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Effective Manning of the U.S. Merchant Fleet

Committee on Effective Manning

Marine Board

Commission on Engineering and Technical Systems

National Research Council

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PREFACE

ORIGIN OF STUDY

In recent years, ship operators, maritime unions, and governments in the maritime nations of Europe and Asia have made substantial productivity gains through more effective manning of merchant vessels. This has been accomplished through various combinations of shipboard automation, changes in ship operating company and vessel crew organization, and government maritime policies. The need to enhance the competitiveness of the U.S.-flag fleet has raised interest in the productivity improvement that might be realized through innovations in manning practices, and in the costs and consequences.

At the request of the Maritime Administration, the Marine Board of the National Research Council established the Committee on Effective Manning. Members of the committee included persons with backgrounds in maritime labor union management, U.S.-flag vessel operations management, and U.S. government oversight of vessel operations and safety. Other expertise on the committee included a labor mediator with experience in maritime labor issues, a scholar whose research focuses on the effect of technology development on the American work force, a social psychologist who was involved in a number of effective manning experimental projects undertaken in Northwestern Europe, and an expert in technical aspects of vessel design and operation. Consistent with the policies and programs of the National Research Council, appropriate balance of perspectives was an important consideration in choosing committee members.

SCOPE OF STUDY

The charge to the committee was to provide technical background and analysis in support of management, labor, and government decisionmaking regarding the means and process by which effective manning may be best accomplished in the U.S.-flag merchant fleet. The committee assessed the experiences of other countries with manning innovations, the similarities and differences between the United States and other countries in the conditions and factors important to implementing such changes, and the considerations important in making decisions about effective manning of the U.S.-flag fleet. Among the factors considered were the safety and efficiency of vessels, and opportunities presented by new technology, management of change, and organization of crews. The committee directed its assessment to providing a basis for decisions and policy. It did not formulate a plan of action or select from candidate alternatives for manning.

The committee's interest extended beyond manning innovations to their impacts on safe and economic operation, and to the mitigation of side effects such as unemployment, altered career paths, and changes in the nature of shipboard work and quality of shipboard life.

The committee addressed a number of issues:

Changes Aboard Ship

- How far can manning levels be adjusted at various levels of existing and proposed technology and still operate efficiently and safely?
- What changes in the organization of crews will need to be accomplished?
- What technological innovations will be required?
- By what method(s) will the safety and efficiency of crews be assessed?

Changes in the Operation of Ship Operating Companies

- What corresponding manning and organizational changes should be made in shipping company offices?

Other Impacts

- How must training programs be instituted or modified to correspond to new organizational forms?
- What regulatory legislative reform must be accomplished to permit vessels to operate at these levels and with new organizations of crew?
- What contractual and/or government policy innovations have accompanied manning adjustments to obviate or mitigate the human costs of increased productivity (e.g., construction programs and retraining schemes)?

CONDUCT OF STUDY

The committee conducted its assessment by means of an information-gathering trip to Northwest Europe, a workshop involving government, industry, and labor participants, and a literature review, which produced an extensive bibliography (Chapter 7).

In June 1983, members of the committee conducted interviews with ship operators, union leaders, government administrators, and researchers in England, Sweden, Denmark, Germany, Norway, and the Netherlands. A list of interviews and discussion topics used by the committee in the interviews appears as Appendix A. The interviews provided an unparalleled opportunity to put the committee's questions directly to researchers and the government, industry, and labor leaders most closely involved with manning innovation in the maritime industry. Committee members gained insight into the motivations of the various interests in and parties to manning innovation, and the intricacies of their involvement. The committee documented its observations of European experience with manning innovation in a working paper.* The observations in the working paper are based on what the committitee learned through interviews, and on literature reporting on overseas innovations. The persons contacted and interviewed in Europe are not necessarily representative of the European maritime industry, since the committee sought out the companies and individuals most heavily engaged in manning innovations.

The working paper provided the committee with a basis for comparison concerning organizational change that might be considered in the United States. Copies of the working paper were provided to U.S. government, industry, labor, and research principals who were invited to a committee meeting, held at the Maritime Institute of Technology and Graduate Studies (MITAGS), Baltimore, Maryland, in October 1983, to consider with the committee the European experience and how manning innovations might best be accomplished in the United States. The participants in and agenda of the meeting are provided in Appendix B. To foster free exchange of information at the meeting, no written record was kept. The meeting enabled the committee not only to discuss the prospects for manning innovation with its guests, but also to bring to their attention the accomplishments that have been achieved overseas.

The committee's observations of European experience and of the attitudes and experiences of U.S. principals provide a basis for this report. The committee's report is, accordingly, based on committee activities and the professional experience of committee members.

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*Much of the material in the working paper appears in Chapter 4 of this report. Limited copies of the working paper are available from the Marine Board, National Research Council, 2101 Constitution Avenue, N.W., Washington, D.C. 20418.

CONTENTS

1

SUMMARY, CONCLUSIONS, AND RECOMMENDATIONS

In the last 20 years, some ship operating companies, notably those in Northwestern Europe and Japan, have accomplished substantial manning productivity gains through various combinations of shipboard technology, changes in ship operating company and vessel crew organization, and government maritime policies. The need to encourage the competitiveness of the U.S.-flag fleet has raised interest in the productivity improvement that might be realized through innovations in manning practices, and in the costs and consequences.

At the request of the Maritime Administration (MarAd), the National Research Council established the Committee on Effective Manning under the auspices of the Marine Board. The charge to the committee was to provide technical background and analysis in support of management, labor, and government decision making regarding the means and process by which effective manning may be best accomplished in the U.S.-flag merchant fleet. The committee conducted its work by means of review of both published and nonpublished information, an information-gathering trip to Northwest Europe, and a meeting of the committee with U.S. government, industry, labor, and research principals in ship operations. This section presents the committee's summary, conclusions, and recommendations.

SUMMARY AND CONCLUSIONS

"Effective manning" encompasses innovations in the crewing of merchant vessels, including number of personnel and functional organization, to improve cost-effectiveness, the human environment of the workplace, and safety. It also includes supporting innovations in vessel design and operating technology, the management structure and operating practices of ship operating companies, the policies and practices of labor unions, government regulations and programs, and the structure and process of collective bargaining. Some manning changes that increase productivity have adverse socioeconomic effects, i.e., they decrease employment and increase workloads. These frequently are coupled with compensating increases in wages and prerequisites.

However, other manning innovations have the potential for simultaneously increasing productivity and improving working conditions, e.g., new types of training, increased flexibility regarding assignment of duties within and across departmental lines, and crew participation in work planning aboard ship.

Effective manning changes characteristically consist of smaller complements of seafarers tasked with enlarged technical and managerial responsibilities. The shipboard changes are enabled or supported by technology advances and changes in shore support, management duties, and logistics. The range of innovations includes changes in vessel design, technology and equipment; the organization of crews; and union/company arrangements, shoreside support, and individual corporate policies.

Changes in vessel design, technology, and equipment have included automated engine room, changes in maintenance requirements, schedules and responsibility, and bridge and navigation automation. They have also encompassed changes in mooring, anchoring, and cargo operations to minimize manpower requirements, as well as improvements in communications and superstructure design.

Changes in the organization of crews have included intradepartmental flexibility (i.e., enlarging mariners' duties within the individual deck, engine, and steward departments), interdepartmental flexibility (i.e., assigning mariners duties in different departments), departmental integration (i.e., general purpose crew, and integrated officers), shipboard management teams, and more participative work planning.

Notable changes in union/company arrangements, shoreside support, and individual corporate policies have been longer-term association of employees with ship operating companies and with vessels, efforts to close the traditional status gap between officers and other crew, and decentralization of ship operating company management to place more decision-making authority onboard.

As important as the substance of the innovations is the process by which they have been developed and implemented. The process of change has been led by individual companies. Government agencies, shipping associations, trade unions, and research institutes have played roles, but have been more successful in cooperative efforts with innovating companies.

Based on the Northwest European and Japanese experience with effective manning, the committee was able to identify the key elements of the change process. These are: (1) leadership in the form of top management commitment; (2) union, management, and government cooperation; (3) the opportunity for participants, especially crew, to discuss, review, and shape the innovations; and (4) efforts to achieve a high level of crew continuity to prevent constant drain of newly acquired skills and value.

In Europe, the rate of diffusion of manning change and the quality of the innovations were enhanced through mechanisms for participants to meet and exchange experience. Furthermore, most manning changes entailed upgrading the technical skills of participants as a result of expanded responsibilities and organizational change.

Some manning changes in Europe and elsewhere have violated laws or practices and required variances, which have had to be modified to enable diffusion of manning changes in the industry. In those instances where seagoing billets have been reduced and mariners' workloads increased, seafaring unions and their members have negotiated appropriate compensation.

U.S.-flag oceangoing general cargo vessels carry crews of about 40, and tankers carry about 30. Ship manning levels can be reduced to about 30 for container ships and 20 for tankers with the adoption of automation technologies which eliminate the necessity of engine-room watchstanding and reduce the labor element of several shipboard tasks. Reorganization of shipboard work to employ unlicensed mariners and officers capable of performing both deck and engine duties would reduce manning requirements by several more billets.

The traditional maritime nations of Northwest Europe and Japan embarked on a transition away from traditional manning and organizational practices in the mid-1960s to early 1970s for two principal reasons. One, they were eager to improve the attractiveness of the seagoing career to alleviate a shortage of manpower; a better educated labor force with employment options ashore was less willing to accept existing shipboard working conditions. Two, operators wished to reduce operating costs to compete better with the expanding low-labor cost fleets of the third world and flags of convenience, and the heavily subsidized fleets of the Eastern bloc countries.

Effective manning changes simultaneously improved the satisfication of mariners with a seagoing career and the efficiency of operations. At the same time, the nature of the manning changes coincided with larger national commitments to greater involvement of workers in job-related decision making. The interest in manning innovation in Europe and elsewhere led to the formation of long-term research programs, information-sharing networks, and an awareness of the mutual management and labor gains achievable through cooperative efforts. Interest overseas has been strengthened as a result of the challenges posed by the international shipping depression which has extended from the late 1970s to the present. Ship operators and seafaring unions are engaged in many individual and cooperative projects to improve the effective use of seagoing labor.

The U.S.-flag merchant marine also has undergone some manning changes. Some modest crew reductions have been based primarily on technological advances. Fewer innovations have been directed toward improving the productivity, safety, and job satisfaction of mariners. Changes that have taken place seem not to build on one another, nor have they been widely diffused throughout the industry. There is, however, some evidence that competition is having a favorable effect on the introduction of effective manning practices into the U.S.-flag fleet.

The economic challenges faced by U.S. operators and unions today are similar to those facing European and Japanese counterparts. There is a strong incentive to minimize the costs and maximize the contribution of seagoing labor, and in all traditional maritime nations, there is currently an oversupply of mariners.

Differences, however, do exist. The U.S. operators are faced with a sizable unfunded pension liability. The median ages of the U.S. seagoing work force and vessels are far older than overseas counterparts. With the exception of temporary shortages of manpower in certain segments of the merchant marine, U.S. operators have not experienced a prolonged shortage of manpower which overseas stimulated interest in effective manning.

RECOMMENDATIONS

The question arises, how best can innovations in the manning of vessels be developed and introduced in the U.S. merchant fleet? Changes are required at two levels--the industry/institutional level and the company/union level. Cooperation is essential at both levels, although the focus at each level will be different.

At the industry level, the task includes addressing obstacles to change, especially certain laws and regulations and unfunded pension liabilities. Industry level initiatives also are required to ensure that the curricula of the U.S. maritime training institutions keep pace with changing manning concepts. These initiatives require the cooperative work of management, unions, and in some instances, government. The multiplicity of separate and sometimes competing maritime unions deserves the priority attention of union leaders.

Another set of initiatives at the industry level can encourage manning changes: workshops which permit potential participants to learn about and assess alternative manning concepts and strategies for introducing change; workshops which enable actual participants in change projects to exchange experience; and research which documents the lessons learned from change efforts.

Specific effective manning changes should be conceived, approved, monitored, and evaluated at the company or ship-specific level--by union and management. It is at this level that the parties themselves determine the manning policies that fit their particular circumstances, the pace of change, any constraints, and economic and human goals to guide their efforts.

Although the removal of constraints at the industry level will improve the climate for innovation and will permit more substantial changes in manning policies, there is no reason why company initiatives should wait for those changes. Some innovations are now possible. As a case in point, the committee considers that it will take considerable time and effort on the part of companies, unions, and the government to resolve the unfunded pension liability problem. While resolution of this problem is likely to affect union participation in manning changes, experimental efforts directed at, for example, crew continuity on the vessel must not wait for that problem to be solved.

To remove barriers in laws and encourage manning experimentation and innovation, the committee recommends that the Coast Guard initiate changes in U.S. laws, rules, and policies. Remedies for the following should be developed and enacted or implemented:

- Specific manning requirements, such as that for a radio officer, may no longer be necessary in light of technological advances and state-of-the-art equipment installed on U.S.-flag ships.

- The situation of conflicting statutes and judicial interpretations concerning the three-watch law and related laws has become even more confusing as a result of technology advances which have obviated the necessity of many watchstanding duties, especially in the engine department.

- The "Crossover Law" (46 USC 8104 (673)), which stipulates that the seafarer may not serve in both deck and engine departments in a single voyage, and the statutory division of deck and engine licenses may no longer be productive or necessary in light of technology advances and shipboard organizational developments that have been demonstrated overseas.

- Updating of the unlicensed mariner designation in regulations and on certificates of inspection would seem to be required as the result of the recent recodification of Title 46, U.S. Code. The revised law requires that a seafarer's documents specify the ratings in which the seafarer is authorized to serve. The law requires further that the seafarer be authorized for service in the capacity in which he is employed.

If timely and complete change is not deemed likely, the Coast Guard should establish an administrative mechanism providing exceptions to rules on a case-by-case basis to allow experiments in effective manning.

For its part, MarAd should review the effect that the Operating Differential Subsidy program has on the climate for innovation, and on maritime training in the United States. It then should develop alternative government programs that provide for the national defense while also providing necessary incentives for ship operators to innovate and operate ships as cost effectively as possible, and which also promote continued excellence of maritime training in the United States.

To effect specific changes in vessel manning, the committee proposes that individual companies or unions, or combinations of companies and unions, as appropriate:

- o Enter into discussion with respect to initiating experiments in effective manning.
- o Agree to modify labor agreements as necessary to accommodate these experiments.
- o Seek temporary relief from regulations to implement change experiments aboard ship.
- o Canvass training schools and related facilities for assistance in launching these experiments.

Based on the Northwest European experience, the labor-management discussions should concentrate on such important items as continuity of employment aboard the vessel, redistribution of shipboard labor and job responsibilities between ship and shore, and other changes that may be available as a result of existing or new technology and do not require resolution of industry-wide obstacles to change prior to their enactment.

The discussion of manning ideas and possibilities among specific prospective participants can be instrumental to promoting and launching effective manning changes in the United States. MarAd can play an important but limited role in this as a catalyst. It could, for example, coordinate the formation of an industry-operated Ship Operation Research Center, as recommended by an earlier National Research Council report (National Research Council, 1983), to promote information exchange on ship operation innovation, including effective manning.

Finally, the committee recommends that MarAd convene a second conference on effective manning similar in format to the first conference, about six months after the public release of this report, in order to stimulate an industry dialogue on effective manning and encourage specific initiatives.

2

EFFECTIVE MANNING

"Effective manning" encompasses innovations in the crewing of merchant vessels, including both the number and functional organization of the crew, which improve cost-effectiveness, the human environment of the workplace, and safety. It also includes supporting innovations in vessel design and operating technology, the management structure and operating practices of ship operating companies, the policies and practices of labor unions, and government statutes, regulations and programs, and the structure and process of collective bargaining. Some manning changes which increase productivity have adverse socio-economic effects, i.e., decreasing employment and increasing workloads. These frequently are coupled with compensating increases in wages and prerequisites. However, other manning innovations have the potential for simultaneously increasing productivity and improving working conditions, e.g., interdepartmental flexibility, decentralized decision making, participative work planning, employment and assignment continuity, and increased training.

Effective manning became an objective in the early 1960s when vessel operators in Northwest Europe and Japan sought to take advantage of shipboard automation to reduce their operating costs, in part by reducing crew, as a counter strategy to the more cheaply manned and operated fleets of developing nations, flags of convenience, and the more heavily subsidized fleets of Eastern bloc countries. Since labor costs prior to the 1973 oil crisis contributed heavily to the operating expenses of ship operating companies in industrialized countries, crew reductions were eagerly sought by management. The high cost of labor was not, however, the only stimulus. The severe and chronic shortage of maritime manpower throughout the worldwide fleet expansion of the 1960s and early 1970s was a strong inducement for management, labor, and government to be flexible with regard to negotiated and legislated manning scales and work practices. (In contrast, rarely has the United States had a shortage of maritime manpower except in time of war.) The initial manning reduction efforts of the 1960s also coincided with Northwest European government and industry commitment to industrial democracy, and concern for the quality of working life.

Manning innovations have characteristically consisted of smaller complements of seafarers tasked with enlarged technical and managerial responsibilities, usually on newly constructed, often highly automated vessels. These technological and organizational innovations have been accomplished by various means. In many cases, they have been developed through research efforts of individual companies and their unions, sometimes drawing expertise from larger multicompany shipping association research projects. Government agencies have sponsored basic and applied research preceding shipboard experimentation, and occasionally have provided monetary support for the experiments. Government agencies also have provided regulatory variance when necessary for experimental purposes, and made permanent regulatory changes consequent to experimental success. A more recent role played by government has been the active promotion of integrated technical and organizational innovations (i.e., ships, equipment, and crew structures) leading to highly competitive new ship construction. Promotion, in this case, consists of hinging builder and/or operator subsidization on participation in substantial research programs, including shipboard experimentation. West Germany's Ship of the Future program (Schiff der Zukunft) and Japan's Modernization of the Japanese Seafaring System and Shipbuilding programs are examples of this approach.

In contrast to the manning innovations tried and made in the merchant fleets of Northwest Europe and Japan, comparatively little has been tried or accomplished in the United States. Most U.S.-flag merchant vessels operate at manning levels higher than those of competing fleets. No programs have been developed in this country to harness the best cooperative efforts of management, labor, and government to make the United States fleet more competitive.

The worldwide maritime business climate has changed in many ways since effective manning became an issue. A sharp economic reversal has beset the ship operating industry from the mid-1970s to the present. Maritime manpower is in oversupply. The price of bunkering and the cost of capital have surpassed and overshadowed manning costs in their proportional contribution to total vessel operating expense. Yet competition continues to intensify as a result of the shipping recession. Thus, manning reduction and attendant organizational innovations continue to be attractive objectives. Although increased fuel efficiency and reduced capital costs also are important goals, government, industry, and labor all agree that manning innovations will be important to the competitiveness of the U.S.-flag fleet. The means of accomplishing the necessary changes is the basic issue.

3

STATUS AND MANNING OF THE U.S. MERCHANT FLEET

STATUS

In this report, the U.S. merchant fleet is considered to comprise U.S.-flag, privately owned, self-propelled oceangoing vessels over 1,000 gross registered tons.* This definition includes nearly all U.S.-flag ships in international trade and the major ships in the domestic, coastal, and offshore trades. It excludes inland, service, and fishing craft, as well as the numerically larger fleets of U.S. corporations registered in other countries. Table 1 describes the U.S. merchant fleet, and compares it to the U.S.-owned foreign-flag fleet. The median age of U.S. merchant vessels is 17 years; that of the world's merchant vessels is 13 years.

Table 2 documents the long-term decline of the U.S. fleet. From a high at the end of the Second World War, the U.S. merchant fleet had fallen to fourth place in shipping tonnage by 1960, with 1,008 ships representing 5.8 percent of the world fleet. By 1981, the U.S. merchant fleet had dropped to eleventh place, with 578 ships representing 2.3 percent of world vessels. In this same period, U.S. trade declined from 50 percent to 30 percent of world trade. The percentage of that trade carried by the U.S. merchant fleet has dropped to 4.6 percent. The fleets of five foreign countries now carry as much or more U.S. cargo as the U.S. fleet. Prospects are dim for any dramatic change in the status of the U.S. merchant fleet.

A drop in the number of seagoing billets has accompanied the decline of the U.S. fleet. From a high of 168,000 billets after the Second World War, there were 49,000 billets in the U.S. merchant fleet by 1960 . By July 1982, there were 18,826 billets (see Table 3). With billets filled primarily on the basis of seniority, the median age of the seafarers has risen to 54 years, which is substantially higher than the world average.

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*Much of the data in this section were provided by the Maritime Administration to the U.S. Congress Office of Technology Assessment (OTA) and published (OTA, 1983).

TABLE 1 Status of U.S. Merchant Fleet and Effective Control Fleet, January 1, 1983

Vessel Type	U.S. Merchant Fleet			U.S.-Owned, Foreign-Flag Fleet	
	Number	Median Age	Tons Capacity dwt ($x10^6$)	Number	Tons Capacity dwt ($x10^6$)
General Cargo	240	16	4.31	73	.52
Break bulk/partial container	104		1.40	52[a]	.33
Container/ship	97		1.86	10	.02
Roll-on/roll-off	18		.27	6	.01
Barge carriers	21		.76	5	.13
Bulk Cargo	18	22	.61	106	6.46
Tankers	233	18	14.22	259	39.42
Special Products/Liquefied Natural Gas	33		1.6	27	.79
Other (coastal, passenger)	17	22	.11	1[b]	.01
TOTAL	541	17	20.85	466	47.20

[a] Includes refrigerator ships.
[b] Passenger only.

SOURCES: U.S. merchant fleet data: Ship Register, Military Sealift Command, U.S. Department of the Navy, Washington, D.C., January, 1983. Vessel age obtained from A Statistical Analysis of the World's Merchant Fleets, annual, U.S. Maritime Administration. U.S.-owned, foreign-flag fleet data: Federation of American Controlled Shipping, March 1983.

TABLE 2 U.S. Merchant Fleet 1970-1983

	Cargo		Tanker	
	Number	Tons Capacity dwt ($x10^6$)	Number	Tons Capacity dwt ($x10^6$)
1970	1,479	15.44	301	7.83
1975	612	8.17	279	9.43
1980	553	7.87	310	16.10
1983	308	6.64	233	14.22

SOURCE: Employment Report of the United States Flag Merchant Fleet Oceangoing Vessels 1,000 Gross Tons and Over, annual, U.S. Maritime Administration. Data for 1983 are from Table 1.

