THE INSTITUTE OF MARINE ENGINEERS

76 Mark Lane, London EC3R 7JN   Telephone: 01-481 8493 Telex: 886841

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SOME MODERN IDEAS ON SHIPBOARD MANAGEMENT

K. H. Mackay

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Some Modern Ideas on Shipboard Management

K. H. Mackay, B Com, MInstAM
BP Tanker Company Ltd.

SYNOPSIS

This paper describes the system concepts which have been introduced into the BP Tanker Company's ships over the past seven years, and are still being developed, to meet the changing requirements (in social and economic environments, and ship technology). Three separate stages are described: the development of the Shipboard Management System concept; the introduction of self-monitoring on ships; the increased involvement of ships' staff in budgeting and decision making. Particular attention is paid to identifying the problems encountered and to describing the solutions adopted, the achievements to date, and the lessons learned. The paper argues that changes in shipboard management cannot be considered in isolation; it describes the consequent changes which have taken place in the ship/shore interface, in the Management information system and in recruitment and training. Finally, the paper outlines some of the future developments foreseen; for example, the effect of satellite communications and the shipboard use of computers; reducing length of time staff spend at sea; and the progressive reduction in crew numbers. System concepts are shown in Fig. 1.

INTRODUCTION

Company Background

The BP Tanker Company, a wholly-owned subsidiary of British Petroleum, was formed in 1915, and is responsible for the world-wide operation of over 100 ships, both owned and chartered. The owned fleet comprises petroleum product tankers, VLCC and other crude oil tankers.

Trading largely falls into two patterns performed by different ship types: long hauls of crude oil from the Middle East to NW Europe, Japan and Australia, and shorter movements of products from refineries to storage depots. Ship Profiles are shown in Table I. Access to ships is not always easy or predictable.

Ships are operated to a high standard, great importance being attached to training, safety and the avoidance of pollution. The Company has pioneered and developed a number of systems such as Inert Gas and Crude Oil Washing to improve safety.

The Company also provides, on behalf of BP, wide-ranging expertise on marine matters, which include contributions to planning and constructing port and harbour facilities, siting installations, jetty building, dredging, offshore developments, diving and small craft operations.

BP Tanker Company employs approximately 450 staff in Head Office, and approximately 4800 sea-going staff, including 800 cadets and 1300 company contract ratings. Cadet schemes for both deck and engineering are long-established so that, increasingly, the senior staff on the ships and ashore, including the AGM (Operations), started with the company as cadets. The Company also makes extensive use of Asian crews.

Social and Economic Environment

Companies, in order to operate their ships successfully, must take into account the different social, economic and technical trends which are developing. For example:

1) ships are getting larger and/or more complex, and the number of UK-registered ships is declining;
2) automation of equipment on ships enables them to be operated with fewer staff;
3) average earnings have been increasing steadily, with the result that labour has become an expensive commodity which must be used effectively;
4) despite the reduction in the numbers required, and the increase in earnings, there is a continuing manpower shortage which the current trade recession has only eased;
5) wastage rates are high. There is increasing recognition that job satisfaction must be improved if staff are to be retained. The Company's concept of shipboard management is aimed at improving job satisfaction;
6) duty periods at sea are being reduced, which leads to problems of continuity;
7) there is increasing legislation on safety and pollution which will force companies to upgrade and operate ships to a higher standard;
8) the present shipping slump,—which for tankers is likely to last a few more years, has underlined the need to reduce costs, if companies are to survive.

Statistics, highlighting some of the above trends are shown in Table II.

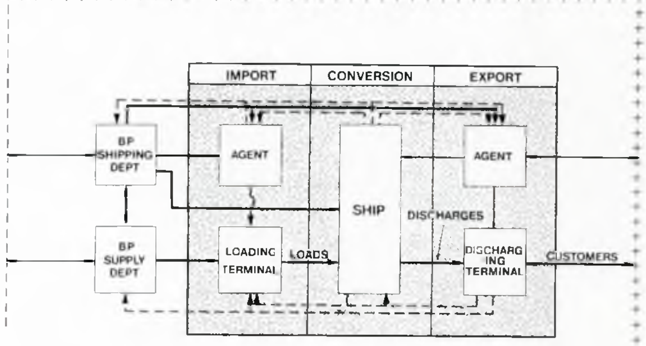

Figure 1. External environment

Table I: Ship profiles, VLCC and Products Carrier

SHIP	VLCC		PRODUCTS CARRIER
Trade	Carrying crude oil		Carrying refined products (clean)
Trading pattern	Persian Gulf to NWE		Coasting NWE
Deadweight (summer)	270,000		25,000
	Full Speed	Slow Steaming	
Average speed (knots)	15.4	12.0	14.8
No. of days at sea	321	328	202
No. of days in port	33	26	151
No. of days ineffective	11	11	12
No. of days voyages per year	5.3	4.2	31.2
Average length of voyage in days	67.3	84.6	11.3
Number of crew, excluding cadets and trainees	33	33	33
Value of cargo carried each voyage ($ million)	28.4	28.4	6.4
Earnings per annum ($ million)			
at World Scale 20	5.0	4.0	0.6
at World Scale 40	10.1	8.0	1.3
at World Scale 60	15.1	12.0	1.9
at World Scale 100	25.1	20.1	3.2
at World Scale 150	37.7	30.1	4.7
at World Scale 200	50.3	40.1	6.3
at World Scale 300	75.4	60.2	9.5
Typical Costs per annum ($ million)			
Insurance	0.6—0.8		0.2—0.4
Seagoing personnel	1.0—1.6		1.0—1.6
Provisions) General stores) Owners disbursements)	0.2—0.4		0.2—0.4
Repairs—main event) Repairs—voyage) Repairs—spare gear)	0.5—1.0		0.3—0.7
Head Office admin.) finance)	2.0—4.0		0.4—0.8
Bunkers) Port costs)	6.5— 7.5	4.0— 5.0	1.6—2.0
Total costs	10.8—15.3	8.3—12.8	3.7—5.9

Sealife Programme

This programme was started in April 1975, to help the British Shipping Industry ease its continuing manpower problems. The author considers it to be a significant step, which will have a growing influence on the way in which shipping companies are organized, both ashore and on board ship. Sealife is actively supported by the Company.

THE SHIPBOARD MANAGEMENT SYSTEM

Developing the System

Ten years ago, various systems were being introduced independently into the Company by different parts of the Head Office organization. A system of Planned

Maintenance had been introduced[1]. Head Office had introduced a system of GP (General Purpose) manning and, as part of this move, had instructed ships to set up a Shipboard Management Committee which was to meet weekly to decide what work was to be done and review the deployment of the GP crew. These meetings showed that there was a need for a formal system of planning the work on ships, which at that time did not exist.

Subsequently, a "Shipboard Work and Environmental Study" was set up. This started out as an examination, carried out by Head Office staff, of the work done on board ship, which led to the installation of an Operational Planning System, based on the system marketed by S. S. Stevenson & Partners Limited[2].

