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Merchant Vessel Crew Levels: An American Perspective

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MERCHANT VESSEL CREW LEVELS:

AN AMERICAN PERSPECTIVE

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ABSTRACT

This paper, with an emphasis on policies of "effective manning," provides a critical appraisal on the issue of crew levels aboard large merchant vessels (those greater than 1,000 gross tons). Non-traditional approaches to crew organization and management are discussed. Special regard is made to addressing the various domestic and international laws, regulations, and conventions that pertain to ships' manning. The relationship between the seafarer and ships' safety is emphasized as it pertains to reduced crew size. It is argued that U.S. manning laws and regulations should be amended to permit not only smaller crews, but organizational changes aboard ship that will permit flexibility, increased efficiency, and ultimately, increased competitiveness. This view is supported with comparisons of present U.S. policy on ships' manning with manning practices in Japan and Germany. Conclusions demonstrate that, although effective manning has the ability to increase a ship operator's competitive posture, the potential for abuse begs that international regulation of manning levels be adopted.

Views expressed in this paper, as well as omissions and errors, are the responsibility of the author.

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LIST OF ACRONYMS

AB	Able Bodied Seaman
ABS	American Bureau of Shipping
AJSU	All Japan Seamans' Union
APL	American President Lines
ARPA	Advanced Radar Plotting Aid
BMC	Board Management Center
COI	Certificate of Inspection
CRP	Contingency Retainer Program
FCC	Federal Communications Commission
FOC	Flag of Convenience
GMDSS	Global Maritime Distress and Safety System
GP	General Purpose
H.R.	House of Representatives
ILO	International Labor Organization
IMO	International Maritime Organization
INMARSAT	International Maritime Satellite Organization
JSA	Japan Shipowners Association
MARAD	Maritime Administration
MEBA	Marine Engineers Beneficial Association (Union)
MSC	Military Sealift Command
MSM	Marine Safety Manual
MSO	Marine Safety Office
MMP	Masters, Mates, and Pilots (Union)
NOAA	National Oceanic and Atmospheric Administration
NRC	National Research Council
OCMI	Officer in Charge of Marine Inspection
ODS	Operating Differential Subsidy
OMBO	One Man Bridge Operated
OS	Ordinary Seaman
PGM	Pacific Gulf Marine
PMS	Preventive Maintenance System
PSM	Principle of Safe Manning
QMED	Qualified Member of the Engine Department
RRF	Ready Reserve Force
S.	Senate
SOC	Ship Operations Center
SOF	Ship of the Future
SOLAS	International Convention on the Safety of Life at Sea, 1978
STCW	International Convention on Standards of Training, Certification, and Watchkeeping for Seafarers, 1978
U.S.	United States
USC	United States Code
USCG	United States Coast Guard
USDOT	United States Department of Transportation
USMMA	United States Merchant Marine Academy
WHO	World Health Organization

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SEAMANSHIP. . .in its widest sense, is the whole art of taking a ship from one place to another at sea. It is an amalgam of all the arts of designing a ship and her motive power, whether sail, steam, or other means of working her when at sea, and in harbor, and the science of navigation by which the way is found from her point of departure to her point of arrival. It thus embraces every aspect of a ship's life in port and her progress at sea.

Oxford Companion to Ships and the Sea, 1976

CHAPTER ONE

INTRODUCTION

To attain profitability and remain competitive, many of the world's merchant fleets are utilizing the upper limit of automation and modern design technology to reduce crew size. During the past 20 years, the trend of operating large ocean-going merchant vessels with an ever fewer number of crew members has evolved as viable method of remaining competitive, particularly against "open registry" or flag of convenience (FOC) ships. FOC ships are registered under the flag of a non-traditional maritime nation--such as Panama, Liberia, or Cyprus--in order to avoid the fiscal obligations and terms of employment associated with registry in a traditional maritime nation (i.e. the U.S., U.K., Norway, and Germany). The commercial environment merchant ships operate within is generally biased in favor of operating FOC ships because: (1) FOC ships are typically manned for very low wages with crews from countries that lack any genuine link to either the owners, or the flag of the ship; (2) FOC vessels are not obligated to adhere to many of the safety or construction standards of traditional maritime nations; and (3) FOC ships enjoy significant tax relief.

With the increased use of satellite navigation and communications technology, automated diesel engines (i.e. unmanned engine rooms), planned maintenance management systems, and one-man bridge operation, the traditional view of what is considered an adequate number of crew is changing. Northern European nations, for example, operate some vessels with crews of 14, while the newest Japanese ships are crewed with 11. In comparison, manning aboard U.S.-flag vessels is somewhat higher; few vessels have less than 21 crew members.

The concept of "effective manning"--the ability to crew a large merchant ship not just with the minimum number of personnel, but also with the most efficient number--involves restructuring of traditional shipboard departments and job descriptions, as well as altering the way vessels are managed from the shore.

Manning reductions aboard ship initially take the form of shifting certain maintenance procedures to shore-side labor. In the second stage of reduction, there is an application of technology, with associated automation of traditionally labor intensive tasks. This second stage reduction of crew includes periodically unmanned (automated) engine rooms associated with the shift from steam to diesel power. In the case of navigation and bridge watch, automation has generally enhanced safety rather than replaced personnel. Although it is still axiomatic that a vessel must keep a sufficient look-out, the introduction of the "one man bridge" aboard European vessels is changing the nature of this important tradition.

Effective manning of the U.S. fleet has generally been limited to newer, diesel powered vessels, while steam powered ships continue to operate with up to 36 in the crew (USDOT, MARAD, 1991). Many factors contribute to this non-competitive posture. Among these factors are restrictive manning laws that prevent more efficient use of existing crews, (as well as preventing further reductions). Labor unions, too, are frequently not agreeable to progressive manning measures. Ultimately, however, it is the overall policy of the U.S. government that is considered to be the leading impediment to beneficial change in the merchant marine (Journal of Commerce, 1990).

The U.S. system of promotional and incentive legislation (subsidies, cargo preference, and the Jones Act) is designed to help many operators compete with foreign competition and FOC ships. But, in the long-run, these promotional measures have not guaranteed the success of the U.S. merchant marine. For example, one of the most respected American carriers--Lykes Brothers Steamship Co.--is currently replacing U.S.-flag ships with FOC ships as their U.S.-flag vessels become too old to continue receiving operating differential subsidies (ODS). Thus, not only is Lykes laying up old ships, with the associated loss of jobs, but the foreign vessels are now competing against the remaining U.S.-flag ships that serve the same trade routes.

Lykes lines is not alone. Moreover, the whole U.S. merchant marine has witnessed an overall erosion of its infrastructure. This includes lost infrastructure associated with ships, such as shipbuilding, and seafaring manpower. FOC competition, lost military sealift capability, and the general decline of the U.S. merchant marine are all strong reasons that justify the advocation of innovation and a new direction for the U.S. merchant marine. Indeed, Japan and Germany, two of the largest economies in the world, have lost traditional flag ships to FOC fleets. In 1984, fifty percent of Japanese tonnage was foreign flag (Yamanaka and Gaffney, 1988: 12) and Germany had 55 percent of its tonnage flagged out in 1986 (Froese, 1987: 9-1). Effective manning is a progressive response to remain competitive with international shipping trends.

Various international conventions concerning safe ship operation, equipment, training, and technical specifications exist. Yet, there is no clear consensus on what constitutes a properly manned vessel. The Safety of Life at Sea convention (SOLAS), Standards of Training, Certification and Watchkeeping (STCW), and International Maritime Organization (IMO) Resolution A.481(XII) "Principles of Safe Manning" indicate only the broadest guidelines for individual flag states to follow in determining crew levels. It is the author's opinion that clear, unbiased, and practical manning levels should be quantified by the IMO through consensus of member states. The pursuit of good seamanship demands that those organizations and individuals responsible for shaping policy give their full attention to this very important issue.

The objectives of this paper are to examine the manning reductions being implemented in the world today, with particular emphasis on how the U.S. merchant marine could benefit from the international experience. In order to make the best of effective manning concepts, the U.S. merchant marine needs, first and foremost, a policy to strive for. This policy must include the means to acquire new vessels, wherever they are built; the support of the U.S. government; alteration of shipping laws; cooperation from labor unions; and the maintenance of a highly skilled and educated workforce. Only if these goals can be met will the U.S. merchant marine prosper.

Hypothesis

The competitive free market business of shipping dictates an environment where cargo is traded and transported at the lowest possible cost. Nevertheless, the international shipping arena is fraught with many direct and indirect forms of maritime promotion and subsidy. Shippers and vessel operators in the U.S. are well acquainted with this country's promotional measures.

Unfortunately, the present system has not produced a merchant fleet as envisioned in the Merchant Marine Act of 1936. In 1990, there were only 368 active, privately owned U.S.-flag ocean going ships (MARAD, 1990). This number is down from 819 active ships in 1970--a 55 percent reduction (MARAD, 1970). Looking ahead, given the imminent phasing out of all operating differential subsidies by the year 2001, a laudable objective for the U.S. merchant marine is prosperity with minimal direct financial aid from the U.S. government. Congress must accelerate their efforts, in the near future, to foster an overall environment where the merchant marine can operate profitably. Recent maritime reform bills in the 102nd Congress (H.R. 5627 and S. 3047) did not include amendments to manning laws.

It is therefore hypothesized, the U.S. should take such legislative and regulatory actions, as necessary, to amend manning laws that retard innovation from occurring in the U.S. fleet. Without the ability to make the best use of automation, technology, and effective manning innovations, all other incentives for domestic operators to invest in new efficient vessels will be stymied; indeed, the continued precipitous decline in numbers of vessels, sealift capability, and seafaring manpower will continue.

CHAPTER TWO

EVOLUTION: TRADITIONAL AND PRESENT MANNING IN THE U.S.

Manning laws and regulations aboard vessels of the U.S. merchant marine have evolved since the early part of this century within a somewhat broad statutory frame-work. Laws pertaining to manning are codified in subtitle II of title 46 USC, with the exception of those relating to radio operator's qualifications which are codified in title 47 USC. In addition to the statutory requirements, there are a vast number of functional criteria that must be observed: (1) to meet regulations mandated by the U.S. Coast Guard (USCG); and (2) to promote good seamanship.

The Ship's Mission

In order to satisfy the mission of a ship--to safely transport cargo and return profit for the owners--the ship must be organized such that there are sufficient personnel aboard to assure safe navigation, operation of her machinery and protection of the marine environment. In addition, maintenance must be accomplished, meals prepared, and the physical and psychological well-being (morale) of the mariners looked after. All of this must be accomplished in a natural environment that frequently involves storms, severe extremes of temperature, and long periods of isolation from society.

Back at the home office, the ship operator has additional factors to consider when manning their vessel. Of paramount concern is the quality of the crew looking after the ship. Operators must decide, will the crew be obtained through collective bargaining with a union or be independent (i.e. non-union)? How much is the company willing to spend for a crew? To what extent will shoreside contractors assist the crew with maintenance, and to what extent is the crew trained? Any attempt to crew a vessel with fewer or sub-standard seafarers than are necessary to accomplish the ship's mission are grounds for considering the vessel unseaworthy.

Shipboard Organization

It is essential to understand the organizational structure aboard U.S.-flag vessels in order to understand why crew size is at its current level. It can then be demonstrated through examples of Japanese and German effective manning programs how their innovations could be applied to the U.S. fleet.

The evolution of departmental organization aboard ships has its roots in customary practice which ultimately is now recognized as law. Back in the age of sail, seamen were signed onto articles in various capacities to fulfill particular tasks. There was no departmental distinction between seamen. One and all were accountable to the master. Later, with the appearance of steam propulsion, the engineers needed to operate the machinery became an autonomous group within the organization of the vessel. Engineers developed their own hierarchy, with a chief as the head of the department. Aboard ships today there are five recognized departments: Deck; Engineering; Radio; Steward; and Staff. Each department has developed specific areas of responsibility, and typically, is also represented by a separate union affiliation, although exceptions will be highlighted later in this paper.

One of the aforementioned departments, "Staff" officers, (defined in title 46 USC sec. 8302 (b)) is presently being eliminated in the U.S. merchant marine. Staff officers are composed of pursers and doctors. Pursers traditionally managed the ship's paperwork whereas doctors are required by law on vessels carrying more than 12 passengers. However, the popularity of computers aboard ship has streamlined the paperwork formerly accomplished by pursers while the concomitant decline in the number of U.S.-flag passenger carrying cargo vessels has virtually eliminated doctors from the U.S. merchant marine. Indeed, there were only 29 staff officer billets in the entire U.S. merchant marine in the year 1991 (USDOT, MARAD, 1991). Former duties of the staff officer are now being assumed by members of the deck department.

The meaning of the terms "seaman" and "sailor," which are often used indiscriminately, are, indeed, very different in the interpretation of law. As per title 46 USC sec. 10101 (3): "seaman...means any individual engaged or employed in any capacity aboard a vessel." When referring to "sailors" the USCG uses this interpretation:

> "[T]hose members of the **deck department** other than licensed officers, whose duties involve the **mechanics of conducting the vessel on its voyage,** such as helmsman (wheelsman), lookout, etc., and which are necessary to the maintenance of a continuous watch (46 CFR sec 15.705 (b), author's emphasis).

The term "sailors" is "not interpreted to include able seamen and ordinary seamen not performing these duties" (46 CFR 15.705 (b)). It is also notable that the master is not considered a seaman under law. "Master...means the individual having command of a vessel" (46 USC sec. 10101 (1).

Labor unions figure prominently in the organization aboard U.S.-flag ships, which, often has the undesirable effect of separating the crew into union affiliation groups. Typically, licensed engineers are represented by one union and licensed mates by another. All of the unlicensed individuals are represented by yet another union. American President Lines (APL), for example, has six different unions representing personnel aboard their vessels (Gaffney, 1989).

Union work rules can be very specific and sometimes lead to inefficiency. Unions, in addition to stipulating work rules and wages, set their own manning levels through the use of collective bargaining agreements with employers. For effective manning to be realized in the U.S., the cooperation of labor unions and management is essential.

To equitably spread the workload, customary organization of merchant vessels requires some form of watch be in use. Current law mandates the use of a three watch system aboard merchant vessels of more than 100 gross tons.

> "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 3 watches, and shall be kept on duty successively to perform ordinary work incident to the operation and management of the vessel..." (title 46 USC sec. 8104 (d)).

Obviously, not all hands stand watch; for example, the stewards department and other supernumeraries do not. However, this statutory requirement is open to interpretation concerning which crew-members are actually bound by the law.

Amending the requirement for a three-watch system would clear a major obstacle preventing further implementation of effective manning aboard U.S. vessels. Keeping individual crew-members on watches impedes the flexibility to use them for more constructive purposes such as maintenance, and contributes to operational expenses by generating overtime payments.

Authority to regulate the shipping statutes of the U.S. is vested in the USCG through secretary of transportation.

> "In the interests of marine safety and seamen's welfare, the secretary shall enforce this subtitle...[t]he secretary may prescribe regulations to carry out the provisions of this subtitle (vessels and seamen)" (title 46 USC sec. 2103).