TABLE 3 Seagoing Employment 1960-1982[a]

Year	Employment (x103)
1960	49.2
1965	39.1[b]
1970	37.6
1975	20.5
1980	19.6
1982	18.8

[a] Estimates of billets on U.S.-flag merchant ships, 1,000 grt and over. Excludes vessels on inland waterways, Great Lakes, and those owned by or operated for the U.S. Army and Navy. Ratio of billets to seafarers is about 2:1.

[b] Decrease due to strike.

SOURCE: U.S. Maritime Administration, 1982.

About 70 companies operate the 541 U.S. merchant ships. Nearly half of these own 5 or fewer vessels; 12 companies operate just 1 ship, and another 12 own 2 apiece. Such figures, taken with the world trade picture, describe a very competitive operating environment both in obtaining cargoes and in keeping operating costs down, and one in which the U.S.-flag operating industry is in a relatively weak position.

Compounding the competition of companies is the multiplicity of unions. There are many maritime unions. Eleven national unions represent 89 percent, or 16,259, of the existing billets. Several unions represent each seagoing discipline. Typically, several unions are represented on each ship. The atmosphere of industrial decline has placed the unions in competition with each other to defend or increase their representation.

A germane problem facing the labor unions and ship operators as a result of the decline in billets and the aging of the work force is the obligations of employer-funded pension plans. Several long-run observable trends are likely to have a measurable effect on the pension plans of the industry. These trends include a gradual decline in the number of deep-sea vessels, the number of vessel operating companies, and average crew size. Obviously, if the above-noted long-run trends continue, they will result in a smaller active seafaring labor force. At the same time, the total number of retired mariners to whom pension benefits are owed will increase substantially; concurrently, the amount of contributions to pension plans will decrease. As a result, pension plans may face severe financial strains; payouts to eligible retirees may significantly exceed receipts from employer contributions and fund earnings.

U.S. General Cargo Fleet

Great changes have taken place in the U.S.-flag general cargo fleet. In the last 15 years, the fleet has changed from mostly small multi-purpose general cargo carriers to large container ships.

The U.S.-flag general cargo industry comprises 8 major ship-operating firms with fleets ranging from 3 to 46 vessels (OTA, 1983). The three largest firms own and operate over half of the total tonnage. Seven of the major firms operate under the U.S. Maritime Administration's (MarAd) Operating Differential Subsidy (ODS) program, which uses direct subsidies to cover the cost differential of foreign-flag ships operating on the same trade route. One of the largest firms, Sea-Land, does not receive direct subsidies.

The percentage of U.S. trade carried aboard U.S. general cargo ships has increased 30 percent over the past decade, while the U.S.-flag industry has remained rather constant in tonnage capacity. However, the fleet has changed in character, improved its productivity, and moved toward offering intermodal services.

Through productivity improvements, subsidy, cargo preference, and marketing practices, the U.S.-flag general cargo fleet has maintained a healthy share of U.S. foreign trade despite effective foreign-flag competition. The U.S.-flag share was 27 percent in 1981, up from 22 percent in 1967. It peaked in 1974-1975 at approximately 30 percent. Most of the productivity improvement has been the result of technological innovation, especially vessel specialization and the application of intermodal concepts.

The crew size of the U.S.-flag general cargo ships has been declining, in part because of technological innovations and labor-management agreement. Net cost savings, however, are offset by expenses associated with the automated equipment and increases in shoreside contracts for maintenance and repair formerly performed by shipboard personnel. Discussions with maritime unions to decrease personnel requirements are likely to continue since the technology exists for further reductions in crew size. The fact remains that the cost of operating U.S.-flag general cargo ships is higher than foreign-flag costs, and that crew costs are a significant factor in this (Ackerman, 1982).

Expenses for subsistence, stores, and supplies are usually proportional to crew size. The costs to U.S. operators of maintenance and repair also are higher. U.S. insurance costs reflect the higher capital costs of ships built in the United States and the fact that settlements made to, and court judgments in favor of, injured U.S. seamen are considerably higher on the average than comparable foreign settlements.

Another significant reason for high U.S. operating costs is fuel. Most of the U.S.-flag general cargo fleet is still powered by steam turbine engines which are much less efficient than modern slow-speed diesel engines which predominate in foreign-flag ships. That portion of the differential, however, should lessen as new U.S. ships come into the fleet. The newer vessels, in general, have greater cargo capacity.

Given higher operating costs, special assistance has been used by the U.S. general cargo operators to compete in world trade. Construction and operating subsidies have helped, as have U.S. preference cargoes. Strong marketing efforts have contributed. The advances noted in ship and cargo-handling productivity also have played a role. It should be noted, however, that no new operating subsidies have been awarded recently, nor are they planned. The last ship to receive a construction subsidy was delivered in 1983, and the policy of reserving cargoes for U.S. ships is being debated in the administration and Congress.

Productivity improvements have helped soften operating cost disadvantages. While the general cargo fleet declined from 403 ships in 1971 to 303 ships in 1976, ton-miles of cargo carried increased 11 percent (National Research Council, 1976). In the future, U.S. general cargo ships should become more cost competitive as older ships are replaced or upgraded with modern, automated, diesel-propelled vessels.

U.S. Oceangoing Bulk Fleet

Worldwide, there is an oversupply of tonnage in the bulk trades, both dry bulk (e.g., iron ore, coal, and grain) and liquid bulk, especially petroleum and petroleum products.

The U.S.-flag dry-bulk fleet operating internationally comprises 23 vessels. Ten of these vessels are 10 years old or less; 9 are 20 or more years old. The fleet operation costs are much greater than that of competing foreign fleets. Crew costs account for the major difference. Expenses for crew and fuel account for a higher proportion of operating costs for bulk ships than for general cargo ships, limiting the opportunities to reduce the cost differential through efficiency improvements in other operating cost components. As a result of this situation, the U.S. dry bulk fleet operates primarily to carry the protected trade of government preference cargoes.

The U.S.-flag foreign trade tanker fleet is similarly burdened by higher operating costs than the world fleet. This fleet is small and attracts little business in the higher volume international markets.

The U.S.-owned, foreign-flag tanker and dry-bulk fleet is cost competitive worldwide. This fleet serves a large portion of U.S. international trade and foreign-to-foreign trade routes. Available cost and technology advantages generally have been adopted by this fleet.

The Coastwise and Noncontiguous Domestic Fleet

The coastwise and noncontiguous domestic waterborne trade of the United States is reserved for U.S.-built, U.S.-flag vessels by the Jones Act. Table 4 describes the U.S. coastwise and noncontiguous domestic fleet. The table shows that tankers account for 93 percent of the U.S. coastwise and noncontiguous fleet.

Most dry-bulk coastwise and noncontiguous domestic cargo is carried on barges. Table 4 excludes barge operations, which are increasingly important because of their lower capital and operating costs.

The coastwise and noncontiguous domestic general cargo trades have been stable for some time. Their growth has paralleled U.S. economic growth, which is presently modest--3 percent per year.

MANNING OF THE U.S. MERCHANT FLEET

Different operating environments--differences in ship types, services, subsidy, and crew and company organizations--make it difficult to interpret comparisons of manning levels. The data in this section should be treated as indicative and not conclusive.

TABLE 4 Active U.S. Coastwise and Noncontiguous Domestic Fleet as of May 1, 1983

	Number of Vessels	Capacity (dwt)
General Cargo	34	484,000
Bulk cargo	7	202,000
Tankers	175	9,139,500
TOTAL	216	9,825,500

SOURCE: U.S. Maritime Administration, 1983.

A 1982 analysis of the manning of the U.S. merchant fleet is summarized in Table 5. The table does not take into account a number of relatively new U.S. vessels, which are manned with crews of less than 24. Most of these vessels are in the domestic (Jones Act) trade, employ diesel power plants, and have automated engine rooms. Table 6 compares the manning of newer and older U.S. ships of comparable size and service. Representative European vessels with a number of manning innovations are also shown for comparison. Again, Table 6 is not truly representative of a number of new U.S.-flag vessels, which are manned with crews of less than 24. Table 7 provides a crew size distribution for the U.S. fleet.

The cost of manning is even more difficult to quantify than manning levels, because of differences in wages, fringes, benefits, pensions, overtime policies, and crewing from vessel to vessel, company to company, and union to union. International comparisons are even more complex because of different national policies. Seafarers may receive benefits such as health care, preferential tax treatment, and retirement from national plans and not from their employers. Table 8 provides vessel characteristics and operating expense data for three classes of U.S.-flag ships: general cargo (Mariner class), modern large container ship, and modern large tanker. In the examples in Table 8, manning costs range from 15 to 30 percent of the vessel operating cost. Manning costs tend to be relatively lower on more modern, specialized ships.

Whatever the exact percentage, manning is a major operating cost, along with fuel and the capital (debt service) costs. As or more important to the operator than costs is cash flow. A C8 container ship carrying a full load of containers between the United States and Europe will generate between $3 million to $4 million in operating revenue. During the voyage, including loading and unloading time, operating expenses as defined in Table 8 might amount to $300,000 to

TABLE 5 Typical Manning of U.S. Merchant Vessels[a]

Vessel Type	Deck		Engineers		Steward Dept.	Total
	Licensed[b]	Unlicensed	Licensed	Unlicensed		
Dry Cargo	6	11	6	8	8	39
Tankers	5	10	4	6	5	30
LNG Carriers	5	11	5	6	5	32
Chemical Carriers	6	11	5	7	6	35

[a] Some rounding and averaging of data entries have been made.
[b] Includes one radio officer.

SOURCE: U.S. Maritime Administration, 1982.

TABLE 6 Manning Comparisons

Vessel Type	Older U.S.	Newer U.S.	European and Japanese Advanced[a]
Cargo Vessels			
1950s-era General Cargo Ship (17,000 dwt)	45		
Modern Large Container Ship (33,000 dwt)		34	18-25
Modern Dry Bulk (45,000-63,000 dwt)		23-30	
Roll on/Roll off (21,000 dwt)		34[b]	16-24
Tankers			
T-2 Tankers	27-38		
37,000-50,000 dwt		21-23	20

[a] From Table D-1 in Appendix D.
[b] One U.S. vessel operates with a crew of 21.

SOURCE: U.S. Maritime Administration, 1982.

TABLE 7 Distribution of Crew Size by Ship Type--U.S.-Flag Fleet

Operation	200+[a]	90+[a]	40/47	35/39	30/34	24/29	20/24	19-
Subsidized Liners	-	4	88	62	12	2	-	-
Nonsubsidized Liner/ Bulk	2	-	20	45	12	8	7	3
Major Oil Company	-	-	-	2	44	32	7	5
Ind. Tanker Operators	-	-	14	25	44	75	2	-
Chemical/LNG/Sulfur	-	-	-	7	12	-	-	-

[a] Passenger vessels.

SOURCE: U.S. Maritime Administration, 1982.

TABLE 8 Vessel Characteristics and Expense Data

Vessel Characteristics	Estimated Daily Vessel Expenses[a]	
Mariner Class (C4 breakbulk)	Wages & fringe benefits	$ 9,765
13,000 dwt.	Subsistence	340
built 1965	Stores, supplies, equipment	543
crew 40	Maintenance & repair	1,551
steam turbine (automated engine room)	Insurance	1,004
fuel consumption/day 590 bbls. (at sea)	Fuel	17,700
Domestic Market Value $2.7 million	Debt Service	1,109
	Other	110
	TOTAL	$32,122
Modern Large Container ship (C8)	Wages & fringe benefits	$10,730
27,500 dwt.	Subsistence	332
built 1972	Stores, supplies, equipment	724
crew 39	Maintenance & repair	2,069
steam turbine (automated engine room)	Insurance	1,750
fuel consumption/day 960 bbls. (at sea)	Fuel	28,800
Domestic Market Value $23.5 million	Debt Service	9,657
	Other	140
	TOTAL	$54,202
Modern Large Container Ship (Diesel)	Wages & fringe benefits	$10,535
42,000 dwt.	Subsistence	357
built 1980	Stores, supplies, equipment	676
crew 34	Maintenance & repair	2,740
diesel (automated engine room)	Insurance	2,504
fuel consumption/day 1,050 bbls. (at sea)	Fuel	31,500
Domestic Market Value $110 million	Debt Service	45,205
	Other	205
	TOTAL	$93,722
Tanker (such as in Alaska trade)	Wages & fringe benefits	$ 8,300
120,000 dwt.	Subsistence	230
built 1975	Stores, supplies, equipment	830
crew 27	Maintenance & repair	2,765
steam turbine (automated engine room)	Insurance	2,092
fuel consumption/day 800 bbls. (at sea)	Fuel	24,000
Domestic Market Value $42 million	Debt Service	17,260
	Other	145
	TOTAL	$55,622

[a] Fuel calculated at $30/bbl.; debt service calculated at 15 percent per annum of market value.

SOURCE: U.S. Maritime Administration, 1982.

$400,000, or 10 percent of operating revenue at full capacity. Thus, it is most important for the vessel operator to concentrate on generating revenue by carrying full loads through strong marketing, reducing port time through intermodal and other technical innovations, and making swift, efficient passages. The operator's first cost concern is buying fuel cheaply and powering the vessel efficiently. In today's operating environment, attention to manning costs comes behind these other items in priority.

Despite the age of the U.S. fleet, much has been done within existing constraints to reduce the manning levels of U.S. ships. Through a chain of vessel automation, vessel resale, and renegotiation of union contracts and Maritime Administration-approved manning levels (subsidized ships), the crews of older ships have been reduced. Some Mariner-class vessels, for example, which were originally crewed with more than 50, are now operated with crews of 35 to 40. As shown in Table 6, some of the newest U.S. vessels have crews in the low 20s. At this level, manning is at or near the minimum permitted under current interpretations of laws.

RULES AND PRACTICES GOVERNING THE MANNING OF U.S. VESSELS

The U.S.-flag merchant fleet is manned and operated along the traditional lines of deck, engineering, and steward departments. The manning of vessels is governed by international and national rules and their interpretations, and union-management agreements. As a general rule, the manning level of each ship is a function of company and union practices and agreement, class and technology of ship, and type of service. The manning level of a particular ship may change if any of these variables change.

The governing documents concerning a vessel's manning are: Coast Guard Certificate of Inspection, which specifies a minimum level; Maritime Administration approval of a manning level, if the vessel operates under subsidy or has been built with the aid of government funding guarantees; and union-management agreements. This section reviews government, industry, and labor rules and practices concerning manning.

Government Laws, Rules, Practices, and Interpretations

A review of government rules* concerning merchant vessel manning is provided in Appendix C of which this section is a summary. Government

*The Maritime laws of the United States have been updated recently (P.L. 98-39, August 26, 1983). This recodification was made to update the language of the various laws and to put them into a logical sequence. While some of the laws that were outdated were repealed, the recodification was not intended to make any controversial substantive changes in the laws replaced. References herein to the new law in this section are followed by corresponding section numbers of the former law in parentheses, e.g., 46 USC 8104 (673).

rules on merchant vessel manning are found in acts of Congress, federal regulations, and judicial rulings which either interpret these pronouncements or apply concepts of liability in admiralty. Another form of government rule is the direct prescription of required crew for an individual vessel under 46 USC 8101 (222). Throughout administrative interpretations and judicial rulings, confusions in terminology are common. Some important terms such as "sailor" are undefined in the law.

There are no international requirements in force concerning the manning of U.S. vessels, other than that in the Safety of Life at Sea Convention of 1974 for a radio officer. In U.S. law, 46 USC 8301(a) (223) requires that inspected machine-propelled vessels have a licensed master and three licensed mates. 46 USC 8301(a)(5) (404), requires that these vessels have a licensed engineer. The first provision of 46 USC 8104(d) (673), requires that the licensed individuals, sailors, coal passers, firemen, oilers, and water tenders shall be divided when at sea into at least three watches, and shall be kept on duty successively to perform ordinary work incident to the operation and management of the vessel.

The classifications of unlicensed mariners are set by statute which merely recognizes preexisting customary capacities, established by Coast Guard regulations, and based on tradition or felt need. The statutes refer to "able seaman," "coal passer," "wiper," and "qualified member of the engine department" (QMED)(46 USC 7314 (672)). This last is left to the Coast Guard to specify, and includes any member of the engineering department below licensed officer and above "coal passer" or "wiper." The three watch law (46 USC 8104 (673)) also recognizes "oiler," "fireman," and "water tender." These last are among the 10 QMED ratings established by 46 CFR 12-21. Still other ratings are specified at 46 CFR 12; for example, "cadet" and "apprentice mate." Many other ratings have been specified on Certificates of Service, such as "librarian," "cattleman," and "musician," although they are not mentioned in any law or regulation. The familiar "boatswain" and "deck maintenance man" are in this category.

Other Coast Guard laws affect manning. A provision of 46 USC 8702(d) (672)(a), declares that none below "able seaman" may be at the wheel in certain conditions. "If one, then three...." would follow from the rigid application of the three watch law, but there is nothing to prevent a mate from taking the wheel when necessary, and a person hired as "maintenance man" may, if holding AB credentials, do the job occasionally. Another law is the lookout rule of 33 USC 221, as well as other precautionary sections in the various Rules of the Road, which requires that a lookout be maintained at all times while underway by a seafarer who shall have no other duties while maintaining the lookout. "Lookout," however, is not a "capacity" in which a seaman is employed, nor is it a rating. While an AB may be prima facie qualified as a lookout, any person in fact may qualify and may be so used.

The International Convention on the Standards of Training, Certification, and Watchkeeping for Seafarers of 1978 (effective April 28, 1984) postulates a bridge watch and recognizes that a lookout should have no other duties which might interfere with his primary object. Under good conditions of weather and ship's equipment, however, the convention permits a mate on watch to be the required lookout. This same document permits an unattended engine room.

Manning reductions have been achieved in the United States under this framework of rules and interpretations. Certificates of Inspection have been issued with no requirements for unlicensed engineering personnel, and for unattended (i.e., no watch) engine rooms. This leaves a contemporary minimum manning of one master, three mates, one radio officer, six sailors, and about three licensed engineers (the proceeding does not include a variable number of probably required unlicensed engine room personnel, and makes no provision for steward department personnel).

If no engine-room watch is necessary, it appears that the number of licensed engineers could be legally reduced to one. Legally the "sailors" could be reduced to three, with "maintenance" personnel, properly identified, required for safety purposes. The introduction of "general purpose" licensed officers, contemplated by some interests, currently contravenes the statutory division of deck and engine licenses, plus the "crossover" prohibition in 46 USC 8104 (673), which stipulates that the mariner may serve in one department only. The use of general purpose maintenance personnel in a department other than deck or engine is possible.

A recent Coast Guard circular, NVC 3-83, recommends certain minimal training for ordinary seamen and other entry ratings before they go to sea. The Coast Guard will allow some of the billets normally filled by able bodied seamen to be replaced by these specially trained ordinary seamen. It has been noted that with increasing numbers of vessels having reduced deck crews, fewer billets are available for entry-level ratings. The use of those specially trained personnel will provide a means for introducing new seamen into the system and provide a supply of trained personnel as more experienced seamen leave the sea.

While the Coast Guard has, in its Certificates of Inspection, supported and approved reductions in manning proposed by ship operators, it has done so conservatively. For example, there have been instances of the Coast Guard's requiring a watch in an automated, designed-to-be-unattended, engine room for extended periods (i.e., a year or more) until the development and its manning have been "proof-tested." On automated vessels where it is deemed necessary for the purpose of maintaining the vessel, its equipment, or for emergencies, maintenance personnel are being required by the Coast Guard. The panoply of rules and interpretations, and the fact that Certificates of Inspection are issued from regional offices, have, on occasion, led to similar vessels in similar trades being issued Certificates of Inspection that set different manning levels. However, regional variances in Coast Guard approvals of manning provisions of Certificates of Inspection are now minimized, since Coast Guard headquarters acts as a central clearinghouse for requests that involve reduced manning.

The other government agency concerned with vessel manning is the Maritime Administration. The Maritime Administration approves the subsidizable manning level of every vessel receiving an operating differential subsidy (ODS). Whenever a change in vessel ownership, character, or service affects the calculation of the ODS, the Maritime Administration reapproves the subsidizable manning level.

Industrial Practices

While U.S. shipping company managers are aware of technical innovations and are employing them to some extent on newer ships, they are generally not eager to undertake expensive retrofits to reduce crew costs.* Most who have done so are uncertain that they are getting an adequate return on their investment. The age of the U.S. fleet, an average 17 years is a particular obstacle to investment--the short life expectancy of older ships often exceeds the payback period of major capital investments, while operators of newer vessels are able to acquire designed-in technologies that require less manning.

Within existing technology and crew structures, ship operators are, in general, interested in reducing billets and compensating with increased overtime because of the cost advantages. The only limit to this approach, besides government rules, is the number of hours a crew member can or is willing to work before performance, including safety performance, is affected. Another innovation pertains to the radio officer who is required by law, but who, as a watchstander, is becoming superfluous with advances in communications technology. With union concurrence, more and more radio officers are serving as electronics officers with responsibility for maintaining certain shipboard electronic equipment.

There is interest in the United States in employment continuity because of the improvement in productivity that results from the longer-term association. Employment continuity of senior officers, by company and vessel, is most advanced. Many junior officers and unlicensed seamen still are placed aboard ship through the union hiring

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*The reporting of industry views in this section is based in part on the discussions of the committee with invited industry and union officials, held at MITAGS, October 31-November 1, 1983.

hall where mainly seniority hiring rules prevail. While the practice of hiring through the union hall has advantages for unions in membership cohesion and work distribution, it helps perpetuate the casual labor system that the European maritime industry is moving away from. It also reduces the opportunity for vessel assignment continuity and for company-specific training. In the United States, company-specific training is not so important because of the general use of multi-employer-funded, jointly administered, industry training schools. Long-term contractual employment, on the other hand, facilitates vessel assignment continuity.

Union Practices

With the exception of major oil company fleets, deck and engineering officers are represented by two national trade unions, radio officers by three unions, and unlicensed personnel by four unions. Table 9 describes the membership and scope of activity of the national seafaring unions. The data in the table show that four unions, two officers' and two unlicensed, have nearly 85 percent of the total seafaring membership.

Union contracts are negotiated through four collective bargaining associations of management and with independent ship operating companies. Contracts specify work rules which can be negotiated on an individual basis and can vary depending on type of ship and service.

The union representation situation is competitive. Labor unions are willing to discuss manning innovations on new ventures; they are much less willing to do so on existing operations unless it is under conditions of expanding opportunity. The unions' top priorities are to protect existing jobs and compete for new ones. Even so, it is possible that some interest in manning innovation can be stimulated in existing billets, especially when adjustments, such as overtime for billets, can be made to protect existing jobs.

