of 1986 about 800 dual purpose Capitaines de lere Classe de la Navigation Maritime have sucessfully completed the programme.

Again from October 1986 the restructured level II has been reintroduced to cater for bivalent officers of ships under 7500 GRT or 7500 KW. Their entrance requirements and course contents are somewhat lower than the Level I. In the following text only the Level I is discussed.

5.3.1 ENTRANCE REQUIREMENTS.

GENERAL EDUCATION REQUIREMENTS:

12 years of general education with an emphasis on Mathematics,physics and technical subjects.
Holders of Baccalaureats.
Entrance Examination.

PHYSICAL REQUIREMENTS:

General fitness in health.
eyesight requirements.
Minimum age 18 years.

PSYCHOLOGICAL REQUIREMENTS:

Nil

PRACTICAL REQUIREMENTS:

Nil

5.3.2 FROM BEGINING OF STUDIES TO MASTER MARINER:

Studies and shipboard service are sequenced as follows(main Stream):
First year of studies (30 weeks) and at least one month shipboard service.
Examination.
Second year of studies (30 weeks) and shipboard service which completes the shipboard service of the first year to four months.

Examination.

Third year of studies (30 weeks)

Major examination-Diploma a merchant cadet,(this is not a certificate of competancy).

10 months shipboard service as cadet.

Certificate of competancy as dual purpose watch officer(brevet d'Officier de la Marine Marchande).

10 months shipboard service as 4th and 3rd officer on deck or in the engine room including at least 3 months in each of the two departments.

4th year of studies (30 weeks).

Major examination for an diploma for higher studies of the merchant marine which entitles the holder to sail as chief mate or second engineer. (This is not a certificate of competancy).

The dual purpose certificate of competancy will be obtained after the effective seatime is completed to 5 years(of which at least 16 months each have to be spent on deck and in the engine). It entitles the holder to serve on ships of all sizes worldwide as master or Chief engineer. /33/

SHORE BASED EDUCATION;

The structure of the course is designed in a way so that students spend 30 weeks (from October to May) studying at the college and few weeks of shipboard studies for a year. 3 years will be spent mostly at shore based instituitions and the fourth and the fifth year has a practical bias and takes into consideration the shipboard experience of the students as watch officers.

The programme consists mainly of lectures and

laboratory work.
In general the study programme is demanding ,well organised and directed towards the requirements which ships with modern technology place on their operators.

CONTROLLED SEA SERVICE;

Each year the students are required to spent atleast 8 weeks of sea service in both disciplines

5.3.3 ASSESMENTS AND CERTIFICATION

The examinations consists of a practical ,a written and an oral parts. They are taken in this order.Practical and written examinations contribute by 28% each to the overall assesment, oral examinations by 44%. Candidates fail if they show an overall unsatisfactory performance, if they do not obtain any mark at all in a subject or if they fail in the International Regulations for the Prevention of Collisions at sea or in Maritime English.

The Practical examinations are held in and by the academies. They may differ from each other provided the available equipment in the EsNsMM does not allow equal treatment of all examinees. The examinations are held by the technical instructers of an academy and not by the professors.

The written and oral examinations are organized, supervised and marked under the control of the Inspectorate General for MET. The examinations are held in June, the written examinations nationwide on the same day at the same time for the same subjects and the oral examinations consecutively in each academy. Those who fail in June may repeat the examinations in September of the same year.

Time allocation per week

	1	2	3	4
	year			
Mathematics	4.50			
Electricity	1.50	2.00	1.50	1.50
Principles of navigation	1.50			
Navigation	4.00			1.25
Thermodynamics	4.00			
English	3.00	3.00	3.00	3.00
Law	1.00	0.75	1.00	
Maritime terminology/ROR/Signals	1.00		0.50	
Workshop technology	3.00			
Drawings	3.00	3.00		
Mechanical resistance of material		2.50		
Electronics		1.50	1.50	2.50
Fluid flow in machines		4.00		
Navigation calculation/chart work		4.00	2.25	
Ship construction		0.75	0.75	1.50
Automation		1.00	2.00	2.50
Machines			5.00	1.50
Manuovring			0.25	0.75
Ship operation			0.75	
Meteorologies			1.00	
Safety			1.50	
Formalities				1.00
Reporting				0.75
Case study				1.00
Radar simulator				1.50
Damage/accidents/safety				0.75
Maritime commerce				1.00
Accounts				1.50
Health				0.50
TOTAL THEORY	26.50	22.50	21.00	23.25
Electricity	1.00	1.50	3.00	1.50
Fuel technology	0.50			
Machine workshop	1.50			
Signals	0.30			
Navigation	0.30	1.00	1.00	
Machines		1.50	1.00	
Electronics		0.50	1.00	3.00
Automation		1.00	1.00	1.50
Steam			3.00	
Hygiene				0.30
TOTAL PRACTICAL	4.00	5.50	10.00	6.50
Knots	0.75			
Boat handling	1.00			
Safety	0.50			
Weekly average		6.50		
Conferences/field trips			1.00	2.00
TOTAL	2.25	6.50	1.00	2.00
GRAND TOTAL HOURS PER WEEK	32.75	34.50	32.00	31.75

ILL 25

Coefficiency given at examinations

ORAL

	1	2	3	4
	year			
Mathematics	6			
Electricity	3	4	3	3
Electronics		3	4	5
Principles of Navigation	2			
Nautical calculations	2	3		
Navigation	5	4	5	
Chart work	4	4	4	4
Thermodynamics	2			
Machines	6		6	6
Work shop	1			
Fuel technology	2			
Maritime terminology	3			
English	2	4	4	3
Law	3	3	3	
Seamanship / Safety	4			
Mechanical resistance of material		3		
Machine automation		6	4	5
Ship construction		3		3
Drawing	2	2		
Ship operation			4	2
Maneuvering / Safety			5	4
Rules of the road			3	
Meteorology			2	2
Hygiene				1
Economics / Politics				1
Commerce				2
Damage /Accidents & Safety				2
Radar simulator				4
Reporting				4
Hygiene				1
Automation			2	4
Work shop	3			
Machines	3	4		
Technology	1			
Electricity	3		5	3
Signals	2			
Documents /nautical instru.		3		
Project work		5		
Steam machines			5	
Electronics		4	3	4
Navigation			2	

WRITTEN

	1	2	3	4
Mathematics	5			
Electricity	5			
Principles of navigation	8			
Nautical calculations	5	5	5	
Thermodynamics	8			
English	5	5	5	6
Mechanical resistance of material		5		
Electricity / Electronics		8	8	8
Machine automation		9	10	8
Navigation		8		
Navigation & Theory of ship operation			8	
Reporting				12
Stability calculations				6
	100	100	100	100

5.4 THE INTEGRATED MARITIME EDUCATION IN JAPAN.

In Japan .the concept of Integrated Maritime Education is well established.Over 80% of Japanese ships are so called M-0 (Unmanned Engine Room) classed and majority of them are classed as Stage A and Stage B. From early 1987 Stage C ships are run on experimental basis. All these classes of vessels needs Integratedly Educated Officers and Ratings.Many Maritime Educational Establishments started training Integrated officers besides training mono disciplined officers.