Further, a Materials Supply Project team looked at the overall supply system, and recommended a new system of stock control to be installed on ships, as a necessary adjunct to a proposed warehouse for stocking general stores and spare gear. Also, an experimental condition-based maintenance system was being developed to replace the existing system of planned maintenance. This work has already been reported[3].

It gradually became clear that these developments were concerned with Shipboard Management, and from that day on, all such developments have been integrated into the Shipboard Management System. This was a great step forward, as it ensured that the inter-relationships of the different elements were considered before changes were introduced

The complete system covers the following elements:

i) operational planning;
ii) planned maintenance;
iii) hotel cleaning;
iv) fabric maintenance;
v) stock control;
vi) defect reporting;
vii) performance monitoring;
viii) operating and other manuals;
ix) feedback to Head Office.

Most of these elements have now been installed in every Company-owned tanker, and are working satisfactorily. The system has already been described in detail in an article in *Marine Engineers Review* for December 1978[4].

This paper concentrates on the problems encountered, and the lessons learned concerned with:

a) defining the managerial role;
b) getting acceptance of the new system;
c) accommodation and layout problems;
d) updating and auditing the system.

Defining the Managerial Role

The author defines the management role to be carried out in the Company's ships as follows:
"To ensure that all the tasks which are necessary to keep the ship operational and in good repair are carried out safely and economically to the standards required, and staff are motivated to improve their skills, performance and job satisfaction."

The management task is therefore concerned with:

1) setting objectives;
2) setting standards;
3) budgeting costs;
4) controlling stocks;
5) planning the use of resources (men, materials, equipment);
6) allocating work tasks;
7) monitoring results (objectives achieved, standards achieved, costs, work done to the required standard, etc.);
8) constraints (human, political, organizational, social, technical) on task performance;
9) revising objectives, budgets and work programmes in the light of changed circumstances.

Table II. Shipping statistics over the period 1960-1979

	1960	1965	1970	1975	Latest 1977 1978+
1) No. of UK registered ships	2919	2403	2017	1921	1770
2) Average size of UK registered ships (GRT)	6004	7138	10613	15809	16630
3a) No. of UK registered seagoing staff (000)	146.1	119.6	99.2	89.0	78.1
b) Wastage rates	N/A	N/A	N/A	13%	11%
c) Average length of service	N/A	N/A	N/A	N/A	16 yrs (1979)
4) Average earnings —officers	1108	1544	3050	5527	7641+
£ per annum —crew	523	750	1519	3176	4257+
5) Ratio of duty/leave —officers	4½ : 1	3½ : 1	3 : 1	2 : 1	2 : 1+
—crew	6½ : 1	5½ : 1	5 : 1	4 : 1	3½ : 1+
6) Bunker prices F.O. $ per tonne	18.7	15.8	21.7	84.3	110 (1979)

Table III defines the managerial role of the Master to illustrate this concept.

Management is thus much more than getting the existing task done; it is concerned with the improved use of resources and thus with improving effectiveness and with reducing the effort involved in getting work done.

These two important concepts are illustrated in Figs. 2 and 3. "Effectiveness" can be defined as "using resources efficiently so that the ship can be kept operational, and thus able to earn freight". The first of these concepts, to increase effectiveness, can be achieved by, for example, increasing the number of days the ship is available to carry cargo, by eliminating break-downs; reducing time in drydock; reducing time spent loading/discharging cargo and other port time and, at the same time, reducing costs by employing fewer staff; avoiding waste; improving maintenance, etc. The distance between each pair of lines in Fig. 2 (A1, B1 or A2, B2 to the right of the break-even point) indicates the level of profits. The two pairs of lines are given to show that lower costs lower effectiveness may in some circumstances be more profitable than higher costs higher effectiveness.

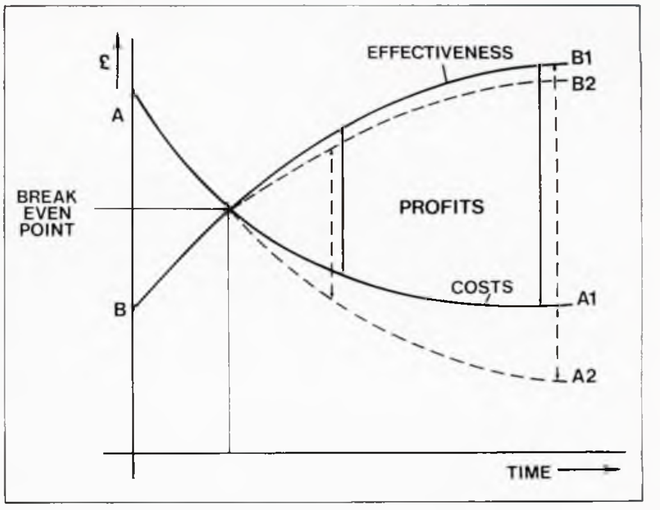

Figure 2. Interaction of effectiveness and costs on profits

Table III: The Managerial role of the Master

1) Managing his ship by leading and directing his Management Team (Chief Engineer Officer, Chief Officer, Second Engineer, Catering Officer, C.P.O.).
2) Setting, jointly with his Management Team, the objectives he wants achieved to improve effectiveness.
3) Translating these objectives into action at the Weekly Management Meetings by allocating resources, and authorizing expenditure.
4) Monitoring the performance of his ship by
   - comparing actual results with the agreed performance standards
   - examining the Data/Information produced e.g., maintenance reports, repair lists, overtime worked
   - regularly inspecting the ship for cleanliness, neatness and condition: covering fabric, stores, spare gear, galley, crew quarters etc.
   - monitoring the various Administrative Systems to ensure that they are correctly maintained and up to date and reporting back to Head Office as required.
5) Reviewing the way in which resources are used.
   - Use of staff
   - Work methods
   - Frequency with which jobs are done
   - Economic use of stores.

   To do this, each voyage a number of activities should be studied, detailed records of times taken, methods used should be obtained, with a view to developing improved techniques which could then be employed on the next voyage.
6) Developing his staff, particularly the Chief Officer, to enable them to undertake more responsibility and to show them how to work more effectively.
7) Monitoring and encouraging all onboard training.
8) Annually, in conjunction with Head Office staff, preparing his Revenue Expenditure budget.
9) Working out arrangements for the organization of the drydocking programme.
10) Ensuring that Officers arrange a proper handover to their reliefs.

The second of these concepts, to reduce effort, can be achieved in several ways. This is shown in Fig. 3, where each column represents the time taken to carry out a particular task. Task times can be reduced by:

i) repetition—the time taken reduces each time the task is carried out to a fixed level (this is the learning curve).

ii) analysis of the work method—examining the sequence of operations, the provision of spare parts, and the tools and equipment required, will usually result in reductions in time taken. This has the effect of moving the base line to AA1.

iii) providing work information cards setting out the method of doing the job, the tools and spares needed, and safety precautions. This has the effect of reducing the time taken to carry out the task on the first occasion from T1 to T4.

iv) carrying out the job at less frequent intervals as a result of condition monitoring. For example, if the frequency over a period can be reduced from six to four occasions, this would cut out either Columns T5 and T6 or Columns T8 and T9.