Through interpretation of shipping statutes and precedent-setting court decisions, the USCG prescribes manning levels for all U.S.-flag inspected vessels. Criteria considered includes watch-standing requirements, work-assignment restrictions, and work-hour limitations (National Research Council, 1990: 133).

<u>The Certificate of Inspection</u>

Manning levels for individual inspected vessels of the U.S. are included in the vessel's Certificate of Inspection (COI), along with pertinent operating guidelines and safety equipment requirements.

> "The certificate of inspection issued to a vessel under part B of this subtitle shall state the compliment of licensed individuals and crew (including lifeboatmen) considered by the Secretary to be necessary for safe operation" (title 46 USC sec. 8101 (a)).

Manning levels are higher than specified on the vessel's COI because the COI specifies only the minimum personnel needed for the vessel's safe "operation." COIs typically make no mention of stewards department personnel or other crew members necessary for maintenance of the ship. With respect to tank vessels, the law is more specific:

> "[A] tank vessel shall consider the navigation, cargo handling, and maintenance functions of that vessel for protection of life, property and the environment." (title 46 USC sec. 8101 (a)(3)).

Until very recently, meeting minimum manning standards was not an issue. Ships always had more personnel than required by the COI. Appendices A and B (pp. 140 and 141) illustrate actual COIs for the freighter John Lykes (steam) and the tanker Exxon Longbeach (diesel). The John Lykes COI indicates the requirement for a crew of 24. In fact, the vessel carries a crew of 36 (USDOT, MARAD, 1991). The Exxon Longbeach COI requires a crew of 15, although she carries 20 (USDOT, MARAD, 1991). In addition to the personnel needed for designated billets, it can be seen that both the Exxon tanker and the Lykes freighter need personnel to meet the requirements for specific tasks. The tanker needs seven lifeboatmen and three tankermen, whereas the freighter needs eight lifeboatmen. These qualifications must be covered either by crew members (typically unlicensed) shipped in their respective billets or by additional crew.

Early Stages of Crew Reduction

The gradual trend of reducing the number of persons aboard ships that has taken place in the last 25 years is generally due to the implementation of labor-saving devices, (e.g. as constant tension mooring winches) and a shift of selected maintenance to shoreside contractors. Automation of steam power plants and the increased use of diesel engines has further reduced the required billets aboard ship. In the early 1970s, U.S. ship operators began assigning their chief mates to watch-standing billets. This change had the effect of eliminating the need to carry an additional third mate to stand watches. Duties that were once performed by staff officers (pursers) were shifted to the master and/or radio operator.

The following data, supplied by MARAD (see Caponiti, 1992) is clearly indicative of the trend towards lower manning levels in the U.S. merchant marine. The average number of billets per ship for three reference years are shown:

1970--47.00 jobs/ship Total billets--35,002

1980--36.50 jobs/ship Total billets--19,218

1991--26.15 jobs/ship Total billets--10,121

Not only has there been a 44 percent reduction in the average number of jobs/ship, but there has also been a tremendous 71 percent overall attrition of available shipboard billets during this 21-year period. In fact, 118 vessels--or 30 percent of the present U.S. ocean-going fleet--have crew levels at 21 or less (USDOT, MARAD, 1991). Table 1 shows the evolution of manning levels from a first generation container vessel of 1965 to the latest diesel powered vessel with unattended engine room.

Despite what appears to be a great improvement in efficiency, the U.S. merchant fleet lags behind manning reductions being implemented in Japan and Germany. One reason is that effective manning is not fully applicable to many of the older steamships still in service in the U.S.

TABLE 1

ALTERNATIVE MANNING LEVELS OF A CONTAINERSHIP

	A--1965	B--1975	C--1985
MASTER	1	1	1
RADIO OFFICER	1	1	1
PURSER	1	-	-
DECK OFFICERS	4	3	3
UNLIC. DECK	11	6	6
CHIEF ENGINEER	1	1	1
ENG. OFFICERS	5	4	3
UNLIC. ENG.	8	5	3
STEWARD DEPT.	8	6	3
TOTAL	40	27	21

Alternative A: Steam turbine powered vessel with watchstanding engine room personnel.

Alternative B: Steam vessel equipted with watch call system, bridge sanitary and messing facilities, labor saving devices for mooring, and automatic radar plotting aid (ARPA).

Alternative C: Diesel powered vessel with navigational aids and unmanned (non-watchstanding) engine room.

Source: MARAD, in National Research Council, 1984. "Effective Manning of the U.S. Merchant Fleet."

Rigid interpretation of statutes, such as the three watch rule and work-assignment restrictions prevent organizational improvement aboard ship. General union opposition to manning reductions is also an obstacle. But, conclusively, the strongest opponents to effective manning will usually cite safety considerations--a valid posture in the wake of the Exxon Valdez debacle.

CHAPTER THREE

EFFECTIVE MANNING: FROM CONCEPT TO REALITY

Effective manning has come to be known as a concept--or perhaps, even a philosophy--to be associated with the application of technology, automation, changes in managerial methods, and more commonly, the reduction of crew billets. Benefits of effective manning have included: (1) cost reductions; (2) improved productivity; (3) competitive renewal; and (4) expansion of skills (Gaffney, 1989). To some people, effective manning is synonymous with reduced manning. This view implies that effective manning means loss of jobs, higher workloads, loss of occupational identity, and even union busting (Gaffney, 1989).

In an effort to compete with FOC vessels and as a general evolutionary response to social change and applied technological advances, effective manning has evolved in industrialized nations' merchant fleets for the past 20 years. Countries such as Japan, Germany, Norway, Sweden, and Denmark are the pioneers of effective manning innovation. Technological and organizational innovations that have been established in these countries' ships are currently far beyond the experimental stage; indeed, effectively manned vessels represent a large percentage of their national merchant fleets. Practices developed in these countries are being phased into ships throughout the world, including U.S. ships.

The objectives of this chapter include examining the ideas, innovations, experiments, successes, and inadequacies that have materialized as a result of effective manning policies in Northern Europe and Japan. In this light, comparisons may be drawn between these nations' experiences, and the United State's own efforts to come to terms with effective manning.

Concepts of Manning

From a purely technical point of view, automation has the potential to reduce ships' crew complements to zero (Froese, 1988). In practice, however, crew levels become a function of the owners' philosophy, regulatory requirements, and in some cases, labor unions.

The methodology followed during the process of effective manning varies between shipping companies and nations, although to a large extent, there are more similarities than differences. In most cases, government participation plays a significant role. A clear sense of goals and objectives are set, and ideas are converted into policy, with ultimate testing and following up on the results. The study Effective Manning of the U.S. Merchant Fleet (1984), sponsored by the National Research Council, identifies a systematic approach that is often used in the process of adapting effective manning. The progression of events is indicated as follows: (1) theory and research; (2) studies, experiments, and practice in ship operations, in the home country, other countries, or in other industries in the home country; and ultimately, (3) actual operating experience (National Research Council, 1984: 47).

The concept of effective manning may be looked at in three distinct sub-groups: (1) policy, regulation, and management; (2) technical aspects (i.e. hardware); and (3) human factors. All three sub-groups form a matrix around the central issue. For full effective manning to take place, all three sub-groups must be addressed; however, there are partial benefits to be gained by adapting any combination of the sub-groups.

Effective Manning Policy

Both government laws and regulations and ship operators' management policies exhibit tremendous influence over the organization aboard ship. Operators must be responsible for many of effective manning's attributes. These include: (1) crew continuity; (2) shipboard policy and procedures; (3) wage scales; (4) training; (5) standardization within the fleet; and (6) maintenance policy (Pollard et. al., 1990: xii). Minimum manning levels are generally determined by some combination of government regulation and labor/management agreement, depending on a ship's type, age, and level of automation.

Regarding maintenance, ship operators need to establish a preventive maintenance system that utilizes some combination of shoreside and shipboard labor. Reduced crew levels are generally too small to allow all the necessary maintenance to be completed by the crew. Frequently, ships employ what are known as "riding crews" or "flying crews"-- these are technicians and laborers carried in addition to the core crew as need dictates. Policies on riding crews differ by country and by operator. For example, Norway primarily increases crew levels in the summer, while Japanese ships generally prefer not to use riding crews (Yamanaka and Gaffney, 1988).

One man bridge operation (OMBO) is a policy being introduced aboard highly automated, large ships. Although common in small vessels and tugs, OMBO has not generally been popular on large ocean-going vessels prior to the introduction of advanced collision avoidance radar systems. Although not technically illegal (OMBO is regulated by international law), OMBO is the topic of much discussion within the nautical realm. A full chapter is devoted to a discussion of this important issue later in this paper.

Policy decisions are also responsible for determining the qualifications and calibre of a ship's crew. Note the opinion of the head of the Marine Transportation Department at the U.S. Merchant Marine Academy:

> "No matter how well the ships are designed and constructed they are no better than the personnel entrusted to operate them" (Stewart, 1992).

Indeed, effectively manned ships in Northern Europe and Japan are crewed by mariners who have extensive education and training. Moreover, education and training facilities in these countries have implemented curricula specifically to meet the needs of effectively manned vessels (Stewart, 1991). Additionally, as entry level ratings aboard ships have been virtually phased out entirely, extensive shoreside training takes on additional importance to meet the need for technically skilled mariners.

The concept of integrated--sometimes called polyvalent--crews, where officers and unlicensed crew-members are knowledgeable in both deck and engineering skills, is utilized extensively on effectively manned ships. The ship is viewed as one operational system, requiring not only a traditional depth of understanding in one discipline, but a breath of understanding as well. In Germany, for example, a general purpose unlicensed rating (GP) is the only certification awarded since 1987 (National Research Council, 1990). Dual-purpose officer qualifications have been mandatory for employment with Shell Tankers B.V./ Netherlands since the early 1980s (National Research Council, 1984). Integration of traditional deck and engine officer billets is one of the most universally accepted attributes of effective manning.

Another policy, having influence aboard ships, is the organization of the bridge watch rotation. Recent studies have attempted to determine the efficiency of watch-standers by analyzing their sleep patterns (Low, et. al., 1987; Schuffel, et. al., 1989; and National Research Council, 1990). As a result of these studies, alternative watch systems to the standard three officers working four-on/eight-off have been proposed and experimented with. One such proposal by the Institute for Maritime and Tropical Medicine, Hamburg, is for the watch to be broken into a short two hour and a longer six hour period, which will allow longer periods of rest between consecutive watches (Low, et. al., 1987). Yet another proposal, worked out by the Hamburg Polytechnic School for Maritime Studies, envisions the bridge watch divided between five watch-standers, including the ship's master (Froese, 1987). This proposal alleviates the monotony of spending eight hours on the bridge by allowing officers to participate in other challenging tasks aboard ship. The Japanese, through the use of their new "k watch officer (KWO)" rating have increased the pool of qualified bridge watch-standers aboard ship, allowing flexibility and diversity.

Since watch-standing on reduced crew vessels primarily affects only the bridge watch-standers, all other personnel are utilized for vessel operations and maintenance during the day, greatly increasing productivity when compared to conventional ships.

Technical Aspects of Effective Manning

Undoubtedly, the most influential of effective manning concepts is achieved through automation and elimination of traditionally labor intensive shipboard operations. Unattended, and periodically unattended, engine rooms are among the list of features aboard streamlined vessels. Modern ships include automated systems that monitor and control operations such as ballasting, fuel oil transfer, liquid cargo pumping, tank washing, navigation and piloting, collision avoidance, communications, and anchoring. The most advanced effectively manned vessels have nearly every aforementioned system capable of being monitored from one central location--typically the bridge (Guest, 1990). Today, automation is both available and reliable. Automation has the proven capacity to increase safety, productivity, and efficiency, while reducing manpower requirements.

An emerging technological development, associated with the automation of shipboard systems, is the concept of a totally integrated navigation system (INS). Such systems utilize three major components: the navigation module (position finding); collision avoidance module; and an electronic chart display. Two of the three major components of INS--satellite navigation (SAT-NAV) and advanced radar plotting aids (ARPA)--have been available since the early 1980s. The other component, electronic chart display and information system (ECDIS), is still being developed. Although INSs are available and utilized aboard some vessels, current SOLAS regulations (chapter V, sec. 20) still require paper nautical charts (Kristiansen et. al., 1989).

What sets INS apart from ships that utilize one or more of the above systems separately, is the fact that all the modules are integrated to provide the watch-officer with real-time logistical information from a single source--typically a large computer monitor screen. When fully developed, ECDIS will have the capacity to completely, and legally, replace conventional paper charts and navigation tools. Through integration with ARPA and SAT-NAV, the ship's position will be indicated on a monitor in its electronically charted surroundings with all other non-charted objects (e.g. other vessels) displayed (Kristiansen et. al., 1989). Information on the ship's course and speed, other vessels' courses and speeds, plus appropriate collision avoidance data will be graphically shown through use of vectors and contrasting colors.

The underlying philosophy behind INS is to provide and store information about the vessel's status with minimal operator input. Theoretically, this method enhances safety when the watch-officer is functioning as the sole look-out during OMBO. However, there is some cause for concern; the ability of the watch-officer to absorb and process vast amounts of information thoroughly is often questioned (Pollard, et. al., 1990). As a result, selected information is being suppressed to avoid information overloading (Kristiansen et. al., 1989).

Human Aspects of Effective Manning

Effective manning concepts such as crew reduction, task automation, integration of job responsibilities, and changes in maintenance practices have resulted in an environment aboard ships that is profoundly different than that found aboard traditionally operated vessels.

In both the living and working environment, many traditional boundaries between officers and unlicensed have been downplayed or eliminated aboard effectively manned vessels. Crews typically eat and socialize in one common area, and they share recreation facilities. With the exception of senior officers, staterooms are typically of the same size and furnishing (Paetow, 1987). Integration of job responsibilities among crew-members has emphasized task similarities and interdependence (Gaffney, 1989). Management decisions have also gravitated away from senior officers, and moved toward an emphasis on achieving overall consensus (National Research Council, 1984). The result of these social innovations has typically been a more cohesive crew and improved morale. The Norwegian Shipowners' Association reports:

> "[S]hip 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" (National Research Council, 1984).

The previous practice of building ships with staterooms adjoining offices and berthing areas on the same deck as workrooms has given way to total separation of living and work areas on German built vessels (Marine Engineers Review, 1990-a). This practice has succeeded in lowering job-induced stresses and eliminating noise occurring from other personnel working in proximity to living areas.

With reference to the functional design of a ship and its relationship to the seafarer, a term called "ergonomics" is frequently cited. The term, as defined by the American Bureau of Shipping, is as follows:

> "Application of the human factor in the analysis and design of equipment, work and working environment" (ABS, 1992).

Ergonomics is most often associated with functional designs that have effects on human senses such as noise, extremes of temperature, vibration, lighting, and physical exertion and endurance. There is a direct relationship between ergonomics and safety. The "Ship Control Panel" summary report, in the Ship of the Future 2000 Workshop Proceedings, included intellectual reasoning and communications among the sensory perception attributes (O'Neil, 1990). The panel further emphasized that application of technology and automation has the potential to both enhance and hinder overall safety. Poor design and application of technology can result in unwanted levels of stress, fatigue, and/or periods of inattention and boredom (Pollard, et. al., 1990). Automation should therefore be carefully thought out, and applied when safety can be enhanced, leaving more rewarding and challenging tasks for the crew.