In Japanese system only special ships are allowed to employ Marine Technical Officers (Integrated Officers) as watch keeping officers and are determined by the construction or equipment carried and navigational area.

To be a Marine Technical Officer first they have to be a Maritime Officer(Navigation) or Maritime Officer (Engineering) and they have to pass sucessfully the state examination for Marine Technical Officers and in addition they must have finished the training course respectively specified by the Ministry of Transport according to the applicants qualifications.

The permission granted could be limited to ship and trade area.

The Integrated education upto date is limited to 3 rd grade watch officer level.

.5.4.1. ENTRANCE REQUIREMENTS.

GENERAL EDUCATION REQUIREMENTS.

9 years of general education plus 3 years of high school education .with mathematics as subject. The admission requirement for Mercantile Marine Colleges are at the Junior high school level and admission for University of Mercantile Marine is Senior high school-

PHYSICAL AND PSYCHOLOGICAL REQUIREMENTS.

Adequate general health and fitness,physically and psychologically.
Eye sight and colour discriminating ability specified.

PRACTICAL REQUIREMENTS.

None.

5.4.2. SHORE BASED EDUCATION AND TRAINING.

Shore based education is conducted in Mercantile Marine Colleges and University of Mercantile Marine which has varing entry requirements. In the Mercantile Maritime Colleges whose entry level is junior high school , the length of shore based education is limited to 5 and half years which includes 12 months of on board training for nautical students and 9 month sea and 3 month workshop practice for engineering officers.
In the university level the admission is on the senior high school level and the duration of studies limited to 4 years of which one year reserved for practical training as before.

Special reeducation courses are available for those who wish to take Marine Technical Certificate and those who wish to take higher certificates.

CONTROLLED SEA SERVICE.

Sea service is carried out on board special training ships which are under motor and sail which is operated and controlled by the Institute for Sea Training under the supervision of Ministry of Education.
For Nautical students 12 months sea service is compulsory and for Engineering students 9 months sea training and 3 months on shipyard training required.

NON CONTROLLED SEA SERVICE.

5.4.3. ASSESSMENTS AND CERTIFICATION.

INTERNAL ASSESSMENT.

Evaluation on every teaching module, having specified number of credits required for graduation.

EXTERNAL ASSESSMENT.

After finishing school, graduates are entitled to sit on National Examination for sea going certificates. If they pass the examination the certificates come in to force after a specified number of years of experience at sea. Those who have graduated from a Mercantile Marine College or University of Mercantile Marine are exempted from written examination for Third Grade Maritime Officers(Nautical or Engineering).
For those who want to be Marine Technical Officers must sucessfully pass the state examination for Marine Technical Officers./34-35/

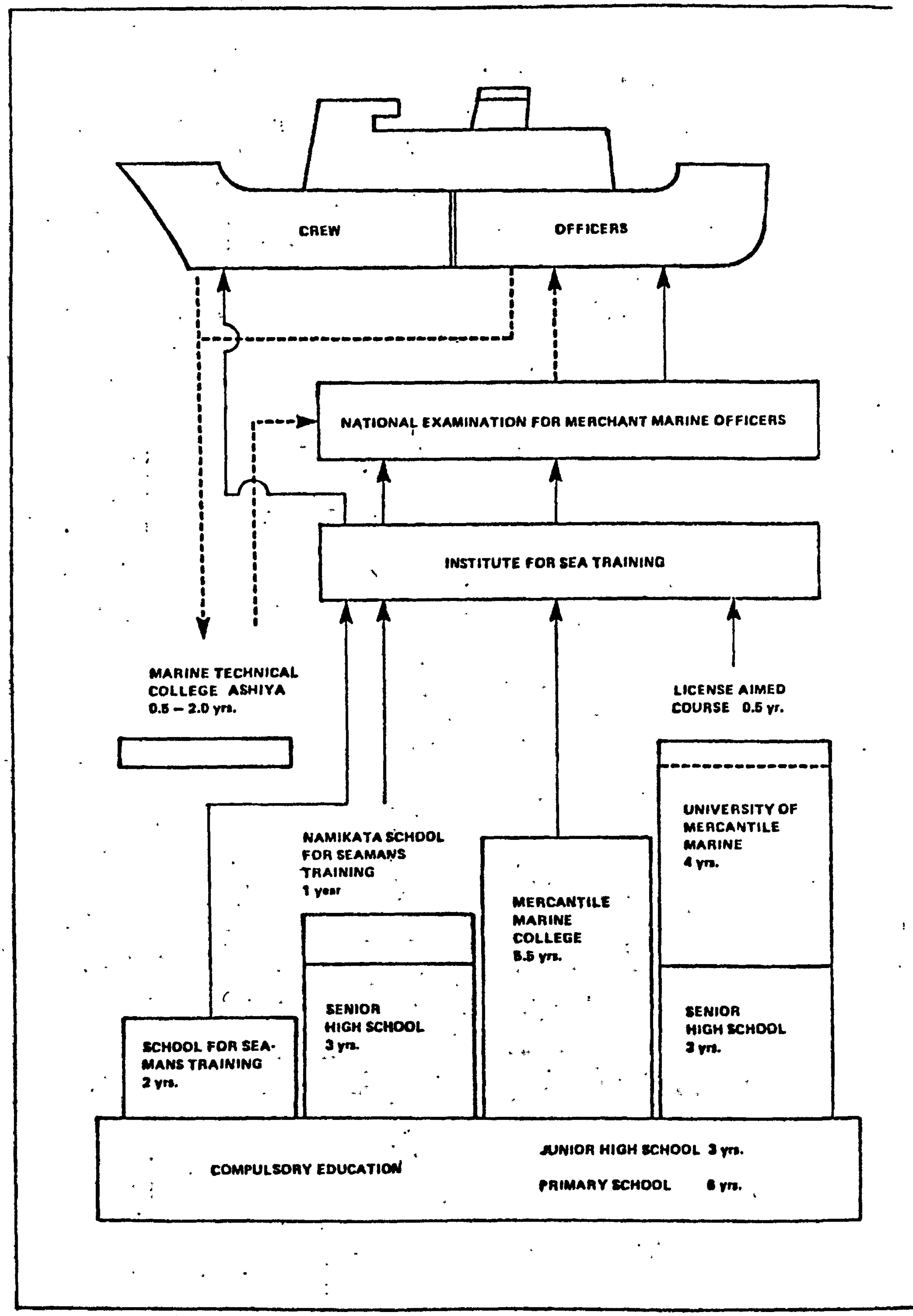
UNIVERSITY OF MERCANTILE MARINE AND MARINE TECHNICAL COLLEGE							
NAVIGATION DEPARTMENT				ENGINEERING DEPARTMENT			
SPECIALISED COURSE		ENGINEERING COURSE		SPECIALISED COURSE		ENGINEERING COURSE	
SUBJECT	ITEM	SUBJECT	ITEM	SUBJECT	ITEM	SUBJECT	ITEM
Watchkeeping	At sea In Port	Watchkeeping	At sea In Port	Watchkeeping	At sea In Port	Watchkeeping	At sea In Port
Navigation	Nav. Planning Coastal Nav. Celest. Nav. Elect. Nav. Bridge Equip.	Operation	Eng. Equip. Engine Control (Harbour) Engineroom Emergencies	Operation	Same as Nav. Dept.	Navigation	Coa[illegible] Nav Cel[illegible] Nav Elect. Nav. Bridge Equ[illegible]
Seamanship	Ship Handling (Harbour, Channel, general unusual ships) Meteorology & Oceanography Maintenance	Inspection & Maintenance	Maintenance Monitoring	Inspection & Maintenance	Maintenance Monitoring Machinery Diagnosis & Rectification	Seamanship	Sam[illegible] Nav. Dept.
Business & Law	Ship Casualty Prevention Damage Control Documents & Reports Wireless for Deck Officers Cargo Operations	Management & Law	Nav. Planning Fuel & Lub-oil Systems Documentation for Engineers	Management & Law	Nav. Planning Fuel & Lub-oil Systems Documentation for Engineers Fitting	Business & Law	Same as Nav. Dept
Shipboard Operation	Emergency Stns. Ship Administration Safety & Sanitation			Shipboard Operation	Same as Nav. Dept.		