If all these methods of reducing task time are employed, the total reduction in time in Fig. 3 is thus the difference between the original time (the heavily lined area) and the reduced time (the shaded area).

Acceptance of the Management role has been difficult to obtain as it implies acceptance by those on board ship of the methods of management, and acceptance by those ashore of the need to transfer the authority to manage. This is considered in more detail later in the paper.

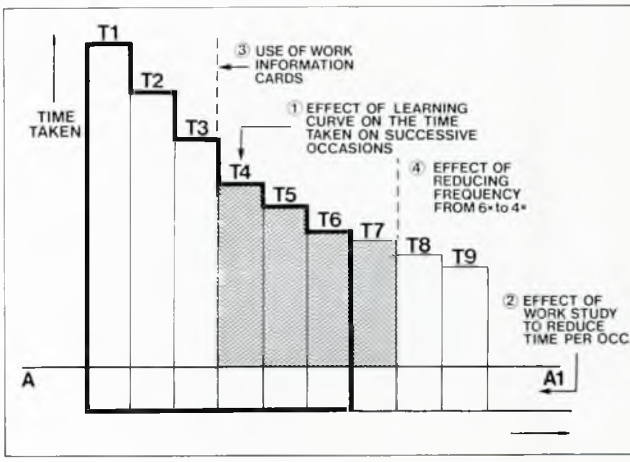

Figure 3. Time taken to carry out tasks

Table IV: Extract from user requirements—Products Carriers

HULL—C—ACCOMMODATION

14. STOREROOMS FOR GENERAL STORES AND SPARE GEAR

14.1 *General Stores* are those stores listed in the F1 indent. They are supplied annually, mainly from the warehouse, in pallet mounted, fibreboard boxes, measuring 1.2 m x 1.0 m high, and not exceeding 750 kg weight.

14.2 *Spare Gear* are those stores ordered on the F2 indent and comprise machinery parts, replacement ship's equipment and miscellaneous stores. They are supplied at regular intervals (depending on ship's movements) mainly from the warehouse. Where possible, packing is in unit loads as for General Stores.

14.3 The control of General Stores and Spare Gear on board is by systems described in the SMS User Manual.

14.4 Storerooms with the following floor area and with appropriate shelving, racks and bins are to be provided.

14.4.1	General	10.0 m x 3.5 m	35 square metres
14.4.2	Oils, Greases, Paint, Chemicals Group 2 and 3, Bulk Cleaners	12.5 m x 4.5 m	56 square metres
14.4.3	Rope	3.0 m x 2.0 m	6 square metres
14.4.4	Stationery	1.5 m x 1.0 m	1.5 square metres
14.4.5	Spare Gear (machinery parts)		50 square metres

14.5 The storeroom for General Stores should be sited aft and open on to a handling area capable of accommodating at least one fibreboard box. The handling area should have direct crane access from either side of the ship.

14.6 It should be possible to wheel a loaded pallet track from the midships cranes to handling areas with minimum of obstruction.

14.7 The storerooms for oils, greases, paint, chemicals and bulk cleaners should be kept separate and have appropriate fire and safety precautions.

14.8 The storeroom(s) for Spare Gear should form part of the machinery space or be within easy access of it.

Getting Acceptance of the New System

Considerable efforts were made to ensure that the SMS was a realistic concept and acceptable to ships. Sea-going staff were seconded to the project teams in order to develop the systems, carry out the necessary preparations for each ship and, finally, implement the system by sailing with the ship.

A number of courses—initially of one day, subsequently of two and a half days, and attended by over 800 officers—were run to explain the various elements and to give participants an opportunity to try out the system on a Simulated Voyage exercise. It was interesting to see how reaction to those courses changed. At the beginning, when the SMS had just started to be implemented, few people attending the courses had seen the system in use, and the participants felt very detached; in fact, some thought the system would never be implemented Fleet wide. However, as implementation proceeded, and more of the participants had experience with it, and it was clear that the system would eventually be introduced to every ship, a very different reaction was evident, and people became interested and involved.

Articles in the company newsletter described the progress being made with the project. An illustrated booklet describing the system and illustrating various operation cycles was sent to each officer, Chief Petty Officer and Petty Officer. A User Manual was published, and is continually under review as further systems are developed.

Accommodation and Layout Problems

The project teams found that considerable attention had to be paid to the layout of office accommodation and storerooms. In the author's view, the whole of the accommodation—separation of offices, individuals' accommodation, dining and recreational facilities—needs attention, and he welcomes the work being done by Sealife and others.

Storerooms

If stores are to be properly kept then appropriate accommodation is required. This involves providing sufficient space, with the necessary racks, etc., so that each item can be stored satisfactorily. For general stores, it requires a main store and a number of small ('ready use') stores. Table IV illustrates the requirement for product carriers.

Offices

Ideally, a central office is required where all the ship's business can be transacted. This was only possible on some of the ships, and only on one ship was it possible to incorporate it into the design before the ship was built. Fig. 4 shows the layout of this General Office, and Table V lists the equipment. This is now a User Requirement for the next generation of ships.

The Conference Room, adjacent to the Central Office, is frequently used for handling confidential and staff matters, where in other ships an individual's private office would be used.

Figure 4. Layout of General Office

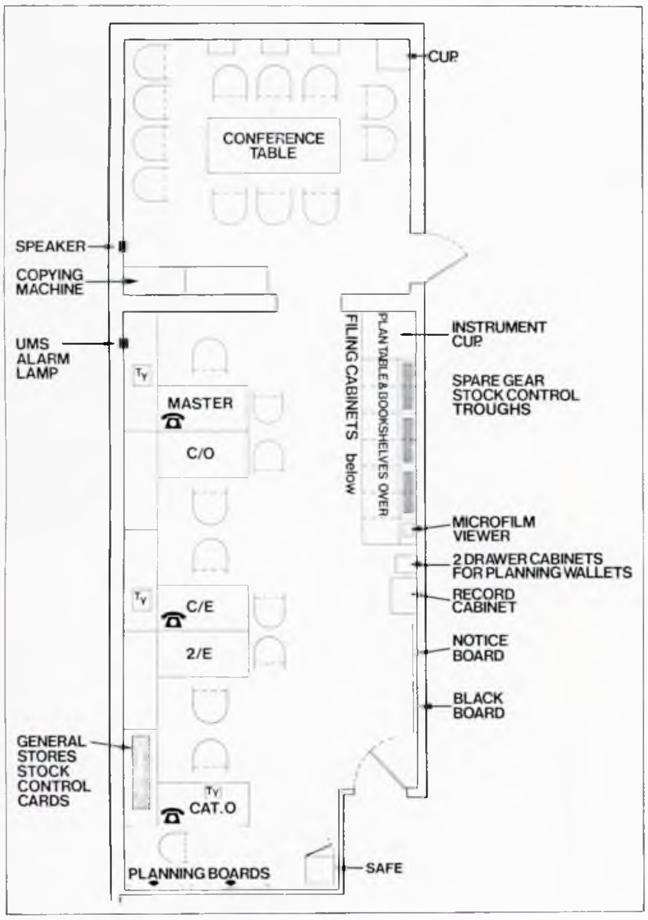

Table V: List of equipment in General Office: *British Respect* (VLCC)

DESKS AND CHAIRS
- 5 Desks with side tables
- 5 Executive 'swivel' chairs
- 5 Visitors chairs.