TRAINING

Maritime training in the United States is accomplished at maritime academies and industry training schools. Generally, licensed officers come from maritime academies through the ranks after receiving company- or union-sponsored training at a training school. Unlicensed mariners enter the industry through the trade unions and are trained at training schools.

All the maritime academies, with the exception of Great Lakes Maritime Academy, are four-year institutions that provide baccalaureate programs, training for operating licenses, and job-entry qualifications. The training schools are jointly sponsored by unions and ship

TABLE 9 Seafaring Unions

Union	Active Seafaring[a]	Areas of Negotiation
Officers		
Master, Mates, and Pilots	10,000	Deck
Marine Engineers' Beneficial Assn. 1	9,000	Deck, Engine
Marine Engineers' Beneficial Assn. 2	2,700	Deck, Engine, Radio
American Radio Association	500	Radio
Radio Officer's Union	300	Radio
Marine Staff Officers	120	Staff
Staff Officers of America	200	Staff
Unlicensed		
Marine Firemen's Union	654	Engine
National Maritime Union	20,000	Deck, Engine, Steward
Seafarer's International Union (deep sea)	9,581	Deck, Engine, Steward
Sailor's Union of the Pacific	3,000	Deck

[a] As of December 1981.

SOURCE: U.S. Maritime Administration.

operators and endowed by contractual commitment of shipping companies. The training schools serve both licensed officers who desire to broaden or advance their skills and unlicensed mariners who endeavor to qualify for Coast Guard ratings. The upgrading and retraining of personnel in new technologies are major functions of the training schools. The training schools add to the number of qualified third assistant engineers and third mates in direct competition with the maritime academies. The licensed unions have given priority to the graduates of their own schools, to the disadvantage of the marine academy graduates.

The technology of maritime training in the United States is state of the art. Videotapes, film, and microfiche are employed. Calculators and microcomputers are used in problem solving. Electronic simulators, each a major investment, have become a cornerstone of the retraining process, providing hands-on experience.

While mariners are prohibited by law from serving simultaneously in both deck and engine departments in a single voyage, some progress has been made in multiskill training. The U.S. Merchant Marine Academy offers a dual license curriculum and graduates some officers with both deck and engine licenses. Similarly some unlicensed mariners hold Coast Guard ratings in both deck and engine departments. It is indicative of the general state of the maritime industry in the United States that only 14 to 50 percent of the 1983 graduating classes of the maritime academies sailed as officers in the merchant marine upon graduation.

EXTENT OF MANNING INNOVATION IN THE U.S. FLEET

While the state of the art of technology in the deck and engine departments in the U.S.-flag fleet has been advancing, little experimenting with manning innovations has taken place. As a consequence, U.S. operators have not been able to take full advantage of their technology advances. Only a handful of U.S. ships have broken below the 25-man crew structure that was prevalent in Europe in the mid-1970s. These successes have been more the result of automation technologies than crew or shoreside reorganization.

An area of some interest in the United States is modification of the seaman-per-billet ratio which typically is 2:1, with each crew member on board ship 6 months per year. Discussion of a 3:2 ratio is taking place between companies and some unions.

There is some evidence that competition is having a favorable effect on the introduction of effective manning practices into the U.S.-flag fleet. For example, recent opportunities to obtain additional contracts for government cargoes from the Military Sealift Command have caused unions and ship operators to reach agreement concerning the manning of existing ships with crews of 24 or less. One would expect that continued competitive pressure will cause these manning levels, and the technologies and effective manning practices which make them possible, to spread in the industry over time. Undoubtedly, there are other developments concerning the introduction of effective manning practices into the U.S.-flag fleet as the result of competition and especially competitive opportunities, but there is not much hard evidence in the public domain, except in cases where new ships have been constructed.

4

MANNING OF MERCHANT VESSELS IN NORTHWEST EUROPE AND JAPAN

ROOTS OF CHANGE

In the late 1960s and early 1970s, the maritime nations of Northwest Europe embarked on a transition away from their traditional manning and organizational practices in ship operations as a result of social and economic factors.

The social motivators for change were felt first, and were both demographic and cultural in nature. Serious maritime personnel shortages appeared in the late 1960s and early 1970s throughout Northwest Europe and in Japan; firms found it difficult to attract and retain crews, particularly officers. The shortage led to several innovations in manning and operating practices, including automation of engine rooms, reorganization of billets, and integration of trade skills in ratings.

Research efforts were undertaken in the United Kingdom, Norway, and other countries to find ways to enhance the quality of life at sea. Measures included such social innovations as permitting families to be on board. More practical was a movement toward permanent, contractual employment of seamen and an effort to encourage crew continuity through longer-term vessel assignment. The General Purpose (GP) ratings and semi-integrated (polyvalent) officer concepts were instituted in the early 1970s to reduce manning requirements and the boredom of shipboard duties and, on the part of unions, to increase wages.

The personnel shortage was a direct outgrowth of social changes including an increase in the level of education, the elevation of middle-class standards of living, and a further leveling of social classes and distinctions. These trends directed the work force away from the isolated life of the seafarer. They also had liberalizing and democratizing repercussions throughout industry. At sea, social and professional barriers between officers and ratings began to dissolve.

Another set of changes rooted in social trends is a shift toward decentralized or shipboard management. Management responsibilities for ship operations are being decentralized from shore to ship. Often shipboard management teams, usually consisting of ship's officers, have substantial authority including budgetary responsibility. A related development is the occasional use of consultative work planning groups onboard ship.

In the mid-1970s, a worldwide recession brought about a sharp downturn in shipping, effectively ending an era of manpower shortage and forcing interest in improved operating efficiencies. In this economic climate, ship operating companies have focused more intently on cost-cutting measures. "Flagging out" and crewing with nationals from low wage, developing nations has become a common practice. Companies are interested in reducing their crew complements, and have begun to examine ways to reduce the number of their shoreside personnel. Aboard ship, automation and other advanced technologies as well as labor-saving innovations in design have been increasingly employed. Companies have supplanted worklife improvement experiments with efforts that will provide more immediate economic relief. Faced with the threat of "flagging out," unions in all the countries affected have cooperated with shipping companies in these billet-cutting actions to preserve some jobs.

The comparatively high cost of labor in the developed maritime nations has motivated innovations in operating practices as well as "flagging out." As in any setting where high wages prevail, an ability to succeed in international competition requires that high hourly wage rates be more than offset by high labor productivity.

With manning costs an important element of total operating costs, companies have been continually and increasingly interested in the cost-cutting potential of manning reduction. Direct labor costs represent a greater percentage of operating costs on smaller, relatively low-cost ships. Shifting into capital intensive shipping does not offer a general solution to high wages since specialized, capital-intensive ships account for only 20 to 30 percent of world transport activity.

Industrial strategies for counteracting high labor costs involve tradeoffs, for example, in technical features, maintenance, training, fringe benefits, and accommodations. Less tangible costs attendant to organizational changes include costs of dealing with unions and shore organizations, for example. The mix of manpower numbers and skills, management structure and policies, and technology has to be evaluated in terms of overall costs versus income. This assessment by management is interactive and continuous and has characterized much of the European experimentation in ship manning.

MANNING INNOVATIONS

This section will review changes that have been experimented with and adopted in the fleets of Northwest Europe and Japan in the long-term effort to reduce manning costs. These changes encompass the design, technology, and equipment of vessels, the shoreside support organization, and corporate personnel policies.

Changes in Vessel Design, Technology, and Equipment

Unattended Engine Room

The most basic level of engine-room automation consists of remote control of main propulsion machinery from the bridge, in conjunction with remote sensing of operating conditions and alarm capability. These provisions eliminate the need for round-the-clock watchkeeping in engine spaces. With additional automation of engineering functions, 24-hour unattended operation is possible, and human intervention is no longer required except for the few remaining inspection and operation tasks. Maintenance and repair then constitute the bulk of engineering responsibilities.

Automated engine rooms have proven to be quite reliable. A study of 300 ships operating with unattended engine rooms revealed that after an initial breaking-in period, alarms averaged 1 every 5 days and faults averaged 1 every 10 days, thus enabling the vessels to operate with true unattended engine rooms.

The highest level of engine-room automation is found in the Japanese "super-rationalized" container ships. MOL's CANBERRA MARU and the NICHIGU MARU of the NYK-MOL-YS consortium have integrated the engine and cargo control stations on the main deck remote from the engine spaces, while NYK's HAKUBA MARU incorporates nearly all engine-room functions in the bridge. Both designs incorporate microprocessors which monitor and log over 300 operating parameters. The status of operations is displayed on printers or screens in a number of locations, i.e., control station, bridge, and chief engineer's office. Malfunctions trigger alarms in various locations in the ship. The systems are interactive in that auxiliary equipment, such as generators or pumps, is controlled automatically. Central control of bunkering has reduced the manpower necessary for that operation.

Maintenance

Vessel manning requirements have been reduced to a great extent by changes in maintenance. In the deck area, the use of epoxy paints and special coatings, which require less maintenance, has become common.

Innovative maintenance approaches such as design-for-maintenance and planned-maintenance systems have had an even more fundamental effect on shipboard manning and organization, especially in the engine area. In the early stages of machinery plant design and equipment selection, considerable attention is given to equipment types and configurations which will minimize manpower requirements for maintenance. Machinery is installed with adequate space for maintenance and parts removal, significantly reducing the time required for maintenance and repair. In selection, maintenance intervals and manpower requirements are considered in addition to life-cycle cost and owner's preference.

Other practices calculated to reduce maintenance include: selection of main and auxiliary engines that require the smallest amount of ancillary operating equipment; the use of shaft-driven electric generators to reduce operating hours on diesel generator sets; totally enclosed electrical equipment; sealed bearings for all electric motors; the use of fresh water rather than salt water; and diesel engines with the smallest number of cylinders possible.

Automatic condition monitoring systems are becoming prevalent as adjuncts to planned maintenance systems. These monitoring systems often permit extended maintenance intervals and provide the advantage that planned repairs may be made before they become critically necessary. Therefore they may be undertaken ashore or by a maintenance gang, and without delaying the ship. In general, much maintenance that cannot be accomplished within the normal workday and an acceptable range of overtime is reserved for shore gangs when the vessel is in port, in shipyard, or in coastwise transit.

Bridge

Manning level adjustments due to automation have not been so significant in the deck department as those proceeding from technical innovations in the engine room. Microprocessors have been incorporated into position-finding and collision-avoidance devices, but for the most part these have augmented rather than supplanted traditional navigation practice.

Mooring and Anchoring

Mooring and anchoring manpower requirements remain the most resistant to reduction through technical innovation. Innovations have been principally mechanical in nature, e.g., self-stowing line baskets, constant tension winches, and smaller and lighter hawsers. Through careful design and placement of multiple, redundant line-handling equipment and communication and control stations, the Japanese have lessened the requirements of brute strength in the handling of lines and the size of the mooring party.

Cargo Operations

Microprocessors have improved the safety and efficiency of cargo operations. These developments extend to loading, ballasting, and heel corrections (i.e., load calculators, hull stress monitors, and heeling sensors). The manpower necessary for deck operating tasks (i.e., the opening and closing of hatches and securing of cargo) has been reduced through minimization of the number of hatch covers and their automation, and innovations in mechanical securing devices for containers. On tankers, cargo control systems permit central control of valves and pumps and provide tank level and flow rate indications, along with appropriate alarms.

Communications

Improved shipboard communications, including remote input devices, displays, and alarms, have been integral to a number of the innovations that have been described. Information exchange between crew members has been enhanced by greater use of telephones, public address systems, and paging systems. Crew communications during deck operations, such as mooring where there are no free hands, have been improved in at least one instance by installing walkie-talkies in safety helmets.

Satellite systems have made possible dependable, high quality voice, telex, and computer ship-to-shore communications. These recent communication advances have made mariners' direct communication with their families more common, and has made it easier for senior officers to be involved in the business as well as the technical aspects of ship operation. Satellite communication enables reversal of the trend toward centralized shoreside management of vessels begun 75 years ago with the introduction of marine radio by providing the ship with current budgetary, stores, and scheduling information from the head office, and allowing for the timely transmission to the office of similar information originating from the ship.

Superstructure Design

Just as technical innovations in working spaces have facilitated crew reductions, so too has the design of living and office areas.

The overall quality of accommodations (i.e., space, privacy, comfort, entertainment, and diversions) has improved steadily, reflecting industry's presumption that, in spite of fluctuations in the market for seagoing labor, the expectations of seamen will continue to rise in parallel with improving living standards ashore. Perhaps more significant than increased comfort through greater space per crew member at the same building cost is the varied environment that ship designers have sought to provide in new ships to promote interaction of crew members. The superstructure layout of a vessel designed for operation by a smaller crew provides greater segregation of working, recreation, and private areas--as is the case ashore. Crew cabins are located in the most remote sections of the superstructure, while food service, lounge, and recreation spaces are reserved for the intermediate deck(s). The ship's office, archives, conference room, and stores are found on or near the main deck.

More attention is being paid to the provision of a good social environment. The integration of officers and ratings becomes more desirable with the elimination of billets. Integrated lounges, mess rooms, and recreational facilities offer a much-needed opportunity for social contact. Traffic flow within passageways of the reduced-manning vessel's superstructure is designed to promote encounters between crew members by reducing the number of ladders and locating recreational and other communal spaces centrally. In at least one case, private cabins have been made only moderately attractive so as to encourage the occupants to join groups as often as possible. The underlying principle of these innovations is that the quality of seafaring life during off-hours can be much improved by reducing loneliness and boredom, and that this improvement will yield gains in productivity, safety, and morale.

Offices have been placed in a central location, rather than the traditional location adjoining the staterooms of senior officers. All of these advantages encourage communication among officers during working hours. At the same time, the segregation of office and living spaces allows the crew to spatially and emotionally separate themselves from their work when off duty.

Central meeting rooms also have been provided. In this arrangement, the shipboard management team works together in one office; there is central storage of data; and work planning may be facilitated by central display of tasks to be accomplished and progress made.

Changes in the Organization of Crews

Intradepartmental Flexibility

Perhaps the simplest manning reductions from an organizational perspective are those which are achieved through elimination of certain billets, accompanied by intradepartmental adjustments to the contents of others. Engineering automation has made possible this kind of manning adjustment. Engine room watchstanding billets have been eliminated. This instantaneous reduction, so closely related to specific technical innovations, also has been made possible by the combination of previously separate and distinct responsibilities into single job descriptions. Within the engine room, this recombination of tasks has taken the form of engineering officer/electricians and dayworking ratings, sometimes retitled mechanics, who are responsible for operations, maintenance, and repair work previously undertaken by oilers, wipers, greasers, donkeymen, and fitters.

In the deck department, the number of dayworking ratings has been reduced as a consequence of less shipboard maintenance work, while watchstanding billets also have been reduced through the occasional combination of watch officer and lookout duties. For deck officers, the reduction has taken the form of chief mates returning to watch-standing and, more recently, some watchstanding by masters. This latter arrangement has been the subject of experimentation on smaller vessels in Sweden, Denmark, Norway, and the United Kingdom. Salen (Sweden) is considering a half-time (4-hour) watchstanding assignment for the masters of their supertankers. The West German shipowners have been asking for permission to sail up to 10,000 grt with a master and two deck officers, and the West German Ministry of Transport has recently drafted a regulation that will move the limit for such operations from 1,000 to 4,000 grt. Deck officer and master unions are uniformly opposed to watchstanding masters, citing as reasons the likelihood of fatigue and the probable reluctance of junior officers to call out a master who recently completed a watch. On the other hand, it has been stated that such an arrangement may reduce accidents by preventing masters from becoming weary during a long passage with little to do.

Masters and deck officers have assumed radio communication responsibilities in the absence of a radio officer billet. As with the watchstanding master, this is being tried on smaller vessels and considered for application on larger vessels.

Reductions in the catering department have been accomplished as a result of diminished hotel services and the smaller size of the total crew. Additionally, intradepartmental integration of tasks in this department has taken the form of chief stewards who also cook, second cooks who also bake, and steward utilitymen whose responsibilities now include all facets of the department's operation.

Although some additional training may be required for the expansion of responsibilities within departments of certain billets, these initial manning reductions have not posed a serious challenge to the traditional organization of crews.

Interdepartmental Flexibility

Further reductions entail alterations in the traditional structure of shipboard work. The most rudimentary structural change, one that maintains for the most part the segregation of departments, is that of interdepartmental flexibility.

On conventional general cargo ships, the departmental structure (i.e., deck, engine, and steward departments) functions relatively well. However, general cargo ships are being less and less frequently built; more technologically sophisticated, specialized vessels are taking their place. Changes in technology and trading patterns have greatly reduced the need for traditional cargo handling skills. The reduction of time in port brought about by developments in cargo technology has substantially increased the time spent in basic navigational watchkeeping. Simultaneously, the need for engineering skills has increased in all aspects of ship operation. Automation has also increased the demand for knowledge and skill in instrumentation and control systems. These changes have affected the officer's role at the same time as they have led to a reduction in the number of ratings.

Task analyses of shipboard work have revealed that the workload intensity of the several departments often is not corresponding, and that ratings of one department might be available and able to assist in the work of another. For example, engineering and galley personnel may assist in mooring operations. Such a system allows for further manning reductions within the crew as a whole, while still meeting the peak manpower requirements of the individual departments. Unlicensed crew members retain their identity with a single department but are called upon to work occasionally on tasks in other departments.

Occasional department crossover is widely accepted in Norway and West Germany, and in the United Kingdom was pioneered by experimentation conducted in 1964 by the British Shipping Federation, Cunard Line, and the National Union of Seamen. The Danish Seamen's Union proscribes the practice for its members, although there is a provision in the Danish Firemen's Union for working in alternate departments.

Departmental Integration: General Purpose Ratings

An even greater departure from the traditional structure of shipboard work is the introduction of general purpose (GP) crew. In this organization there is no departmental (deck or engine) distinction between ratings who share operations, maintenance, and repair responsibilities. GP manning experimentation began in the late 1960s on tankers and bulk carriers. The roles of senior deck and engine ratings have been redefined in conjunction with GP experimentation. GP crews frequently are placed under the supervision of a single "ships foreman" rather than under the traditional departmentalized billets of "bos'n" or "storekeeper."

Some GP implementations in Europe have not been very successful. Experience has shown that ratings who participate in GP arrangements risk a loss of occupational identity, and, without training, are qualified to do only low-skilled tasks in the alternative department.

The system works most satisfactorily in those crew structures which are designed to provide meaningful content in these jobs, and in those organizations that provide the necessary training. Furthermore, the system of general purpose ratings has been implemented most efficiently where mariners have not previously served in one department or another, but are trained initially for general purpose service.

In spite of some disappointments with early GP experiments, the more serious companies and countries are expending much effort and money to modify crew organizations and national training schemes to make GP work as it was intended. Since 1980, only GP ratings have been produced by the nautical training system of the Netherlands, and within 5 years, the only entry rating training available in West Germany will be for GP. The Norwegian training scheme has been turned toward GP, an evolution that has been accelerated as a result of the new 1983 manning scales that formally recognize the necessity of GPs for reduced manning operation. In the United Kingdom, 10 to 15 percent of ratings are sailing in a GP capacity.

Department Integration: Semi-Integrated Officers

A more recent innovation in crew flexibility is that of the dual-purpose or semi-integrated officer. Still in the experimental stage in several countries, the intention is to license and employ officers capable of standing navigation watches, monitoring engine controls, and undertaking mechanical, electrical, and electronic repairs.

The objective of semi-integrated officer operation, beyond that of further manning reduction, is to redistribute the bridge watch-keeping and technical maintenance and repair functions among more officers. The French were the first to train dual-purpose officers. In the Dolabella experiment, the French nautical education system was modified to produce officers equally expert in deck and engine skills. However, reportedly because of union opposition, few changes were made in the organization of shipboard work to make use of dual-purpose officers.

The multiple-skill concept of matrix manning has been developed in Northwest Europe. It differs from the polyvalent or dual-purpose scheme in that the goal is not a homogeneous work force of seafarers holding identical billets. Rather, a matrix crew is composed of individuals, each with a specific specialty and varying levels of competence in a secondary skill. These matrices of skills cross departmental boundaries--hence the flexibility--but still distinguish between areas of principal competence. This semi-integrated officer is one whose predominant training is in one department, with less background in the other. Officers graduate from nautical college with both entry level licenses, but are expected to maintain one at entry-level, while pursuing advancement in the other. In the primary specialization, the officer is responsible for all aspects of a part of the ship's operation; his secondary expertise is relied upon by other specialists to provide assistance as needed. The basic purpose of the matrix concept, with its provision of greater versatility in individuals, is to enable peak variations in workload to be dealt with by fewer officers.

The Norwegians tested the matrix officer concept in the early 1970s (Hoegh Multina) with success, but for political reasons the necessary educational reform to diffuse the innovation did not take place until 1978. The Dutch turned their attention to semi-integrated officers at about the same time (Shell in 1978 and Nedlloyd in 1981), and now have a number of experimental ships sailing under this system. (Shell has 65 semi-integrated officers--10 percent of their total.) The Dutch nautical colleges are designing a 4-year program for semi-integrated officers. Both Shell and Nedlloyd hope to convince the colleges to provide only semi-integrated officers in the future. Shell has announced that in the future this will be the only type of officer they will recruit from the colleges. In addition, the Japanese are experimenting with semi-integrated officers.

Related to this concept of semi-integrated officers is another concept which might be labeled "semi-officer." The Japanese are the greatest proponents of this innovation, in which watchstanding certificates are awarded to other than fully licensed officers. More than 500 Japanese ratings have now been awarded watchstanding certificates after completing a 5-month training course. A similar proposal has been made to the U.K. Department of Transport by the General Council of British Shipping (GCBS). The GCBS had been advised by the Department of Transport that the government would prefer that they pursue a fully dual-licensed officer approach.

One attraction of the "semi-officer" approach is that it provides an intermediate billet for individuals moving up from rating to officer status. That transition is becoming more difficult as the educational standards of the nautical colleges are being raised. There is some concern that the educational barrier to mobility will work against efforts to break down the traditional barriers between officers and ratings.

Decentralization: Shipboard Management Teams

A number of ship operators throughout Europe are transferring some management responsibilities from the head office to the ships to improve the job content of ships officers, to improve the effectiveness of the shipboard organization, and in some cases to permit reductions in the staff of the shore support organization. The management team consists of the master and department heads and occasionally junior officers and senior ratings. In general, the shipboard management team has authority over operating expenses and budget, personnel, and maintenance. Although managers ashore may establish performance and profit objectives for the ship, the role of the shore office is reoriented toward supporting rather than directing the ships.