Length of Period of Practical Training, Number of Hours for each course, Level of each course will be determined by GRADE of LICENSE.

SCHOOL FOR SEAMEN'S TRAINING	
BASIC TRAINING COURSE	
HOME TRADE OFFICERS COURSE	INDUCTION COURSE
SUBJECT	SUBJECT
Working knowledge for Deck Officer Working knowledge for Engineer Officer Basic Ship-board Operation	General Ship Knowledge

ILL 27 SOURCE /35/

DIAGRAM OF NATIONAL INSTITUTE FOR MERCHANT MARINE EDUCATION SYSTEM



ILL 28 SOURCE /35/

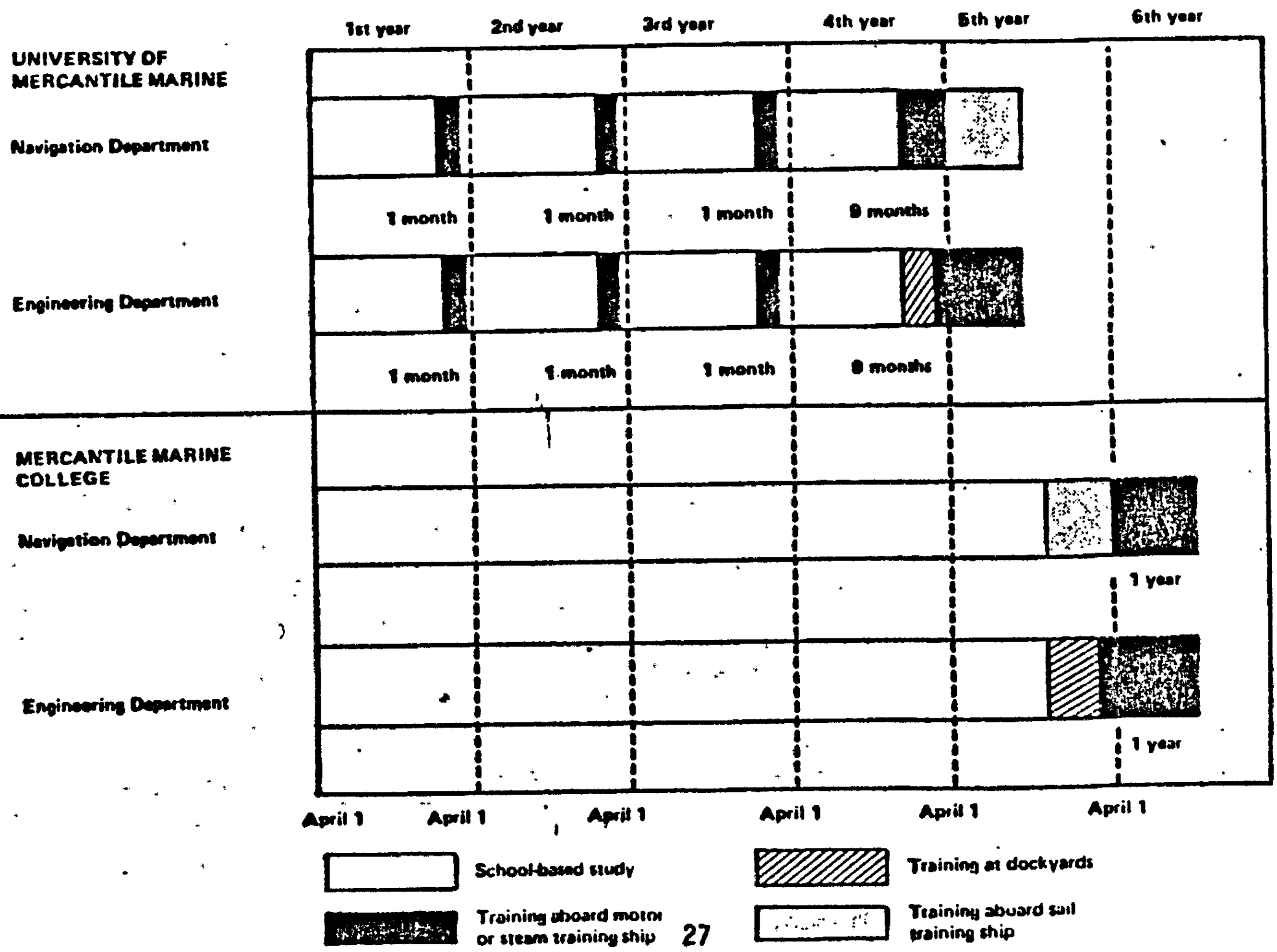
TRAINING TERMS (NATIONAL INSTITUTE FOR SEA TRAINING)