STORAGE AND FILING
- 1 Safe
- 1 Microfilm viewer and table
- 7 Two-drawer filing cabinets
- 1 Plan table and bookshelves above
- 1 Cabinet for instruments etc.

COMMUNICATIONS
- 3 Telephones (1 linked to Public Address system)
- 1 Public Address speaker
- 3 Typewriters
- 1 Photocopying machine
- 1 UMS alarm lamp

OFFICE SYSTEMS
- 1 Main planning board
- 1 Task allocation board
- 4 Troughs for stock record cards
- 4 Special two-drawer cabinets for planning wallets.

OTHER
- 1 Notice board
- 1 Blackboard
- Hooks for coats and hats.

Table VI: List of criteria against which to judge the suitability of a transfer of decision making to ships

1.	Can the ship be given the information required to make the decision? And how easily can that information be provided?
2.	Can information be transmitted sufficiently quickly and accurately?
3.	When decision making depends on having rules, do these exist, or can they be provided?
4.	Is the Head Office capacity for support/backup likely to be affected? (Through lack of information or delays in getting information and how can one get information in an emergency?)
5.	Could the transfer create potential legal problems?
6.	Can accountability be clearly established?
7.	What education of ship's staff in the use of the information provided is required?
8.	Are additional costs and resources likely to be incurred? If so, what?
9.	What measurable benefits are anticipated? (Cost savings).
10.	What intangible benefits are anticipated? (Job satisfaction).

Updating and Auditing the System

Once the basic implementation had been carried out it was decided that a small Shipboard Management System Unit should be established to continue to develop the system, to revise and update the User Manual, and to audit the system.

Lessons Learned

From experience, the following items are crucial to success:

1) to co-ordinate and integrate the various system elements;
2) to involve seafarers in the concept and design of systems, and Superintendents in the development, implementation and auditing of the system;
3) to define the storage and accommodation requirements sufficiently far in advance to enable them to be incorporated in the ship design;
4) to install systems in new ships before they leave the shipyards. This will make the provision of an equipment list, itemized spare gear, drawings, makers' manuals, etc., an essential part of the building contract;
5) to prepare the User Manual much earlier, so that it can be issued to ships as the installation is made, used on training courses, and referred to whenever changes are proposed;
6) to allow sufficient time for the systems to become established. BP's experience is in line with that of other companies who have been involved in introducing changes into ways of managing ships[5].

MANAGEMENT AND DECISION MAKING ON SHIPS

Role of the Steering Committee

Now that the basic systems have been introduced, BP Tanker Company has set up a Steering Committee to examine the feasibility of increasing the involvement of ships' staff in managing their ships. The Committee is concerned with establishing what further delegation to ships is feasible, and what the consequences of such changes would be on the ship/shore interface, particularly on the shore's ability to provide support and back-up to ships.

Working Groups have been established in the following areas:

1) self-monitoring;
2) budgeting and cost control;
3) operating decisions.

Work to date is reported under each of these headings. Table VI lists the criteria against which to judge the suitability of a transfer of decision making to ships.

Self-Monitoring on Ships

For several years, ships have been sending in a Weekly Message covering speed, bunker consumption, pumping performance, ineffective time, etc. Standards were set against which the current performance was compared. The Weekly Message has recently been replaced by two messages: a Port Data Message (PDM) and Sea Data Message (SDM). The procedures established are flexible, so that data can either be sent to Head Office for analysis; or analysed on the ship, and Head Office advised only when the performance is unsatisfactory; or analysed at the end of each voyage.

Experiments are in hand to allow ships to monitor their own activities (self-monitoring). Guidance notes and instructions have been prepared for the ships. Initially, self-monitoring is being applied to VLCC and crude oil ships, later on in the year it will be applied to product carriers. Eventually the ship will be responsible for monitoring most aspects of its performance, viz.:

1) speed/bunker consumption;
2) hull fouling using the mathematical model developed by the Company;
3) ineffective time;
4) port performance;
5) pumping performance;
6) use of bunkers for tank cleaning and other purposes;
7) water consumption;
8) energy losses;
9) repairs and maintenance—estimated value of work done on board; estimated cost of repair work outstanding;
10) stocks—usage and levels;

11) appearance of the ship—condition of paintwork, cleanliness, state of equipment, stockrooms, etc.

In order to ensure that the system is working satisfactorily, the Master and the Chief Engineer Officer are required to call into the office to report to their Operations Manager on their ship's performance over their last tour of duty. This is a control and communications exercise which will:

i) cause the Master and Chief Engineer Officer to review what has been done over the previous four months and consider, in conjunction with Head Office staff, what needs to be done to put things right;
ii) enable the office to inject their experience of other BP ships;
iii) lead to joint setting of budgets and performance targets.

Budgeting and Cost Control

At present, ships' revenue budgets are prepared in Head Office and the budget and actual revenue expenditures sent to some ships. Ships would welcome more involvement in the budgeting process. The main problem is to achieve this without involving the ship in a considerable workload. The ship can be held accountable for the following costs:

1) sea-going staff—variations from the standard manning scale and overtime;
2) provisions;
3) general stores;
4) spare gear;
5) repairs—main event, voyage, SGM (sea-going maintenance).

The ship has a limited control of certain costs:

i) bunker costs—on quantity used but not on the price, as the Company dictates the grade and where bunkers are taken;
ii) port costs—those ports where arrival/departure times and the length of stay affect the charges;
iii) seafarers' travel costs—the ship can only influence these if it is involved in the timing of reliefs.

Other cost items—standard manning scale, insurance, administration costs, finance, etc., are only required in order to present the ship with the total cost picture. This overall cost total is important, as savings in one cost area can result in additional costs in another area and vice versa. For example, an increase in overtime costs can reduce the amount of work to be carried out in drydock, so that the repair costs are lower. Total costs must also be considered in the light of total earnings and the resultant profit or loss (see Fig. 2).

Within the Company there are two major constraints which affect the degree to which ships can prepare budgets:

a) the extended time factor involved with ships on world-wide trading which makes the communication of, and receipt of, information from ships sometimes a slow and cumbersome business.
b) the need to transfer a considerable amount of data held in the Head Office. For example, to budget repair and maintenance costs properly the following data are required:
    —a price list for major repairs;
    —a spare gear price list.

The Working Party on budgets and costs is examining a number of cost areas to see precisely what information is required and how easily it can be obtained and made available to the ships.

Operational Decision Making on Ships

The author believes that more delegation of authority to ships can take place than is commonly accepted provided that:

1) delegation can be made without losing control. This implies that the shore already has that control as, for example, the Company has with its operational control system. Although the system will be largely replaced by the self-monitoring system, key control data will continue to be fed back to Head Office;
2) ship's staff clearly understand the limits within which they have to operate, and when they must come back for guidance, or for confirmation of their proposed action, or for a decision. This will require a clear definition of the respective roles of the ship and the shore, the definition of decisions to be taken by the ship and the constraints on the ship;
3) the information which Head Office has accumulated over time to help them improve their decision making is made available to the ship;
4) people understand the financial implications of decisions.