CHAPTER FOUR

PROCESS OF CHANGE IN THE U.S.: PROBLEMS, SOLUTIONS, AND EXAMPLES

Manning levels aboard most U.S. ships are presently at their lower operating limit. This fact reflects the regulatory and operational environment of the shipping industry. Laws such as the three watch rule, work assignment restriction, and work hour limitation are considered too restrictive to allow further manning level innovation from taking place. Labor unions are seriously concerned with on-going manning reductions. As representatives of most American seafarers, they collectively promote the livelihoods of over 50,000 members (MARAD, 1992).

Future stages of effective manning aboard U.S.-flag ships will involve more than just crew reduction. Organizational structure aboard ships will need to change. Departmental separation will blur as the ship becomes one operational unit. But, before this next stage can occur, legislation will have to be passed that changes the aforementioned laws and permits new regulation to be written.

Rigid boundaries between crew-members on U.S. ships are a major impediment to increasing efficiency. Examples of these crew member delineations are the classic separation of licensed and unlicensed seamen, affiliation with different unions, and the sometimes adversarial relationship between departments, especially deck and engine. Only the licensed/unlicensed boundary is supported in law. The others, real or created, are a result of custom and the social structure aboard ship.

Work Assignment Restriction

Work assignment restrictions, more commonly known as "the cross-over rule", are one of the major obstacles preventing U.S. ships from fully embracing the European example of general purpose crew-members. General purpose crew are trained to be utilized in the engine room or on deck. The U.S. law is clear:

> "[A] seaman may not be (A) engaged to work alternately in the deck and engine departments; or (B) required to work in the engine department if engaged for deck department duty or required to work in the deck department if engaged for engine department duty" (title 46 USC sec. 8104 (e)(1)).

However, this statute has been interpreted loosely by the USCG during the past ten years such that some flexibility has been achieved. Some U.S.-flag vessels now utilize a seaman in the billet of deck-engine mechanic (DEMAC). Moreover, the DEMAC may be employed in the maintenance of deck equipment, though they are really members of the engine department, under the supervision of the chief engineer.

This emerging concept is further enumerated later in this chapter.

The use of dedicated general purpose crew-members (officers and unlicensed) would, in all likelihood, improve the efficiency of shipboard operations, as fewer crew-members would be needed to accomplish tasks. It is not uncommon for officers on German vessels to stand bridge watch part of the day and conduct engine maintenance too, without additional overtime. Proposed changes in this law will likely be met with strong opposition from labor unions. Under the present union affiliation structure aboard U.S.-flag ships, work rules are very specific concerning job description. A tremendous restructuring of union work rules would need to take place to accommodate changes in the cross-over rule.

Shipboard efficiency is further impeded by union job/task rigidity. For example, union rules require that a small job involving welding requires a licensed engineer and two unlicensed engineers. The licensed engineer performs the welding, one of the unlicensed engineers carries tools and sets up, and the other unlicensed engineer cleans up. If one of the unlicensed engineers were occupied with other maintenance at the time, but an able-bodied seaman (AB) was available and qualified, law, union rules, and customary practice would prohibit the AB from assisting.

Clyde Dodson, former executive vice president of the Marine Engineers Beneficial Association, District #1 (MEBA-1), voiced his opinion about manning upon return from an effective manning fact-finding mission to the Far East in 1987. He pointed out that "changes in Europe and Japan are not necessarily suitable for this country" and "a customized U.S. solution must be developed through negotiation" (Yamanaka and Gaffney 88: 69). His insight is perceptive. Labor unions wield a lot of weight in Congress, as well as in the shipping industry. Those parties wishing to change an embedded law such as the cross-over rule will find a challenge awaits them.

The Three-Watch Requirement

The literal interpretation of the "three watch rule" is the requirement for: (1) licensed individuals; (2) coal passers; (3) sailors; (4) firemen; (5) oilers; and (6) water tenders to be divided into three watches. This means that the COI requirement to carry someone in that billet, such as an AB (sailor), necessitates carrying crew in multiples of three (since one per watch is needed). Inclusion of the statute here will help clarify the law and be of value in demonstrating how some U.S. operators have managed to circumvent the literal spirit of this law.

> ". . .the licensed individuals, sailors, coal passers, firemen, oilers, and water tenders shall be divided, when at sea, into at least 3 watches and shall be kept on duty successively to perform ordinary work incident to the operation and

management of the vessel." (title 46 USC sec. 8104 (d)).

On the surface, the law appears to make sense. And it did, in 1915, when it was enacted to help stop some of the ambiguity concerning seamans' work requirements. Today, however, assigning crew-members to watches is often inefficient because of this law. As excerpted in section 8104 (d) of 46 USC, the actual manpower needed to "perform ordinary work incident to the operation and management of the vessel" requires much less personnel than in the past due to automation. Crew-members assigned to watches often perform duties that are redundant or no longer needed on automated modern ships. These individuals would be much better utilized if devoted to performing maintenance. Presently, much of the maintenance that is performed by watch-standers occurs on overtime hours, with concomitant overtime pay.

Labor Unions

Some of the barriers that prevent ship operators from taking a more proactive approach to effective manning are the result of maritime labor unions. The traditional role of unions--to collectively represent employees--is being clouded. For example, the "International Organization of Masters, Mates, and Pilots (MMP)," a deck officers' union, are actually involved as owners of a number of U.S.-flag tankers. Similar to businesses, unions compete with each other and occasionally take bold moves. In this light, unions take whatever steps are necessary to ensure that their members can get jobs. In addition, most of the unions have raided each other's "turf" over the years such that a union that once provided jobs only to licensed engineers, now places mates and masters too. The three major maritime unions have now gone all-out in some cases and supply all billets aboard the ship. This is known as top to bottom, or vertical manning.

A related problem with union affiliation is the topic of vertical mobility. As unlicensed seafarers gain time and experience, many aspire to become officers. In order to sail on their licenses, they must change union affiliation, which often means forfeiting substantial vesting in pension funds. The Seafarers International Union (SIU) has both licensed and unlicensed divisions, thus embracing one of the concepts of effective manning--vertical integration, i.e. career mobility.

Employment continuity is a recognizable attribute of effective manning. Seafarers are attached to the same vessel for a prolonged period of time; when they return from vacation, they join the same vessel or class of vessel. This continuity assures employee familiarity with a vessel and alleviates vast amounts of wasted time in constantly training new crew-members unfamiliar with the ship. Unfortunately, with the exception of the senior officers and the captain, this concept is rarely practiced in the U.S. at this time. Unions generally view employment continuity as weakening the bond between the seafarer and the union (Gaffney, 1989). Because of high unemployment among seamen, continuity causes some seamen to have jobs and others not. This system of casual labor may have to continue for the time being.

Perhaps the logical reason for unions to be concerned with effective manning is their survival. On the one hand, reducing crew levels aboard present or future vessels eliminates jobs and jeopardizes the union's future pension funds (National Research Council, 1984: 70). On the other hand, by not cooperating with the industry, U.S. merchant ships will continue to be non-competitive and union billets aboard ship will continue to decline.

Impediment Policy

"Impediment policy" may be a more fitting term to describe the United States' current promotional policies toward the merchant marine. Rigid operating guidelines associated with the ODS program are a major obstacle to implementing effective manning innovations for subsidized operators, whereas non-ODS operators--although being in a somewhat better posture--are still subject to numerous governmental restrictions.

A majority of the subsidized vessels now in service are older, and have lower carrying capacities and higher crew levels. They are also fuel inefficient steam-ships. These vessels are not generally suited for crew reduction and high levels of automation. To receive subsidy, operators are required to purchase new tonnage at American shipyards (as per section 615 of the MMA-36). However, the high cost of building in the U.S. and the concomitant restriction from building ships overseas, has meant that subsidized operators are holding onto their old ships. Although Congress has granted limited waivers to section 615 of the MMA-36 (Public Laws 97-35 and 98-151, described in this chapter), subsidy payment generally eliminates the incentive for a ship operator to apply effective manning techniques. ODS payments to 90 vessels, which in 1990 represented 24 percent of the U.S. fleet, were over 199 million dollars (MARAD, 1990). Had all these vessels been effectively manned, the financial outlays would have been appreciably smaller.

Other impediments that discourage investment in new automated ships are: (1) the 50 percent ad-valorem tariff on maintenance and repairs performed in foreign shipyards; (2) the waiting period that prohibits foreign-built U.S.-flag vessels from carrying Department of Defense cargo for three years; (3) the requirement that U.S.-flag ship-owning corporations be U.S. citizen-owned, inhibiting foreign investment capital and joint ventures; and (4) the requirement of spending Capital Construction Fund money in U.S. shipyards, since these tax-deferred funds could be used for the construction of vessels overseas and would likely encourage operators to build new vessels.

The original spirit of the Merchant Marine Act of 1936 (MMA-36) is laudable. Its objective is still sound, although many of the Act's promotional programs are no longer valid. The MMA-36 declaration of policy states:

> "It is necessary for the national defense and development of its foreign and domestic commerce that the United States shall have a merchant marine (a) sufficient to carry its water-borne commerce and a substantial portion of the water-borne export and import foreign commerce...(b) capable of serving as a naval and military auxiliary in time of war or national emergency...(c) owned and operated under the United States flag...(d) composed of the best equipped...vessels, constructed in the United States and manned with a trained and efficient citizen personnel..."

The Act further states:

> "It is hereby declared to be the policy of the United States to foster the development and encourage the maintenance of such a merchant marine" (MMA-36, in National Research Council, 1990: 149).

The Secretary of Transportation, on behalf of the USCG, can not unilaterally change manning laws. Future productivity gains from effective manning will only be realized if the U.S. Congress and the President take legislative action. Recent maritime reform Bills in the 102nd Congress (H.R. 5627 and S. 3047) addressing the aforementioned impediments were a positive attempt to further the process of change and embrace the spirit of the MMA-36.

Examples of Change in U.S. Effective Manning Practice

Changes in manning levels and organizational structure aboard U.S. ships has been implemented over the last 20 years, although not to the same degree as those in Japan and Germany. The popularity of fuel-efficient diesel engines have enabled the automation of engine controls. U.S.-flag diesel vessels are able to operate with unattended engine rooms, thus saving manpower and promoting better maintenance. Maintenance departments have been established aboard some ships, allowing dedicated maintenance to be performed independent of the watch requirement. There is also an increased reliance on shore labor to assist the ship's crew while in port.

Effective manning practice has not been ignored in the U.S.; in fact, it has been studied in great detail. Full implementation awaits overcoming obstacles, such as those discussed in the previous chapter. In order to advocate further acceptance of effective manning in the U.S. fleet, it is instructive to examine successful examples of U.S. effective manning that have already been applied.

Shipboard Automation

To date, the largest improvements in shipboard productivity have occurred in the engine room (National Research Council, 1984). Widespread use of diesel engines has reduced the overall number of engineering personnel aboard ship. Diesel engines are readily adaptable to automation technology and can be relied upon to operate with minimal human intervention, with the exception of maintenance. Diesel engines permit a major productivity measure; there is no need to maintain round-the-clock watches. Most efforts in the engine department can then be devoted to maintenance during the working day. The machinery remains unattended the rest of the time, with control functions being monitored on the bridge and various other places aboard. U.S.-flag diesel powered vessels have been dually certified (ABS and USCG) for automated operation since the mid-1980s, with the stipulation that enough crew be available to stand watches should the automation systems fail (Marine Safety Manual, 23.A.3).

Appendix A and B (pp. 140 and 141) are indicative of manning in ships' engine rooms. The John Lykes, with a conventional steam power plant and watch-standing personnel, carries 14 engineers (6 officers/8 unlicensed) while the Exxon Longbeach, an automated diesel powered ship, carries 7 engineers (4 officers/3 unlicensed (USDOT, MARAD, 1991).

Other examples of shipboard technology that have reduced manpower requirements include constant-tension mooring winch systems, whereby the lines are permanently kept on reels and use of co-polymer and epoxy coatings that reduce the frequency of painting.

Maintenance Department

Increased efficiency has been achieved by the assignment of certain members of the crew to perform devoted routine and preventative maintenance. Recent interpretations of the manning laws by the USCG have concluded that the duties of some seamen includes watch-standing, while the duties of others does not (National Research Council, 1984: 102). For example, taken literally, title 46 USC sec. 8104 (e)(1) states that seamen may not be alternately engaged to work in both the engine and deck departments. Since seamen assigned to a maintenance "department" are not specifically assigned to either the deck or engine departments, they are not considered bound by this statute.

The Marine Safety Manual states:

> "Maintenance and repair personnel. Maintenance personnel in the deck and engine departments generally are not included in a watch system. As there is no statutory requirement for titles of the crew's positions to be identical to those stated on the COI..." (Marine Safety Manual, volume III, sec. 22.E).

As per Marine Safety Manual, volume III, sec. 21.C:

> "A maintenance person (any rating, either deck or engine) may be required on the COI for vessels having reduced crews, due to automation or installed labor saving devices. The OCMI may determine that such personnel are necessary for the maintenance and safe operation of automated systems...Maintenance persons may be identified by department affiliation... or by no affiliation, in which case the master has the discretion to determine how to best utilize the person."

Reference to the Appendix B (p. 141) indicates the written requirement for a maintenance department on the Exxon Longbeach's COI. Commensurate with the utilization of a maintenance department on reduced-manning vessels is a USCG-approved planned maintenance system (PMS). The PMS is a formal commitment, outlined in writing, of how the ship operator intends to meet the maintenance objectives of the ship. Frequently, shore-side contractors are used to perform maintenance that was traditionally done aboard ship when larger crews were carried.

Widespread use of maintenance departments has not occurred in the U.S. fleet. Unions oppose this concept (USDOT, MARAD, 1987: A.17) and in most cases, the traditional departmental structure remains intact. Productivity improvements that lie ahead for the U.S. fleet involve the introduction of a general purpose crew member billet--such as those already used on Japanese and European vessels.

Flexibility and Waivers

One of the more straightforward crew reduction techniques has been achieved through intra-departmental flexibility. Traditional jobs such as steward, cook, baker, boatswain, and AB, have been combined (Gaffney, 1989). Typical job descriptions today call for steward/cook, cook/baker, and boatswain/AB. Seamen in other billets; such as general vessel's assistant (GVA), general ship's utility

(GSU), deck engine utility (DEU), and deck engine mechanic (DEMAC), are able to work in any department, exempt from the cross over provision and the three watch restriction.

Vertical manning, where all employees aboard the vessel are members of the same union, does not cause the jurisdictional problems encountered aboard multi-union vessels. Frequently, seamen sailing in the unlicensed ranks are licensed, and can be relied upon for their extra degree of training. In addition, on ships that employ vertical manning, there is an added sense of teamwork and camaraderie. This practice is found aboard several U.S.-flag tanker fleets (USDOT, MARAD, 1992).