UNIVERSITY OF MERCANTILE MARINE (4.5 years)		
	NAVIGATION DEPARTMENT	ENGINEERING DEPARTMENT
GRADES 1, 2, 3	Each 1 month	Each 1 month
GRADE 4 LICENSE AIMED COURSE	* 9 months	** 6 months
TOTAL	1 year	9 months

MERCANTILE MARINE TECHNICAL COLLEGE (5.5 years)		
	NAVIGATION DEPARTMENT	ENGINEERING DEPARTMENT
GRADES 5 – 6	* 1 year	** 9 months

* Containing the ocean training voyage aboard sail training ship
** Containing the ocean training voyage aboard motor or steam training ship

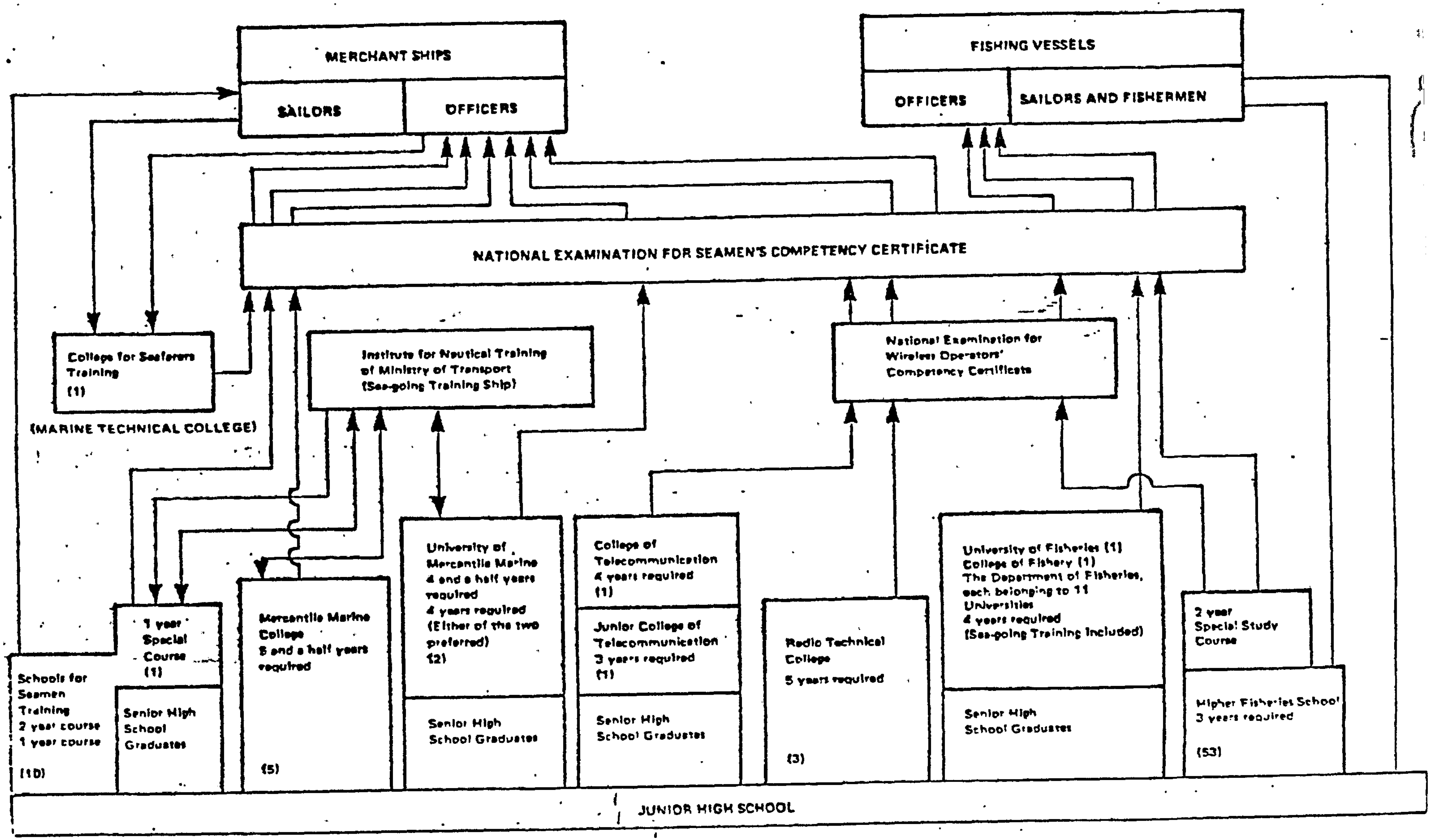
SCHOOL FOR SEAMENS TRAINING	
BASIC TRAINING COURSE	
INDUCTION COURSE	HOME TRADE OFFICER COURSE
10 days	1 month



ILL 29 SOURCE /35/

SEAMEN'S EDUCATIONAL SYSTEM OF JAPAN

NATIONAL AND PUBLIC



ILL 30 SOURCE /35/

5.5 THE INTEGRATED MARITIME EDUCATION IN U.S.A

The integrated or dual license scheme started in U.S.A. many years back and had been producing many dual licensed officers until now.

This training of dual purpose officers is done beside training of mono disciplined officers.

In the dual purpose training only personnel who have highest marks at the entrance examination ie SAT or ACT will be eligible to follow and at the end of first year if their ability to continue in the dual license is not satisfactory they are required to join any of the mono disciplined courses.

It is observed these students have to be prepared for both the coast guard examinations for third deck officer as well as third assistance engineer. Their curriculum is different from that of mono-disciplined officers but other activities remains the same including the coast guard examinations.