The Company believes that its senior staff on ships have the management potential to take more decisions. However, advance is likely to be slow, perhaps confined initially to a few ships where the confidence of Head Office staff in the ship's staff is high. As progress is made, anything which is delegated to one ship should be considered as an option which could be given to other ships.

The model shown in Fig. 5 illustrates the process of transferring the level of decision making to ships:

i) the present situation, where "potential" exists to allow a transfer of decision making to ships;
ii) the first stage, where the transfer of decision making up to the level of competence has taken place;
iii) the final stage, where additional training raised the level of competence and allowed further decisions to be transferred.

This is a very simple model which illustrates the problem. It does not indicate which decisions can, or should, be transferred. The Working Group is now engaged on examining this problem. Currently out of 27 decisions (or decision areas) identified, 19 are taken by the ship, and eight by Head Office. However, of the

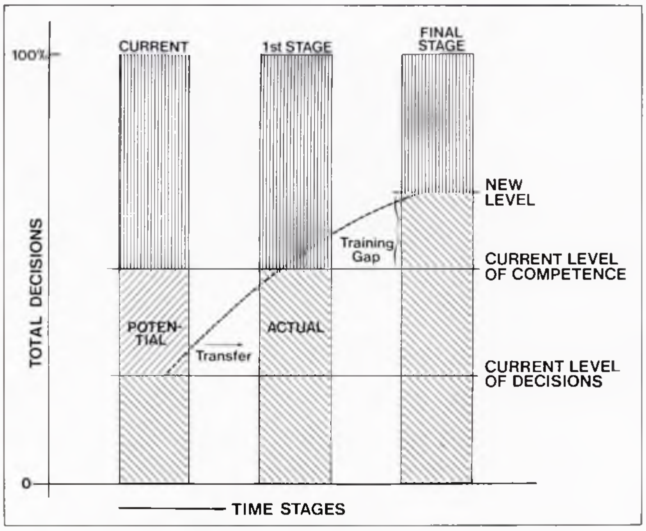

Figure 5. Transferring level of decision making to ships

19 decisions taken by the ship it is suggested that, in 12 cases, better decisions could be taken if more information was available to the ship.

Most of the decisions are primarily concerned with the physical operations on the ship: how to get the ship from A to B at minimum cost, and how to get the maximum of work done on the ship at the minimum cost. The decisions currently taken by Head Office are:

a) should the ship leave a port without completing cargo loading?
b) where should bunkers be taken and in what quantity?
c) when and where should the ship stop to await orders, ullage, etc.?
d) is it economic to have the hull scrubbed? if so, when and where should it be done?
e) when and where should staff due for leave be relieved?
f) when should the ship go into drydock? (Within this decision area, Head Office is also concerned with all the aspects of drydocking, such as preparing and costing the specification; deciding on the repair yard; supervising the drydocking).

The additional information required by the ship to make these decisions covers such items as:

1) value of the ship's time;
2) knowledge of charter parties (penalties, demurrage rates, etc.);
3) future trading requirements (particularly "arrival windows");
4) cost information (own costs, costs at ports, repair costs, etc.);
5) delays at the next port;
6) port facilities.

Decisions involving the value of the ship's time are mainly concerned with decisions on whether or not to take the ship out of service, speed up loading/discharging, speed up a particular voyage to catch a tide, or arrive before a certain time, etc.

For example, should the ship be taken out of service for two days for hull scrubbing now or in six months time? The savings in bunkers to be obtained over the next six months must be compared with the cost of scrubbing the hull, plus the cost of any deviation plus the value of the ship's time for two days.

When freight rates are high, emphasis will undoubtedly be on saving time, and thus keeping the ship operational as long as possible, in order to maximize earnings. When freight rates are low, as they are currently for VLCCs, then time is of less significance and attention will be paid to reducing costs; for example, by slow steaming, and by in-water maintenance as opposed to drydocking the ship.

Future trading requirements must be known if the ship is to be able to plan ahead. Unfortunately, with product carriers, orders are often subject to continual change, and "final" orders are only transmitted to the ship a few hours in advance. Where it is possible to give advance notice the Master can then choose the best solution out of several alternatives. For example:

i) at what time should the vessel enter or leave a port, i.e., during hours of darkness or daylight; weekend or holiday or weekday?
ii) at what rate should the ships be loaded or discharged i.e., when will demurrage become effective? Is there a time limit on the operation?
iii) how much ballast should a ship carry for optimum safety/comfort/speed?
iv) what speed should the ship proceed at, bearing in mind all available information concerning requirements, "arrival windows", weather, hull/engine condition?

Methods of providing quick answers to these questions should be given to the Master whenever possible from the available data. When necessary this must be supported by a regular or *ad hoc* feed to the ship from Head Office.

In time, this data may be made almost instantly available using satellite communication and onboard computer facilities, as described later.

EFFECTS ON THE SHORE ORGANIZATION

Ship/Shore Interface

Once a significant amount of delegation to ships takes place, then the role of the Head Office staff will change. For example:

1) Operations Managers in consultation with ships' staff must define clearly and unambiguously what they expect the ships to achieve, and the information to be sent back from the ship.
2) with self-monitoring, *less* information should be sent to Head Office for analysis.
3) the regular visits of Masters and Chief Engineer Officers will ensure that the performance of ships is reviewed regularly and Fleet Superintendents should make fewer visits to ships. Their roles will be supportive and auditing.
4) ships will increasingly demand information regarding costs, future movements, "arrival windows", etc. as Masters and Chief Engineer Officers understand the commercial significance of their actions.

As a result of these changes the numbers of operational staff in Head Office may be reduced. At a subsequent stage BPTC will have to review its organization structure to see whether changes need to be made.

The ship will fulfil its role best when the ship's Master, his Management Team and the Operations Management in Head Office act together as a team and the effectiveness of their joint action will be measured by:

i) the number of days a ship is available to earn freight;
ii) the level of cost achieved, in relation to the budget set, and other ships of the same class;
iii) the physical state of the ship and its equipment as revealed by a performance audit, or inspection by the Marine or Engineer Superintendent;
iv) the contribution made to extending the information available on operational experience, reliability of machinery, and defining 'User Requirements'.

In order to aid the joint understanding of the ship/shore roles, an interchange of staff by secondment both from ship to shore and vice versa will be desirable.

Management Information Systems

There are developing links with the Head Office Management Information systems, which include:

1) inputs to the Fleet Data Analysis system, ship repair and maintenance system, materials management system, budgetary control and accounting systems, personnel system;

2) feedback of information from these systems to the ship;
3) improving communications by experiments with telex, satellites, microfilm, facsimile.

Work done in the office over the past few years in using information for Management purposes has highlighted just how much reliance is placed on information coming from the ship, e.g.,

i) for developing the ship performance model;
ii) for setting performance standards;
iii) for providing information on port delays, etc., which is used in making demurrage claims.

Recruitment and Training

Current changes are increasing the importance of the managerial role of the ships officers. This will continue, particularly when in the future more complex ships are run by smaller crews.