The elimination of radio officers aboard ships--a somewhat controversial practice introduced aboard vessels that run coastwise--has developed in the past few years. Federal Communications Commission (FCC) regulations allow an exemption from carrying radio officers: (1) if the master or deck officers obtain the general radio-telephone operators license; (2) if the vessel is not on an international voyage; and (3) if it does not go more than 150 nautical miles from the nearest land (title 47 USC sec. 352 (b)(2)). By combining jobs, the deck officer also assumes the role of communications officer. However, this practice is under severe criticism from a safety point of view (Stoller, 1992).

Acceptance of the international Global Maritime Distress and Safety System (GMDSS) convention, by the U.S. will open the radio officer/operator issue to further debate in the near future. A full discussion of GMDSS will be addressed in a subsequent chapter.

The Maritime Administration

The growing interest and concern over the erosion of U.S. sealift capacity prompted the U.S. Maritime Administration (MARAD) to initiate a study of the feasibility of applying foreign productivity improvements to the U.S. merchant marine. This interest in effective manning culminated in 1983, with the formation of the Committee on Effective Manning by the National Research Council (National Research Council, 1984). The committee was composed of representatives from the USCG, ABS, MARAD, maritime labor unions, and academic institutions.

Since the inception of the Committee on Effective Manning, MARAD has continued to participate in subsequent studies. Two prominent studies published as collaborative efforts with Pacific Gulf Marine Inc. in 1987, and American President Lines in 1989 were the end results of innovative experiments and trials (USDOT, MARAD, 1987; and Gaffney, 1989). MARAD's role in both cases, was, to contribute relevant data, provide consultants, and to publish the final results. MARAD, on behalf of the U.S. taxpayer, stands to save a substantial amount of money with the inception of effective manning; currently, 61 percent of a subsidized operator's crew wages are paid through ODS (MARAD, 1991, see Appendix C, p. 142).

American President Lines

The catalyst to implementation of effective manning at American President Lines (APL) came in the form of a Congressional waiver to section 615 of the MMA-36 (Gaffney, 1989). This waiver, as part of Public Laws 97-35 and 98-151, allowed subsidized operators a "window of opportunity"--in 1981 and again in 1985--to purchase foreign-built vessels and still be eligible to receive ODS on the new acquisitions.

The two vessels acquired under this law are designated as J-9s and were the first of APL's vessels to implement effective manning techniques. Crew levels aboard the J-9s, as negotiated with the unions and approved by the USCG, were 21 persons. Lessons learned aboard the J-9s were subsequently introduced to other vessels in the fleet. Currently, 14 vessels at APL (61 percent of its fleet) are manned with 21 crew (USDOT, MARAD, 1991), and effective manning innovations of participative management have been applied to all APL vessels. Favorable results have come from APL's management policy of allowing crew-members' wives to ride the ships, as well as integrating the crew by holding all-crew meetings at regular intervals.

The highlight of APL's effective manning study was the formation of a Labor-Management Committee in early 1984. This committee, composed of company managers, union officials, and senior sea-staff from the APL fleet, joined together to discuss non-collective bargaining issues (Gaffney, 1989). Some of the issues discussed included: work methods and procedures, productivity, working/living conditions, safety, paperwork, tools and equipment, and crew training.

The Labor-Management Committee originally proposed the removal of some of the management tasks from the ships' officers to allow them to concentrate on the technical aspects of their jobs. This policy proved to be inconsistent, in that the officers actually wanted more participation in management decisions aboard ship (Gaffney, 1989). Spreading management decisions to the fleet seems to follow the Japanese example of human resource practices of the 1970s and 1980s, which ironically, are the U.S. and European examples that were academically touted, but never followed (Gaffney, 1989: 15).

The Labor-Management Committee, after meeting four times in 18 months, disbanded in November of 1985 due to conflicts of interest with one of the labor unions. It was thought that the union was giving to much attention to APL, perhaps encouraging a "sweet-heart" contract (Gaffney, 1989). Other union problems also surfaced; reports of licensed and unlicensed crew-members infringing upon each others jobs continued. Gaffney reports that:

> "[T]he issue of jurisdiction (union) continues to be the single most problematic aspect of effective manning operation of the J-9s" (Gaffney, 1989).

Crew continuity is one area where APL is unique among U.S.-flag union crewed vessels. As of July 1992, all deck and engineering officers are considered permanent employees. Thus, APL has a vested interest in the quality of their personnel. Company policy requires officers to attend courses to upgrade their skills on a regular basis.

Where does APL stand in regard to further crew reduction? APL's German built C-10 class containerships are designed to be operated by a crew of 12; indeed, similar vessels in Germany are now operating with 13 (Vail, 1988). Lacking the cooperation of labor unions and restricted by U.S. law and regulation, APL is handicapped from making any further innovations in crew structure.

Pacific Gulf Marine

Another independent effective manning program/study was introduced to ships operated by Pacific Gulf Marine (PGM) in 1985. Results of the study were later published by MARAD as Shipboard Productivity Methods (USDOT, MARAD, 1987). Similar to APL, the project was a cooperative effort among the labor unions, MARAD, and PGM. Areas of potential improvement included: "ship and shore policy and procedures, shore services, the organization and distribution of functional duties among personnel, manning procedures, personnel training requirements, and new equipment and materials" (USDOT, MARAD, 1987).

Among the more successful redistributions of functional duties aboard ship was the creation of a maintenance department. Under the direction of the chief engineer, seven seamen are now available for dedicated maintenance work. Three Abs remain to fulfill the requirements of the navigation watch.

Ships' senior officers were given control over expenditures and management within their jurisdiction. To give the officers an overall perspective of their expense management, PGM sends voyage-operating-expense spread sheets to the ship at the end of a voyage. Maintenance objectives are reviewed prior to commencement of a voyage by the ship's officers. Later, upon completion of the voyage, officers meet again to discuss results.

PGM's shore-side management organizational structure was also reorganized to provide a system of checks and balances. Areas of responsibility were established, with limits on individual authority.

Personal communication with the Port Captain of PGM indicates that most proposals from the MARAD study on effective manning are working. The Captain further indicated that his philosophy on crew reduction was, "It is going to far" (Neilson, 1992). Presently, PGM operates four ocean-going ships, one vessel with a crew of 19, two with 20, and one with 21 (USDOT, MARAD, 1991).

USCG: Regulatory Creativity

Any future proposal related to manning reduction and/or safety of life and property at sea is a subject under USCG jurisdiction. Regulatory responsibility for the U.S. merchant marine is administered by the USCG. Predicated on safety considerations, ships' manning levels are established by the Merchant Vessel Personnel Division of the USCG, through interpretations of Federal law (title 46 USC sec. 2103). Additionally, the Coast Guard is called upon to interpret irregularities in the law. Merchant marine manning laws were not written with the unattended engine room in mind; moreover, creation of the maintenance department aboard ship is another case where the Merchant Vessel Personnel Division had to create regulations to fit the need without going outside the spirit of the law.

Manning determination, as practiced by the Coast Guard, may involve responding to criticism or pressure from vessel operators. Regarding this reactive posture, the Coast Guard has categorized manning reductions into three stages (Connaughton, 1987: 10-7).

The first stage to occur--a general reduction of crew numbers--is associated with elimination of billets not required by the COI, and moderate use of automation in deck and engine equipment. Included in the automation are constant-tension winches, bridge sanitary facilities, and watch-call systems. Coast Guard involvement at this stage is limited to approving design and operation of automated equipment.

The second, and present, stage of crew reduction involves unattended engine rooms and maintenance departments. Existing ships wishing to operate at this level must keep detailed overtime records, machinery operating histories, records of equipment failure. In addition, they must have an approved planned maintenance system (PMS) in effect (Cannaughton, 1987). The operator is then given permission to proceed with the manning reduction on a six month trial basis. At the conclusion of the trial period, records are reviewed, and if everything is in order, the COI is permanently amended.

New ships wishing to operate with lower numbers of crew, maintenance departments, and/or high levels of technology, must follow the traditional procedure for determination of manning levels. The new vessel must be "classed" by a classification society--usually the American Bureau of Shipping (ABS). Once classed, the owner develops a manning proposal in concert with the USCG Marine Safety Manual, Volume III. If the vessel is similar in design to another ship, or one of a series, the approval process is easier, and is generally done through the nearest Marine Safety Office. If the design is the first of a class, manning requests are forwarded to the Merchant Vessel Personnel Division in Washington for approval (National Research Council, 1990). Similar to the manning reduction of an existing ship, the new vessel must undergo a trial period, and ultimately, Coast Guard officers ride the ship as observers.

The third, and presumed final, stage of manning reduction embraces most of the organizational and technological concepts used aboard modern Japanese and German ships. At this level of crew reduction, the USCG is seriously concerned with the abilities of the nominal crew to deal with emergencies.

USCG officers from the Merchant Vessel Personnel Division are very actively involved with manning and related safety issues. This fact is in evidence by virtue of their participation in international, as well as domestic forums. Examples include: International Maritime Organization (IMO) Sub-committee on Standards of Training and Watchkeeping and Sub-committee on Safety of Navigation (IMO, Documents, 1992). The USCG has also participated in the drafting of international conventions concerning manning and personnel qualification (STCW), and Safety of Life at Sea (SOLAS) (Noll, 1981).

CHAPTER FIVE

EFFECTIVE MANNING IN JAPAN AND GERMANY: CASE STUDIES

There is significant common ground among traditional seafaring nations in their impetus to pursue effective manning. Initial incentives to promote change were both social and economic. Beginning in the late 1960s, ship operators in Germany and Japan experienced personnel shortages. Wages and benefits of shore-side work, education levels, and standards of living had improved to the point where the desirability of an isolated seafaring life became unattractive (National Research Council, 1984). The proliferation of FOC vessels and inexpensive foreign seafarers further aggravated the competitive posture of traditional seafaring nations such as Japan, Germany, Denmark, Norway, Holland, England, and the U.S. To remain competitive, each of these countries began to experiment with their own versions of effective manning. The results have been partially successful in improving the competitive stance against FOC ships, and generally improved ship operating efficiency is a welcome result.

Effectively manned vessels tend to be the newest, largest, most fuel efficient, non-labor-intensive vessels in the world. Their crews represent the best--most highly trained and educated--seafarers, being managed by progressive and innovative shipping companies. Lessons learned through effective manning experimentation are generally applicable to other less automated vessels in modified form. Statistics may some-day show that effectively manned vessels are also the safest vessels in the world.

The balance of this chapter will examine Japanese and German versions of effective manning; both are leaders in the field. Each country's unique methodology has been applied to address a specific problem or set of problems. It will be observed that there are many more similarities than differences in each country's approach to effective manning.

Effective Manning in Japan

Automation of engineering systems aboard Japanese vessels were the first noticeable sign that reductions in crew level could be achieved through technology. A precedent-setting vessel, the Mississippi Maru, with centralized remote control of the engines, was capable of reducing crew levels from 48 to 32 seamen in the early 1960s (Yamanaka and Gaffney, 1988). Further refinements in automation technology led to the development of the M-0 (machinery space zero) classification in 1969 (Yamanaka and Gaffney, 1988). By 1984, M-0 ships, manned by an average 22 crew-members, represented over 50 percent of the Japanese-flag fleet (Marine Engineers Review, 1990-b).

In the early 1970s, Japanese operators and shippers began to take advantage of FOC vessels and their lower costs. The Japanese merchant marine (both ships and seafarers) began to show signs of decline. Recognizing the potential harm that could occur to its merchant marine, Japan took a somewhat protectionist attitude and decided to pledge resources toward building a strong merchant marine. In 1976, Japan's Ministry of Transport (MOT) set up a Council for Rationalization of Shipping and Shipbuilding Industries. This development was followed by the Research Committee for Modernization of Seafarers' System (RCMSS), in 1977. Representatives of the government (MOT), labor (All Japan Seamens' Union), management (Japanese Shipowners' Association), and the public (academic institutions) participated on the committee. Its objective was clear:

> "The underlying theme to the recommendations of the council was that the core of all maritime policy be the maintenance of a Japanese-owned, Japanese manned merchant fleet (Yamanaka and Gaffney, 1988: 18).

The RCMSS was dissolved in 1979 when, after spending two years investigating information gathered within Japan and abroad in the U.S. and Northern Europe, Japan had a methodology to pursue. The RCMSS became the Committee for Modernization of Seafarers' System (the Committee) which was appointed by the MOT to implement the initial experiments.

One major innovation pursued by the Committee--horizontal crew integration--involved consolidating the jobs of deck and engine personnel, the result being a dual purpose unlicensed crew-member functioning wherever needed aboard the ship. Officers are likewise trained to have either a deck or an engine specialty and are expected to be technically qualified in one discipline and operationally qualified in the other.

The Committee also introduced "vertical" crew integration, which is unique to Japanese effective manning. A new rating called a "k watch officer (KWO)" was established (Yamanaka and Gaffney, 1988). Formerly unlicensed crew-members are trained to have either deck or engine watch-standing capabilities, though without full officer qualification. KWOs are trained to meet the minimum watch-standing requirements, as set forth in the IMO's Standards of Training, Certification and Watchkeeping (STCW) convention. Utilizing KWOs increases the number of qualified watch-standers aboard ship and therefore allows flexibility in the watch system.

Another highlight of the Committee's recommendations was restructuring the ship into only two departments--an operations department and a social department. The operations department does everything from stand deck watches to change lube-oil filters. The social department, made up of the cook(s), is responsible for "life/general affairs" (Marine Engineers Review, 1990-b). Other effective manning procedures, learned from the trips abroad, were applied as well. These included: (1) further significant additions of automation and/or electronics; (2) planned shore-side maintenance; and (3) education and training, for both new recruits and upgrading (Yamanaka and Gaffney, 1988).

Beginning in 1981, Japan embarked on a series of crewing experiments that have continued to the present time. The same systematic methodological process initiated by the RCMSS was used throughout four stages of trials. Trials consisted of four phases: (1) an initial experiment; (2) a proof experiment; (3) a correcting experiment; and (4) a verification experiment (Yamanaka and Gaffney, 1988). Once through the "experimental phases," vessels move into the "mature operation phase" and become certified by law to operate at their respective crew level for that stage. Table 2 illustrates the four stages of experimental manning and the associated crewing level at each stage. Stage A was initiated in 1981, Stage B in 1982, Stage C in 1986, and the Pioneer Ship program in 1987. Presently, all four stages are occurring simultaneously with ships in various levels of experimentation within the four stages.

TABLE 2

JAPANESE EXPERIMENTAL MANNING LEVELS

POSITION	STAGE A	STAGE B	STAGE C	PIONEER SHIP
CAPTAIN	1	1	1	1
CHIEF ENGINEER	1	1	1	1
CHIEF OFFICER	1	1	-	-
RADIO OFFICER	1	1	1	1
1/ST ENGINEER	1	1	-	-
2/ND OFFICER	1	-	-	-
2/ND ENGINEER	1	-	-	-
** WATCH OFFICER	2	3	4	4 (3)
++K WATCH OFFICER	-	2	-	-
DUAL PURPOSE CREW	6	4	4	3 (4)
COOK(S)	3	2	1 (2)	1
TOTAL	18	16	12 (13)	11

** Watch officers are designated WO D/e, WO E/d, and WO E/D, depending on functional specializations.

++ K Watch officers are certified to head a watch (i.e. k WO/d for a navigation watch, or k WO/e for engineering watch).