They have to write papers for Third deck officer and Third assistant engineer exams conducted by Coast Guard.

It is attempted to give them the contents of most of the Engineers syllabus and contents suitable enough for watchkeeper level on deck syllabus. In other words they are basically marine engineers with an introduction to deck watch keeping.

Due to this reason (in my view) most of the trainees have chosen engineering subjects for future career.

Their failure rate has been very low compared to other disciplines.(may be due to higher entry standard)

5.5.1. ENTRANCE REQUIREMENTS.

GENERAL EDUCATION REQUIREMENTS.

Must have passed minimum high school graduation with 16 units of credits.

Also should have passed the following subjets at the time of graduation.

English	4	units
Elementary algebra	1	unit
Plane Geometry	1	unit
Plane trigonometry	1/2	unit
Intermediate algebra	1/2	unit
Physics or Chemistry	1	unit

Should submit results of Scholastic Aptitude Test (SAT) or

American College Test (ACT).

PHYSICAL AND PSYCHOLOGICAL REQUIREMENTS.

Medical test for fitness , eye sight etc.

Age between 17 - 25 .

PRACTICAL REQUIREMENTS.

None

5.5.2. SHORE BASED EDUCATION AND TRAINING.

Between periods of shipboard training during the sophomore and junior years , each midshipman returns to the academy and continues academic work in his or her chosen field. Each major has a core curriculum consisting of appropriate professional technical courses in nautical science or engineering and common courses in the science , humanities and management areas. The dual license core contain courses in both nautical science and engineering.

A midshipman's senior year is devoted primarily to completion of intensive study in the major , his or her elective and preparation for the written examinations , administrated by the United States Coast Guard ; which leads to licensing as a Third Mate and Third Assistant Engineer.

CONTROLLED SEA SERVICE.

As part of the professional training , each midshipman participates in a corporative educational program consisting of two quarters of the sophomore year and two quarters of junior years at sea (approximately five months for each sailing period) aboard commercially operated merchant ships. Every effort is made to assign midshipmen to several different vessels during their two periods of training. They there by become familiar with the performance and operating characteristics of various classes of ships and with the diverse operating requirements of different trade routes while at the same time gaining valuable practical performance of shipboard duties.

The shipboard training program provides all midshipmen with the opportunity to use a ship as a seagoing laboratory. Midshipmen are given a study guide called a "Sea Project" and , in addition to performing shipboard duties , are required to complete written assignments which are submitted to the academy for evaluation and grading. The assignments are carefully designed to ensure that, while aboard ship , midshipmen apply the knowledge and skills learned in the academy classrooms and acquire a firm foundation for advanced study upon their return to the academy.

Aboard ship, Marine transportation majors are assigned to the deck department and Engineering majors to the engine department, and Sea Project assignments concentrate on subject matter appropriate to the midshipman's speciality. How ever , during the first period of training , deck and Engineering majors are requied to complete assignments in the opposite department to ensure basic familiarity with all aspect of ship operation. Dual license majors spend half of their time at sea in each department , and their study program is designed to ensure intensive experience in both specialities.

Should a student , prior to the second sailing period ,acquire a definitive maritime career goal, a program of specialisation can be arranged that will provide special opportunities for experience in the last sea period. Through counselling, the department of Shipboard training can assure the student of assignments that will provide maximum exposure in the desired area of specialisation

during this cooperative program.
During the second sailing period a midshipman may select a 30 day sailing period aboard U.S. Navy ships.

The sea year is concluded with a two week internship assignment ashore for internship training in a maritime related activity. Depending upon a midshipma's field of speciality and individual interest , he or she may be assigned to a steamship company , shipyard , shiprepair facility , ship brokerage/chartering firm, stevedoring firm, surveyors office, towing company , port and terminal facility or some similar enterprise. Each midshipman is required to complete a written report on these experiences, which is submitted to designated ATR for evaluation and grading.
Midshipmen receive credit for courses and reports completed as part of their shipboard training and internship during the sophomore and junior years.
Academy training represntives in New York , New Orleans and San Fransisco assign midshipmen to ships , monitor and guide their progress , and maintain liaison between the midshipmen , the steamship companies ,and the Academy's office of shipboard training.Fitness reports and progress reports are submitted at frequent intervals.

NON CONTROLLED SEA SERVICE.

After obtaining dual certificates as Third mate and Third assistant Engineer they are required to select which discpline to carry on and serve appropriate sea service.

5.6.3. ASSESSMENTS AND CERTIFICATION.

INTERNAL ASSESSMENT.

In addition to completing the required core carriculum in Marine Transportation and Marine Engineering , every midshipman is also required to complete a specific number of elective courses. The marine transportation and marine engineering major must complete 18 quarter credit hours of electives.Dual license and marine engineering systems majors are not required to complete an elective program since these carriculums are elective.

To meet the elective requirements, midshipmen may choose any elective course for which they have the prerequisites, or they may complete a prescribed sequence of courses leading to a concentration in a specific academic discipline.

EXTERNAL ASSESSMENT.

This is carried out by the U.S. Coast guard marine department in way of examinations prior to granting licenses.

5.5.4 SYLLABUS.

	QUARTER CREDIT HOURS		
	SOPHOMORE	JUNIOR	SENIOR
		YEARS	
Metal joining process	0.75	-	-
Introduction to computer	3.00	-	-
Engineering mechanics	7.00	-	-
Thermodynamics	3.00	7.50	-
Business/maritime law	5.00	-	-
Economics	6.00	-	-
Mathematics	4.00	-	-
Physics	7.00	-	-
Naval weapon system	3.00	-	-
Physical education	1.00	1.00	2.00
Marine electronics	-	3.00	6.00
Marine material handling	-	3.00	-
Seamanship	-	2.00	3.00
Meteorology	-	4.00	-
Strength of material	-	4.50	-
Navigation	-	4.00	2.00
Naval architecture	-	3.00	-
Fluid mechanics	-	3.50	-
Electricity	-	7.50	3.75
Marine refrigeration	-	-	3.75
Marine engineering	-	-	13.25
Internal combustion engine	-	-	7.50
History	-	-	9.00
Humanities	-	-	3.00
Marine transportation	-	-	3.00
Managerial process	-	-	3.00
Marine insurance	-	-	3.00
Marine safety	-	-	3.00
Communication	-	-	1.00
Bridge simulation	-	-	3.00
Naval operations	-	-	6.00

6. A PROPOSAL FOR AN OUTLINE OF A INTEGRATED MARITIME EDUCATION SYSTEM.

6.1. INTRODUCTION.

In this chapter an attempt will be made to discuss the key issues in a Integrated Maritime Education system which could be valid for any country in a general way.It should be made clear this is only a framework of a system and it should be tailored to suit any individual country.