It is clear that, as a result of past decisions and the introduction of the various cadet schemes, with their insistence on high educational standards, the Company employs officers of high quality, with considerable potential to meet future challenges. This standard must be maintained.

BPTC also carries out a significant amount of training. What additional training requirements are foreseen? So far the following requirements have been identified, covering:

1) the role of the Manager;
2) work study;
3) conducting meetings;
4) report writing;
5) methods of analysing data.

User Requirements

The development and operation of the Shipboard Management System has highlighted the need for changes to be incorporated in the next generation of ships. This is being done by examining various proposals covering for example:

1) storing equipment (cranage, movements of pallets, etc.);
2) storerooms;
3) workshop facilities;
4) accommodation;

and incorporating them in the User Requirements (see Table IV).

FUTURE DEVELOPMENTS

Effect of Improved Communications

The improvement in communications—including telex, satellite communications, facsimile, etc.—will have the result of bringing the ship closer to the Head Office, or the Head Office closer to the ship depending on whether one is sitting in Head Office or on the ship.

From the ship's point of view this will enable it to ask for information to help prepare budgets, consider alternative courses of action and make it easier to act as an independent unit able to take the initiative.

On the other hand, from the Head Office point of view, contacting a ship will be no different from having to contact someone in the same building and, hence, there could be a great temptation on the part of Head Office to ask the ship for information to enable the Office to make all but the most trivial decisions.

The Shipboard use of computers

Using computers on board ship is not as easy as it sounds. Computers will increasingly be used, but they can be used in several different ways:

1) small micro-processors will be built into various pieces of equipment in order to carry out particular calculations, or to monitor performance. This has already happened, for example, with navigating and engineering equipment, and has led to Unmanned Machinery Spaces (UMS), with controls being centralized on the bridge;
2) mini computers may be installed on ships in order to carry out a number of different tasks, e.g.,

i) monitoring operations;
ii) monitoring fuel, water consumption, pumping performance, etc.;
iii) the application of the ship performance model;
iv) monitoring machinery condition;
v) maintaining stock records;
vi) recording personnel data;
vii) stress/trim calculations for loading, discharging the ship;
viii) budgets and financial data;
ix) estimating the cost of repair jobs;
x) voyage planning;
xi) overtime accounts, marine payroll accounts;
xii) voyage analysis and voyage accounting;
xiii) calculation of tank quantity from cubic capacity and specific gravity;
xiv) calculation of intercept from ALT, GMT and DR position.

This is the opposite approach to the micro-processor solution. Unfortunately, the software required for the various applications listed above is in many cases not yet available so that individual companies will have to develop their own, an expensive and time-consuming business. Demand terminals or VDUs could be established on ships in order to access information in Head Office. This will make particularly good sense where the Head Office has computerized the majority of its data so that for example a ship wanting to know

a) costs of spare gear;
b) port costs;
c) repair costs;
d) shipyard costs;
e) port information;
f) availability of stocks;
g) weather data;
h) availability of staff;

could obtain this by dialling up the computer. This would reinforce the ship's desire to retain the initiative in making decisions.

The use of VDUs on ships in particular would lead to a considerable reduction in paper work. It would also help to impose a discipline for updating records and programs could be written to validate data input and thus avoid situations where incomplete or incorrect data were fed to the system and subsequently passed to Head Office.

Thus, in the author's view, the use of VDUs or demand terminals connected to the Head Office computer is the one to be exploited, particularly as ships would have access to all the data they required which would be as up to date as possible, e.g., on future ship movements.

Reducing Periods of Sea Duty

With reducing periods of sea duty the problem of continuity becomes increasingly important. This can no longer be achieved by a system of self-relieving. The

Company has already found the need to change to a form of team-relieving where a team relieves senior staff on several ships. As the ratio of work to leave approaches a 1 : 1 ratio it will be necessary to have two teams appointed to each ship, each team relieving the other in turn. When this happens, it will be the duty of the outgoing crew to ensure that everything is working properly for the incoming crew and that handovers are reduced to a set routine, possibly using the computer to hold all the information. This need to hand the ship over after a short period will also mean that the need for discipline will be that much greater, to ensure that all the work that has to be done gets done. Reducing periods of sea duty is also likely to affect the recreational and social activities. Wives may not wish to accompany their husbands for such short periods. Individuals may not wish to carry out hobbies which involve taking a lot of materials to and from the ship. The author foresees a situation when a programme of television and films (all on cassette tapes) and magazines, etc., would be organized by the Head Office and taken out to the ship by some of the officers travelling to the ship.

Progressive reduction in crew numbers

It has been proposed by the Japanese that a nine man crew would be sufficient to operate a bulk carrier and get it from A to B, and carry out emergency repairs. The Company does not think that ships with such a reduced number will be seen for a very long time, if at all, for the following reasons:

1) it is still cheaper to maintain ships afloat using the ship's staff rather than to take them out of service as, once out of service, they are no longer earning freight;
2) there is a need to carry staff who are being trained, e.g., cadets;
3) additional staff may need to be put on board for mooring/unmooring and possibly assisting with loading/discharging. In such cases, even though they are not on the ship, they should be considered as additional crew.

The author's view is that 10 to 15 is the adequate size of future crews *once ships have been specifically designed to operate with this number of staff*. With two crews to each ship, and additional "back-up" to cover training, sickness, etc., it should be possible to achieve this development with the existing numbers of staff, so that recruitment and training problems should not be any more difficult than at present.

CONCLUSIONS

The Shipboard Management System is a continuing accepted system, which is being used and developed.

The systems provide continuity and this is of increasing importance as the periods staff spend at sea are reduced.

The systems must be updated and developed in line with changing circumstances and audited regularly to make sure that they are being properly maintained and used to improve the way in which work is done on the ship and resources are utilized.

Having established the basic systems and the appropriate control mechanisms the Company is now considering how the tight centralized control can be loosened and people on the ships entrusted to make more decisions themselves. The Company is tackling this in two stages. Firstly, by the introduction of self-monitoring. Secondly, by delegating more authority and accountability to the ships. This will be a gradual process and will depend, in part, on how easy it is to provide ships with the necessary information.

The benefits of this centralized expertise must be made available to the ship, otherwise the Head Office will, in delegating the task to the ship, be in danger of getting the work done less efficiently at greater cost.

Finally, the next developments will involve the design of a new generation of ships which will be run by smaller crews and will incorporate the necessary changes in accommodation, computers, monitoring equipment and so on.

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Discussion

MR. P. SHARPE (Sealife Programme) said that the paper had most lucidly portrayed the application of sound reasoning to the particular problems of managing a tanker fleet. The author might readily agree that the philosophy underlying BP Tanker Company's Shipboard Management System, although modern, was not untested in land-based organizations and industries, particularly in the oil and processing industries. It was, perhaps, not surprising that it was among the oil majors that one found some of the most determined efforts being applied to the adoption of land-based management practices for shipping operations.