Source: Marine Engineers Review, June 1990.

Yamanaka and Gaffney, 1988. Effective Manning in the Orient.

As of June 1990, 34 ships were operating in mature stage A, 93 in mature stage B, 26 in the verification experiment of stage C, and seven ships were in the Pioneer Ship program (Marine Engineers Review, 1990-b).

Much of the success associated with the Japanese effective manning program can be attributed to the close relationship of mutual cooperation between the Japanese Ministry of Transport, the Japanese Shipowners' Association (JSA) which represents ship operators, and the All Japan Seamens' Union (AJSU). Such unprecedented cooperation is not surprising; the AJSU represents 99 percent of Japanese seafarers and the JSA represents about 75 percent of the owners (Yamanaka and Gaffney, 1988). The AJSU expects that seafarers will have their jobs for life. It is therefore almost an obligation of the AJSU to provide work or re-training for their members.

Similar experimentation such as that occurring in Japan is not likely to be applied in the U.S. The diverse nature of American maritime labor unions is likely to inhibit the concept of dual purpose officers. U.S. manning laws, as discussed in a previous chapter, also restrict most of the manning innovations that work successfully for the Japanese. Furthermore, Japanese culture tends to be very "protectionist," thereby virtually assuring success.

Effective Manning in Germany

(Authors note: the reader should bear in mind that this discussion is focused on the former Federal Republic of Germany (West) prior to unification). The high cost of German seafarers and increased competition from FOC vessels precipitated a severe decline in the German-flag merchant marine. Between 1972 and 1987, the number of German-flag ocean-going vessels decreased approximately 66 percent to 330 vessels, while the German FOC fleet increased over 500 percent (Froese, 1987). This alarming scenario echoes the situations of other traditional seafaring nations. The following discussion of effective manning is intended to highlight the features and results of the German "Ship of the Future" program, which represents Germany's attempt to stem the decline of its merchant marine.

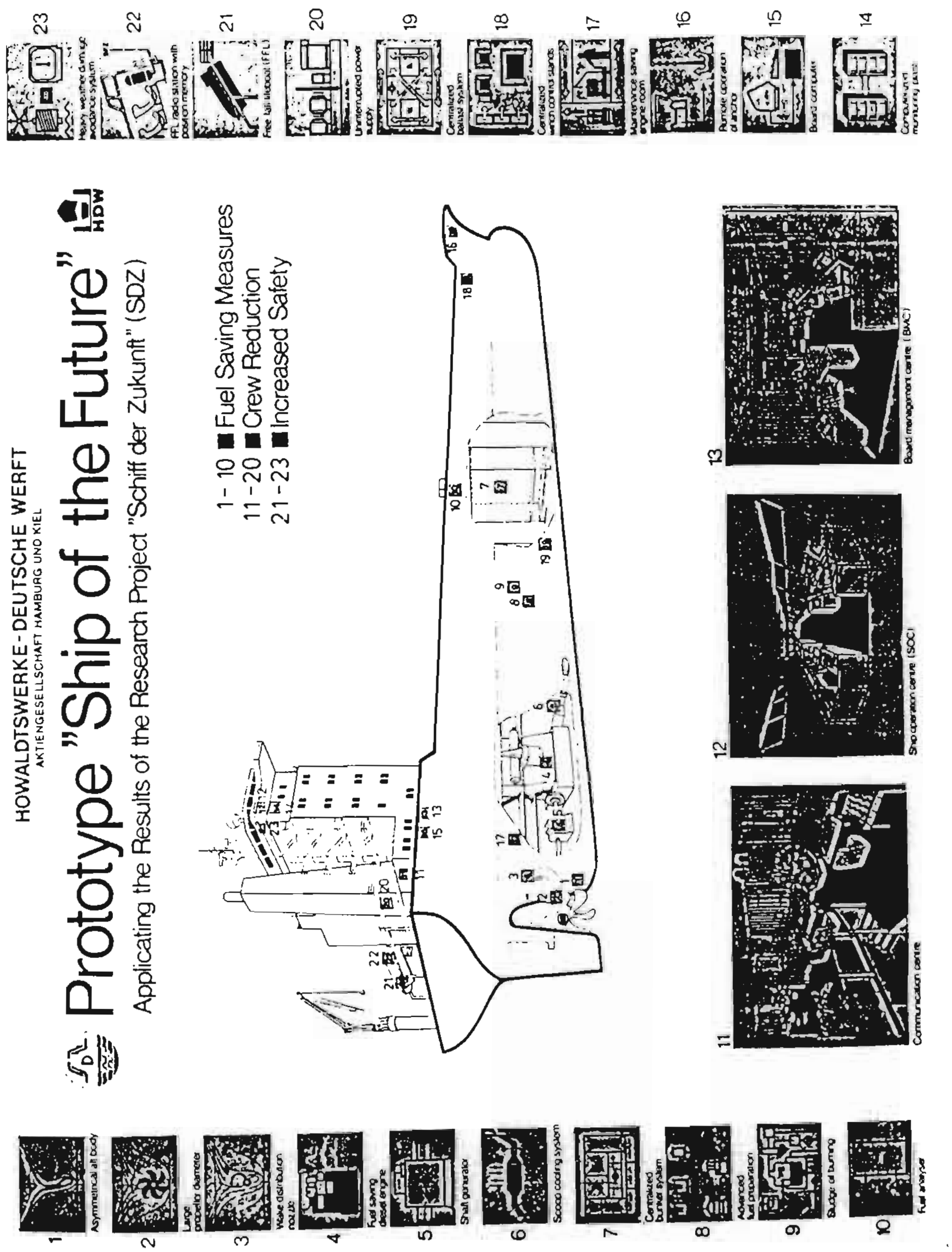
Comprehensive government and industry research commenced in 1980, with the goal of restructuring the German shipbuilding and ship operating industry. The research project was given the name "Development of a New Ship Service Technique for a Ship of The Future" or "Ship of the Future" (SOF). The SOF project's ultimate success resulted from the cooperation of labor unions, government authorities, ship-owners, shipyards, universities, classification societies, and associated industries within Germany. Success was also promoted with combined funding from the government (Federal Ministry for Research and

Technology) and industry amounting to 35.7 million dollars (Paetow, 1987).

The goals of the SOF program included designing a ship to be operated by an optimal crew of 12, without increasing work-loads or decreasing safety, and reducing fuel consumption through state-of-the-art technology, two areas of significant cost to ship operators. Research in specific areas included: (1) hull design; (2) ship management; (3) engineering systems; (4) servicing and maintenance; (5) navigation, communication and safety control monitors; (6) life-saving equipment; and (7) ergonomic and organizational design (Paetow, 1987, see Figure 1). It is interesting to note that the German aircraft industry was involved with the SOF project in an advisory capacity. Academicians have frequently drawn analogies between highly automated ships and aircraft (Vail, 1988; and Schuffel, et. al., 1989).

The first large vessels (27,300 deadweight ton containerships) to be built incorporating SOF design features were the Norasia Samantha and the Norasia Susan, launched in October, 1985 and January, 1986 respectively (Paetow, 1987). These ships underwent sea trials with a 16 person crew, which was soon reduced to between 13 and 15 for normal operations (Paetow, 1987; and Vail, 1988).

FIGURE 1



Source: Paetow, K. In "Ship of the Future," Paper presented at the Ships Operations Management and Economics--International Symposium, Kings Point, N.Y. Sept. 17-18, 1987.

Thus, as the research and development phase came to a close, the benefits of the SOF program were soon to be realized; German shipyards have been active meeting orders for new ships from operators both within Germany and abroad. For example, American President Lines is one such company that took advantage of SOF design features, and the attractive prices being offered by subsidized German shipyards, when they purchased their C-10 class vessels (Marine Log, 1988).

There are many notable similarities between the German SOF and the Japanese effective manning programs, though there are some variations as well. Similarities in organizational structure include the use of dual purpose (or general purpose) crew-members, integrated officers, and increased reliance on shore-side maintenance and repair. The German SOF bridge deck is known as a Ship Operation Center (SOC); like Japanese ships, it includes video monitors and controls for all shipboard functions. Also like Japanese vessels, the SOC is designed to be operated by a one man bridge, 24 hours a day. Both German and Japanese crews use common messing and recreation facilities. What really appears to set the German SOF apart from Japanese and other nations' effectively manned vessels are the quality of the living environment and human amenities aboard ship.

Special attention has been devoted to reducing noise and vibration within the ship's accommodation areas. This feature is intended to reduce stress levels that are often associated with noisy environments. Modern German built ships also include what is known as the "Board Management Center" (BMC). Located on the main cargo deck, the BMC is a welcome departure from the traditional office/stateroom arrangement found on most U.S.-flag vessels. The remote control gauges, monitors, and switches found in the engine control room of conventional diesel ships are located in the BMC. All cargo, maintenance, administrative, and external communications (radio room) functions that were previously scattered throughout the vessel are consolidated in the BMC. As a result of the SOC and BMC concepts, living and recreation areas are separated from the work environment to allow seafarers quality off-duty periods.

Apparently, the SOF program has been a success. Various literature reviewed by the author has shown a fair number of German new-buildings designed to meet SOF standards. Research and development has continued since the conclusion of the SOF program with a project called "Ship Operation System-90," managed by the classification society Germanischer Lloyd (Marine Log, 1988). This program is designed to expand on computer models and software with the intention of aiding both ship and cargo operations. Ship Operation System--90, like the SOF program, is funded with the assistance of the Federal Ministry of Research and Development.

Manning Comparisons: Germany, Japan, and the U.S.

Comparisons of effective manning practice between countries will, in most cases, highlight more than just technical or operational differences. Moreover, cultural differences among the nations accounts for differing effective manning styles. Stating that a comparison of manning techniques is to be shown may imply that similarities will be emphasized. In fact, there are also distinct differences in effective manning styles to be shown as well, especially with respect to the U.S. The following recapitulation includes 12 salient issues that emphasis the U.S.'s effective manning posture. Direct comparison with Japanese and German policies will then highlight where similarities and differences lie.

(1) Job Continuity

Many U.S.-flag operators rely on the system of casual union labor to supply seafarers for their vessels. Seafarers generally owe allegiance to the union, not the company. Notwithstanding some exceptions, only senior officers are usually permanent or semi-permanent employees. In Japan and Germany, there is much more permanency with officers and crews usually serving one ship and/or one company. Advantages of continuity include increased understanding of the ship and its systems (especially safety systems) and a higher degree of employee concern for the well-being of the company.

(2) Dual Licensed Officers and General Purpose Crew

Both the Japanese and Germans utilize integrated crew-members. Although the U.S. does have a dual license officer program at the U.S. Merchant Marine Academy, this program is of limited value. The officer is restricted by law from working in two departments simultaneously. This law applies to unlicensed seafarers as well. Integration of the crew appears to be a sound method of reducing crew levels while increasing productivity and safety.

(3) Shipbuilding Policies

The U.S. merchant marine shipbuilding industry is dormant at this time. Various policies either restrict or impede the ability of U.S.-flag operators to purchase new ships designed and built for effective manning. Applying full effective manning to older steam vessels is not economically popular, although crew needs can be reduced by the use of preventative maintenance systems. Labor unions are reluctant to give up billets on existing vessels, but are much more amenable to innovative manning on new vessels. Japan has a thriving and competitive shipbuilding industry, whereas Germany has a small shipbuilding industry that frequently receives government assistance.

(4) Providing Shore-Side Maintenance

The concept of utilizing shore-side contractors for maintenance work is popular in Japan, Germany, and the U.S. This is another proven method to reduce crew levels aboard ship. It has been shown, however, that the costs of maintenance may simply be shifting from the vessel account to a different account.

(5) Research and Development

Much of the research and development concerned with crewing in the U.S. has involved looking at the results of other countries. (Note the MARAD supported studies in this paper's bibliography). In comparison, both Japan and Germany are well beyond the stages of experimentation and are presently operating and receiving the benefits of, full effectively-manned vessels.

(6) Government Support

It is hard to quantify how much support various countries give their merchant marines. Much of the support is covert and may involve cargo promotion, subsidies to allied industries, operation of maritime academies, fuel subsidies, and/or tax incentives. Japanese and German effective manning programs had tremendous support from their respective governments. What is apparent in the case of the U.S. is that further government support is needed to modify laws and to assist the merchant marine through monetary incentives.

(7) Education and Training

The U.S. maritime academies, union, and private training schools operate first-class facilities, on par with any facility in the world. State-of-the-art simulators and hands-on training are popular, with safety issues always given the highest priority.

(8) Automation and Technology

Although Japanese and German companies are leaders in the field of automated ships, equipment is available in the world market that could be installed aboard U.S.-flag vessels. However, the U.S. also has the capability to produce any item of high technology equipment currently in use.

(9) The Global Maritime Distress and Safety System (GMDSS)

Installation of GMDSS equipment aboard a vessel relieves it of the international requirement to carry a radio officer. This is currently an issue being discussed throughout the world. Some foreign companies have already (December 1992) eliminated radio officers, while others are utilizing radio officers as electronics officers (Safety at Sea International, 1992-b). In the U.S., the FCC requirements to carry a radio officer pre-empt the international requirement (see title 47 USC sec. 351).

(10) One Man Bridge Operation (OMBO)

OMBO is internationally accepted with IMO sanctioned trials currently being conducted for OMBO at night (IMO Documents, 1989-b). In referring to OMBO, the Vice President of Operations for American President Lines maintained, "We would never contemplate operating such a vessel in a one man mode. Never." (Mottley, 1990). This opinion may or may not be representative of the U.S. merchant marine.

(11) Innovative Watch Arrangements

The intent of this paper is not to argue the merits or detriments of one watch system over another--suffice to say that innovation and experimentation does occur outside the purview of the U.S. fleet; note the example of the Japanese "k watch officers". Also, some German ships on shorter voyages utilize the two-watch system, while there has been thought of having watch-standing masters (Low, et. al., 1987). The USCG position on watch-standing masters states:

> "...[E]xcept on small vessels...it is not normally acceptable therefore, that the master have watch[-]standing duties in the regular routine of the vessel" (Marine Safety Manual, volume III).

(12) Military Requirements

Neither Japan nor Germany have any military adjunctive responsibilities for their merchant marines. However, the U.S. merchant marine has an extensive military obligation to fulfill by virtue of the statement of policy in the Merchant Marine Act of 1936 (in National Research Council, 1990: 149). If the military role of the U.S. merchant marine is to stand, the U.S. must assess the implications of effective manning on the ability to utilize ships and personnel in a national conflict.

CHAPTER SIX

RADIO OFFICERS ABOARD SHIP:

NEW BEGINNING, OR FINAL FAREWELL

Radio communications have been used at sea continuously since 1899, with the result that thousands of lives have been saved. Those individuals saved--passenger, seaman, officer, fishermen, and recreational boaters--all owe their lives to the fact that their vessel, and/or another vessel nearby, had sufficient radio equipment aboard with personnel competent in its use. The primary purpose of having radio equipment aboard ship, after all, is for the safety of life at sea. Perhaps this vital posture towards radio communications has been clouded by the more common use of radio for daily business transactions aboard ship.