It is my proposal to limit the extent of Integrated Maritime Education to the watchkeeping officer level,for the time being due to the fact most of the vessels which are at sea are not so called, "Technically Advanced ships" and the concept of Integrated Maritime Education solely depending on the level of automation introduced to ships.The level of automation which can be expected on ships world wide in the next ten years will justify in my view, only to the level of watchkeeping officer. But for countries which has more percentage of "Technically Advanced Ships" which justify higher levels of Integration they should consider going to higher levels. Authour proposal is prepared by analysing all Integrated Maritime Education systems which are presently conducted by countries described in the earlier chapter and edited to suit a global way in general. In authour proposal the authour is am describing a system which is based on a 3 year term with 2 year shore based academic training and 1 year of controlled shipboard training.

6.1.1. ENTRANCE REQUIREMENTS.

GENERAL EDUCATION REQUIREMENTS.

Since the work load of future Integrated Maritime Officers curriculum load will be more scientific , and technical it is felt the recruits should have a high educational standard at the entrance level with mathematics as subjects. Also since the trend is to integrate the maritime education with the National Higher Education System , the entrance requirement should be comparable with entrance qualification requirements of the National Higher Education System. By going through entrance requirements of many maritime education systems it is felt at least 12 years of general education in the science media with special emphasis on mathematics and physics should be minimum entrance requirements.

6.1.2. PHYSICAL AND PSYCHOLOGICAL REQUIREMENTS.

PHYSICAL REQUIREMENTS.

It is unnecessary to point out the importance of medical fitness for a seafaring career. Some countries have been imposing very high military standards for merchant navy. But in my view in the days of high technology in communication ,it is no longer very important to have very high medical standards. Of course they should have general medical fitness which enables them to discharge their duties effectively.

Specially regarding eye sight in view of the advancement of optic techniques the strict rules could be relaxed to include wearing of optical aids.

PSYCHOLOGICAL REQUIREMENTS.

With the reduction of the size of crew and time spent in harbour the sea life is no longer romantic or adventurous as in the past. Job satisfaction will be less than before due to the fact most of the work will be done for him by the equipments and major part of his job will be to read the information from the instruments and to interpret intelegentlly.

The new crews who will be manning the future ships should be able to withstand more emotional stresses and isolated conditions.

The new recruits should be screened by a psychologist/psychiatrist for his stress resistance and mental stability prior to entrance.

6.1.3. PRACTICAL REQUIREMENTS.

By going through many maritime education systems it is observed presently only very few countries emphasize the requirement of practical sea experience prior to recruitement for shore based maritime education.

In view of higher educational requirements at the entrance level it will be difficult to get recruits to go to sea prior to start of college education.

In my view also it is not important to have practical experience for entrants. The practical experience can be given in between studies during the college vacation.

6.2.1. SHORE BASED EDUCATION AND TRAINING.

This part of student's career should be carefully planned to get the best use of facilities available and as well as to make the product ie the future maritime officers will be useful for the industry.

It should be mentioned here only about 40-50% of knowledge can be given to a maritime officer at the shore based education institute and the rest will be acquired by practical work on board.So the basis of the shore based education should be to help the maritime officer to acquire the practical knowledge during his shipboard career.

It should be made clear that the aim of this course is to teach the basic principles of many aspects of shipboard operations , and teach in detail, on selected subjects which are important for safe execution of bivalent shipboard operations.The out put will neither be Marine Engineers nor Navigators in the present sense , but they will be " Maritime Operators " who are a specialised breed.The first year of the college time should be used for developing basic knowledge and skills needed for safe execution of deck and engine room operations.It should be mentioned ,although future ships will have much technically advanced equipment it should not be the policy to forget basic principles of seamanship and work shop practice.

This time should be used to give maximum exposure to basic theoritcal aspect of safety on board and safe handling of equipment on board.

In order to encourage team work as well as to keep fitness physical education training should be encouraged.
Second half of shorebased training should be used to teach basic fundementals of professional subjects such as Navigation, Cargo work, Meteorology, Marine engineering.

The academic studies should be aimed at developing skills needed to be able to understand the basics of watchkeeping on deck and engineroom as given in the regulation II/1 and III/1 of the STCW 1978.

6.2.2. CONTROLLED SEA SERVICE.

Many countries have approached this item in different ways.Some introduced sea service in a sandwich form in between studies and others do after completing shore based studies.
In my view sea service in between studies is more suitable in view the students have an opportunity to put in to practice what they learned at the college at an earlier stage and they will understand what they are doing much better and it will help them to understand further theoritical studies much better.
But the problem comes from the practical aspect of it.In order to assign students to ships for short times means additional travelling expenses for shipowners or colleges. This may be an additional burden specially for developing countries.
Therefore the sea practice at the end of shore based studies is more practical in view of economy.

The concept of operating own training ships is also a good practice if the colleges have financial resources.

In order to control the training of students during their sea service many countries have adopted the concept of "Cadets Record Book" where the students are given selected tasks to be fulfilled during their sea training and progress can be monitored effectively.The students are required to forward this book to Master or Chief Engineer at regular intervals upon completing a task and get aknowledged by them and at regular intervals when the circumstances permit has to forward to the college for monitoring purposes.

Steps should be taken to ensure equal time is spent on watch keeping on each discipline while on board.

6.2.3. NON CONTROLLED SEA SERVICE.

This will be in the form of watch keeping certificate or testimonials which is given by the Master or Chief Engineer as the case may be after obtaining the dual watch keeping certificates which is issued by the authority.

6.3.1. ASSESSMENTS AND CERTIFICATION.

6.3.2. INTERNAL ASSESSMENT.

This assessment should be conducted in line of the National Education System so the certificates are accepted in the National Education System for higher education. It could be either conducted by the College or the University administration on a continous assessment basis.

The contents in the Record Book and project work given to them for use during their sea service should be included for assessments.

The main aim of assessments should be to test on their ability of safe operation and correct response to normal and emergency situations under shipboard conditions. This could be done effectively by use of simulators.