For DFDS (Denmark), "shipboard management" begins after the company selects a master for a ship under construction. The master assists in the selection of officers. This shipboard management team then plans jointly for the organization and operation of the new ship, including recommending a crew size. The company takes this proposed crew level to the Board of Trade for approval. Hoegh Line (Norway) sends its full shipboard management team and their families to the construction site where they have the responsibility to oversee construction and prepare the ship for operation.

In operation, the shipboard management team may elect to undertake major engine overhauls or maintenance tasks using the ship's own crew, or to hire shore gangs. Such teams are generally permitted to spend funds to a certain limit without consulting the head office, and to oversee shipyard repairs, rather than to depend on engineers from the home office.

Shell Tanker B.V. intends to employ a "ship manager" on every ship who will be assisted by five semi-integrated officers. New constructions include in the accommodation layout an administration room which is a centrally located grouping of offices where the management team conducts its daily work.

Shipboard management teams are the maritime expression of decentralizing, a trend throughout Northwest European industry to push management decision making to lower levels of organization. The underlying theory is that the best decisions are made by those individuals closest to the problem. In the case of ship operation, this generally means those on board the ship. Not only should this lead to better, economically sound decisions, but it is intended to produce greater job satisfaction on the part of local managers--which translates into improved retention, motivation, and overall performance.

Decentralization is facilitated by vessel assignment continuity of at least senior officers. Many companies have adopted this for a dock-to-dock period.

The experience of a number of companies reveals that shipboard management is easier to implement onboard than at the head office. Officers often are eager to take on added responsibilities while middle managers ashore typically are reluctant to release control. Thus, this change requires top management commitment and attention. If there has been any disappointment in shipboard management from the shipboard side, it is that the involvement of junior officers and ratings has been less substantial than anticipated, especially where senior officers have enjoyed assignment continuity, while junior officers have not.

Work Planning

Shipboard management teams, as so far constituted, have consisted almost exclusively of officers. In those instances in which shipboard decision making has been devolved to the level of the ratings, it has generally taken the form of work planning sessions. These entail periodic meetings of the ratings and supervisory officers for the purpose of jointly reviewing and planning maintenance and repair activities. Communication between ratings and officers may be beneficial at any level of manning, but especially important on reduced manning vessels. The logic is that reduced crew vessels do not offer the luxury of dedicated supervision, nor is the caliber of reduced-crew seamen such that they require or desire such supervision. Ideally, the greater sense of professionalism of GP ratings results in their desire to be involved in the work planning process.

Work planning by ratings was first introduced experimentally 10 years ago in conjunction with the elimination of the bos'n billet. The latter innovation often was not effective. Where implemented today, work planning operates in association with the billet of GP foreman.

The ship foreman billet has filled the need of a single rather than dual system of shop floor supervision. The ship's foreman reports to the chief mate for deck maintenance, and to the chief engineer for machinery and engine space maintenance.

With both department heads striving to maximize their individual use of a unified but now reduced work force, reorganization of the management of GP crews was inevitable. For some companies this has taken the form of placing the GP foreman and the GP crew under the chief engineer, who assumed responsibility for maintenance and repair throughout the ship.

The fullest implementation of work planning has been in Norway and the Netherlands. On Shell B.V. tankers, all junior officers and ratings are invited to contribute to the daily work planning session of the shipboard management team. In Britain and Denmark, the emphasis has been on involving the officers. DFDS, however, is in the process of revising its shipboard meeting reporting requirements to press the officers to bring ratings in on the work planning process.

Formal work planning structures are not employed on Swedish ships because it is felt that the traditional ease of communication between ratings and officers allows this process to take place informally.

Although there has occurred on West German vessels a degree of informal work planning, the West German companies remain fairly centralized in their approach; in general, they are not pushing in the area of shipboard management. It should be noted that, even where decentralized work planning is not practiced, there are commonly other consultative structures in place on European ships to deal with issues such as safety.

Changes in Union/Management Arrangements, Shoreside Support, and Corporate Policies

Employment Stability

Long-term employment contracts to seafarers are an established practice for some Northwest European ship operators. Such contracts give the seafarer slightly better pay and benefits, a more systematic vacation schedule, and more employment security. Employers generally get a higher quality employee, and one from whom they feel training expenditures will be recovered. With the exception of the Danish Seamen's Union, European seafaring unions have permitted their members to accept such contracts. In addition, in each country, there are also a number of mariners who, while declining to accept contracts, still remain "de facto" in the employ of individual companies.

Concomitant with their interest in reduced manning, European ship operators are interested in long-term contracts with seafarers because of the employment stability that they bring. The operators are convinced that longer association between seafarer and company, and consequently longer-term association between seafarer and ship, and among crews, results in greater operating efficiency. New crew structures generally require additional training that is company-specific, and companies are reluctant to invest in training for seafarers who are not long-term employees. Also, as the size of vessel crews diminishes, the quality of the crew and crew organization become more important.

In Sweden, national legislation has had the effect of making Swedish seamen permanent employees of their companies. The Shipowners Association reports that 10 years of experience has demonstrated that legislation intended to provide social benefits (employment security) also has been commercially successful.

All Danish officers and approximately 10 percent of the membership of the Firemen's Union are under contract; the Seamen's Union does not allow it. In an attempt to encourage Danish ratings to accept contracts, Lauritzen has extended to them privileges formerly reserved for officers such as taking wives on trips. DFDS attracts ratings with a two-on/one-off vacation schedule. They feel that they have achieved substantial continuity on an informal basis and are not concerned about formal contracts which would cost the company additional money.

Norway has traditionally relied upon casual labor, although Hoegh and other companies are attempting to achieve employment stability. The Norwegian Shipping Directorate has approved a reduced manning plan for the Jebsens fleet with the proviso that the company employ all crew members of these ships on a permanent basis. This also has been a bargaining objective of the Norwegian Seamen's Union in their agreements to provide reduced crews.

In the United Kingdom, the ship management firm of P.A.L. (formerly Pan Ocean Anco) has 75 percent of its officers on contracts, and 40 percent of its ratings. Another ship management firm, Furness Withy, has nearly all of its officers under contract. In the Netherlands, Shell Tanker seafarers are all permanently employed.

European ship operators recognize that it is no longer possible to rely on casual workers with standard skills to meet the needs of operating environments that have ceased to be standardized and narrowly defined. They consider permanent employment of mariners essential to the manning of vessels with smaller, reorganized crews.

Vessel Assignment Continuity

As greater management responsibility is assigned to billets it becomes more desirable to give crew members a longer period of association with a specific ship. This is most critical with members of shipboard management teams. European observers recommend that the officers given the responsibility of development and execution of budgets onboard ship be assigned to one vessel for a period long enough to become familiar with the maintenance and repair requirements of that vessel. Observers also note that, to a lesser degree, ratings with work planning responsibilities are likely to be more efficient if they remain for some time on the ship for which they will be doing work planning.

Just as European ship operators are now offering contracts of permanent employment to their seafarers, so too are they attempting to place their seamen on vessels for longer periods of time.

A common technique for crew continuity is to rotate three full crews between two vessels. This is the approach taken by Jebsens (United Kingdom), DFDS (Denmark), and Nievelt Goudriaan (Netherlands). Where senior officers receive leave on a one-for-one basis, it is possible to have two men share a single billet; Nedlloyd does this with their masters and chief engineers. Salen attempts to replace 50 percent of a vessel's crew at one time, reassigning them to the same ship if possible. Company preference is for two individuals to share a billet and to let these pairs determine their mutual work and vacation schedules. Hapag Lloyd is experimenting with the replacement of entire crews at a time.

Another approach to continuity focuses on the length of crew assignment. DFDS assigns its seafarers to individual ships for a minimum of 3 years, although it has tried for greater continuity among senior rather than junior officers. Junior officers, it is felt, benefit from experience with a greater variety of ship types. Shell Tankers B.V. (Netherlands) makes 2.5-year assignments, which include a drydocking, for the 4 senior officers on 13 of their vessels. Junior officers and ratings still rotate within the fleet as a whole.

The relief system also influences crew continuity. DFDS employs a "yo-yo" system of internal temporary promotion, in which a billet vacated because of a permanent employee's leave is filled by another qualified member of the crew. The master is relieved by the chief mate, the chief mate by the second mate, and so on. Under such a system, when new men are brought into the crew it is in the lower positions.

The traditional reliance of the industry on casual labor would not have been so widespread if it did not serve some useful function. It has in the past been a practical strategy in an industry subject to chronic fluctuations in labor demand. Assignment discontinuity is also practical in view of the expense of personnel transportation.

The traditional practices of casual labor may also have functioned, albeit indirectly, as a "safety valve" to alleviate tensions stemming from the traditional organization of crews. One way of defusing volatile personnel problems is to reduce the chances that individuals will work together frequently or for any period of time. In the context of monotonous traditional jobs aboard ship, they also offered the opportunity to experience a variety of trades and technologies. Given the traditional structure and operation of merchant crews, permanency of position may not necessarily be desirable. Only when the organization of work aboard ship is improved so that knowledge of the job and the ship and team performance become important does crew continuity become a positive innovation. Even then there should be some provision for mobility in the event of the inevitable interpersonal problems that occasionally accompany isolation.

Social Integration of Crews

Manning innovations have been accompanied throughout Europe by deemphasizing the traditional status difference between officers and ratings. Social integration is reflected in design changes in accommodation spaces. The Brostroms 16-man Ro-Ro's, for example, have only one class of cabin. Other indications of this change include in various fleets, ratings on salary rather than hourly pay, extension to ratings of the privilege of taking spouses on trips, and the various consultative structures in which ratings play a management or planning role. All of these are reflections of new organizations of shipboard work in which supervisory, technical, and menial tasks are not so rigidly prescribed on the basis of the officer or rating distinction.

Cultural values and traditions play a role in the degree or ease of acceptance of this diminishment of shipboard status differences. The Scandinavians seem to be having the least difficulty in adapting, followed by the Dutch, and at a greater distance the West Germans and British. The Norwegians in particular are enjoying success in this change; this is partly a reflection of the recruitment and nautical educational system in that country, in which all the officers come up "through the hawsepipe." But Hoegh reports that even in Norway, there was some discussion and complaint at first. Swedish officers are also recruited exclusively from the ranks of ratings, but this is no guarantee of social homogeny of crews. The person recruited to officer status is not necessarily of the same social background as the person who is content to remain a rating. Another factor influencing this trend may be the changing social values generally at work in the industries of the Scandinavian countries.

In some Scandinavian and Dutch companies, it is common practice to have a single bar and mess room for both officers and ratings. While this innovation was initially resisted, it is now accepted. All new ships built by Hoegh and Shell Tankers B.V. are fitted with common recreational and dining facilities.

The lessening of importance of traditional shipboard status distinctions must also be understood as the consequence of the higher level of technical and managerial tasks being assumed by ratings on reduced manning vessels. The logic is that high cost countries can compete only if they run their vessels with very small numbers of well trained, highly competent seafarers. Such competent ratings will not serve long, however, if they are treated as a class below and separate from the officers, as has been the traditional practice. It is precisely this chain of logic that has led Brostroms (Sweden) to successfully introduce social integration on its 16-man Ro-Ro's. Another related reason given for social integration is that smaller crews are challenged more than conventional crews and require a team effort and sense of "esprit de corps." Integrated, rather than divided, status for crew members is felt to contribute to the achievement of this team effort.

There is concern that the technical content of the ratings jobs may be diminishing on the more technically advanced ships, especially those on which officers, now freed from watchstanding, have encroached upon maintenance and repair work traditionally handled by the ratings. These pressures may cause the status of ratings to slip rather than to be elevated. Such billets would not attract the quality of rating that is envisioned, nor would they offer ratings the opportunity to earn the respect of officers. To counteract this, technical training programs have been initiated and organizational changes onboard have been made to increase the technical content of the jobs of ratings.

The U.K. Merchant Navy and Airline Officer Association (MNAOA) feels that its membership would accept social integration if the quality and training of the ratings would improve. P.A.L. reports that their officers initially had difficulty with management's initiatives toward social integration, but that this is no longer a problem because the ratings are much better trained and motivated. Perhaps 75 percent of those officers who were suspicious or hostile at first are now in favor of integration because it has simplified their jobs. Running a ship as a one-class entity, rather than two-class, eliminates the "them v. us" problems. In some cases, ratings object to integrated messing because they feel it allows the officers to supervise them more closely and continuously.

Alteration of the physical layout of certain accommodation spaces may aid, but will not guarantee, integration. While physical alterations to promote one-class operations may offer savings for owners in construction and operation costs, this approach has not been accepted in every instance.

It is also probable that, regardless of nationality, rigid status distinctions are more acceptable when the privileged are few, and become less acceptable as that ratio increases to the point at which the officers begin to outnumber the ratings. One effect of manning innovations has been a steady increase in the officer/rating ratio. The ratio for all vessels of the O.E.C.D. member countries was 1 officer to 2.35 ratings in 1965, and changed to 1:2.04 in 1970. A ratio of 1:1 has been achieved in many instances.

Ratings, and their unions, in general, have been enthusiastic proponents of innovations that will lead to integration. Denmark may be an exception, especially the Seamen's Union. The officers and their representatives, on the other hand, have more difficulty with integration. In a practical sense, it means comparatively fewer perks and privileges, but more basically it means a relative loss of status and calls for a substantial adjustment of self-image.

There is also concern that social integration cannot succeed in the absence of career mobility across the officer/rating boundary. In fact, it appears that the national educational systems of some of the European countries are developing in such a way that it is becoming more--not less--difficult for ratings to make the transition to officer status.

Shoreside Reorganization

Although the initial focus of manning experimentation has been on shipboard organizational change, experience has taught that modifications to shore-based organizations are necessary to the realization of the overall objective of effective manning. This is particularly true of the shipping companies' head offices, but it applies as well to the union organization.

Office Reorganization Since the advent of radio, European ship operating companies have maintained central control over their fleets. The traditional management structure is based on broad functions, e.g., personnel, accounting, engineering, insurance, marketing, and purchasing. Each department controls the corresponding function on all ships. Shipboard management teams, and other manning innovations, alter the traditional departmental division of responsibility. To take advantage of an integrated management approach on the ship, companies have found it necessary to make corresponding changes in headquarters organization. Manning innovations also have involved the delegation of authority from shore to ship. However, the traditional fleet management structure is set up to direct, rather than support operations afloat; thus, changes have been necessary in this respect as well.

A characteristic change is the institution of the "ship manager" position. The ship manager is responsible for coordinating shoreside support of a small number of vessels; usually such ships are alike in terms of trading conditions or technology. The ship manager is considered to be an element of the shipboard management team, the member best situated to see that the needs of their ships are being met by the several divisions of the office staff. The ship manager provides a single, rather than multiple, line of accountability between ship and shore.

Reorganization of the office most directly affects the managers who are the architects of change, and it generally involves the surrender of management controls that are not replaced by other control tasks passed down from higher levels. A change that has facilitated and been made necessary by reduced manning has been the reduction of maintenance work required by the crew. Alternative arrangements for maintenance include more extensive shipyard work lists, and the completion of maintenance and repair work in port or by a mobile team of contractors or temporary employees.

The latter arrangement provides for occasional shoreside employment of a firm's seagoing staff. Norway's most recent innovation in the area of reduced manning maintenance is the "flexible manning scale," as used by Klaveness. On the basis that the prescribed manning scale is larger than that actually required for vessel maintenance, ship management teams are given the authority and flexibility to increase or decrease the size of the crew to match immediate maintenance requirements, and weather conditions or other opportunities.

Union Reorganization Experimentation with manning has led to union involvement in a variety of consultative structures such as tripartite (i.e., government, industry, and union) manning committees and research oversight groups. Unions also participate on company-level or shipboard safety, work planning, co-determination, and project guidance committees. One union, the National Union of Seamen (NUS), has found it advantageous to tailor its structure to participate more effectively in manning innovations. Just as companies are decentralizing, unions are creating shipboard branches and placing greater reliance on company, as opposed to industry, level agreements.

Such contracts are negotiated by the same national officers that negotiate the national agreement. Furthermore, unions are recognizing that each company has specialized needs and particular requirements, and that the membership should play a more direct role in the negotiation of the company contracts. NUS in the United Kingdom has instituted a structure in which company-level agreements are negotiated by the local leaders of the membership working for their companies. The national officers are available at such negotiations for counsel and assistance, but the principal responsibility lies with the local leaders.

The concept of a shipboard branch is not merely an elaboration of the traditional shipboard union committee. Delegates from these branches report directly to the union executive council and the congress. In NUS, the shipboard branch is becoming the fundamental organizational unit.

PROCESS OF CHANGE

Nature of Organizational Change

The process of change has been as important to manning innovation in Europe as the innovations themselves. The process of change has been led by individual, innovating companies. Institutions--government agencies, shipping associations, trade unions, and research institutes --have also played roles, but have been more involved and most successful in collaboration with innovating companies.

The change process is long term; some consider it continuous. Some years ago Shell B.V. initiated an experimental ship project which it named "Project with a Long Breath," because they were sure that it would take many years to accomplish the degree of change envisioned at the start. The sort of innovations being worked on in the project today were not even envisioned then.

Ideas for organizational change may be derived from theory and research; they may be adapted from studies, experiments, or practices in ship operation in other countries, or in other industries in the same country; or, they may spring from operating experience. The top management of the innovating company may be enthusiastic, skeptical, or uninformed about the need for change. Other parties, such as unions or governments, may be many or few, and more or less influential. In the early stages of organizational change in an industry, one or a few companies may be in the vanguard in experiments or projects. The results of the experiments or projects will be assessed by the parties involved and the innovations will be embraced or abandoned, or modified and experimented with in an interactive process. As innovations prove themselves successful and produce confidence, they will become more widely known, accepted (as reflected in changes in supporting institutional policies), and adopted elsewhere in the innovating company and industry. Diffusion of organizational innovations involves information exchange, education, and attitude change. The focus of change evolves as attention shifts from the "pioneer" companies, to the other early changers, and finally, to the companies that are more reluctant to change.

Innovation in the manning of merchant vessels has included equipment-based crew reductions, limited crew organizational change, and comprehensive organizational change. The simplest changes have focused exclusively on reduction in numbers and not on changes in other manning policies or practices. The reductions are made possible by labor-saving equipment and approved by governmentally specified procedures. The objective is cost savings. A variation of this model is one where functions, such as maintenance, are removed from the shipboard crew's responsibilities with corresponding manning reductions. The next level of change focuses on two types of policy modifications: a) interdepartmental flexibility of multiple-skilled ratings; and b) greater continuity of employment. It may be based upon, or merely reinforced by, an assumption of decreases in crew size. The objective is to go beyond labor savings from technical change and to become more efficient in the use of human resources.

Provision must be made for the cross-training of existing ratings or the multi-purpose training of new GPs. It may be necessary to provide additional pay for multi-skilled ratings and to provide some inducements for ratings to accept company contracts.

The management responsibilities of officers also may be broadened. This limited level of organizational change typically is responsive to the need to improve operating costs.

The most complete change incorporates participative work planning, officer role flexibility, vertical role flexibility between officers and ratings, and stability of crew assignments. A number of other supporting changes are often made, including leave time and common facilities. This degree of change assumes and encourages increased social integration. It is supported and made possible by a better correspondence between management and union objectives.

Key Ingredients in the Change Process

Regardless of the degree of innovation attempted, success depends on the change process. The following review highlights those elements of change processes followed in European and Japanese manning innovations, which, in the committee's view, have differentiated effective change efforts from those which have been less effective.

Leadership

Top management commitment was cited as an important ingredient in the success of many projects, for example those of Hoegh, DFDS, Hapag-Lloyd, P.A.L., Jebsens, and Shell Tankers B.V. This factor was missing in other cases, where projects were directed principally by the researchers.

One of the lessons learned by the sponsors of the Sealife Programme in the United Kingdom is the importance of clarity of purpose. It is not enough to have a strong business or human rationale; it must be communicated to all participants. Symbols are sometimes important. In Hoegh, beginning in 1975, management shifted from annual conferences of top officers of project ships to "grass-roots" conferences which included ratings, thereby signaling management's intentions regarding participation.

Change is often championed by one or a few individuals within a company, the industry, or both. The champion could be a top executive of an experimenting company but need not be. Successes in the change efforts of Hoegh, Nedlloyd, DFDS, and P.A.L. were attributed to the championing of individuals who were strong, persistent, strategically placed, and influential advocates for change.

The more similar the innovating company and experimental ship to others that follow, the better the prospects for diffusion, the committee learned. Firms that are seen as leaders generally within the industry will be more effective in pioneering industry-wide organizational change. Hoegh and Hapag-Lloyd appear to score high on these criteria and have been effective pioneers as a result. Brostroms, because of its unusually large shore-based experience and facilities, may have been less effective as a general model. A very early pioneer, Shell Tankers B.V., may have been less persuasive to the other Dutch shipping companies because of perceived differences between a division of a large oil company and independent ship operators. DFDS was small, peripheral, and differentiated from much of the Danish fleet, which may help explain the negligible diffusion of its internally effective shipboard management innovations.

Involvement of Institutions

The involvement of union, management, and government parties has a bearing on whether an experiment may go forward and, if it does, whether its results will influence policy.

Three cases illustrate a broad spectrum from a minimum to a maximum amount of institutional involvement:

- In Denmark, the Moller company presented the authorities with a proposed experiment utilizing GP crew. The Seaman's Union insisted upon being involved in deciding the conditions and in monitoring the results. The company refused. With such a poor rapport between the parties, no change has occurred.

- Shell Tankers B.V. negotiated with its unions, both officers' and ratings', the early GP trials and subsequent policy change. The result was a relatively rapid diffusion throughout Shell's fleet. It was not necessary to have this agreement approved at the industry level, however, and no diffusion beyond Shell to the Netherlands shipping industry occurred for almost a decade. When the rest of the Netherlands shipping industry experimented with manning innovations, they operated their own project ships rather than base their decisions on Shell's decade of experience.

- In Norway, the Hoegh experiments with GP and other concepts were discussed, debated, approved, monitored, and evaluated by an industry-level "contact group" composed of union, government, and shipowner representatives and researchers. Not only did Hoegh change on the basis of these experiments, but industry-level learning occurred. Other Norwegian shipping companies, notably Jebsens and Klaveness, initiated manning innovations on the basis of the Hoegh experience.