In February 1992, communications technology and international regulations joined together to ratify the Global Maritime Distress and Safety System (GMDSS) convention. The convention ushers in a new era of ship communications possibilities, with enhanced safety as a primary attribute. Overwhelming support for the GMDSS convention is exemplified from its ratification by 116 countries (including the U.S.), representing 97 percent of the world fleet (Safety at Sea International, 1992-a).

Between now and 1999, phasing in of GMDSS equipment to meet treaty requirements will assuredly have an impact on present-day radio officers aboard vessels flying the U.S.-flag--or any flag. The automated nature of GMDSS equipment eliminates the need for knowing morse telegraphy; and in fact, GMDSS has the potential to greatly enhance both business communications and safety, without the requirement for a dedicated radio officer.

Many foreign flag vessels, which have GMDSS aboard have already taken advantage of the option of eliminating radio officers, as have certain U.S.-flag vessels in the coastal trades. This chapter will give an overview of the present statutory requirements for radio officer/operators in the U.S. and according to international law. Highlights of the GMDSS convention will be discussed, with emphasis on its implications for either retaining radio officers or phasing them out.

Legal Basis For Radio Operators

It must be emphasized from the outset that in U.S. law, there is a difference between a radio officer and a radio operator. A radio operator is any individual given authority by the Federal Communications Commission (FCC) to operate a particular radio transmitting device. A radio officer is an individual licensed by the USCG to serve aboard merchant vessels, who also meets appropriate FCC qualifications as a radio operator. The USCG uses the following regulation as guidance:

> "The determination of when a radio officer is required is based on the Federal Communications Commission Requirements" (46 CFR sec. 15.830).

The above piece of regulation will have a significant effect on determining the future of radio officers aboard U.S.-flag vessels. With recent international acceptance of GMDSS, the FCC has already proposed to Congress legislation that will amend the Communications Act of 1934 (FCC, 1992). This proposed legislation would phase in GMDSS while eliminating radio-telegraph operators aboard ships. It is speculated that most U.S.-flag operators will consider eliminating the radio officer, or at least, changing their job description to "electronics officer".

Present U.S. statutory requirements for radio operators aboard large ocean-going vessels are as follows:

> "For any ship of the United States, other than a cargo ship of less than three hundred gross tons, to be navigated in the open sea outside of a harbor or port...unless such ship is equipped with an efficient radio station...in charge of and operated by one or more radio officers or operators..." (title 47 USC sec. 351 (1)).

The requirement for an operator is linked to the concomitant requirement for a radio station:

> "Passenger ships irrespective of size and cargo ships of one thousand six hundred gross tons and upward shall be equipped with a radio telegraph station complying with the provisions of this part" (title 47 USC sec. 351 (1)(A)).

Many U.S.-flag vessels are presently circumventing the requirements of title 47 USC sec. 351 (1)(A) and not carrying radio officers because of the language contained in title 47 USC sec. 352; "Exemptions":

> "Radio station unreasonable or unnecessary---Cargo ships which in the course of their voyage do not go more than one hundred and fifty nautical miles from the nearest land" (title 46 USC sec. 352 (b)(2)).

The above statute, known as the "general exemption" by the FCC, does not relieve the vessel of its requirement to carry certain communications equipment, nor the requirement to carry a radio operator (Stoller, 1992). However, due to the vessel's proximity to land, radio telegraph equipment is not required. But, to satisfy the radio operator requirements, masters and/or deck officers are required to obtain a FCC General Radio Telephone Operator License (Coughlin, 1989-b). (This is, incidently, the same license necessary to operate GMDSS equipment). Data, published by MARAD, indicates that 51 large ocean-going vessels--mostly tankers--under the U.S.-flag do not presently carry dedicated radio officers (USDOT, MARAD, 1991).

It is important to bear in mind that according to the SOLAS convention (chapter IV), GMDSS or radio telegraph equipment--and therefore radio officers--are required for vessels on international voyages. Therefore, until such time as Congress may change the above laws, it is still a requirement for U.S.-Flag commercial cargo vessels to carry a radio officer on international voyages--irrespective of GMDSS.

GMDSS on the Horizon

Historically, carrying a radio operator aboard ship has been predicated on the requirement for a person to operate morse telegraphy equipment. In radio's early days, two-way communications were possible only with morse code. However, satellite technology has changed communications aboard ship; telephones, electronic mail/telex, facsimile reproduction, and automated distress signaling are common aboard much of the world fleet today. Additional benefits of satellite technology include eliminating reception difficulties, guaranteeing conversation privacy, and eliminating congested "airspace". The net result is that both safety and business communication are improved. With the introduction of GMDSS, a full distress and safety communications network has been integrated into the satellite network as an automated system that functions without dedicated radio officers.

Some of the major differences of GMDSS compared with current distress communications are that: (1) GMDSS is primarily a ship-to-shore system, though it retains ship-to-ship capability; (2) GMDSS equipment requirements are based on vessel operating area rather than vessel size; (3) communications range is worldwide (due to satellites) rather than nominal 200 mile range; and (4) GMDSS is relatively easy to use, rather than requiring radio officers skilled in morse code.

GMDSS actually had its beginning in 1973, when the IMO Maritime Safety Committee agreed to investigate the potential of using satellites for lifesaving purposes. Three conferences were held between 1975 and 1976, the last one resulted in the adoption of the International Maritime Satellite Organization (INMARSAT) convention (IMO NEWS, #1-1992). The INMARSAT convention entered into force in 1979, and became fully operational in 1982. INMARSAT is unique in that it is a private--non-government--corporation with shares owned by companies within the member countries. Presently, 65 countries are signatory to the convention with the largest share--25 percent--owned by COMSAT, an American corporation (Mottley, 1992-b). Although distress and safety attributes were the principle reasons for initiating INMARSAT, its primary use has so far been for commercial communications.

Rapid phasing in of GMDSS is predicted since the additional equipment needed to meet the requirements is ancillary to equipment already installed aboard many ships. Of the approximately 26,000 ships worldwide, 14,500 already have satellite communications equipment aboard (Mottley, 1992-b).

Radio Officers Today

The GMDSS convention entered into force on February 1, 1992 as an amendment to the international SOLAS convention. It replaces previous chapter IV completely. Existing vessels will have until 1999 to meet full compliance, with new vessels complying immediately if built after February 1, 1995. The question still remains--what will happen to radio officers aboard U.S.-flag vessels?

On the one hand, there is sound rationale for keeping radio officers aboard ship. Technology and automation have resulted in tremendous amounts of electronic equipment being installed aboard vessels, both on the bridge and in the engine room. Most radio officers see themselves as the logical choice to be charged with the maintenance of this equipment. However, not all radio officers are qualified as electronics technicians, consequently, radio officer unions have had enough foresight to implement training programs that upgrade radio officers to radio electronics officers (Stoller, 1992). The radio officer unions are also courting young individuals with electronics degrees or technical training.

Another argument for keeping radio officers, or radio electronics officers, aboard ships is based on the perceived need to maintain the new communications equipment. Amended chapter IV, regulation 15 of SOLAS specifies that ships must ensure the availability of equipment:

> "by using such methods as duplication of equipment, shore-based maintenance or at-sea electronic maintenance capability, or a combination of these..." (IMO News, #1 1992: 17).

Inspection of the aforementioned regulation brings up valid concerns. Duplication of equipment is expensive and shore-based maintenance may not always be available. Conceivably, the third choice, at-sea electronics capability, should be the preferred method as it should prove more economical in the long run.

On the other hand, there are seductive financial incentives for ship operators to consider full GMDSS installation without carrying a radio officer. Existing ships in compliance with pre-GMDSS SOLAS regulations would only incur additional expenses of about 22,000 dollars to upgrade to GMDSS (IMO News, #1 1992). Although this price does not include the cost of installation or training existing personnel in its use, it is far less expensive than the up-front annual 142,000 dollar billet cost of a radio officer aboard a typical U.S.-flag ship (MMP, 1991).

Bernard Stoller, Assistant Regional Representative of the American Radio Association, a union that represents approximately 400 ships' radio officers, is personally concerned with the interim period before full GMDSS compliance is established. He states:

> "I expect most third world countries will not comply with GMDSS until 1999, the year in which full international implementation is required. In the interim their distress messages will continue to be sent by radiotelegraph with fewer and fewer

> nearby vessels, in the best position to assist but unable to respond by radiotelegraph. Undoubtedly, until 1999, lives will unnecessarily be lost" (Stoller, 1992: 2).

Conclusively, there are many valid concerns centered around the radio officer issue. The U.S. has already set precedent by eliminating radio officers aboard many coastwise vessels. What courses of action other ship operators take in the near future may well set additional precedent throughout the U.S. fleet. The Japanese have an innovative approach--one of their shipping companies is retraining radio officers to become engineering or deck officers (Yamanaka and Gaffney, 1988).

CHAPTER SEVEN

THE LOOK-OUT: AN INTERNATIONAL QUANDARY

No single person aboard a merchant vessel has as much responsibility for life, property, and the environment as the look-out. Keeping a proper look-out can often mean the difference between safety and disaster. Consequently, any discussion of effective manning and associated crew reductions must consider the implications of keeping a proper look-out. The watch-officer's responsibility as look-out is especially relevant, in regard to the popularity of the "one man" bridge concept being accepted internationally.

Look-out's Role

The U.S. law is clear:

> "Nothing in these rules shall exonerate any vessel...from the consequences of...any neglect to keep a proper look-out" (title 33 USC sec. 221).

This law is echoed in the International Regulations For Preventing Collisions At Sea--1972 (COLREGS), ratified by the U.S. in 1977. Rule 5 states:

> LOOK-OUT
> "Every vessel shall at all times maintain a proper look-out by sight and hearing as well as by all available means appropriate to the prevailing circumstances and conditions so as to make full appraisal of the situation and of risk of collision." (codified in title 33 USC)

What is often not realized by non-seafarers is that a look-out is not a capacity, billet, or rating aboard ship; the look-out is a responsibility. This responsibility is so important that typically, in addition to the officer of the watch, a seaman is posted as a dedicated look-out.

The International Convention On Standards Of Training, Certification And Watchkeeping For Seafarers--1978 (STCW), in force as of October 1991 for the U.S., has very specific language about maintaining a proper look-out. Regulation II/1, paragraph 9 (a) states:

> "The look-out must be able to give full attention to the keeping of a proper look-out and **no other duties shall be undertaken or assigned** which could interfere with that task;" (IMO, 1978 author's emphasis).

Paragraph 9 (b) seems to relax the strict intent of the regulation:

> "...**The officer in charge of the watch may be the sole look-out in daylight** provided that on each such occasion: (i) the situation has been carefully assessed...(ii) full account has been taken of all relevant factors including, but not limited to: state of weather, visibility, traffic density, proximity of danger to navigation, the attention necessary when navigating in or near traffic separation schemes;" (IMO, 1978, author's emphasis).

It may be hard for an officer to embrace the full spirit of the STCW regulations. There are other "duties" to perform in the course of a navigational watch. Further, it is uncertain precisely when, and how, the criteria spelled out in paragraph 9 (b) will be verified. The officer may feel that automatic radar plotting aids (ARPA) and satellite navigation enhances his/her ability to handle challenging situations. All of the aforementioned criteria are subject to personal judgement, which is, in fact, a major contributor to marine accidents.

One Man Bridge Operation at Night

The fact that one man bridge operation (OMBO) not only occurs, but is sanctioned in international law, appears unfavorable in terms of the ability of a ship to keep a good look-out. OMBO is an accepted method of decreasing billets aboard ship, or increasing the amount of man-power available for ships' maintenance. Recall that with the three-watch system, three seamen are affected. The next progression beyond OMBO in daylight is, of course, OMBO at night. Justifiably, the controversial nature of OMBO at night has piqued the interests of the international maritime community (IMO NEWS, 1991).

The IMO Maritime Safety Committee first gave consideration to OMBO at night in the spring of 1987, following Norway's announcement that trials with some of its vessels would be taking place (IMO Documents, 1989-a). By January of 1989, the Sub-Committee On Safety Of Navigation had drawn up guidelines for night operation of OMBO; then, in January of 1991, the Maritime Safety Committee began authorizing trials (IMO NEWS, 1991). As members of the committee, the USCG has a voice in IMO decisions and, as such, indicated their disapproval of the trials. Similar concerns were voiced by the delegation from Greece:

> "[OMBO] being regarded as in breach of the rules currently in force, not conductive to safety and, in the case of accident, the master of the ship concerned would not be exonerated because he was taking part in a trial authorized by IMO" (IMO NEWS, 1991).

For now, the IMO allows OMBO at night only on a trial basis, and no final ruling is yet in place.

Trials of OMBO at night, when they do take place, are managed in the following manner: they may not be conducted by passenger ships, gas or chemical carriers, or tankers, and not within internal waters of countries that are in opposition to the trials (IMO NEWS, 1991). As part of the trials, it is expected that the vessel will systematically observe, record, and eventually publish, results of the experiment (Habberly, et.al., 1990). Flag States that participate in trials are requested to authorize vessels under their flag on a ship-by-ship basis, depending on the suitability of the automation and equipment, and likewise, to notify the international community when trials begin and terminate (IMO Documents, 1989-a).

A study of OMBO at night was published by the Marine Directorate of the United Kingdom in 1990. The experiment, as reported in Seaways, occurred during a 15 week study period, aboard two vessels less than 1,600 gross tons (Habberley, et. al., 1990). Researchers made comparisons of one-man versus two-man watch-standing. Physiological and psychological factors affecting the watch officer were observed with the conclusion that the ship is actually better guarded at night than in the daylight. The reason given is that the officer spent less time doing "other things".

Another study, conducted in the Netherlands by the TNO Institute For Perception, compared the navigational accuracy of two officers on a conventional bridge, one officer on a conventional bridge, and one officer on an automated bridge (Schuffel, et. al., 1989). A simulator was used for the experiment. The officers had two tasks to perform: (1) navigate the ship on a series of course lines (the navigation task); and (2) memorize strings of alphabet letters (the continuous memory task). Results showed that the performance of one officer on an automated bridge was similar to two officers on the conventional bridge because navigation was automated. With one officer on the conventional bridge, too much time was invested in routine tasks (e.g. navigating) to allow proper execution of additional tasks (e.g. memorizing letters). The authors also analyzed 100 random shipping accidents in the Netherlands. They attributed 276 related events to those accidents, with 209 of those events attributable to human error. With the use of automation to assist/replace human judgement, the authors claimed that the human error events could have been reduced to 47 (Schuffel, et. al., 1989).

The following material, excerpted from IMO draft provisional guidelines of OMBO ships, "Officer of the Navigational Watch Acting as the Sole Look-out" once again echoes prudent seamanship:

> "The Master should ensure that the officer of the watch should only continue to act as the sole look-out when in that officers judgement the work-load is well within his capacity to maintain a proper look-out and full control of the prevailing circumstances" (IMO Documents, 1989-a).