6.3.3. EXTERNAL ASSESSMENTS.

Many countries have delegated the theoretical aspect of final assessments from Maritime Authorities to College or University Authorities in order to make assessments more cost effective and more efficient. Still , the Maritime Authority conducts the practical aspect of assessments by way of oral examination and have a greater hold on the contents of the theoritical examinations which is conducted by the College or University authorities.

6.3.4.CERTIFICATION.

The Education Authorities award appopriate certificate for the successful candidate for academic studies, and the Maritime Authority awards either separate Watch Keeping Certificate for Deck and Engine Departments or issue a Combined (Dual) Watch Keeping Certificate after being successful at the oral examination.

6.4.1.SYLLABUS.

The time taken on the basis of average 43 weeks per year with a weekly average of 32 hours (45 min) of academic studies. It is assumed guided study on selected subjects should be carried out during sea phase.

For countries whose higher education system does not accommodate the total number hours mentioned for that grade of certificate have to consider extending the time for at least another semester.

The level of knowledge aimed at this stage should be the basic principles for understanding the subjects and through knowledge on practical aspect of the shipboard operations.

Students will be studying deeper in to the professional subjects upon their return for higher certificates after serving at sea,at which time they should have decided their future carrier ,ie on what discipline to pursue or whether come for a shore position rather than continuing sea life. In this sub chapter on proposed syllabus I would like to make the following brief comments on individual subjects.

The coefficiency to be given at the examinations for each subject is indicated as value with a maximum of 1.5 for most important subjects. The following syllabus is based on syllabuses of the education systems discussed previously.

APPLIED HEAT/REFRIGERATION:(Value 1.0)

Aim- To broaden the knowledge and understanding of combustion process;to give an introduction to the principles of heat transfer;to introduce the students to the Entropy Function so that the Entropy changes may be calculated for a perfect gas;to apply new and previousely acquired knowledge to calculations on gas power cycles;to introduce the student to steam turbine velocity diagrams;to develop a student's knowledge of the thermodynamics principles of marine machinery to enable advanced assessment of performance to be made.

APPLIED MECHANICS:(Value 1.0)

Aim- To broaden the knowledge of Kinematics, Dynamics and Hydrostatics.

ASTRONOMICAL NAVIGATION:(Value 0.75)

The importance of this subject is fading off due to the fact most of the ocean navigation in the future will be by electronic navigational systems,and also due to the fact the accuracy which can be gained by the best fix will be below I.M.O.standards.(4 miles). Still the students should be given the principles of astronomical navigation so they will be able to pursue it at a latter stage.
Astronomical Navigation training can be taught in a shorter time by using computer aided instructions.

COASTAL NAVIGATION :(Value 1.0)

Since this subjected is important whether the vessel is technically advanced or not great importance should be given to understanding chart, routeing ,traffic separation as well as position fixing by conventional manual methods with such as bearing and ranges etc.

CONTROL ENGINEERING /AUTOMATION:(VALUE 1.0)

The integration concept depends on the level of automation available on the ship. So more and more automation and remote control will be available on future ships. The future operators should have a through understanding of control engineering in order to operate the ships efficiently.

In this stage an introduction should be given to the following topics.

Orientation to automatic controls;closed loop versus open loop systems;dynamics of mechanical,hydraulic,pneumatic,electrical and electronic systems.

COMPASS WORK (GYRO/MAGNETIC):(Value 1.0)

A general understanding of principles of gyro compass and it's operation together with it's error sources and it's correction should be given.

In magnetic compass , since it will stay as a primary direction indicater even in technically advanced ships the principled of magnetic compass , it's errors etc should be known by the students.It is not necessary to teach deeper into compass adjustment but they should be able to determine the sources of errors and should be able to apply the errors correctly and get the true course .

ELECTRONIC NAVIGATION SYSTEMS:(Value 1.5)

This subject will be one of the most important subjects for future marine education.A through knowledge on the basic principles of all the electronic navigational systems available to merchant mariners now or in the near future as well as their errors ,error sources and level of accuracy and reliability should be given.

FIELD TRIPS:(Value 0.5)

Most aspects of maritime education depends on student's understanding of the ship board operations.Since under the system of pre sea training , the recruit's knowledge about shipboard operations will be very low. To off set this more field trips to ships,dock yards,harbours, shipping companies,container depots etc should be carried out.

It is better if the students can be given on job training at the above mentioned instituitions during college vacations (where practicable).

FORMALITIES:(Value 0.25)

Although different countries had different formalities in paper work on customs/immigration procedures with the efforts of the Facilitation commitie's work those formalities are being standardized.The students should be taught the standardized forms as well as any deviations by any individual country in a general way.

FLUID MECHANICS:(Value 0.5)

Basics of properties of fluids; fluid statics;mamometry; forces on submerged surfaces; accelerating fluid masses; steady, one-dimensional flow of incompressible fluids; Euler's equation; Bernoulli's equation; applications.

INTRODUCTION TO COMPUTERS:(Value 1.0)

In the future much of the ship board and shore based operations will be computer based.Students should be able to converse with the computers in order to get maximum benefits from them. The level of knowledge required is being able to operate basic programmes and being able to make any adjustmunts in the programmes to suit the situations.

MATHEMATICS /PHYSICS:(Value 0.75)

With the higher entrance level,the need to teach mathematics and physics is less. However the curriculum of National Education System's mathematics may lack some aspects of mathematics and physics needed for other units of the programme.. These topics should be singled out for teaching.

MARINE ELECTRICITY:(Value 1.0)

Teaching of electricity should be given higher priority in order what the student can understand and operate equipment safely.Following are to be included.

Principles of electrostatics, electromagnetism, alternating current, direct current, radio electricity, electrotechnique. Dangers of electric currents. Principles of transformers, alternators,A/C motors, Dynamos, D/C motors, collectors, commutators. Main panel, coupling, distribution, cables, batteries. Principles of Solar power conversions and Nuclear power generation.

MARINE ELECTRONICS:(Value 1.0)

Basic knowledge on principles of electronics is vital for future marine operations. Following topics are sugested.

Two terminal devices; semi conductor theory; Pn junctions; transistors; amplification with transistors; transistor junctions; open & closed circuits; principles of signals non sine; sine signals; radio propagation,reception & transmission, antennas types, polarization.

MARINE OPERATIONS/CARGO WORK:(VALUE 0.75)

The aim of this subject is to develop aspects of marine operations needed to operate a safe and effective cargo watch.Since most of the cargo are containerized bulk of work and thus the knowledge required is reduced.But handling of bulk (Liquid or solid)needs higher knowledge. Handling of hazardorous cargo calls for specialized training.