The Hoegh-Shell comparison is particularly instructive. Both were leading edge companies in their countries. The choice to make Hoegh's experiments industry property, approved and monitored by the industry-level contact group, resulted in slower diffusion of the new manning model within Hoegh, but it spread Hoegh's influence throughout the Norwegian ship operating industry.

The tripartite contact group in Norway was copied later in the Netherlands. There have been no comparable mechanisms in Sweden, Denmark, and the United Kingdom capable of creating industry-wide sponsorship of experiments.

In several countries, inter-institutional mechanisms played a role in creating industry-level ownership of experiments, in promoting industry-wide learning from them, and in bringing about required changes in industry education, certification requirements, and manning rules. Inter-institutional mechanisms sometimes offered a way for each institutional representative to develop a deeper appreciation of the others' concerns and to gain an understanding of the ingredients of effective change. Whether the existence of an inter-institutional mechanism actually had the effects just described depended on a number of factors: the quality of pre-existing rapport among the parties, the amount of time the parties committed to the process, and the participation of individuals who were effective in promoting discussion and learning. In Norway, the contact group was launched at a time when management, union, and government officials were all concerned about attracting more qualified mariners and enjoyed reasonable, positive rapport. The parties met more than 30 times over several years; the Norwegian researchers were accepted as legitimate partners in the process and evidently were skillful catalysts. The contact group started in the late 1960s and continues today.

In the European experience, the quality of relationships among labor unions, ship operators, and government was a very important ingredient determining how much effective change occurred. When a country's industry was characterized by frequent discussion, mutual respect, and trust among these institutions, it was better able to innovate new manning policies and diffuse them.

Several factors complicated the development of cooperative relationships among institutions. The most important factor was the complexity and diversity of the constituent elements of each institution.

Consider the trade union structure. At one extreme, the Netherlands has a federation of unions. At the other extreme, Denmark has seven different unions representing seagoing personnel, including different unions for engine-room ratings and deck ratings. It is not difficult to see that the Netherlands' union structure played an important role in enabling the unions to accept interdepartmental role flexibility. In Norway, Hoegh's Multina ship project, started in 1971, convinced many in the industry of the desirability of role flexibility between navigation and engineering officers; but because of separate engineering and mates' unions, a decade later there still have been only modest steps in that direction. The mates, especially, suspect they would not fare as well as the engineering officers in qualifying for integrated officer positions. The effect of union structure is also illustrated by the fact that in Sweden, radio officers are represented by the mates' union; Sweden has made the most progress toward eliminating the radio officer position, and communication functions have been assigned in some cases to other officers.

Diversity and complexity among shipowners must also be addressed. In West Germany, two of the largest and most influential shipping companies, Hapag-Lloyd and Hamburg Sud, had opposing preferences about the manning models they wished to employ and therefore about what practices should be promoted or required by industry-level action. The industry in the United Kingdom is comprised of a large number of small- to moderate-sized firms with no large, dominating companies. As a result, the U.K. shipowners association has evidenced less leadership in manning innovations than its counterparts in other European countries.

Complexity and diversity within the government is also a factor. Sweden has recently consolidated government responsibility for shipping matters in one agency. West Germany is moving in the same direction.

Involvement of Participants

Another major factor influencing the success of experiments as well as subsequent diffusion in the Northwest European ship manning experiments was the degree to which direct participants, including the crew, were given an opportunity to discuss, review, and shape proposed or pilot innovations.

Norway's Hoegh first learned the lesson when they omitted this step in their initial efforts to transfer elements of an experiment to two other ships. They found that the crews on the new ships did not have the commitment required to make the innovation work effectively. Hoegh concluded that participative planning is an essential step in organizational change. A further implication of this decision for Hoegh is that innovations need to be tailored to the conditions on each ship.

A related lesson was learned by Sweden's Salen. In the mid-1970s, top management approved a trial in which increased shipboard management was delegated to officers on four ships. When the results proved encouraging, management made the change a policy and attempted to implement it throughout the company's fleet of several dozen ships. They encountered difficulties. The officers for the experimental ships had been carefully selected and the personnel onshore who served as liaisons for the experimental ships had been carefully briefed and involved in the planning. However, the company's program for implementing the change company-wide overlooked the importance of these two aspects of the experiment. The company found that many officers in the additional ships targeted for change were either reluctant or unprepared to take on the additional responsibility, and many of the shore personnel were unwilling to transfer authority because to do so would threaten their current role.

From this failure in diffusion, Salen management learned that careful preparation is required to lay the groundwork for diffusion of organizational innovation. They concluded that preparation must encompass participative planning by all affected groups to achieve acceptance, education and training for the new roles, and compliance mechanisms to ensure that individuals carry out their new responsibilities.

Adequate Information and Evaluation

There has been a general tendency in the diffusion of organizational innovations for followers to oversimplify. The methods by which new manning innovations were developed, approved, and monitored influenced the type of changes that were copied, if they were copied at all. This can be illustrated by reviewing the Brostrom case.

The Brostrom manning innovations, which have been extended to seven Ro-Ro ships over the past several years, have the following well-publicized aspects: a 16-man crew, 6 general purpose crew members, and an operational strategy which transfers almost all maintenance to shore-based facilities. It is regarded as successful, safe, cost effective, and satisfactory to crew members.

When other Swedish managers and government and union officials consider the general applicability of the approach, they especially focus on whether it is practical for other shipping companies to transfer maintenance functions to shore-based crews. These officials, however, may be missing important lessons from Brostroms' experience. When examining less publicized aspects of the Brostroms model and when one listening closely to what Brostroms' management itself considers to be the basis for its success, a more complex picture can be sketched.

The company negotiated the manning innovation initially with their unions and made them partners in the monitoring and evaluation of their early experiences. Crew members, who were required to be experienced, were recruited from among volunteers. There was a conscientious commitment to give more voice to crew members and to be more responsive to their stated needs. There was greater provision made for role flexibility between ratings and officers and for including ratings in the work planning. The manager with line responsibility for these ships emphasized that a major factor in the success of the innovation was motivated, spirited crew. This aspect of the success of the innovation is not well appreciated by observers, nor is there an information diffusion mechanism in Sweden which could help other ship operators understand the many ingredients for success that were built into the Brostrom's approach.

There are other illustrations of this tendency to fix on an aspect of an innovation, usually its most controversial aspect, while neglecting the key ingredients of its success. When in the late 1970s the Sealife Programme in the United Kingdom attempted to duplicate the Norwegian manning experiments, the intention was to test several concepts: general purpose crew, continuity of assignment, and crew participation. As it happened, the U.K. officers, ratings, their unions, and many managers were hindered by the question of social integration. A better grasp of the Norwegian experience might have enabled the participants to see that it is more appropriate to treat social integration as a by-product of work role integration, rather than as a precondition for other changes or as the central element of the planned change.

Technology Transfer

Each industry has, as a rule, insisted upon conducting its own research and trials rather than directly applying the experiences of other countries. For example, the Sealife Programme in the United Kingdom explicitly set out to reproduce the Norwegian experiments "on U.K. ships with U.K. personnel." Even within the Netherlands, Shell experiments were not regarded by the rest of the industry as a basis for evaluating the GP concept or the semi-integrated officer.

This repetition served several purposes. It provided a common experience which all of the affected parties could evaluate. It provided a concrete basis for all of the parties to learn about the detailed requirements of the change process. The planning and evaluation discussions among parties provided an opportunity for them to develop a more systematic understanding of the innovations, including their key ingredients and subtle effects. These discussions, like other instances of participative planning, developed ownership and commitment.

Much of the reporting on effective manning developments has been descriptive. There has been little assessment of the innovations, their strengths and weaknesses, and advantages or disadvantages.

Once several different companies were experimenting in Europe, the possibility existed for them to interact and influence one another. The rate of diffusion of change and the quality of the specific models which evolved were enhanced as networks were created in which participants in these innovations could meet and exchange their experiences. Some networks have been formalized, such as the companies participating in the Sealife Programme (United Kingdom), the Ship of the Future Program (West Germany), the Committee on Modernization of the Japanese Seafaring System, Provo (Netherlands), and the Ship Operation of the Future Program (Norway). Others consist of informal exchange among those companies that have an interest in the subject. Examples of informal networks include the 1980s Group (alumni of the Sealife Programme), the proposed Advanced Manning Group of the General Council of British Shipping, and similar but nameless networks in other European shipowner associations.

Compared to other industries worldwide, ship operators in Northwest Europe and Japan have devoted a remarkably large amount of effort to learning about organizational innovation. Also impressive is the very high quality of both the research and policy implications drawn from the research efforts. Most of this social science research has focused heavily, but not exclusively, on the Norwegian and British experiences--but it has had broad relevance to all of the countries studied. Moreover, the conferences exploring organizational innovations in ship operation often have been broadly international in their content and in their participant roster. The many trade journals and magazines which track developments in the international ship operating industry have reported frequently, and sometimes in depth, on the status of and trends in manning policies and practices.

Importance of Training

Training has played an important role in the process of change. Most innovations have entailed training of participants in technical skills related to expanded responsibilities and also in participative organizational change. A number of countries have revised rating and officer training schemes to support manning innovations in the national fleets. Norway has expanded its "ship's mechanic" training program to fill the demand for such ratings. West Germany has modified its national training program for ratings to the extent that the only entry training available is for GPs. Japan has revised its national training and certification scheme for officers to bring it into accord with the International Convention on the Standards of Training, Certification, and Watchkeeping for Seafarers, and also to support the trend toward semi-integrated officers and certified nonofficer bridge watchstanders. The most substantial changes in training have been those for ratings because manning innovations affect ratings more than officers; a reduction in the number of crew members leads to an increase in required skills and qualifications. In addition to changes in national training programs and requirements, companies have initiated programs to meet specialized needs. This company training is provided to recruits emerging from the training schools as well as to upgrade employees for innovative service. The scope of company training depends on the scope of the company's manning innovations. Nedlloyd in Holland started an experimental program with two project ships in 1978 using the Multi-Purpose Crew concept. They provided 5 days of special training in firefighting, safety, first aid, and lifeboat certification; 3 weeks of shoreside training; and 2 months of on-the-job shipside training in the opposite department. Other examples of companies engaging in similar experimentation and training efforts are Hapag-Lloyd in West Germany (3 weeks of shoreside and 3 weeks of shipside training); Hamburg Sud in conjunction with other West German companies; P.A.L. in the United Kingdom with shoreside schools to improve ratings' skills; and Leif Hoegh in Norway with structured training programs for GPs onboard the ship.

Dual competency has brought about major changes in officer training schemes. Dual competency is now a hiring requirement in Shell Tankers B.V., with pressure being brought on the Dutch government to make such training mandatory in the nautical college. The system offers the "minor" competence through an additional 6 months of college and 6 months at sea in the opposite department. The goal is to design a dual-purpose officer education program of 4 years. For the future, a fully integrated officer training system is envisioned. In West Germany, the new system of officer training consists of 13 years of compulsory schooling, 18 months on ship, then 3 years of theoretical work at a polytechnic school. Attempts on the part of West German shipowners to have a semi-integrated educational program implemented have not gained approval by the government, but there is mounting pressure to include special provisions for such manning in manning regulations under consideration. Semi-integrated officer experimentation undertaken by Leif Hoegh in Norway several years ago was allegedly highly successful, but failure to gain support in the educational system made it impossible for the company to sustain the arrangement.

Given the importance of leadership to successful innovation, some training has been directed to the development of leadership skills, and understanding of participative organizations, among those involved. Officers have received training in management and meeting techniques, so as to be more competent in handling situations resulting from the implementation of shipboard management/matrix organizations. Shoreside office staff members have been given training in communication appropriate to their roles as teachers of skills to be transferred from shore to ship.

While these additional training components may not seem very significant in and of themselves, they signal a new emphasis on cooperation and a move towards decentralization and a self-contained ship.

Government and Union Rules and the Process of Change

Some manning innovations in Northwest Europe have contravened laws or regulations. Some experiments and trials have required variances from requirements. Where experiments have been successful, laws or regulations have had to be modified to enable the innovation's diffusion in the industry. The two types of laws or regulations that bear most directly on manning innovations are manning scales that specify numbers and qualifications of seafarers for specific tonnage and power vessels, and work environment laws which specify maximum numbers of hours of allowable work. The pattern throughout Europe and Japan has been to move away from legislated manning scales in the direction of regulations which can more easily be modified and interpreted for special circumstances. In some cases, industry advisory bodies have assisted government agencies in considering requests from operators to crew at levels less than that prescribed by law. Japan has gone so far as to remove manning from the realm of legislation and now relies upon regulation for guidance, which provides the legal elasticity to experiment.

For years, Norway had a means of providing for regulatory variance for experimental vessels. In 1983, a new manning scale law was passed that permits considerably smaller crews. The size of the crew is determined by the technological standard of the ship and the type of organizational innovations implemented.

Just as variances from government rules have been needed for manning innovation, variances from union rules have also been needed prior to manning experimentation. In the United Kingdom, there has been a trend in the direction of individual companies negotiating separate contracts with the unions whenever they want provisions unlike those specified in the national agreement. The West German 18-man Containership Experiment operated under the provisions of an agreement signed by both the German Shipowners' Association and the two unions. A number of companies and most unions were signatories to similar agreements in Norway.

Two of the more difficult issues attendant to manning innovation are watchstanding of captains and the requirements for a radio officer. The radio officer requirement is increasingly being viewed as obsolete because of substantial advances in communications and navigation; although it is provided for in international law. In the countries reviewed, resolution of these issues has or will involve statutory changes.

Compensating Workers for Their Participation

Compensation has been provided throughout Europe and Japan because some manning changes can have negative consequences for mariners and their unions. In Norway, an industry-labor agreement provided for permanent employment, fixed annual salaries, and more vacation time. In West Germany, the 18-Man Containership Experiment also provided for continuous employment, additional holidays, guaranteed overtime, and other fringe benefits. Throughout Europe it is understood that one compensation to the ratings for shouldering the brunt of billet reductions is improvement in the status of those that remain. Unions representing the ratings have attempted to incorporate within manning experiments provisions for better training, facilities, and social status for their members.

The All Japanese Seamen's Union, which has cooperated in the national program to restructure merchant crews, has revised its views on wage policy as a result of the increasing unemployment and radical changes envisaged for the seafaring career. The union is now attempting to obtain a new pay and benefits structure that would provide lifetime security to the seafarer and his dependents. The union is also pushing for a selective retirement formula to promote the early retirement of an aging work force. With a usual retirement age of 55, the Japanese seafaring work force has a high proportion of individuals in the 40 to 54 age bracket. As in the United States, the ratio of reserve to active seamen in Japan has risen dramatically. The number of reserve seamen decreases at a far slower rate than the number of billets eliminated through crew reductions. Thus, savings through elimination of active shipboard positions is insufficient. Early retirements may alleviate the unemployment problem.

Another means of alleviating unemployment among seafarers has been retraining for other than seagoing careers. The Japanese have been most active in this regard, both through the efforts of individual companies and the government. NYK runs a job development program which assists in finding NYK seafarers jobs ashore with affiliate companies (e.g., steel and shipbuilding). K Line and Mitsui have similar schemes, and on a broad basis the Japanese Ministry of Transport established in 1978 a Seamen's Employment Promotion Centre. These voluntary programs are assisted by the fact that these shipping companies are a part of larger industrial groupings.

RESULTS OF MANNING INNOVATIONS

Reflecting those historical conditions of the industry which led to effective manning programs, evaluation of innovations has focused primarily on the economy of vessel operation and the degree to which changes have improved the quality of working life. The effect of manning reductions and modification of traditional work practices on safety and health also has been an area of concern.

Economy of Vessel Operation

While earliest change efforts were concerned with providing a remedy to the manpower shortage problem, and were directed toward improving the quality of work life at sea, economy of operation always has been a measure of the success of effective manning projects. Cost reduction has become increasingly important in recent years due to overtonnaging and severe competition.

Savings in direct payroll costs as the result of billet reductions has been the primary objective of a number of European and Japanese ship operators. These operators have introduced organizational or working practice changes only for the purpose of supporting the primary objective of manning reduction. Problematic in these cases is the degree to which direct payroll savings are offset by other costs associated with manning reductions (e.g., additional overtime for remaining crew members, additional training for remaining crew members, expanded shoreside maintenance, and declining resale value of the vessel, especially if it has not been maintained as before).

The degree to which individual companies have monitored the costs and benefits of effective manning projects has varied. There are no figures available for the industry as a whole, or for any national fleet. The Norwegian Shipowners' Association, in a review of that country's experience with effective manning experiments, flatly states: "It is not possible to estimate the cost that has been incurred in the new equipment, additional training, or savings made." A number of companies, including DFDS, Hoegh, and Shell Tankers B.V., have made comparisons of developments over time. Whereas costs on conventionally manned ships rose steadily over a couple of years, the costs on project ships rose much less sharply. The results were encouraging both in terms of operational performance and maintenance costs.

Operators engaged in effective manning programs claim that reduced and reorganized crews operate project vessels not only without increasing operational costs in areas other than payroll, but in a fashion that has reduced these costs as well. In other words, effectively manned vessels are not only saving payroll costs, but are providing savings in such areas as fuel economy, economy of equipment and stores, less days off-hire, and less illness and accident claims.

Quality of Working Life and Job Satisfaction

During the era of manpower shortage, the companies were insistent that changes in operating practices should result in the seafarers being more satisfied with their employment and consequently remain at sea. With the shift of emphasis to economy of operation, the social goals or quality of work-life goals have not been lost. Operators still voice the concern that the quality of work life resulting from effective manning changes be a positive improvement rather than simply "not degrading" as manning levels are reduced and economic working practices introduced. The most effective innovations are felt to be those that simultaneously increase productivity and improve working conditions (e.g., decentralized decision making, participative work planning, assignment continuity, higher levels of training, competetence, and responsibility).

It is widely reported that seafarers employed under effective manning arrangements enjoy a substantially improved quality of work life, and are not inclined to revert to traditional employment and working practices.

Bibby Bros. reports of their project ships that:

> "Management inspections of the ships reveal higher levels of achievement in the maintenance and appearance of the ships and also indicate improved management and morale on board...In short, both the teams themselves, and company management, think that they have a much better grip on affairs and greater satisfaction in their work. In essence, we would see the main benefit from these developments as being a much improved trust and collaboration between shore and ship management. There has been a marked departure from traditional attitudes and a lessening of unproductive conflict. Issues are still confronted, but in a more constructive and less status-conscious manner. The organization as a whole is displaying a greater continuity and coherence of purpose and effort." (Smith, Gosden, and Elkington, nd.)

The Norwegian Shipowners' Association reports that ship-to-shore relationships have been remarkably improved, and that barriers between officers and ratings and between departments have been broken down, and are in some ships almost nonexistent. Furthermore, the crew works as a much closer team than before.

Safety and Health

Concern about safety and health in manning projects has generally taken the form of precautions that they not deteriorate.

Different parties have had different safety and health concerns in overseas manning experiments. The ministries of transport and their industry advisory committees have, in reviewing requests from operators for permission to sail with smaller crews than provided for by law, considered the possible vessel safety implications of proposed changes. In some cases, these agencies and advisory groups have played a further role in monitoring the performance of vessels granted such variance and operating with reduced crews. In countries with work environment laws (e.g., Norway and West Germany), agencies with this responsibility have monitored the hourly work records of experimental ships.

Operators and shipowner associations generally claim that effective manning vessels are not only as safe as traditionally manned ships, but have resulted in better safety records because the smaller, higher trained, better motivated crew is more alert and attentive to duties. Some of these operators claim to have quantified these safety gains.

Those union leaders that are cautious with regard to the new crew structures argue that quantity, in terms of numbers of crew, is important in addition to quality, and that expanding the responsibilities of ratings and officers beyond traditional duties is resulting in seamen less qualified in their principal departments. Although they have no data to support their claim that these ships may be less safe than those traditionally manned, one union observed that it is the most modern well-equipped vessels that are being crewed in the new fashion. Arguing that such high-technology vessels should be safer than older ships simply from a technical point of view, this union maintains that effective manning vessels should therefore be required to show safety gains, and not just the absence of safety slippage.

Additional Comments on Measurements of Results

Characteristic of company-level efforts in organizational change in any industry, the results of such projects in shipping are not well documented. If projects are reported at all, and many are not, the reports frequently take the form of descriptive case studies. Few change programs are conducted in a scientific fashion. There are several reasons for this. Companies are interested in results, not scientific documentation. They are not motivated to increase the cost of the project. Another reason is that formalization of manning projects in a scientific mode can reduce the enthusiasm of participants, and therefore the likelihood of successful changes. Finally, the active participation of evaluators--managers, union representatives, and seafarers --in experimental manning projects has provided experiential proof of results which has been sufficient for corporate purposes.

5

OPPORTUNITIES FOR AND OBSTACLES TO CHANGE IN THE U.S.-FLAG MERCHANT FLEET

The committee's analysis of the status and manning of the U.S.-flag merchant fleet and of manning innovation in Northwest Europe and Japan enables a number of comments to be made on the potential for introducing manning innovations in the U.S.-flag fleet.

TECHNOLOGICAL AND ORGANIZATIONAL CONSIDERATIONS

The most comprehensive manning changes have entailed both technological and organizational alterations. However, manning changes also have been accomplished by technological or by organizational innovations alone. For example, an unattended engine room can be operated with a lesser number of traditionally organized engineering personnel--a technological innovation alone; or a shipboard management team approach can be introduced on conventionally equipped vessels--a purely organizational innovation.

Technologically based manning reductions are likely to be less effective if not supported by concurrent organizational changes; for example, a lesser number of ratings works best if the ratings serve as a general purpose crew. Organizational changes, to be most effective, require technological adaptations.

There is a general belief among ship operating management that the typical 40-man crew on containerships and 30-man crew on tankers could receive its biggest reduction by diesel conversion, automated engine room, and high technology for navigation and deck operations. They feel that with improvements along these lines, and with reductions in the steward's department, containership crews could be cut almost in half, and tanker crews between 30 and 35 percent. An indication of what can be and is being accomplished in the United States is provided by a Maritime Administration study, summarized in Table 10.

A major barrier to the introduction of automation technologies into the U.S.-flag fleet is cost. Another barrier has been the difficulty of reaching company-union agreement on manning issues.