Conclusively, the question must again be asked: Is OMBO prudent seamanship and if so--in daylight, at night, or both?

Classification Societies: Technical Endorsement of OMBO

Although it is technically feasible to operate ships with one officer acting as sole look-out, the type of equipment used on the bridge, including its design, use, and performance, is critical to the overall safety of OMBO. Classification societies can not set manning levels, however they can have significant input by virtue of specifying and approving technical standards aboard ship; which, is traditionally the case in approving unattended engine rooms. More recently, classification societies have published technical standards to be used in implementing OMBO. One such case involves the American Bureau of Shipping (ABS)--their recently published "Guide For One Man Bridge Operated (OMBO) Ships" was released in June 1992.

Endorsement of OMBO by classification societies should not be viewed as international acceptance. Rather, it should be viewed for what it is--a reaction to pressure from ship operators for an acceptable technical standard that will meet insurance underwriters requirements for safety (Stove, 1988). Collaboration with ship operators is evident from a note printed on the cover of the "Guide For One Man Bridge Operated Ships":

> "This guide represents the present approach of the ABS in this subject and is being released for trial use. ABS will consider the modification of these requirements as necessary and appropriate" (ABS, 1992).

Before listing detailed technical criteria for OMBO operation, the ABS booklet makes a disclaimer, asserting that:

> "[OMBO] requirements are based on the understanding that the applicable regulations [SOLAS, COLREGS, STCW] and guidelines issued by the IMO are complied with" (ABS, 1992: 1).

International acceptance of OMBO presently awaits results of the trials being conducted throughout the world, or, perhaps the world awaits an accident attributable to OMBO.

CHAPTER EIGHT

COST VARIABLES OF SEAFARING LABOR

It is widely believed that the costs of operating an American ship are much higher than costs of operating a FOC ship; however, bottom-line comparisons of this type do not describe the complete operating environment of U.S.-flag vessels. U.S.-flag ships must compete in an international forum that is fraught with subsidies and/or promotional incentives. Operating costs can vary significantly as a direct consequence of these promotional measures. Typical promotional measures provided to encourage the construction and/or operation of merchant vessels throughout the world include operating subsidies, construction subsidies, and tax and regulatory incentives.

Although application of effective manning and crew reduction will lower costs, the U.S. Congress and the President need to take additional actions, such as those proposed in "The Maritime Reform Act of 1992", to foster an overall climate that stimulates the U.S. merchant marine to compete internationally.

Ship Operating Expenses

The objective of the following discussion, and data, is to highlight some major expenses that all ship operators have in common, no matter what country they operate from, or what flag their ships fly. It will then be easier to discuss the specific costs of operation on a comparative basis with U.S.-flag vessels.

Conventional ship operators experience vessel expenses as outlined in Table 3. Most of the expenses are common to all free market operators, with exception of state-owned vessels such as from the former Soviet Union. Fuel and insurance are bought on the world market and port-call expenses are common to all operators. Within a certain margin, cargo expenses are also common to operators who compete on similar trade routes. The two categories where costs can differ significantly are wages and capital expense (i.e. the cost of purchasing and/or chartering a vessel). Thus, financial gain is the basis for the popularity of building ships in subsidized shipyards and employing international crews aboard FOC ships.

Perhaps only of academic interest, but nevertheless important, is determining to what extent effective manning crew reductions could be applied to U.S.-flag vessels to bring costs into line with FOC vessels. Inspection of Table 4 highlights daily wage costs for three vessels. Vessels I and II represent actual ships, while vessel III is a hypothetical, effectively manned U.S.-flag vessel.

TABLE 3

LIST OF VESSEL OPERATING EXPENSES

Direct Vessel Expense:

- Wages
- Stores, Supplies and Equipment
- Maintenance and repair
- Insurance
- Fuel

Port Call Expense:

- Pilots
- Tugs

Cargo Expense:

- Equipment
- Cargo handling
- Cargo freight stations
- Cargo transportation

Capital Expense:

- Vessel depreciation
- Vessel interest cost
- Charter hire

Source: "Daily Operating Costs of Liner Vessels," MARAD, Division of Ship Operating Costs. Complete data in Appendix A

TABLE 4

WAGE COMPARISON OF F.O.C. AND U.S.-FLAG VESSELS

	VESSEL-I	VESSEL-II	VESSEL-III
NUMBER OF BILLETS ABOARD SHIP	24	24	16
** OWNERS TOTAL DAILY BILLET COST	1,299	7,222	5,327
TYPE OF VESSEL	AUTOMATED DIESEL BULK SHIP	STEAM TANKER NON-AUTOMATED	AUTOMATED DIESEL CONTAINER SHIP

VESSEL-I Cost effective open registry bulk carrier, 78,000 dead weight tons, Indian officers and Filipino unlicensed crew.

VESSEL-II U.S.-flag tanker, conventional manned engine room, vertical manning by union crew, 30,000 dead weight tons, overtime inclusive in pay.

VESSEL-III Hypothetical, effectively manned U.S.-flag container ship, automated engine room, fully intergrated bridge, vertical manning by union crew, 45,000 dead weight tons, overtime inclusive in pay, no radio officer.

** All figures in 1991 dollars.

Source:

Open register crew costs:
Marine log, Feb. 1992: pages 22-26.

Union crew costs:
MMP, 1991. Masters, Mates, and Pilots. Memorandum of Understanding between the MMP and American Heavylift Shipping co., July 1, 1991.

Notwithstanding a savings of 26 percent on crewing costs, manning on vessel III is still over three times as costly as Vessel I.

One major reason for the large differential is that FOC operators do not pay most of the fringe benefits that U.S. seafarers receive. For example, the operator of the U.S.-flag vessel in Table 4 must pay the following fringes in addition to the seaman's daily wage: (1) vacation contribution; (2) individual retirement account plan; (3) health and welfare; (4) health and welfare co-pay; (5) future retirees health and welfare; (6) political action committee contribution; (7) pension contribution; and (8) education fund contribution (MMP, 1991). These employer contributions collectively increase the cost per billet an average 115 percent (MMP, 1991). U.S.-flag wage costs can not compete on a dollar-for-dollar basis with an international crew at this time, but wages are only one factor to consider in the operating expenses of a ship.

Cost-Effective Manning

When comparing seafarers' wages to the overall operating expenses of a U.S.-flag vessel, the cost per billet seems to shrink in significance. In fact, cargo expenses for subsidized containerships amount to over seven times the cost of wages (Appendix C, p. 142, contains full comprehensive data). The following information supplied by

MARAD compares the daily average operating expenses of subsidized vessels with daily billet costs.

Daily operating expense:

Breakbulk, Lash, Ro/Ro----66,508 dollars

Container----------------113,619 dollars

Daily billet cost:

Breakbulk, Lash, Ro/Ro----11,737 dollars

Container-----------------11,833 dollars

By dividing billet costs into expenses, the percentage share represented by billet costs can be compared to overall operating expenses. Billet costs are therefore 17.6 percent and 10.4 percent of the total operating expenses for non-container and container vessels respectively. Assuming a hypothetical 30 percent reduction in billet costs due to crew reductions, non-container crew costs become 12 percent, and container crew costs become 7.2 percent of total vessel operating expenses.

Indeed, wages do represent a notable portion of operating expenses; however, fuel costs also bear significantly on operating expenses. Typically, increases in fuel efficiency can have an impact on operating costs similar to reductions in crew complement. For example, a large 30,000 deadweight ton containership can burn fuel at the rate of 1.2 barrels per mile (bbls./mi.) at 19 knots.

Table 5 indicates potential savings associated with increases in fuel efficiency. Decreasing fuel consumption from 1.2 bbls./mi. to 1.1 bbls./mi. saves 912 dollars with fuel costing 20 dollars per barrel, almost enough to pay the daily billet costs of the captain and third mate (MMP, 1991).

Cost comparisons and economic analysis can be deceiving. Figures can be interpreted in numerous ways to present a convincing argument that can be made in support of a major policy decision. Reducing the number of shipboard personnel through automation and technology, may necessarily shift certain maintenance duties to shore contractors and therefore increase the capital expense of the vessel. In such a case, savings in wages aboard ship will only be distributed to other accounts, with little net benefit. Moreover, economic efficiency through technical innovation can also be achieved by FOC vessel operators. Crew costs remain one area of vessel operating expense that are wholly dependent on existing manning policies within the flag state of the vessel.

It often appears that the seafarer, whether an international or U.S. citizen, is but a pawn in a larger socio-economic arrangement that seeks to achieve the lowest expense and highest profit from shipping. The crew of a ship must be viewed not as an expense, but as an investment; care in crew selection yields dividends in the long-run.

TABLE 5

DAILY INCREMENTAL FUEL COSTS

+ FUEL CONSUMPTION	MILES	* PRICE	TOTAL FUEL COST	SAVINGS
1.2 bbls./mi.	456	20.00	10,944.00	-------
1.1 bbls./mi.	456	20.00	10,032.00	912.00
1.0 bbls./mi	456	20.00	9,120.00	1,824.00

\+ Approximate fuel consumption of 30,000 DWT steamship

* Approximate price per barrel Bunker Fuel 1992 (U.S. Dollars)

Source: Hypothetical ships' operating criteria.
Authors calculations

To the extent that effective manning is pivotal to the future of U.S. maritime policy, ship operators must endeavor to make sure that the seafarers who man their vessels are of the highest calibre attainable.

CHAPTER NINE

EDUCATION, TRAINING, AND MANNING

No policy supporting the implementation of effective manning aboard U.S.-flag vessels can stand alone. There must be an infrastructure that fosters successful operation of the modern vessels, which includes, among other things, the education and training of sea-going personnel. Education and training are vital elements of a ship's operation. For instance, the possible consequences of not having the highest quality mariners aboard a vessel can mean: (1) increased cost of maintenance; (2) potential delays at sea and in port; (3) potential liability for environmental damages, collisions, and accidents; (4) higher fuel consumption; (5) cargo damage; and (6) decreased life expectancy of the vessel.

It is a credit to this nation that U.S. education and training institutions have in fact taken a proactive approach in considering future needs. In many ways, the maritime education facilities and schools in the U.S. are far ahead of potential changes in manning regulations; indeed, they are already preparing personnel for advanced ships. Objectives of this chapter include discussion of maritime education and training in the U.S., as well as pertinent comparisons to various education institutions in other countries. Specifically, education and training will be judged as a philosophy with the objective of preparing mariners for the ships of tomorrow.

Philosophy of Education and Training

There is an ongoing dialogue within the maritime academies in the U.S. concerning the relationship between education and training. (The State academies are located at Vallejo, CA; Castine, ME; Buzzards Bay, MA; Traverse City, MI; Fort Schuyler, NY; and Galveston, TX. The Federal academy is located at Kings Point, NY). A recent paper, written by the head of the Marine Transportation Department at the United States Merchant Marine Academy (USMMA), contends that education is "the development of mental and moral knowledge" while training is considered "perfecting skills" (Stewart, 1991: 1). The guiding principle at all the maritime academies is a sound education, supplemented with practical experience aboard ship. Although cadets at the academies are being "trained" as future ships' officers, the underlying philosophy is that first and foremost, cadets receive an interdisciplinary education. The value of education can again be emphasized by the following example. The USCG recognizes the quality of an engineering education to such a high degree that they require only six months of engineroom experience after receiving an engineering degree to qualify, to take the exam, for an officers license (Hirschkowitz and Maclean, 1990: 17).

American maritime education and training institutions need to be able to define their mission and philosophy, bearing in mind the numerous parameters that must be observed. These factors may include: (1) duration of the program; (2) international requirements (STCW and SOLAS); (3) national requirements (USCG); (4) amount of education, training, or both; (5) military requirements (US Naval Reserve); and (6) financial constraints. Conclusively, it is also desirable that high standards rather than minimum standards will be set as a goal.

Some people contend that much of the traditional methodology and subject matter taught at maritime academies is becoming outdated due to new technology and automation. Others, however, feel that theoretical knowledge has not changed, but that technology has actually increased the need for a more indepth study of the subject matter (Stewart, 1991).

A further development in the U.S. fleet, already embedded in many ships' crew requirements, has been the elimination of entry level positions aboard ship (i.e. ordinary seamen and wipers). Effectively manned ships generally carry only trained, highly qualified seafarers. By eliminating entry level jobs and on-the-job training, the necessity for education and training on shore takes on a much more significant role.

Education is decisively linked to the successful application of effective manning. Ships' personnel need to know how to think and act independently; developing these skills is required to produce quality ships' personnel. A strong theoretical foundation in sciences and engineering, through education, will enable mariners to adapt to individual ship's requirements--both present and future.

Training

According to Stewart (1992), training should be the responsibility of the ship operator, with education being provided by schools or the government. Indeed, this is the case in the U.S. at this time. Most of the shipping companies in the U.S. either have agreements with their respective labor unions to provide advanced training at union operated training facilities, or the companies provide financial assistance to their employees to get advanced training at a private training facility.

Shoreside training is much more typical today than it was 20 years ago. For example, the APL collective bargaining agreement with the Masters, Mates, and Pilots Union stipulates that in addition to the officer holding a USCG license, he or she must satisfactorily complete numerous specific courses in order to qualify for employment as an officer aboard their ships (Landry, 1992). These courses include advanced training in fire-fighting, ship's stability, personnel management, medical care, and ship handling.

Utilizing state of the art simulators is also quite common today. Almost any type of operation aboard ship can be simulated, including: navigation and piloting, ship handling, cargo operations, ballast and stability, engineering, and radar plotting. A member of the International Shipping Federation voiced the following opinion at a recent IMO meeting of the Sub-Committee on Standards of Training and Watchkeeping:

> "[E]xperience in the shipping industry has demonstrated that simulators permit knowledge and skills to be imparted with greater speed and effectiveness than traditional methods alone. They also permit the reproduction of a variety of shipboard situations rarely met with at sea and provide useful experience in coping satisfactorily with such situations when they do happen" (IMO Documents, 1992-a: 21).

Bridge navigation simulators are currently an approved method of facilitating U.S. maritime academy cadets to meet the current one-year seatime requirement imposed by the STCW convention (Noll, 1981). Prior to U.S. ratification of STCW, cadets sitting for third mate licenses required only six months of at-sea experience. Simulators remain a growing training asset because they give seafarers the opportunity to perform functions, and get feedback in "real time".

Technologically sophisticated ships associated with effective manning and crew reductions require personnel of higher calibre than was traditionally accepted. In the future, with fewer people aboard ship, personnel will have to assume more responsibility, regardless of the amount of automation. It is a credit to the maritime education and training institutions in the U.S. that advanced ships' operations are currently being embraced and phased into curriculums.

Dual License Officers

Perhaps one of the most notable features aboard Japanese and German effectively manned vessels is that there is little distinction made between deck and engine departments. However, because of the prohibition imposed by the "cross-over" statute, the closest U.S.-flag vessels have come to dual competency (with few exceptions) is the maintenance department concept. Ironically; the USMMA has graduated dual licensed officers since 1969.