MARINE TRANSPORTATION:(VALUE 0.5)

This covers the structure of the maritime industry and it's role in the world economy; the role of the Governments in regulating and promoting the Merchant Marine; labour relations in the maritime industry.

MARINE ENGINEERING PRINCIPLES:(Value 1.0)

The basic aim of this subject is to introduce the students to the machinery systems fitted on board ship with particular reference to function and working principles; to introduce methods of measurement of pressure, temperature levels etc; to ensure awareness of the common hazards in machinery space; to increase knowledge of the construction and operation of main propultion machinery; to broaden knowledge of instruments , their principles of operations and their application to control loops.

MARITIME BUSINESS/LAW/R.O.R.(Value 0.75)

With transferring of many aspects of maritime operations to shore one will argue it is not necessary to teach this subject.But bearing in mind that the personnel who will be entrusted to carry out shore operations will be mariners who has come off from active sea life,it is still necessary to teach this subject.

Suggested topics for this stage are as follows.

A thorough knowledge of Rules of the Road with interpretations;rules regarding safety; International and national maritime and labour conventions, Captain & Crew ; Introduction to chartering, commerce,insurance.

MARITIME ENGLISH:(Value 0.25)

Countries whose mother language is not English should give more importance in order to give a working knowledge in conversation and reading/writing.Standard Marine Vocabulary should be used as a guide for training Maritime English.

MARITIME ECONOMICS(Value 0.5)

The idea of teaching maritime economics to marine students is for them to understand the state of maritime trade ,and they will be in a better footing , when they decide to come for a shore position. The knowledge required is an introduction only.

METEOROLOGY/ OCEANOGRAPHY(Value 1.0) Meteorology will continue to be an important subject.Since the weather predictions have improved a long way the mariner should be able to interpret the weather predictions and assess the local weather around him. He should have thorough knowledge of behaviour of tropical storms and necessary avoiding action etc.

The principles of oceanagraphy or ocean science should be introduced so the mariners will be well aware of effects of pollution and will be able to understand the effect of waves on structures etc. This will also help him in future when he decides to come ashore.

NAVAL ARCHITECTURE/STABILITY:(Value 1.5)

This subject will remain very important.

Ship geometry and definitions ; ship form calculations ; hydrostatic properties and curves of form ; weight properties and calculations; initial stability; heeling and trimming problems.

OCEAN NAVIGATION:(Value 1.0)

At this stage this subject should be able to give the students a basic working knowledge of navigation.

Should include the following; principles of plain sailing; rhumb line and great circle sailing; tidal calculations; analysis of line of position.

PROCESS AND MATERIAL:(Value 0.5)

The aim of this subject is to familiarize the students with metal joining process including the safety precautions; understanding of strength of joints and materials.

PHYSICAL EDUCATION:(Value 0.5)

Physical education is important to maintain and improve physical fitness and team spirit which is very important in isolated conditions in shipboard life. The group should be encouraged to participate in activities such as foot ball, water sports, swiming, as well as indoor games.If they are practiced in indoor games,they have a oppertunity to participate in indoor games whenever possible on board resulting relaxed mental conditions.

ROUTEING/PASSAGE PLANNING:(Value 1.0)

Aim- To develop skills in passage planning by applying the technique learned in chart work and to analyse the factors needed to ensure the safe conduct of vessels in coastal waters:

REPORTING/CASE STUDY:(Value 0.5)

Aim- To improve standard of reporting. This will be done in the form of project work. The students will be given case history of actual situations and hypothetical situations and will be required to report that incident.

SEAMANSHIP PRACTICE/THEORY:(Value 1.5)

This subject will remain very important. Practical knowledge on seamanship such as rope/wire work,anchor work as well as their theory should be throughly understood.

SAFETY/HYGIENE:(Value 0.5)

The importance of industrial safety in ship and in dock as well as importance of personal hygiene should be clearly understood.

WATCH KEEPING PRINCIPLES:(Value 1.0)

Bridge/Engine control room procedures, procedures of handing over watch etc. as given in the STCW 78 convention should be clerly understood. Also responsibilities for survivers of ship wrecked,pilotage waters, with master on bridge and emergency situations etc.

WORK SHOP PRACTICE:(Value 1.5)

The students should be able to operate lathes, drilling machines and all other engine room tools effectively and safely. Importance of engineroom cleanliness as well as wearing personal protective equipments.

SYLLABUS.

	Total Hours	Semesters 1st	2nd	3rd	4th	Sea/ Proj
Applied Heat/Refrigeration :	130	40	40	20	20	10
Applied Mechanics :	80	25	25	15	15	-
Astronomical Navigation :	75	25	25	-	-	25
Coastal Navigation/Chart work :	80	10	15	15	15	25
Control Engineering/Automation:	75	-	-	35	40	-
Compass Work (Gyro/Magnetic) :	30	-	-	10	20	-
Engineering Drawing :	50	15	15	-	-	20
Electronic Navigation Systems :	175	-	-	75	75	25
Field Trips :	40	10	10	10	10	-
Formalities :	10	-	-	-	10	-
Fluid mechanics :	45	-	-	20	25	-
Introduction to Computers :	70	30	30	10	-	-
Mathematics/Physics :	70	35	35	-	-	-
Marine Electricity :	150	60	60	30	-	-
Marine Electronics :	150	60	60	30	-	-
Marine Operations/Cargo work :	100	-	-	35	35	30
Marine Transportation :	70	-	-	35	35	-
Marine Engineering Principles :	60	25	20	15	-	-
Maritime Business/Law/R.O.R. :	100	-	20	40	40	-
Maritime English :	65	40	25	-	-	-
Maritime Economics :	25	-	-	15	10	-
Meteorology/Oceanography :	100	10	15	30	30	15
Naval Architecture/Stability :	100	20	20	20	20	20
Ocean Navigation :	105	-	-	40	40	25
Process & Material :	40	-	-	10	20	10
Physical Education :	100	25	25	25	25	-
Routeing/Passage Planning :	25	-	-	10	15	-
Reporting /Case Study :	35	-	-	-	25	10
Seamanship Practice/Thoery :	250	100	100	25	25	-
Safety/Hygiene :	30	20	10	-	-	-
Watch Keeping Principles :	45	-	-	20	25	-
Workshop Practice/Theory :	250	100	100	25	25	-
TOTAL :	2730	650	650	615	600	215

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