TABLE 10 Alternative Manning Levels of a Container Ship

Position	ALTERNATIVE			
	A	B	C[b]	D[b]
Master	1	1	1	1
Radio Officer	1	1	1	1
Purser	1	a	a	a
Deck Officer	4	3	3	3
Unl. Deck	11	6	6	6
Chief Eng.	1	1	1	1
Eng. Officer	5	4	2	3
Unl. Engineer	8	5	3	3
Steward	8	6	5	3
TOTAL	40	27	22	21

[a] MarAd recommended that duties of purser be transferred partly ashore and partly to other members of the crew.
[b] Based on a permanent crew with the exception of entry personnel.

Alternative A: Present vessel--steam turbine with watchstanding engine room. Present manning.
Alternative B: Present vessel equipped with a watch call system, bridge sanitary and messing facilities, labor saving devices for mooring, and automatic radar plotting aid.
Alternative C: Present vessel with equipment as in B and changing engines to diesel classed for an unattended engine room.
Alternative D: Latest slow-speed diesel vessels with navigational aids and an unattended engine room.

SOURCE: U.S. Maritime Administration.

Technologies that permit reduced manning have not been adopted to the same extent in the U.S.-flag fleet as they have in some Northwest European fleets, primarily because of cost considerations and the age of the U.S.-flag fleet. By and large, it is more cost effective to introduce automation technologies on new ships than to retrofit. Some of the newer U.S. vessels are equipped with state-of-the-art automation technologies that make them technologically comparable to the most effectively manned vessels of Northwest Europe.

Shipboard Innovations

There is already a degree of intradepartmental flexibility in the U.S.-flag fleet. Some U.S. operators now employ chief steward/cooks, second cook/bakers, steward utilitymen, QMEDs, and watchstanding chief mates. Additional opportunities are constrained only by the absence of investment in supporting technological innovations, and by the lack of management and labor support to date for experimenting with changes and implementing those that are successful.

Innovations that further, interdepartmental flexibility--general purpose ratings and semi-integrated officers--must spring from management and labor support and cooperation for change. This cooperative atmosphere has been lacking in the United States. However, business conditions are such that labor unions are increasingly open to considering changes in this area, at least in new ship construction, in the interest of preserving jobs.

The crossover provision of 46 USC 8104(e) (673), may prohibit interdepartmental arrangements, but these departments are neither created nor limited by the law. A court has already accepted the concept of a maintenance and repair department (see Appendix C). The way seems open, if the form of a Certificate of Inspection is altered and the appropriate rating designations used, to avoid having deck departments and engine departments, or at least to minimize them by also recognizing a maintenance department and using properly designated and identified general purpose seamen. The concept of mate is traditionally linked to deck duty. While an engineerless ship is not out of the question, the expansion of the mate's duties to include engineering duties would possibly require statutory change. The current licensing laws may not permit the Coast Guard to create a dual-purpose license by rulemaking.

An innovation that can be introduced unilaterally by management is the shipboard management team. The outstanding obstacle in this instance is not external to the ship operating company, it is internal --the corporate culture policies of central authority. Shipboard management teams require that headquarters personnel share their responsibilities with the seagoing work force. While there have been few studies made of the subject in the United States, it may be that the culture or tradition of U.S. ship operators is more centralized and directive than that of their counterparts overseas because U.S. operators have not always enjoyed the stability of employment of officers that has been commonplace overseas.

As with shipboard management teams, the innovation of work planning is not discouraged by legislation, regulation, or union contract. However, participative work planning usually is introduced only in connection with other more basic changes, such as shipboard management teams and interdepartmental flexibility.

Supporting Innovations

Changes in maritime employment leading to longer-term association of employees with ship operating companies and with vessels, and also redefinition and reorganization of job content, are essential elements of effective manning. Achievement of such changes hinges on cooperation and agreement between management and labor.

The unions find it difficult to approve those portions of changes that lead to reduced manning because of the large number of seafarers willing to work who cannot find billets. The unions, understandably, want to spread the work over the membership. Even in an environment of balance between labor supply and demand, greater continuity of employment may be viewed by the unions as weakening the ties between the union and its members. However, unions readily support manning innovations that assure job survival or promise growth in billets.

Outside of the above understandable and manageable union concerns, there are no legal, policy, or technical obstacles to greater employment or vessel assignment continuity in the U.S.-flag fleet. Nor are there any obstacles, outside of union or corporate culture, to the reorganization of shipping offices and union organizations in support of effective manning. However, if for no other reasons than communication and representation, the relatively large number of industry entities compared to the small number of union members or ships is a considerable obstacle to change. This fragmentation complicates the formation and execution of manning innovation projects, and the reorganization of shipboard work.

MANNING RESEARCH AND EXPERIMENTATION, AND TECHNOLOGY TRANSFER

Effective manning of the U.S.-flag fleet has been the object of several studies, including job satisfaction surveys, manning-level task analyses, and projects directed towards defining "the ship of the future." A kind of research, which has been key to the development and implementation of manning innovations in the effectively manned fleets of Northwest Europe and Japan, and which has been absent in the U.S.-flag fleet, is action research.

Action research is organizational development research that has as its objectives both the development of new knowledge and simultaneously the promotion and implementation of organizational change. In action research, the project participants (i.e., seafarers, corporate managers, union and government officials) participate in the planning and execution of the experiment and the implementation of results. The European experience with effective manning demonstrates hands-on experimenting (including a structure for doing so and for transferring experimental results to other users) is an important aspect of innovation, especially if the innovation is to be adopted by other users.

Moreover, action research allows each user the opportunity to participate in the development and implementation of innovations. The European experience has shown that changes tailored to one workplace may fail in another without the molding and shaping that results from action research. Stated another way, the most successful organizational changes have been the product of action research.

While action research is absent from the U.S.-flag maritime industry, it has been an element of organizational change in other sectors of U.S. industry. The introduction of quality of work life and other employee involvement programs into the automobile, communications, rubber, and other U.S. industries has been facilitated through action research. The elements of union and management agreement to cooperate for technological and organizational change in these instances have been:

- Common statement of objectives;
- Joint plan for change, respecting the organizational integrity of each party;
- Joint committee for approving and monitoring change projects; and
- Joint and also separate education and training for union and management personnel.

In addition to the absence of action research in the U.S.-flag fleet, mechanisms for technology transfer in the United States are not being adequately used. Unlike overseas, the United States lacks a single technologically oriented ship operators' association which could document and disseminate information on developments to members. The existing organizations are concerned primarily with government policies and also are fragmented, being organized around issues of protection, subsidy, and trade.

There is also no established ship operating research program in the United States. However, a framework for such a program exists within the Maritime Administration; also, a report of the National

Research Council (National Research Council, 1983) has recommended that industry sponsor such a program. Since no U.S. companies are engaged in formal effective manning projects comparable to those undertaken in Northwest Europe and Japan, it is no surprise that there are no informal networks of such companies sharing the results of their trials. That inhibition may be exacerbated by the antitrust laws of the United States, which, whether for fear or fact, have a chilling effect on industrial cooperation. Overseas, there are enough experimenting companies, unions, researchers, and interested parties to sustain a number of workshops, conferences, publications, and other forums for technology transfer.

TRAINING

Through training programs designed to give officers and unlicensed mariners multiple technical skills, U.S. maritime training centers are contributing to setting the stage for effective manning innovation in the United States. The training centers are often the product of union-shipping industry cooperation; usually union operated and company funded. The decline in billets has reduced the annual contributions of operators to the training centers, and the use made of them. Thus, while the U.S. training centers are progressive and have good facilities, they are also underutilized and underfunded. Nevertheless, the industry-labor cooperation that is evident in the training centers provides a basis to extend cooperation to other sectors of maritime industry, especially manning innovations.

Any further modifications to training curricula that may be necessary in support of effective manning are not likely to cause problems with accreditation boards or to extend the course of instruction; the U.S. Merchant Marine Academy already graduates dual-licensed officers in 4 years. Training for expanded managerial responsibilities can be developed and provided by existing management training or continuing education programs. Training in organizational development processes, both for shipboard and shoreside personnel, could be obtained through a number of organizations in the United States which have conducted such training for other industries; or existing maritime training centers could provide such training.

GOVERNMENT RULES

With certain exceptions explained in the text and in Appendix C, minimum manning levels are determined administratively by the Coast Guard. The Coast Guard performs that duty by means of policy guidelines which are implemented in the field through issuance of Certificates of Inspection. The flexibility of this approach contrasts favorably with that of Norway and elsewhere, where manning levels are prescribed by law. There are, however, several legal impediments and observations:

- Specific manning requirements such as for a radio officer may no longer be necessary in light of technological advances and state-of-the-art equipment installed on U.S.-flag ships.

- The situation of conflicting statutes and judicial interpretations concerning the three-watch law (46 USC 8104 (673) and related laws (46 USC 8301(a) (223); 46 USC 8301(a)(5) (404)), has become even more confusing as a result of technology advances which have obviated the necessity of many watchstanding duties, especially in the engine department.

- The "Crossover Law" (46 USC 8104 (673), which stipulates that the seafarer may not serve in both deck and engine departments in a single voyage, and the statutory division of deck and engine licenses may no longer be productive or necessary in light of technology advances and shipboard organizational developments that have been demonstrated overseas.

- Updating of the designation of seafarers' ratings in regulations and on Certificates of Inspection would seem to be required as the result of the recent revision of Title 46 of the U.S. Code. The revised law requires that seafarers' documents specify the ratings in which the seafarer is authorized to serve. The law requires further that the seafarer be authorized for service in the capacity in which he is employed.

IMPLICATIONS OF CHANGES FOR SEAFARERS

Certain patterns of involvement are common to both some European experimental ship projects and some U.S. manufacturing plant projects. The two groups most likely to become involved and positive about changes are the unlicensed mariners/shopfloor workers and vessel masters/plant managers. The two groups likely to be most threatened and therefore least actively involved are the junior officers/lower and middle managers in plants and shore staff/division staff. The patterns were reflected in the Hoegh Mistral-Multina sequence, when the second project attempted to remedy the problems of involvement, which had been encountered in the first. It also was reflected in Sealife's containership project (1976-1978) which focused on the ratings and was followed by three project ships within the same company to pursue shipboard delegation to junior officers.

Manning changes that redefine work content, promote involvement in decision making, and increase the continuity of crew members have complex implications for the development and utilization of skills. Such changes can be developed in a way that takes into account the interests of both mariners and ship operators. Properly formulated and implemented, these changes can enhance both economic performance and human satisfaction.

However, other manning changes often reduce billets and sometimes increase workloads. These kinds of changes have led mariners' unions and their members to negotiate compensation for their concurrence and participation. Compensation has taken the form of compensating payments or retraining. A major obstacle in the United States to union concurrence with reduced manning is the unfunded pension liabilities, which increase when manning is reduced. Compensation arrangements will have to take pension liabilities into account as well as the needs of participating mariners. However, unfunded pension liabilities may in the future exceed the ability of ship operators to pay.

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APPENDIX A

EUROPEAN INFORMATION GATHERING TRIP

Organizations Contacted

OPERATORS

- P.A.L. Shipping Services (U.K.)
- General Council of British Shipping (U.K.)
- Bibby Line (U.K.)
- Swedish Shipowners' Association (Sweden)
- Salen Shipping Company (Sweden)
- Danish Shipowners' Association (Denmark)
- DFDS Shipping (Denmark)
- German Shipowners' Association (West Germany)
- Leif Hoegh Line (Norway)
- Norwegian Shipowners' Association (Norway)
- Nedlloyd Shipping Company (Netherlands)
- Shell Tankers (Netherlands)
- Van Nievelt Goudriaan (Netherlands)
- Netherlands Shipowners' Federation (Netherlands)

UNIONS

- National Union of Seamen (U.K.)
- Merchant Navy and Airline Officers Union (U.K.)
- Swedish Seamen's Union (Sweden)
- Swedish Engineer Officers Association (Sweden)
- Swedish Ship Officers Association (Sweden)
- Merchant Navy Officers Association (Denmark)
- Danish Radio Officers Union (Denmark)
- German Employees Union (West Germany)
- Transportation and Public Services Union (West Germany)
- Norwegian Shipmasters Union (Norway)
- Norwegian Seamen's Union (Norway)
- Norwegian Union of Marine Engineers (Norway)
- Norwegian Mates Union (Norway)

GOVERNMENT

- National Administration of Shipping and Navigation (Sweden)
- Ship Safety Administration (West Germany)
- Ministry of Transport (West Germany)
- Ministry of Trade and Shipping (Norway)
- Coast Guard (Netherlands)

RESEARCHERS

Dr. David Moreby, Plymouth Polytechnic (U.K.)
Tavistock Institute (U.K.)
Mr. Arne Rebnes, DFDS (Denmark)
Work Research Institute (Norway)
Ship Operation of the Future (Norway)
Institute for Ergonomic and Organizational Research, Bremen University (West Germany)

Interview Topics

- What have they done? (A list of projects, experiments, and implemented changes, specifying both technical and organizational content, e.g., what devices employed, how many in crew, how employed).
- Why did they do it? (What prompted the various parties to participate?)
- How did they do it? (Describe the process by which the above has been accomplished.)
  - What has been the role of the research community?
    - What basic research was undertaken?
    - What applied research was undertaken?
    - What action research (i.e., experiments) was undertaken?
  - In each case, how was the research done?
    - Who sponsored it?
    - Who did it?
    - How was it communicated?
    - How did it lead to the next step?
  - What has been the role of the ship operators?
    - The individual firms?
    - The shipping associations?
  - What has been the role of the seafarer unions?
    - In support of research?
    - In provision of regulatory variance for experiments?
    - In encouragement of experiments through subsidy leverage?
    - In subsequent regulatory amendments?
- What has been done to mitigate undesirable side effects of manning adjustments? (Describe contractual, i.e., labor-management and government policy initiatives.)

APPENDIX B

MEETING OF GOVERNMENT, INDUSTRY, LABOR, AND RESEARCH PRINCIPALS IN U.S. MANNING INNOVATION

Maritime Institute for Training and Graduate Studies

Baltimore, Maryland
October 31-November 1, 1983

I. Participants

Leo Collar, Executive Vice President, Delta Steamship Lines
Thomas Crowley, President and Chairman, Crowley Maritime
Henry Disley, President, Marine Fireman's Union
Frank Drozak, President, Seafarers International Union
Jack J. Ervin, President, Trinidad Corporation
Arthur W. Friedberg, Director, Office of Maritime Labor and Training
Maritime Administration, Department of Transportation
Harrison Glennan, President, Falcon Carriers
James G. Gross, Senior Advisor for Research and Development
Maritime Administration, Department of Transportation
Arthur J. Haskell, Senior Vice President, Matson Navigation Company
George Hearn, Senior Vice President, Waterman Steamship
Marcus Johnson, Vice President, Sea-Land Service, Inc.
Peter Johnson, President, Pacific-Gulf Marine
Robert E. Johnston, Vice President, OSG Bulkships
Jerome E. Joseph, Assistant to the President, Associated Maritime Officers
Warren Leback, Deputy Administrator, Maritime Administration, Department of Transportation
Zelvin Levine, Director, Office of Advanced Ship Operation, Maritime Administration, Department of Transportation
William Loefstedt, Chief, Manning Branch, U.S. Coast Guard
Robert J. Lowen, President, Masters, Mates and Pilots
George F. Lowman, Chairman and Chief Executive Officer, Farrell Lines
Clyde T. Lusk, Chief, Office of Merchant Marine Safety, U.S. Coast Guard
Robert P. Magee, Senior Vice President, Puerto Rico Marine Management, Inc.
Raymond T. McKay, President, Marine Engineers Beneficial Association, District 2
William Nations, Training Director, American Radio Association

Thomas Pross, Associate Administrator for Shipbuilding, Ship Operation, and Research, Maritime Administration, Department of Transportation
William Ristine, Vice President, Keystone Shipping
W. Bruce Seaton, President, American President Lines
Eugene Spector, Research Director, National Maritime Union
Richard Sutherland, Chief, Office of Merchant Vessel Personnel U.S. Coast Guard
Allen Taylor, Vice President, Lykes Brothers Steamship Company
Stanley S. Unger, Senior Vice President, Ogden Marine
Shannon Wall, President, National Maritime Union
Virgil Williams, Program Manager, Office of Ship Performance and Safety, Maritime Administration, Department of Transportation
John A. Zotkowski, Secretary Treasurer, Radio Officer's Union

II. Guests

John E. Flipse, Chairman, Marine Board
President, Texas A&M Research Foundation
John F. Wing, Vice Chairman, Marine Board
Senior Vice President, Transportation Consulting Division, Booz, Allen, and Hamilton

III. Committee

Wayne Horvitz, Chairman, Labor-Management Consultant
Harry Benford, The University of Michigan
Frank J. Boland, Upgrading and Retraining Plan, National Maritime Union
John V. Caffrey, Mobil Corporation
Clinton J. Maguire, U.S. Coast Guard (Capt. ret.)
John W. Reiter, American Bureau of Shipping
Jacques Roggema, Consultant, Organizational Development (Netherlands)
Julian H. Singman, Maritime Institute for Research and Industrial Development
Thomas J. Smith, Farrell Lines (ret.)
Richard E. Walton, Harvard University

IV. Staff

Jack W. Boller, Executive Director
Donald W. Perkins, Assistant Executive Director
Michael E. Gaffney, Consultant
Terrie Noble, Secretary

AGENDA

Monday, October 31, 1983

0930	Welcome	Mr. Wayne L. Horvitz, Chairman Committee on Effective Manning
	Introductions	Admiral Harold E. Shear (USN ret.) Administrator, Maritime Administration
		Rear Admiral Clyde T. Lusk Chief, Office of Merchant Marine Safety, U.S. Coast Guard
	Plenary Session Process of Organizational Change in Industry	Dr. Richard E. Walton, Professor of Business Administration Harvard University Dr. Jacques Roggema, Organizational Development Consultant, Kantens, Netherlands
1200	LUNCH	
1300	Workshop Session No. 1	Effective Manning: Goals and Problems o Work Group Discussions
1500	Plenary Session	
1700	Adjourn	
1730	Dinner	
1830	Workshop Session No. 2	Manning Innovations, Technical and Organizational o Work Group Discussions
2030	Plenary Session	
2200	Adjourn	

Tuesday, November 1, 1983

0830	Workshop Session No. 3	Complementary Changes Affecting Shipboard Manning o Work Group Discussions
1030	Plenary Session	
1200	LUNCH	

Agenda (continued)

1300	Workshop Session No. 4	The Process of Change: How Approached Abroad and Implications for the United States o Work Group Discussions
1500	Plenary Session	
1630	Summary-Closing Remarks	Mr. Wayne L. Horvitz
1700	Tour (Optional)	

APPENDIX C

LAWS AND RULES OF THE UNITED STATES CONCERNING VESSEL MANNING

By Capt. Clinton J. Maguire, U.S. Coast Guard, Ret.

Government control* of manning is exercised through statutes (i.e., acts of Congress), regulations, and court rulings. Regulations are promulgated by the commandant of the Coast Guard under authority conferred by acts of Congress. U.S. court rulings interpret the statutes and apply the principles of admiralty law.

The Coast Guard's general policy guidelines for the administration of manning laws and regulations are found in the Maritime Safety Manual and are available to the public. The Coast Guard's general rules on manning are published as notices in the Federal Register and collected for convenience in its compilation, the Code of Federal Regulations (Title 46, Shipping). These deal only with those requirements actually imposed by statute and are little more than repetition. More important is the authority given by 46 USC 8101 (222), for the Coast Guard to prescribe the minimum complement of persons, licensed and unlicensed, considered necessary for the safe navigation of each individual vessel. These requirements are set out in the Certificate of Inspection issued to the vessel.

In the most familiar and customary form, a Certificate of Inspection calls for a licensed master, three mates, three or four licensed engineers, enough sailors to have three per watch, and enough unlicensed engine-room personnel on a steam vessel to have three per

*The laws regarding vessel inspection, manning, licensing, and shipment and discharge of seamen were recodified by P.L. 98-39 of August 26, 1983, to update the language of the various laws and to put them in logical sequence. While some laws were repealed, the recodification was not intended to make any substantive changes in the laws replaced. References herein to the new law are followed by corresponding section numbers of the former law in parentheses, e.g., 46 USC 8104 (673).

watch.* The standard has thus been 26 individuals. Actual crews have been larger primarily because of food service personnel and, on the few passenger vessels, supernumeraries, but these personnel are not found necessary to safe operation.

Many laws recognize and impose duties upon the master. One law declares that a vessel subject to the section must have a "licensed master." The law governing vessel documentation allows certain vessels to have a master who is not even aboard at any time and who may be the master of more than one vessel. It is theoretically possible for a vessel to have two masters aboard at the same time, one to fulfill the "licensed master" requirement and another to be the master for the marine document.

The oddity of "seaman" is that it includes licensed officers, cooks, staff personnel, waiters, musicians, and more, but is sometimes confused with "sailor," a term traditionally reserved for seamen with deck department duties.

Certificate requirements change both with the vessel's nature and equipment improvements. The Coast Guard has broad discretion. The Coast Guard is presumed to understand what is necessary; it is open to persuasion in individual cases; and its rulings if unreasonable are subject to review in the courts.

The only statute that explicitly states in terms and numbers that certain people must be aboard is 46 USC 8301(a) (223). It requires that every machine-propelled vessel, of the type involved, have one duly licensed master, and three licensed mates, and a licensed engineer.

Pursuant to Chapter 4 of the International Convention for the Safety of Life at Sea, 1974, a radio officer is required on most vessels. Among other acts of Congress, there is one that pertains directly to manning, and there are others that do so indirectly by establishing shipowner's liability.

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*Before considering the effect of governmental control on the manning of American vessels, the reader needs to take into account that the field suffers from a history of loose terminology usage. Many terms in common use have never been defined. Some general understandings and concepts have changed resulting in two distinct, generally understood meanings for the same term in different but overlapping contexts. Examples are the terms "master," "seaman," and "sailor." In 46 USC 713, the master was defined as the person in command, and a seaman as a person employed in any capacity aboard the vessel. These definitions are perpetuated, with minor exceptions, to the "seaman" concept in the new law at Sec. 10101. This on its face applies only to one part of the new law, but the definitions may be expected to receive varying application.

The Three-Watch Provision

Known as the three-watch provision, 46 USC 8104 (673), states:

> "On a merchant vessel of more than 100 gross tons...the licensed individuals, sailors, coal passers, firemen, oilers, and water tenders shall be divided, when at sea, into at least three watches, and shall be kept on duty successively to perform ordinary work incident to the operation and management of the vessel."

Its concern is with safety, not conditions of labor.