The fact that even the household names, including BP, had only found it possible to mount such initiatives in an integrated way within the last six or seven years was, in his opinion, both a testament to the resilience of the shipping industry to change, and also evidence of the sheer technical difficulties of managing ships and seafarers, i.e. basic problems of attitudes and technology.

Early in the programme, Sealife had worked with BP Tanker Management for a time to see what types of change would be possible and how those could be approached. Reactions to the implications of just one possibility alone, that of delegating certain authorities to the ship, graphically revealed the scale of the problem in those same areas of attitudes and technology. When it was learned that that was true of an organization as well versed as any in the advanced arts of management, it was realized that Sealife had difficulties previously unsuspected.

He applauded the Company's persistence and skill in advancing its objectives over such rough ground.

The problem of coping with attitudinal resistance was a large topic in itself and he would not ask Mr. Mackay to say whether he thought it was particularly pronounced in the industry and if so, why? Instead, he would ask him two technical questions:

1) Could he identify compelling technical or economic arguments as to why a "normal" shipping company, say with 10 ships and 40 shore staff, should not seek the objectives and follow the principles set out in his admirable paper?
2) He had recently read a Japanese paper presenting the results of an extensive study into the feasibility of a seven-man ship. The major company concerned had appeared to be convinced that the investment cost of the radical layout and equipment improvements needed to reduce maintenance work to a minimum, would be acceptably repaid by the expected crew cost savings.

He suspected that the Japanese research machine had been busy again and had identified a market for such ships, and had ascertained that they would find ready buyers in the world: even if their own unions would not allow such vessels to be manned with Japanese nationals, they could see other customers for their shipbuilders. In the light of that, might Mr. Mackay not agree that his estimates about the pace of developments in that respect might be conservatively optimistic for the UK shipping industry at large?

MR. J. G. D. CAIN, CEng, MRINA, MIMarE (Sealife Programme) commented that the paper had demonstrated the value of a systems approach towards managing a complex organization.

The concept contained in the paper had formed a model for achieving operationally effective ships and had shown the way a major organization was effectively tackling the change process. The value of such an approach would become increasingly important as a way of coping with change.

The paper had demonstrated the important interaction between technology and manpower. It had been shown that an integrated manpower and technical policy was essential for effective organizational performance: technical excellence alone was not enough. Such policy followed from a clear and explicit management objective.

Mr. Cain's own work in the industry had supported that finding. Yet, arriving at the right balance between the needs of technology and manpower presented major organizational difficulties. There were powerful communication barriers to be overcome. The author's company had successfully overcome many of them and he would ask the following:

1) Getting such a system accepted generated conflict and could produce pain, for many functional divisions were involved in some change. What advice would the author offer to others who wished to go down that road, and what were the major pitfalls to avoid?
2) At times, standard ships made good economic sense. Yet rarely would they satisfy the author's organizational requirements. What would be the best approach by those who produced standard ships so that they would more nearly meet such needs?
3) Imposed technical changes on board, without complementary organizational change, could nullify any assumed technical benefits. Had the author experience of that?
4) Was it indicative of the difficulties of implementing change that only one ship in the fleet had so far incorporated those ideas?

MR. I. JONES, CEng, FIMarE (Sir William Reardon Smith & Sons Ltd.) said that minimization of manpower on board ship could, and did, present great problems when dealing with the necessary automation put on board to carry out the required tasks. Getting specialists to the ships to undertake repairs beyond the means of the ships' officers could, in itself, be an extremely costly and difficult task. It appeared that there was a sensible limit to the minimization of manpower on board ship and to the amount of automation put on board.

MR. P. G. KLEIN (Ship Design Ltd.) asked the author if, to ensure better crew interaction, he had felt the need for further modifications to his conventional accommodation layout, apart from the new office layout.

His own experience had been that a neutral area in conjunction with the office area, which might be used for tea/coffee breaks at sea and "waiting room" space in port, would increase interaction.

CAPTAIN W. LUCAS (The Mercantile Marine Service Assoc.) in a contribution read by Mr. R. G. Boddie, CEng, FIMarE, said that the presentation had been a very realistic analysis of shipboard management problems and had identified major constraints and limitations which affected the degree to which decision-making and budgetry control could be devolved from shore to ship and vice versa.

It had also identified the extended time factor that inhibited communications and had acknowledged the difficulties which could be encountered in transferring data to the source of operation. At the same time, account had to be taken of different trading situations and the fact that systems, which could be operated under world-wide trading conditions in relatively calm tropical waters, would impose excessive strains on those involved in short passage, quick turn-round operations, such as North Sea to UK or Continental ports.

It could not be emphasized too strongly that the degree of management responsibility that could be accepted on board a ship was governed by certain factors which included the geographical limits of the voyage, the climatic conditions likely to be encountered during the voyage, the length and frequency of voyages and the number of ports to be visited.

There was another area of responsibility which could not be completely delegated to the master, i.e. the responsibility for structural and mechanical integrity of the ship unit. Experience was beginning to reveal that, whilst planned maintenance schedules might be a convenient method of adjusting to budgets, expediting quick turnrounds and achieving short lay-off periods, the results fell far short of the standards of watertight integrity and mechanical efficiency achieved following regular overhauls and thorough surveys under the watchful eyes of two independent bodies, i.e. DoT and Classification Societies.

MR. A. R. ANDERSON (College of Nautical Studies) had two questions to ask:

1) Current training patterns gave the deck officer only minimal training in management principles and techniques, whilst the engineer officer received none. The paper had envisaged an increase, and change in direction, of the management role of ships' personnel. How did BP overcome that obvious deficiency in training?

2) Many changes had already taken place and the author had envisaged further changes to the duties and responsibilities of both sea and shore staff within BP. Had he encountered any problems of staff acceptability and, if so, how had they been overcome?

MR. D. C. BOOTLE, CEng, FIMarE (BP Tanker Company Ltd.) made a contribution at the request, and in support, of Mr. Mackay concerning the questions posed by Mr. Anderson about management training for ships' staff, and the involvement of seafarers' unions and associations in the manpower developments that had taken place in BP Tanker Company.

On the first point, to complement the systems' developments to which Mr. Mackay had referred, the Company had for some ten years been involved with various degrees of management training for seagoing staff. That had taken the form of specialized training courses organized by either the General Council of British Shipping and/or Management Training Consultancies. It had been their intention to develop progressively on the one hand, supervisory and leadership skills for the staff while they were relatively junior in rank and, at the other end of the scale, to train the senior officers in more advanced management skills related to getting people to do work in a more systematic and cost effective way. That had been linked to a "management by objectives" approach which had been adopted both ashore and afloat enabling joint objective setting between ship and shore. The responsibility was then placed with the ship's senior staff for setting their own shipboard objectives and work programmes, and that in turn demanded a more systematic and organized approach to achieving such work and objectives. Mr. Mackay's Table III had referred to the managerial role of the Master and had shown that process.

A much stronger link between ship and shore had been established by sea staff briefings and debriefings prior to, and after, appointment to their vessels; joint objective-setting exercises, and work done on their seagoing staff conferences, where groups of multi-discipline seafarers worked together in syndicates considering shipboard problems and making presentations for discussion with the general management team of the Tanker Company. That had led to the development of a better team approach—the team being the shore staff and the ship staff.