When first enacted in 1915, the provision had no reference to licensed officers. It imposed at least two watches on sailors and did not include coal passers among those enumerated for three watches. Today's application was introduced in 1936 to cover licensed officers, move sailors to the three-watch system, and add coal passers. Other provisions of the section speak of a "seaman" in recognition of the long understood concept of "person employed aboard a vessel, other than the master."

The language is precise as to those unlicensed engineer categories which must be divided into watches. It is clear that if an unlicensed person is engaged for engine duties other than as coal passer, fireman, oiler, or water tender, he is not covered by the language of the statute. It is a different matter with a sailor. Sailor is not a term defined elsewhere; it is one of many assumptions in the law, presuming that everyone knows what a sailor is. Duties such as steering, when required, and lookout are traditionally sailor's work. It is when chipping, scraping, painting, or other maintenance duties are considered that trouble may be encountered.

The provision for licensed officers is the one which seems to contain the most significant assumption. Licensed officers are to be divided into three watches. From 1915 to 1936, there had been no reference to licensed officer. When this category was covered for the first time, radio operators were not "officers" and even "registered staff officers" were not recognized by statute. There were, then, the following classes of license provided for under 46 USC 7101(c) (224):

(1) Master;
(2) Chief mate;
(3) Second and third mate (if in charge of watch);
(4) Engineer; and
(5) Pilot.

Specific statutes* then went on to deal with:

(1) Master of steam or sail (46 USC 226);
(2) Chief mate, ocean or coastwise, steam or sail, and second and third mate, ocean or coastwise steam (46 USC 228); and
(3) Engineer of any steam vessel (46 USC 229).

A curiosity here is the establishment of grades of mate with no distinction as to engineers. Another is that no recognition was given to mates other than ocean or coastwise, with no provision for lesser mates than chief on sail vessels. A third is that the law did not apply to engineers on other than steam vessels.

The letter of the law requires the three general categories of licensed officer (i.e., masters, mates, and engineers) to be divided into three watches. It seems certain that the law did not contemplate forcing the master to stand a watch. The requirement for three mates on the great majority of vessels (46 USC 8301(a) (223)) reinforces this exception.

Of lesser importance, but of some value as precedent, is the fact that the larger passenger vessels generally carried a second licensed master who was denominated "staff captain" or something similar. This officer was not required or expected to stand a watch simply because his duties lay elsewhere in the management of the ship. The conclusion must be reached, given the unquestioned status of a "master," that when Congress declared that "the licensed officers...shall...be divided into at least three watches," it incorporated the unstated qualification of "officers...whose activities involve watch duties."

From a converse situation, the real world produces another confirming instance. Although engineers are not divided into classes by statute, as deck officers (including the master as deck officer) are, the administrator has created four grades of license: chief, first assistant, second assistant, and third assistant. When a vessel is required to have four licensed engineers by its certificate of inspection, no one has ever questioned that the chief engineer need not, and in fact does not, stand a watch. The law must be taken to understand that the duties of some seamen traditionally involve watchstanding while those of others, especially food handlers and many supernumeraries (e.g., musicians, librarians, and supercargoes) do not.

Court Application of Three-Watch Law

The Supreme Court decided a case involving sailors in 1926, O'Hara v. Luckenback Steamship Company, 269 U.S. 364 (1926). The two-watch rule was still the law for sailors. The vessel had aboard 13 sailors.

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*There are no direct substitutes for these three code sections in the new law.

Neither a Certificate of Inspection nor shipping agreement was mentioned. Three of the sailors were said to have been designated as quartermasters.

There were, in fact, three watches, not two. Each watch used a quartermaster and one able seaman, "the remaining seven sailors being kept at day work only." While the lower courts had been satisfied that the watch requirements of the law were met if qualified personnel were selected for quartermaster and lookout duties, the Supreme Court saw the issue as a matter of "equality" of the watches, alone. It decreed that the 13 sailors had to be divided into equal watches, presumably 4, 4, 5.

Under the principle announced by the court, the division would be six-seven had the master chosen to comply only with the two-watch requirement. Indeed, he could have chosen a six-watch system with quartermaster and lookout on each.

By quoting an earlier court of appeals decision, the Supreme Court silently construed the words "ordinary work incident to the sailing and management of the vessel" as including capability in each watch to meet "all exigencies of the intended route" and "any exigency that is likely to happen." The Court cited allegations that several marine disasters had been worsened by a total shortage of able seamen or by incompetency of lifeboat handlers. The court had resolved the narrow issue of equality of watch size in language that is cited in every watch law case.

Almost immediately after this decision, and under the same law, came a district court decision, El Estero, 14 F.2d 340 (S.D. Texas 1926). Here, a Certificate of Inspection showed that the vessel was required to have, in the words of the court, "only six seamen; four able seamen and two seamen." In addition to the required crew, other seamen were aboard for ship maintenance. The court saw the respondent's position thus: "If the ship can satisfy the local inspectors as to her navigation requirements, she may employ as many additional seamen as she wants, without any of them having the protection of that part of the act providing for their division into watches." Despite the Supreme Court's heavy emphasis on the safety purposes of the statute, the district court saw it as a "protection" to the seamen.

The American Shipper (McCrea v. United States), 3 F. Supp. 184 (SD N.Y. 1932), still in the era of the two-watch sailor provision, provides some curiosities. After citing O'Hara v. Luckenback for the proposition that the division law applies to "all the sailors of a vessel...as nearly equal to each other as the whole number of sailors will permit," the court provides facts as follows:

> "...the 13 seamen on the vessel were not as equally divided into watches as that number permitted. Instead, three seamen were placed on each of three watches, and four men were used for day duty and were not on any watch. It further appears that three oilers were not placed on any watch but were assigned to day duty. The firemen and water tenders, however, appear to have been equally divided into three watches."

It is obvious here that the court means "sailors" by "seamen" because the enumerated personnel would otherwise cause the total to go above 13. It recognized that the vessel carried more of these than were required by the Certificate of Inspection--"the additional men should have been divided into watches."

The petitioner, however, was a fireman. The firemen were divided into three equal watches. The court allowed the petitioner the remedy of quitting the ship for the master's breach of the law. "Whenever the master of any vessel shall fail to comply with this section..., the seamen shall be entitled to discharge from such vessel." Since the petitioner was not of a class offended directly by the watch-law violation, seamen is construed in the broad sense: any person employed aboard other than the master. The mates, the licensed engineers, and the cooks all are entitled to discharge if there is a breach. This decision was upheld by a court of appeals and the Supreme Court [The American Shipper, 70 F. 2d 632 (2d Cir. 1934); McCrea v. United States, 234 U.S. 23 (1935)].

An innovation is found in The Chilbar, 10 F. Supp. 926 (D.C. Pa. 1935) which held that "repairmen" hired and described as part of a "maintenance department" (a term not found in law or regulation) need not be divided into watches.

The Youngstown, 110 F. 2d 968 (8th Cir. 1940), cert. denied, 311 U.S. 690 (1940), probably offers the most hope for achieving compliance with the law within a desired shipboard organization. It was held that a wiper and a boatswain were not under the three-watch rule. For long, boatswain, known to be a supervisory position over deck department maintenance work, was not required in a Certificate of Inspection. A seaman employed as boatswain might well be the only deck department rating hired beyond the requirements of the Certificate of Inspection.

The Youngstown also recognized that an oiler performing the duties of deck engineer, while other oilers stood watches, was not subject to the provision on watch division. It seems that on this side of the case a "regular" deck engineer was not carried. Some speculation is needed here. Deck engineer is a rating classified as "a qualified member of the engine department." It is not a rating enumerated in the three-watch provision. Since a regular deck engineer was not carried, either the rating was not mentioned in the shipping agreement or, if it was, no one was employed in that capacity. It seems to follow then that the seaman in question was signed on precisely as oiler. The court has looked beyond nomenclature to see just what kind of work was done to determine the seaman's capacity within the three-watch law as distinct from the shipping agreement. The conflict with El Estero is obvious, but no court has ever mentioned it, and some courts will cite both as if in harmony.

The most recent decision of a court on this law appears to be District 2, Marine Engineers' Beneficial Association v. Adams, 477 F. Supp 72 (ND Ohio 1977) which presents serious questions for crew management.

The Marine Engineers' Beneficial Association, the plaintiff union, was found to have standing to sue because it represented the class of seamen who were assertedly offended by violations of the law. By a writ of mandamus, the union asked the court to compel both the vessel's owner, and the U.S. Coast Guard, government administrator of the laws involved, to enforce the law. Alleged was a violation of the three-watch law (46 USC 8104(d) (673)) with respect to the licensed engineers on the vessels.

The Certificate of Inspection required three licensed engineers, one chief, and two further-unclassified assistants. It was agreed that the vessels "do not operate a three-watch system for licensed engineers" and that the Coast Guard is approving operation of the vessels "on a non-three-watch basis to licensed engineers." The vessels were equipped with full pilot-house control of the engines.

Since no other persons were required in the engine department and unattended engine room was a factor, it is cause for apprehension that the court never considered the possiblity that the law attached only to seamen whose work performance involved watchstanding duties, or whether, if the requirement had been for unlicensed engineer personnel not enumerated in the statute, the result might have been different. There was no thought given to the basic reality that it is the master who is ultimately responsible for setting watches and not the administrator who is, on that particular point, authorized only to set the complement required. Suit against the owner was dismissed as beyond the jurisdiction under the federal mandamus laws.

The court declared that the remedy given to aggrieved seamen, to quit the vessel when a violation of the three-watch law occurs, was inadequate. It ordered the administrator to enforce the law, giving adequate remedy to the plaintiff union, by imposing monetary penalties on the owner for violations. The "remedy" for the plaintiff union is an order to the government agency to impose a statutory penalty of $500 on the owner of the vessels which when collected goes to the Treasury of the United States.

No monetary penalty has been imposed on the owner for conditions before or since the date of the suit. Current (1983) Certificates of Inspection issued to the vessels still require the same three licensed engineers and still have the same proviso as to unattended engine rooms and operation in confined and congested waters. It is not known whether successive watches on a full-day schedule are being maintained. The net effect of the decision in the real world appears to be nothing. No changes and no complaints have arisen since 1977.

It may well be suspected that the suit was a mere camouflage for a different question. If the plaintiff feared that a new manning requirement for less than three licensed engineers might be forthcoming, regardless of who stood or did not stand watches or perform day work, the suit might have used some ready-to-hand statute merely to get into court and direct the attention of the administrator. If that be the case, the result can be seen as a victory for the plaintiff since the administrator has not in fact reduced the requirement.

If this is true, it is unfortunate that the problems could not have been dealt with without recourse to judicial intervention. The decision itself stands out as the only pronouncement in recent decades on the three-watch law and, taken alone, as lawyers and courts will take it without inquiry into collateral and unraised issues, will imply that:

- A licensed engineer watch must be maintained on all machine-propelled vessels.

- Since chief engineers traditionally do not stand watches, three watchstanding engineers also must be required.

These implications, in light of the unexhaustive reasoning applied both by litigants and by courts, forewarn that next case may have results which could not now be anticipated.

Interpretation of the three-watch law, and the potentiality of reducing crew size, involves a mixture of the mode of hiring seamen according to the vessel's Certificate of Inspection and the written shipping agreement between master and crew. Each involves terminology questions as well as actual work expectations. Each is a requirement of statute, the certificate under 46 USC 8101 (222), and the agreement under 46 USC 10302 (564). Regulations appear as to unlicensed seamen in Part 12 (Certification of Seamen), Title 46 (Shipping) of the Code of Federal Regulations.

The shipping agreement, or "articles," is required to show "the respective employments" and "the capacity in which to serve." The certificate, as seen before, shows the complement found necessary for "safe navigation," in terms of "ratings" for the unlicensed seamen. It is with the ratings that complications develop.

Two basic laws affect this problem. 46 USC 643(a) requires that each seaman hold either a certificate of identification or a continuous discharge book; and 46 USC 672(i) requires that each seaman below the grade of licensed officer hold a certificate of service to be employed aboard a vessel. Other subsections create categories of certificates of service*:

- o Able seaman (AB) (subsection b);

- o Qualified member of the engine department (QMED) (subsection e); and

- o Ratings other than the above, "which certificates shall authorize (the seaman) to serve in the capacities indicated in such certificates" (subsection g).

The QMED certificate is required for every member of the engine department below the grade of licensed officer and "above the rating of coal passer or wiper." Note that the term "ordinary seaman" does not appear, although "service on deck" is required for qualification as AB. Note also that the QMED ratings are left to the creative discretion of the administrator, and that, while coal passer and wiper are mentioned as ratings, the "other" ratings are also unidentified. (The "others" are to be issued without examination, except for medical examinations in the case of a food-handler. They have commonly been called "entry ratings.")

The restated matters in the new law have one minor and one potentially major difference. Coal passer and wiper are declared to be entry ratings (7313(b)). This seems to confirm the authority to designate the other "entry ratings" that already exist.

The first major change is that the "merchant mariner's document," representing both certificates created by 46 USC 643 and 672, is now the only document to be issued. New subsection 8701(b) requires the document for service and new subsection 7302 provides for its issuance. Although 8701 (b) appears in a chapter entitled "unlicensed personnel," licensed officers including masters must possess this document.

Of potentially greater impact is that the document, when presented for employment (except in the case of a licensed officer), "must authorize service in the capacity for which...employed," while the document itself must "specify...each rating in which the holder is qualified to serve." There are numerous positions which may be entered on the shipping agreement for the "capacity" of a seaman. Librarian, musician, waiter, and cattleman have been seen as

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*For purposes of this survey "tankermen" are excluded from consideration.

examples. The statutes mandate only one, i.e., AB, and leave to the administrator the designations for QMED. Other statutes, like the three-watch law, enumerate positions or capacities; they were not keyed originally to identifying documents.

The administrator has followed the certification laws by providing in the regulations for AB seaman and QMEDs. He has declared that an engine rating of assistant electrician is on a level with coal passer and wiper. Wiper, ordinary seaman, and steward's department are recognized. Created are the ratings of cadet, student observer, apprentice engineer, and apprentice mate. No other ratings of any kind are acknowledged in the regulations.

Two unmentioned ratings which exist as capacities and, in a few cases, as ratings and which can prove troublesome are boatswain and maintenance personnel. On automated vessels where it is deemed necessary for the purpose of maintaining the vessel or its equipment, or for emergencies, maintenance personnel are being required by the Coast Guard. Where maintenance personnel are required, the Certificate of Inspection delineates the ratings acceptable to fill the position, e.g., "two deck maintenance persons (any deck rating)."

A prudent master has usually arranged the listing of his crew in the shipping agreement to reflect quickly and easily the employment of these persons required by his Certificate of Inspection. The articles are prima facie evidence that he has aboard the required licensed officers and ratings. It is also customary to present all those in the traditional deck department first, those in the engine department next, and stewards and other supernumeraries last, with the required persons grouped together in their respective departments.

In practice then, an official checking for compliance with a requirement for "six ABs - three ordinaries" will look to the articles and observe the billets designated for those ratings. If that official finds the necessary "six and three" he will pay no heed to a boatswain or any other position listed in the unlicensed part of the deck department. If a boatswain is shown, however, and if the articles reflect that one of the required ratings was lost to the vessel in the course of the voyage, he will, upon the master's representation of compliance, look to the qualifications of the boatswain, especially if AB is the questioned billet.

Although it may appear that the Coast Guard is requiring a rating that is not acknowleged in regulations, the maintenance person is meant to be identified with the ratings deemed acceptable by the Coast Guard. The requirement for such a person to be aboard reflects a judgment that such person is necessary to the continued adequate performance (maintenance) of the vessel and/or to the adequate manning of the vessel for emergencies. The specific duties to be assigned or the level of rating to be hired (within the parameters allowed on the Certificate of Inspection) are left to the discretion of the vessel's master.

Other Manning Laws

The last clause of the first proviso of 46 USC 8702(d) (672(a)), declares that "in narrow and crowded waters or in low visibility none below the rating of able seaman shall be permitted at the wheel." This must be understood to be in a context of deck department alone. The duty is clearly a sailor's. If an AB seaman is used, the caution would be: "if one, then three."

There is no law that says a vessel must have a lookout. However, 33 USC 221 states, "Nothing in these rules shall exonerate any vessel...from the consequences of...any neglect to keep a proper lookout." The courts have seen that the need for proper lookout is inherent in the operation of ships. They have given this negative an affirmative status by declaring that a failure in this respect is a "statutory fault" (like failure of a burdened vessel to keep clear) such that the offender, to escape liability, must prove that his fault not only did not contribute to the collision but could not have so contributed.

Lookout has unquestionably been accepted as sailor's work. Considering the strictures that a proper lookout cannot be kept by one who is distracted by other concerns and the myriad duties of an officer in charge of a watch, it appears certain that at some time there must be a specific sailor lookout, and "if one, then three" attaches.

The Annex to the International Convention on the Standards of Training, Certification, and Watchkeeping for Seafarers, 1978, contains formalized warnings which not only reflect tradition but also conform closely to the principles long announced by the U.S. admiralty bench. Chapter 2 deals with the master and the deck department. The master is charged with supervision of the navigational watches which should principally be concerned with avoidance of collision and grounding. Noting the relevance of prevailing circumstances and conditions and an ever-present need for maintaining a proper lookout, the "watch arrangements" paragraph declares flatly "at no time shall the bridge be unattended." On the matter of lookout specifically, it is declared that no other duties may be permitted which could interfere with the primary function and that except "in small ships" a helmsman cannot be the lookout.

The navigation watch has always been the subject of scrutiny. Chapter 3 of this Annex attempts to crystallize responsibilities of engineers on machine-propelled vessels. Here, the chief engineer, acting "in consultation with the master," is recognized as supervisory of watchkeeping arrangments. Interestingly enough, a watch is presumed, although the possibility for there being no ratings below the officer of the watch is acknowledged. A distinction is made between a "manned" and an "unmanned" condition of the "machinery space." Despite this, the officer of the watch must be "immediately available" and he must "ensure that the main propulsion system...(is) kept under constant surveillance." It seems that if a system is under constant surveillance, despite an unmanned machinery space, there must be a watch even though it may be only one person at an observation center.

Standards such as these are most likely, when occasion arises, to be seized on by the courts. Thus, assuming the normal nonwatchkeeping master, the way is open to four deck officers but still open to only three engineer's officers. Engine ratings can be dispensed with under proper conditions, but, given the limitation on the deck watch officer as lookout, a deck rating (and thus, under a three-watch system, three crewmembers) is essential for each watch.

Summary

From all this must be distilled the laws that might hinder efforts and remedies available or to be sought to facilitate the objective.

It is clear that safety remains the principal element to be reckoned with in any system. Efficiency is a paramount consideration in selection of methods, but convenience, compatability of individuals, and quality of life are not subject to specific legal restraint when numbers alone are in question. A simple observation is that beyond radio, navigation, and propulsion, in the case of machine-propelled vessels, the law would not affect a decision to eliminate all supernumerary berths.

The law is presently imperative as to a master and three mates, but the three-watch law is more subtle in its influence. The initial approach must be to attempt to avoid possibly misguided court interference, and it must be to the administrator that recourse should first be had.

The interest of the administrator is evidenced in visible form in the 13-page document, Navigation and Vessel Inspection Circular No. 5-67, superseded by a similar Circular No. 1-69 which in turn led to the innovative Certificates of Inspection involved in the Marine Engineers Beneficial Association decision.

On these certificates, having examined propulsion systems, the administrator elected to require absolutely no unlicensed personnel in the engine department, and this decision, undoubtedly a product of extensive conference and discussion, has been contested by no one. It means as to application of the statute, "no oilers, no three watches."

It is easy to say that Congress should be called upon to clarify its real intent by defining or refining its concept of sailor, thus reducing the opportunity for courts to interpret. Such a course is lengthy and could produce unexpected results. If the objective can be reached by administrative action, the effort is easier and the results are more quickly seen.

If it is agreeable to the parties, the formal designation by the administrator of watch berths and nonwatch berths on the certificate can be used and is not as likely to be challenged in a court as some other efforts to resolve the problem.

The concept of "unattended engine room" implies no watch. If more than one person is considered necessary for engine maintenance, and if the requirement for, say, two licensed engineers is seen to bring them into the three-watch provision, a solution is to require only one licensed engineer, a chief, and for the other required position(s) create a new QMED rating which can carry licensed qualifications but can have a descriptive title plainly indicative of nonwatch activity. (It is emphasized here that under the convention it is the engineer "in charge of a watch" who must be licensed.)

Considerations such as dignity, pay, and "social" status may be considerable in other contexts; they are not controlling of or even relevant to the purely legal issue.

The author's view, then, is that under existing law and practice, the statutory minimum crew is:

- One licensed master;
- Three licensed mates;
- Three qualified deck sailors; and
- Three licensed engineers.

This then is subject to the "if one, then three" rule if sailors are increased or if firemen, oilers, or watertenders are found necessary.

Some comment has been given on the licensed engineers. Given the changes in propulsion machinery and its requisites, industry and the administrator could well agree upon and create new descriptions and terminology in the shape of engine room ratings other than those named in the three-watch law.

As to the licensed master and mates, to achieve a reduction to three officers (already permitted for a run of less than 400 miles and for smaller vessels) requires a change in the law. This can be accomplished either by a flat change, probably impossible to achieve at present, or an exception. The exception, if inserted into the 46 USC 8301(a) (223), would necessarily be encumbered with conditions. It would be difficult to draft, more difficult to enact, and possibly unworkable when finally in place. The administrator could, however, be authorized by Congress to grant a reduction, under general guidelines, when "in his judgment" safety considerations would permit. Here, of course, the more discretion the drafters could vest in the administrator the better the results.

The three sailors above have been presumed irreducible by reason of the traditional concept of lookout, combined with the three-watch law. In light of the reference to the mate in daylight in the Annex to the International Convention, it is possible that thought could be given to reliance on day workers' availability to assume lookout duties at times that the mate could not. While a lookout must be "qualified" and "adequate," it has never been held that he must be an AB seaman, and in fact in the traditional organization of three sailors to a watch, with rotation, the ordinary seaman is the designated lookout one third the time. If exploration of this is undertaken in the practical order, it may well be that the three sailors could be reduced to the number actually found necessary to supplement the watch officer under the right conditions and changed from the sailor category on the certificate. It is repeated that the law does not specify a lookout, nor does a certificate denominate a required berth as lookout.

Much of this speculation is predicated on the assumption that the three-watch law would be difficult to change. This law is not one, like the three-mate law, which the administrator could be authorized to dispense from, since it is directed to the master of the vessel. If changes were attempted, "sailor", as already indicated, should be clarified, as also the status of the licensed officer. It is not believed feasible to attempt diminishment of watch requirements in those areas where watches are obviously required or already clearly specified.

The "crossover" provision of 46 USC 8104(e) (673), stipulates that the seafarer may serve in either deck or engine department and not both, thereby prohibiting any crossover. No law prohibits stewards department personnel from working on deck, or in the engine room, or vice versa. "Departments" are not created or defined in the law. A court has already accepted the concept of a maintenance and repair department. The way seems open, if the form of a Certificate of Inspection is altered and the appropriate rating designations used, to avoid having deck deparments and engine departments, or at least to minimize them, with the outright recogntion of a maintenance department, and the use of a properly designated and identified "general purpose" endorsement for seamen.

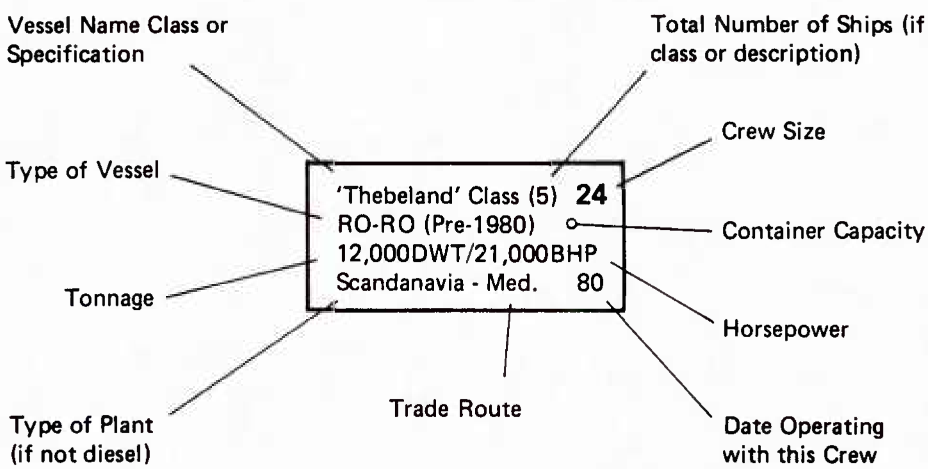
The licensed officer presents a different case. The concept of master does not in general preclude watchstanding. The concept of mate is so traditionally linked to deck duty that, while an "engineerless" ship is not out of the question, the expansion of mate to include quasi-engineer duties would, it is believed, require a basic statutory change. It does not seem that the administrator, under the specific license laws now on the books, could create by fiat a new license dedicated to such a dual purpose. The concept of an unlicensed, superior-type QMED could alleviate the problem of body count but if a true general-purpose licensed officer is needed, appropriate legislation is needed. This is made more certain by the "crossover" prohibition in 46 USC 8104(e), which applies to "seamen" generally, not just to unlicensed personnel.

Whatever is attempted in the way of administrative arrangement or statutory change, the caveat remains as always for a shipowner that liability is not necessarily limited to mere statutory compliance. In the event of collision, the court sitting in admiralty is not going to be diverted by a certificate showing numbers of crew required from a finding of inadequate lookout. Appropriate designations and arrangements may serve to prevent internal management disorder, as among owner, master, and crew, and avoid the impact of obsolete legislation or too-ingrained custom. The burden imposed by the general concept of negligence must be kept in mind in all analysis and consideration of even safe reduction in crew numbers.

APPENDIX D

DATA ON VESSEL MANNING IN NORTHWEST EUROPE AND JAPAN*

Key to TABLE D-1



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*The committee updated and expanded these data from "Reduced Manning in the Linear Trades: Technological Capabilities and Organizational Implications," by Michael E. Gaffney. Proceedings of the Conference: The Management of Change Aboard Ship; Center for Advanced Studies, Maine Maritime Academy, 1981.

TABLE D-1 Effectively Manned Ships of Other Countries

JAPAN	JAPAN LINE	Standard EØ 25 Containership 1569 TEU 38,000 GT Gas Turbine			
	NYK	Standard EØ 25 Containership 1973	Hikawa Maru 19 Containership 1979	Hakuba Maru 18 Containership 1979 1578TEU 29,701DWT/27,200BHP Japan - Australia	Futuristic 12 NYK/Mitsui E&S 1976
	'K' LINE	Transworld Bridge 18 Containership 1980 1600TEU 29,000DWT			
	MOL	Standard EØ (8) 24 Containership 1969 1800TEU(5)814TEU(3)	Monteblanc Maru 22 Containership 1974 1400TEU 40,000BHP Far East - Med.	Canberra Maru 18 Containership 1979 1570TEU 29,888DWT Japan - Australia	Futuristic 14 MOL/Mitsu E&S
	NYK/MOL/YS	Nichigu Maru 18 Containership 1980 1570TEU 32,023DWT/30,700BHP Japan - Australia			
	JAPAN SHIPBUILDING RESEARCH ASSOC.	Futuristic 18 1973			
	NKK	Futuristic 7			
	MITSUI E & S	Futuristic 10 1975			
	MINISTRY OF TRANSPORT	Futuristic 9 1971			

W. GERMANY	HAPAG-LLOYD	'Erlangen' Class 25 Full Container (Conversion) 1978 13,700GT/22,500BHP	Standard EØ 25 Containership 1973 1750TEU 30,000BHP	'Erlangen' Express 18 Containership 1979	Futuristic 12 Hapag-Lloyd/Assoc. of German Shipowners
W. GERMANY	ASSOC. OF GERMAN SHIPOWNERS	Futuristic 12			
SWEDEN	SWEDISH ORIENT LINES (BROSTROMS)	'Thebeland' Class (5) 24 RO-RO (Pre-1980) 12,000DWT/21,000BHP Scandanavia - Med.	'Thebeland' Class + (5) 16 RO-RO 1978 12,000DWT/21,000BHP Scandanavia - Med.		
SWEDEN	BROSTROMS	'Scandia' Class (2) 21 Containership 1972 13,000DWT	RO-RO 9 1980 North Sea		
SWEDEN	SCANDIA CONTAINER LINES	Brage + (2) 11 North Sea			
SWEDEN	SALEN	Proposed 18 VLCC/ULCC Turbine 83			
SWEDEN	SWEDISH SHIPOWNERS ASSOCIATION	Futuristic 11 RO-RO 83			
DENMARK	MAERSK	Standard EØ (9) 23 Containership 1975 29,391DWT/36,000BHP			
DENMARK	DFDS NORDANA LINE	Dana Arabia + (3) 20 RO-RO 7900DWT Med. - U.S. East, Gulf			

TABLE D-1 (cont'd) Effectively Manned Ships of Other Countries

NETHERLANDS	NEDLLOYD	Loire Lloyd + (1) 22 Multipurpose 9600 GT	Newbuilding 22	Not Type-Specific 21 83	Not Type-Specific 20 88
	NIEVELT GOUDRIAAN	Standard EØ (15) 25 Multipurpose 1980 10,000 GT	"Project Ships" 21 Not Type-Specific 83	Experimental (2) 16 Multipurpose 288TEU 1980 14,700DWT Europe - S. America	Futuristic 15 Multipurpose 1987
	SHELL TANKERS B.V.	"Project Ships" 20 Tankers 83			
NORWAY	KLAVENESS	Summer 17 26,750DWT Winter 23			
	SEATRANS	ı 2800DWT 14			
	NORWEGIAN SHIPOWNERS ASSOCIATION	Futuristic 14 Not Type-Specific 83			
U.K.	SHAW SAVILL LINE	Dunedin 29 Multipurpose 1980 16,300DWT/20,500BHP Australia - U.S. Gulf, Carib			
	BRITISH SHIPBUILDERS	'Menelaus' Class 31 Multipurpose 1979 20,080DWT/14,300BHP			
	P.A.L. (FORMERLY OF PAN OCEAN ANCO)	Standard 24 Chemical Carriers 83			

TAIWAN	EVERGREEN	Standard EØ **22** Containership 1977 1200TEU 15,000GT/20,000BHP Far East - Europe, U.S. East	'L' Class **18** Containership Everlight + (3) 1900TEU 28,900DWT/22,260BHP			
BELGIUM	COMPANIE MARITIME BELGE	(4) **17**				
ISRAEL	ZIM	Standard EØ **31** Containership 1700TEU Steam Turbine				

TABLE D-2(a) Crew Composition of Effectively Manned Vessels

	LOIRE LLOYD		NEDLLOYD EXPERIMENTAL SHIPS (1983)		NIEVELT GOUDRIAAN PROJECT SHIP (1983)		NEDLLOYD SEMI-INTEGRATED OFFICER SHIP (FUTURISTIC-1988)		SHELL B.V. PROJECT SHIPS (1983)		AVERAGE DANISH CREW	
DECK	1	MASTER	1	MASTER	1	MASTER	1	MASTER	1	MASTER	1	MASTER
	3	MATES	3	MATES	3	MATES	2	MATES	1	CHIEF MATE	3	MATES
											1	BOS'N
											5	AB's*
ENGINE	1	CHIEF ENGINEER	1	CHIEF ENGINEER	1	CHIEF ENGINEER	1	CHIEF ENGINEER	1	CHIEF ENGINEER	1	CHIEF ENGINEER
	3	ENGINEERS	3	ENGINEERS	3	ENGINEERS	1	ENGINEERS	1	ENGINEERS	2-3	ENGINEERS
			1	FITTER			1	FITTER			2	FIREMEN
GALLEY	5	STEWARDS	1	CHIEF STEWARD/COOK	1	CHIEF COOK	1	CHIEF CATERER/COOK	4	CATERERS	1	PURSER/COOK
			1	ASSISTANT COOK	1	2nd COOK/ STEWARD	1	ASSISTANT COOK			2-3	STEWARDESSES
			3	STEWARDS	2	STEWARDS	2	STEWARDS				
OTHER	1	RADIO OPERATOR	1	SHIP FOREMAN	1	RADIO OPERATOR	1	RADIO OPERATOR	1	RADIO OPERATOR	1	RADIO OPERATOR
	8	GP RATINGS	6	GPs	1	FOREMAN	2	SEMI-INTEGRATED OFFICERS	3	SEMI-INTEGRATED OFFICERS		
					1	FITTER (GP)	1	SHIP FOREMAN	8	GPs		
					6	GPs	6	GPs				
TOTAL	**22**		**21**		**21**		**20**		**20**		**19-21**	

*None carried on VLCC/ULCC

	HIKAWA MARU	EVERLIGHT 'L' CLASS	ERLANGEN EXPRESS	HAKUBA MARU CANBERRA MARU NICHIGU MARU	SALEN 18 MAN TURBINE SUBTANKER	THEBELAND
DECK	1 MASTER	1 MASTER	1 MASTER	1 MASTER	1 MASTER	1 MASTER
	3 MATES	3 MATES	3 MATES	3 MATES	2 MATES	3 MATES
	6 RATINGS	5 RATINGS				
ENGINE	1 CHIEF ENGINEER	1 CHIEF ENGINEER	1 CHIEF ENGINEER	1 CHIEF ENGINEER	1 CHIEF ENGINEER	1 CHIEF ENGINEER
	3 ENGINEERS	3 ENGINEERS	2 ENGINEERS	3 ENGINEERS	2 ENGINEERS	2 ENGINEERS
	1 RATINGS	2 RATINGS*			1 OILER/WIPER	
GALLEY	3 STEWARDS	1 COOK	3 STEWARDS	3 STEWARDS	4 CATERERS	1 COOK/STEWARD
		1 BOY				1 MESSMAN
OTHER	1 RADIO OPERATOR	1 RADIO OPERATOR	1 RADIO OPERATOR	1 RADIO OPERATOR	1 RADIO OPERATOR	1 RADIO OPERATOR
			1 GP FOREMAN	6 GP RATINGS	6 GPs	6 GP RATINGS
			6 GP RATINGS			
TOTAL	19	18	18	18	18	16

*1 FITTER
1 WIPER

TABLE D-2(a) (cont'd) Crew Composition of Effectively Manned Vessels

	NORWEGIAN SHIPOWNERS ASSOCIATION 14 MAN SHIP (FUTURISTIC)		SWEDISH SHIPOWNERS ASSOCIATION 11 MAN RO/RO (FUTURISTIC)		FUTURISTIC CARGO EØ							
DECK	1	MASTER	1	MASTER	1	BOS'N						
	3	MATE	2	MATES								
ENGINE	1	CHIEF ENGINEER	1	CHIEF ENGINEER	1	ELECTRICIAN						
	1	ENGINEER	1	ENGINEER	1	LEADING HAND						
	1	ELECTRICIAN										
GALLEY	2	CATERERS	1	COOK/STEWARD	1	STEWARD						
OTHER	1	RADIO OPERATOR	5	SHIP OPERATORS	4	POLYVALENT OFFICERS						
	4	GPs			2	GP RATINGS						
					1	DECK/ MESSMAN						
TOTAL	**14**		**11**		**11**							

TABLE D-2(b) Conventional Crew Composition (for Comparison)

	AVERAGE CONVENTIONAL CARGO - 1960's		ZIM STANDARD CONTAINERSHIP		ZIM STANDARD EØ CONTAINERSHIP		AVERAGE CARGO EØ 1976		NYK STANDARD EØ CONTAINERSHIP		'ERLANGEN' CLASS CONVERSION	
DECK	1	MASTER	1	MASTER	1	MASTER	1	MASTER	1	MASTER	1	MASTER
	3	MATES	3	MATES	3	MATES	3	MATES	3	MATES	3	MATES
	1	BOS'N	8	RATINGS	8	RATINGS	1	BOS'N	6	RATINGS*		
	10	RATINGS					3	RATINGS				
ENGINE	1	CHIEF ENGINEER	1	CHIEF ENGINEER	1	CHIEF ENGINEER	1	CHIEF ENGINEER	1	CHIEF ENGINEER	1	CHIEF ENGINEER
	3	ENGINEERS	7	ENGINEERS	4	ENGINEERS	2	ENGINEERS	3	ENGINEERS	3	ENGINEERS
	1	ELECTRICIAN	1	ELECTRICIAN	1	ELECTRICIAN	1	ELECTRICIAN	5	RATINGS		
	1	LEADING HAND	5	RATINGS	5	RATINGS	1	LEADING HAND				
	6	RATINGS					2	RATINGS				
GALLEY	6	STEWARDS	6	STEWARDS	6	STEWARDS	6	STEWARDS	4	STEWARDS	5	STEWARDS
OTHER	1	RADIO OPERATOR	1	RADIO OPERATOR	1	RADIO OPERATOR	1	RADIO OPERATOR	2	RADIO OPERATORS	1	RADIO OPERATOR
			1	PURSER	1	PURSER	1	PURSER			1	GP FOREMAN
							3	GP RATINGS			10	GP RATINGS*
TOTAL	34		34		31		26		25		25	

*1 Bosun
3 Quarterworker (AB)
2 Dayworker (OS)

*Some of these numbers may have been assigned to a single department.

TABLE D-2(b) Conventional Crew Composition (for Comparison)

	MOL STANDARD EØ CONTAINERSHIP		P.A.L. CHEMICAL CARRIER		MAERSK STANDARD EØ CONTAINERSHIP		EVERGREEN STANDARD EØ CONTAINERSHIP		NEDLLOYD NEWBUILDING		MONTEBLANC MARU	
DECK	1	MASTER	1	MASTER	1	MASTER	1	MASTER	1	MASTER	1	MASTER
	3	MATES	3	MATES*1	3	MATES	3	MATES	3	MATES	3	MATES
	6	RATINGS	2	CARGO MECHANICS*2	6	RATINGS	5	RATINGS			6	RATINGS
ENGINE	1	CHIEF ENGINEER	1	CHIEF ENGINEER	1	CHIEF ENGINEER	1	CHIEF ENGINEER	1	CHIEF ENGINEER	1	CHIEF ENGINEER
	3	ENGINEERS	3	ENGINEERS	4	ENGINEERS	3	ENGINEERS	3	ENGINEERS	3	ENGINEERS
	4	RATINGS	1	ELECTRICIAN	1	ELECTRICIAN	6	RATINGS*	2	MECHANICS	2	RATINGS
			1	FITTER	2	RATINGS						
GALLEY	1	CHIEF STEWARD	1	MARINE CATERER*3	1	CHIEF STEWARD/COOK	1	COOK	1	COOK/STEWARD	1	CHIEF STEWARD
	2	COOKS	1	DEPUTY MARINE CATERER	3	STEWARDESSES	1	BOY	4	MESSMAN	2	COOKS
	1	STEWARD	2	CATERERS							1	STEWARD
OTHER	2	RADIO OPERATORS	1	RADIO OPERATOR	1	RADIO OPERATOR	1	RADIO OPERATOR	1	RADIO OPERATOR	2	RADIO OPERATORS
			1	CHIEF OPERATOR*4					1	SHIP FOREMAN		
			4	SENIOR OPERATORS*5					5	GP RATINGS		
			2	OPERATORS								
TOTAL	24		24		23		22		22		22	

*1 Chief Mate Now Watchstander
*2 Formerly Pumpmen
*3 Steward (Cook)
*4 Formerly Bos'n
*5 Formerly AB's
*6 Formerly Ordinary Seamen

*3 FITTERS
3 WIPERS

TABLE D-3 Incorporation of Manning Innovations--Effect of Manning Levels

		WATCHSTANDING ENGINEROOM >30	EØ OPERATION 30-20	GP RATINGS 20-15	POLYVALENT OFFICERS 15-10	EXTENSIVE SHORE SUPPORT <10
JAPAN	JAPAN LINE		Standard EØ 25 Containership 1569 TEU 38,000 GT Gas Turbine			
	NYK	1968 30	Standard EØ 25 Containership 1973	Hakuba Maru 18 Containership 1979 1578TEU 29,701DWT/27,200BHP Japan - Australia	Futuristic 12 NYK/Mitsui E&S 1976	
			Hikawa Maru 19 Containership 1979			
	'K' LINE			Transworld Bridge 18 Containership 1980 1600TEU 29,000DWT		
	MOL		Standard EØ (8) 24 Containership 1969 1800TEU(5)814TEU(3) Mideast, U.S. Pacific, U.S. East	Canberra Maru 18 Containership 1979 1570TEU 29,888DWT Japan - Australia	Futuristic 14 MOL/Mitsu E&S	
			Monteblanc Maru 22 Containership 1974 1400TEU 40,000BHP Far East - Med.			
	NYK/MOL/YS			Nichigu Maru 18 Containership 1980 1570TEU 32,023DWT/30,700BHP Japan - Australia		
	JAPAN SHIPBUILDING RESEARCH ASSOC.			Futuristic 18 1973		
	NKK					Futuristic 7

TABLE D-3 Incorporation of Manning Innovations--Effect of Manning Levels

		WATCHSTANDING ENGINEROOM >30	EØ OPERATION 30-20	GP RATINGS 20-15	POLYVALENT OFFICERS 15-10	EXTENSIVE SHORE SUPPORT <10
JAPAN	MITSUI E & S					Futuristic 1975 **10**
JAPAN	MINISTRY OF TRANSPORT					Futuristic 1971 **9**
W. GERMANY	HAPAG-LLOYD	'Erlangen' Class Container/Break-Bulk 1970 13,700GT/22,500BHP **38**	'Erlangen' Class Full Container (Conversion) 1978 13,700GT/22,500BHP **25**	'Erlangen' Express Containership 1979 **18**	Futuristic Hapag-Lloyd/Assoc. of German Shipowners **12**	
W. GERMANY	HAPAG-LLOYD		Standard EØ Containership 1973 1750TEU 30,000BHP **25**			
W. GERMANY	ASSOC. OF GERMAN SHIPOWNERS				Futuristic **12**	
SWEDEN	SWEDISH ORIENT LINES (BROSTROMS)		'Thebeland' Class (5) RO-RO (Pre-1980) 12,000DWT/21,000BHP Scandanavia - Med. **24**	'Thebeland' Class + (5) RO-RO 1978 12,000DWT/21,000BHP Scandanavia - Med. **16**		
SWEDEN	BROSTROMS			'Scandia' Class (2) Containership 1972 13,000DWT **21**		RO-RO 1980 North Sea **9**
SWEDEN	SCANDIA CONTAINER LINES				Brage + (2) North Sea **11**	
BELGIUM	COMPANIE MARITIME BELGE				(4) **17**	

Country	Company	WATCHSTANDING ENGINEROOM >30	EØ OPERATION 30-20	GP RATINGS 20-15	POLYVALENT OFFICERS 15-10	EXTENSIVE SHORE SUPPORT <10
NETHERLANDS	NEDLLOYD			Loire Lloyd + (1) 22 Multipurpose 9600 GT		
				Newbuilding 22		
	NIEVELT GOUDRIAAN		Standard EØ (15) 25 Multipurpose 1980 10,000 GT	Experimental (2) 16 Multipurpose 288TEU 1980 14,700DWT Europe - S. America	Futuristic 15 Multipurpose 1987	
NORWAY	KLAVENESS			Summer 17 26,750DWT Winter 23		
	SEATRANS				2800DWT 14	
DENMARK	MAERSK		Standard EØ (9) 23 Containership 1975 29,391DWT/36,000BHP			
	DFDS NORDANA LINE			Dana Arabia + (3) 20 RO-RO 7900 DWT Med.-U.S. East & Gulf		
U.K.	SHAW SAVILL LINE		Dunedin 29 Multipurpose 1980 16,300DWT/20,500BHP Australia - U.S. Gulf, Caribbean			
	BRITISH SHIPBUILDERS		'Menelaus' Class 31 Multipurpose 1979 20,080DWT/14,300BHP			

TABLE D-3 (cont'd) Incorporation of Manning Innovations--Effect on Manning Levels

		WATCHSTANDING ENGINEROOM >30	EØ OPERATION 30-20	GP RATINGS 20-15	POLYVALENT OFFICERS 15-10	EXTENSIVE SHORE SUPPORT <10
ISRAEL	ZIM	Standard Containership Watchkeeping ER 1700 TEU Steam Turbine **34**	Standard EØ Containership 1700 TEU Steam Turbine **31**			
KOREA	KOREA NATIONAL LINE	Standard Containership Watchkeeping ER 25,000 GT 1600 TEU Turbine **36**				
EUR.	BUREAU VERITAS	Conventional Cargo Watchkeeping ER 1960's **34**	Cargo EØ 1976 **26**		Futuristic **11**	
TAIWAN	EVERGREEN		Standard EØ (26) Containership 1200 TEU 1977 15,000GT/20,000BHP Far East-Europe, U.S. East **22**	"L" Class Containership 1900 TEU Everlight + (3) 28,900DWT/22,260BHP **18**		

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