To help the ships' officers and crew work better together as a team, several developments had taken place over the previous ten or so years. The initial and, perhaps most significant, change had been the introduction of GP manning as opposed to conventional manning. The training had been adjusted to enable the change to take place and, in its early days, it was not without some problems, particularly in the field of attitude changes to which Mr. Mackay had previously referred. However, GP manning did demand a management team approach on board: work planning was then undertaken by a planning team, which met weekly, consisting of senior officers from each department plus the Chief Petty Officer. The team would discuss, among other things, work allocation and deployment of the crew.

A more recent innovation had been to retain the crew with their CPO as a team, and allow them to move from ship to ship as an autonomous body. The CPO had been given responsibility for his crew in that he had some say in their selection, had control of their training and work allocation and, additionally, was required to report upon their performance through an established staff appraisal system. That change, although in its early days, had had a beneficial effect on the wastage and attitudes of the people and had encouraged ship staff to adopt a whole team approach to ship management and to develop attitudes which were complementary to the aims and objectives of the systems to which Mr. Mackay had referred.

In order to prepare young people coming into the industry, and officer cadets in particular, some changes had also been made to the cadet schemes as a result of various recommendations by the Merchant Navy Training Board where seafarers' organizations, colleges and shipowners were represented. More management, supervisory and legislative studies had been introduced into the cadetships which, hopefully, would give the young officer a much stronger management training foundation upon which to build in the shipboard environment.

To answer the second point briefly, it had been the Company's policy to consult, when appropriate, the various seafarers' organizations when significant changes were proposed, and that had been the case throughout the many stages of the developments to which they had referred.

Author's Reply

The author was pleased at the level of interest the paper had aroused and appreciated the helpful contributions made by the various speakers.

Mr. Sharpe had mentioned the problem of coping with resistance to change in the shipping industry. In his view, the shipping industry did have particular problems. For example, the impossibility of getting all Masters and/or Chief Engineers into the office at the same time for a briefing (compare the position of a sales manager and his salesmen); higher costs of supervision through the inaccessibility of ships; the pronounced gulf between deck and engine departments, and so on. In his experience, it took longer to get the message across, and much more effort had to be expended in so doing.

With regard to the first question, there was, in principle, no overwhelming reason why smaller companies should not adopt the approach outlined in the paper. However, systems development was not cheap and his company had found that the best way was to develop the systems and then to try them out on one ship. When one was satisfied that the systems were working properly and that the necessary procedural instructions had been prepared, the system was implemented on the remaining ships. The composition of the Fleet was crucial. If, in his example of 10 ships, each ship was identical then developing a system (covering perhaps 150 items of equipment) would be confined to one ship, and the remaining nine ships could be provided with copies. However, if all 10 ships were different (manufactured by different shipyards, fitted with different engines, different equipment) then each ship was a "one-off" and the costs for all 10 ships would be very much higher. Therefore, a company needed to be clear from the start of the likely amount of effort and cost involved. The smaller company should then consider whether it would be more economic to buy proven systems from consultants or other shipping companies.

With regard to the second question, he had no doubt that a seven-man crew was theoretically able to operate a ship, in terms of getting it from A to B and loading/discharging cargo, but in practice he felt that a larger crew would be carried for reasons stated in the paper and because of the increasing attention being paid to safety and environmental factors. There was also the question of what minimum manning levels governments would allow for ships sailing under their flag.

Mr. Cain had asked what major pitfalls one should try to avoid when introducing systems. From his experience, the author would suggest that the following points needed to be taken into account:

1) Be prepared for the long haul. Results could not be obtained quickly, particularly when covering a large number of ships.
2) Get the backing of the top management; that was crucial.
3) Involve both Head Office and seagoing staff. There had to be a joint approach as it was fatal if Head Office staff did not support the system and were seen by the seagoing staff not to do so.
4) Proceed slowly and do not try to bring about change by decree. Be prepared to treat ships differently.
5) Get the systems right. Seagoing staff resented systems which were perpetually changing.
6) Go for solving a specific problem.
7) Keep people informed.
8) Develop training courses and workshops.

With regard to Mr. Cain's question on the best approach by those who produced standard ships to ensure that they more nearly met shipowners' needs, the shipowner would have his views on the good and bad points of his existing ships and the things he wanted to put right in the future tonnage: changes in design, or the choice and specification of equipment, fuel economy, time between drydockings, etc. So the starting point had to be for the shipbuilder to get hold of that information by collaborating with a shipowner who had developed a clear and detailed user specification. From that, the shipbuilder must decide how much should be included in the basic standard ship, and what optional standard extras were to be provided for at a given cost. Design workshops to consider particular aspects of the ship, e.g. accommodation, bridge layout, etc., were particularly useful, as was the canvassing of seagoing staff opinion. It was very important to consider not just the first cost of the ship but its likely repair and maintenance costs over its life. There would, however, be occasions when price/delivery dictated the purchase of a ship which did not meet the user's own specification, however clearly and concisely that had been defined.

Mr. Cain's third question had suggested that imposed technical changes on board, without complementary organizational change, could nullify any assumed technical benefits. That had come up in several instances in implementing their system. In the first case, his company did not involve the Marine and Engineering Superintendents attached to the Fleets early enough, with the result that when visiting ships, they did not know enough about the system to handle queries and that left the ships' staff in some doubt as to shore involvement and underwriting of the systems. The second case, when BPTC revised its Planned Maintenance System by introducing condition monitoring, it looked as though the speed of implementation would be constrained by the number of implementation teams available to visit the ship to install the system. That involved drilling holes to fit sensors to equipment and then taking readings with the vibration analyser to establish the normal pattern. It was suggested that the process could be speeded up by sending the equipment to the ships for the work to be done by the ships' staff. Their experience was that it did not happen in many cases, because of the Officers' unfamiliarity with the equipment and their not always having the time to do such work.

The contributor's last question had been based on a misunderstanding. All BP's ships had had the system installed—the author's point had been that, because the building programme was so far advanced at the time of implementing the system, it was only possible to install the Central Office described in the paper on one of the later VLCCs. In other ships, the Company had had to settle for an enlarged Chief Engineer's Office. That reinforced his plea for future requirements to be considered well in advance of any building programme so that they could be incorporated in the user specification.

In answer to Mr. Klein's question, the Central Office concept had highlighted the need to review all the accommodation needs with particular reference to dining and recreational facilities. He would hope that they would use a design workshop to produce alternative solutions which could be presented on videotape, together with a questionnaire, and sent to ships for their views to be canvassed.

Mr. Mackay was in basic agreement with Captain Lucas's contribution regarding the difficulties of implementation and the need to take external factors into consideration. He also agreed that with some maintenance systems, particularly those on a calendar basis, there was no guarantee that the work had been carried out to a satisfactory standard. However, with condition monitoring systems where the work done could be checked on completion, that not only assured the Chief Engineer that the work had been done properly and the equipment had been restored to its proper working level, but also the record of equipment readings over time was being accepted by Classification Societies as evidence that the machinery was in good condition and did not need to be opened up specially for survey.

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