In what was considered a bold step at the time, the faculty at the USMMA foresaw a need for deck officers to also be trained in engineering skills. This need seems to have germinated aboard the Nuclear Ship Savannah:

> "The Savannah experience made it abundantly clear that ship's deck officers, **particularly on high technology ships**, should have a sound engineering education" (Hirschkowitz and Maclean, 1990: 2, author's emphasis).

This need was also becoming apparent due to the increasing complexity of modern vessels' safety devices, such as the inert gas systems installed aboard crude oil tankers to prevent explosions.

What sets the USMMA dual license program apart from some of its international counterparts is that the USMMA educates cadets for both deck and engineering licenses. Upon graduation, USMMA cadets receive both licenses, and are considered fully competent to sail in either capacity. Whether they chose to sail in the deck department or the engine department is entirely up to each individual. As discussed earlier, impediments to sailing on both licenses simultaneously include the cross-over prohibition of U.S. statute and impracticality of having two union affiliations. However, as reported by Hirschkowitz and Maclean (1991), dual-licensed officers have been able to utilize both licenses, sailing on alternating trips when employed by non-union U.S.-flag tanker operators.

The popularity of dual-license programs and/or emphasis on engineering skills for deck officers is now incorporated into the curricula of maritime academies, both in the U.S. and throughout the world (Meers and Douglas, 1991). Comparable programs in Germany and Japan emphasize developing strength in one discipline with general knowledge in the other (Yamanaka and Gaffney, 1988); whereas the Hamburg School of Maritime Studies in Germany and the Dutch

Maritime Academy have proposed issuing one all-embracing license in the near future (National Research Council, 1990; and Stewart, 1991). Japan has had a program since 1984, that certifies deck watch specialists for basic engine watch-standing, and engine watch specialists for basic deck watch-standing (Yamanaka and Gaffney, 1988). The Korean Maritime University has a program that grants Bachelor of Engineering degrees with third mate licenses (Stewart, 1991). In 1986, some German companies initiated a 20 month program that trains senior deck and engineering officers in their opposite roles (National Research Council, 1990). In fact, the tremendous popularity of dual officer programs prompted the IMO Sub-Committee on Standards of Training and Watchkeeping to begin discussing seatime and other certification requirements, to amend the STCW convention to internationally recognize dual deck/engine officers (IMO Documents, 1992-a).

Looking Ahead

The quality of mariners aboard a ship should be of vital concern to any ship operator. As stewards of the owner's property, these individuals are vested with the care of a tremendous capital investment. Education and training are therefore invaluable prerequisites to assure safe and efficient operation of merchant ships throughout the world.

In order to prepare mariners for careers at sea, progressive education and training must continue, however, maritime education in the U.S. is constrained by several limiting factors including: (1) falling enrollment at academies; (2) cutbacks in government support and financial assistance; (3) meeting the needs of a fast changing shipping environment; and (4) providing alternative employment possibilities due to the limited availability of shipboard jobs.

In order to recruit quality candidates for potential careers at sea, institutions must stress the attributes of such a career. Any negative image of seafarers as second-class citizens must be overcome. Furthermore, comprehensive recruitment should be implemented with the goal of making young people not only aware of their maritime heritage, but proud of it.

The U.S. maritime academies have traditionally received government financial assistance for providing maritime education to meet the national objectives of the Merchant Marine Act of 1936. This assistance is provided by MARAD through their division of Maritime Labor and Training. In accordance with the provisions of the Maritime Education and Training Act of 1980 (Public Law 96-453), students at the six State maritime academies receive 1,200 dollars per year in incentive payments (MARAD, 1990). The Act also calls for provision of a training vessel for each State school (except the Great Lakes academy) and direct financial aid of other academy programs. In the case of the USMMA, at Kings Point, MARAD has total fiscal responsibility. Yet, there are groups within the U.S. Office Of Management and Budget (OMB) who have attempted to undermine the maritime academies' missions by suggesting budget reduction measures that are nothing more than attempts to eliminate the schools. As recently as 1987, the previous maritime administrator, John Gaughn, suggested that all five State training vessels be decommissioned (U.S. Congress, 1988: 399). Congress intervened when, in fiscal year 1987 and 1988, OMB and MARAD recommended zero funding for the State academies (U.S. Congress, 1988).

Thus, State academies must continuously lobby Congress to defend their existence. This presents a somewhat hypocritical situation within the U.S. government. For example, in fiscal year 1991, Congress appropriated 225 million dollars for maintenance of the nation's Ready Reserve Fleet (RRF), but only 8.8 million dollars in assistance for all six State academies (U.S. Congress, 1991-a). It is difficult to foresee ships operating without crews. A shared relationship should exist between the academies and ship operators; shipboard personnel must be educated, trained, and most important--employed--aboard a ship (Joseph, 1987).

Meeting the needs of education and training for technologically-advanced ships requires an investment in equipment, such as simulators, but even more important, educators must be adaptable to the process of change. Stewart maintains:

> "The educator must be careful that "tradition" does not blind them to innovation and the development of visionary curriculums" (Stewart, 1992: 8).

It would be desirable if maritime interests throughout the U.S. were somewhat less traditional, ideally putting aside their personal interests for the common benefit of the U.S. merchant marine.

CHAPTER TEN

CREW REDUCTION AND SHIP SAFETY:
A DICHOTOMY OF INTEREST

Safety is the most-often cited reason for proceeding cautiously with further effective manning crew reductions aboard U.S.-flag ships. The organizations most concerned from the safety point of view are the USCG and maritime labor unions (MMP, 1989; and Gaffney, 1989). The USCG has a tremendously broad overall mission to accomplish (e.g. marine inspection, licensing, drug interdiction) although, marine safety is certainly one of their paramount concerns. Maritime labor unions, as representatives of American seafarers, have a responsibility to their members of insuring the best possible living and working conditions obtainable. If effective manning principles, such as crew reduction, in any way jeopardizes safety or degrades the working environment, the unions voice their concerns.

Many valid issues have been raised concerning the actual and potential effects of reduced manning levels. These concerns include: (1) the ability of the crew to handle emergency situations, such as, fire, man overboard, or catastrophic equipment failure; (2) the potential for longer working hours; (3) the lack of supervisory ability, if all crew-members are occupied; and (4) possible negative effect associated with increased isolation (Stove, 1988; and Pollard, et.al., 1990).

Numerous studies have been conducted during the past few years (National Research Council, 1984 and 1990; Froese, 1988; MMP, 1989; Schuffel, et.al., 1989; and Pollard, et.al., 1990) to try to determine possible negative effects associated with reduced crew levels--more specifically, to try to determine if there is a casual link between crew size and safety. A recent study sponsored by MARAD, for the Office of Technology Assessment, concurs on what is widely held to be true at this time:

> "While "human error" has long been believed to be the most common cause of transportation accidents, the precise relationship between fatigue and human error is not known...The validity of this perception has been neither established nor refuted" (Pollard, et. al., 1990: 1-1).

While some individuals may in fact refute the aforementioned quote, it does not deny the existence of a relationship between fatigue, crew size, and safety; indeed, it only begs that further research be conducted to confirm such a relationship.

Fatigue: Potential Effects on Human Performance

Fatigue among shipboard personnel has the potential to cause catastrophic results. A person in a fatigued condition may make hasty, delayed, or poor decisions; these can result in collisions, fires, stranding, oil pollution, and ultimately, death. Early discussions by the IMO on fatigue causing factors were indecisive in establishing a clear definition of fatigue (IMO Documents, 1990). However, one definition for the term--inattention--"the lack of ability to direct the mind at an object" (Pollard, et. al., 1990: 2-1)--more significantly describes the consequences of fatigue. These degrading effects may include reduced attention span, drowsiness, increased reaction time, diminished memory, and mood changes. In most respects, these are the same behavioral patterns exhibited by intoxicated persons.

Both MARAD's study on shipboard crew fatigue, safety and reduced manning (Pollard et.al., 1990) and the IMO's Sub-committee on Standards of Training and Watchkeeping (STW) recognize that shipboard fatigue can be caused by any one, or a combination of the following factors: (1) a lack of quality sleep; (2) excessive workloads and total hours worked; (3) noise; (4) temperature extremes; (5) exposure to stressful conditions; and (6) interpersonal conflict (Pollard, et. al., 1990; and IMO Documents, 1992-a). The IMO's focus, at this time, seems to be concerned with the responsibilities of international shipping administrations and flag states in preventing fatigue causing situations from occurring aboard their ships. Appendix D (p. 143) contains the IMO's list of fatigue related factors from a recent draft of the STW document "Fatigue Factors in Manning and Safety" (IMO Documents, 1992-a). It is instructive to note that "management ashore" and "responsibilities of administrations" are included in the list of fatigue-related factors and that these policies often have more influence on fatigue than specific ship/crew or external environmental factors.

A particular aspect of fatigue that deserves attention is working hours. One school of thought is that manning cutbacks aboard vessels necessitate longer hours and increased workloads for the remaining crew. Thus, it is understandable that seafarers look upon crew reduction with apprehension. However, this view may be self-contradictory in some respects, since U.S. seafarers are often anxious to maximize their overtime pay. John Bobb, academic director of the Maritime Institute of Technology and Graduate Studies (MITAGS), the MMP-operated union training facility, makes a valid point:

> "It is unfortunate that the experience and opinions of the people doing the job are often ignored because of the mistaken belief that they are unduly biased" (MMP, 1989).

U.S. law is cognizant of the need to have adequately rested deck officers taking charge of watches immediately after leaving ports. The law states that a deck officer may take charge of a watch when leaving port "only if the officer has been off-duty for at least 6 hours within the 12 hours immediately before the time of leaving" (title 46 USC sec. 8104 (a)). However, the problem is that masters are not willing to delay their vessel's departure while the mate rests. To again quote John Bobb:

> "On three mate vessels, the 6 hour rest period requirement is honored more in its breach than in its observance" (MMP, 1989).

Working hours of some crew-members aboard ship are actually limited to an eight hour day by U.S. law:

> "A licensed individual or seaman in the deck or engine department may not be required to work more than 8 hours in one day" (title 46 USC sec.8104 (d)).

Despite the laudable intentions of these laws, mariners typically work more than eight hours a day, especially while in port.

Despite seafarers apprehensions about heavy workloads, overtime is usually viewed as highly desirable by U.S. seafarers, since it increases their base pay significantly. Moreover, a precedent-setting court case, "The Youngstown" 110 F.2d (5th circuit, 1940), recognized that seafarers can indeed work more than eight hours a day by virtue of the inclusion of overtime in a union collective bargaining agreement or other contract (National Research Council, 1990). The USCG views overtime as being voluntary as long as "direct or indirect coercion" is not used to induce the crew-member to work (Marine Safety Manual, volume III, sec. 22.C).

Overtime hours have been a topic of concern to many ship operators. In Germany, for instance, a cap of 90 hours per month is written into its national shipping laws

(Pollard, et. al., 1990), while Japanese law restricts its seafarers to a maximum of 40 hours per month in addition to normal weekend overtime (Yamanaka and Gaffney, 1988: 53). In contrast to these figures, a typical chief mate aboard a U.S.-flag vessel averages 150-180 overtime hours per month. It can be seen that shipboard working environments are very challenging and, at times, labor intensive. Therefore, it is considered imperative that effective manning be considered only when a vessel is specifically designed, built, managed, and operated to reduce workloads and fatigue-inducing situations.

Human Element of Crew Reduction

Fatigue is just one aspect of the broader subject of human elements affecting seafarers. Human elements are those factors such as physical, emotional, psychological, and environmental factors which affect the daily lives of seafarers. With respect to effective manning, a partial listing of shipboard situations that impact the seafarer include: (1) level of automation; (2) reliability of equipment; (3) management policies; (4) quality of the working/living environment; (5) shipboard organization and watch-keeping practices; (6) the level of training and experience of shipmates; (7) hours of work; and of course, (8) morale (IMO Documents, 1992-b).

High levels of automation, with minimal human input, have the potential for degrading critical skills. Functions traditionally done with considerable human input are now so automated that human input is often not even needed. The mariner is no longer an operator/task master but a monitor. Traditional operations that have been automated should therefore be replaced by other meaningful duties to prevent boredom and the associated lack of attention. Schuffel et. al., (1989) maintains that it is not a matter of whether a function <u>can be</u> automated, but whether it <u>should be</u>. Low workloads can potentially be as undesirable as high workloads. Workers' performing activities that require low levels of physical or mental input, such as watch-standing, are susceptible to a low metabolic rate and day dreaming which have been shown to make error detection difficult (Pollard, et. al., 1990).

Much can be learned from the German experience with effective manning. Traditional departmental boundaries have been de-emphasized with the result that crews function much more as a team (e.g. eating together rather than in separate dining areas). Also, with the exception of the deck watch-officers all of the crew are normally working during the day, which results in ample opportunity for social interaction. The use of modern, quiet, well-maintained, and reliable vessels also goes a long way toward promoting a quality working environment.

Human elements of seafaring and their relationship to maritime safety are a topic of specific concern to the IMO at this time. It is making a concerted effort to standardize casualty reporting/investigation procedures throughout the world (e.g. IMO Assembly Resolution A.637(16)) with the intention of gathering data on fatigue/human factors and then analyzing how those factors relate to maritime accidents (IMO Documents, 1992-b). Topics proposed to be covered by casualty investigators are presented in Appendix D (p. 143).

Safety is First

A cogent argument could be made asserting how interest in promoting safety usually involves the introduction and/or upgrading of hardware (i.e. technical solution), with correspondingly less interest shown in the human factors (i.e. fatigue, training). Perhaps, this stems from the fact that human error is generally responsible for the majority of marine casualties; therefore, people assume that if the human component is eliminated, the error is likewise eliminated. Some of the regulations emerging from the Oil Pollution Act of 1990 (OPA-90) are an indication that human factors are being taken more seriously. For example, substance abuse testing, rest period restrictions, and the recent requirement of having a second licensed officer on the bridge while in coastal waters are clear indications that technology is not being relied upon to solve all of the safety-related problems (Young, 1992).

Another area that begs improvement is the role of ship management in promoting safety aboard vessels, especially vessels with limited manpower resources to deal with emergencies. At the international level, the IMO is recognizing that management maintains a significant influence in vessel operations (IMO Documents, 1990, 1991, 1992-a, and 1992-b). Under present international law, crews must have "certificates of competency" and ships must be approved by classification societies, but ship management policies go unregulated. Quality management is undoubtedly responsible for most of the successes of the German "Ship of the Future" program, as well as American President Lines, and Pacific Gulf Marine, to name some examples. Management policy, after all, decides on the type and quality of vessel safety systems, the standards of physical vessel upkeep, training and performance of personnel, and the amount of shore support (Middleton, 1990).

Competitive pressure--the same driving force that is responsible for interest in crew reduction--affects maritime safety. Insurance premiums, which cost U.S. operators between 2,000 and 3,000 dollars per ship per day (Caponiti, 1992) indirectly have the potential to increase safety aboard ships. By looking more closely at safety features, management policies, and manning levels, insurers could promote safe practices through tiered premiums. The reality of the insurance market is that competitive pressures induce underwriters to overlook safety for the objective of writing the account (Banham, 1991). Competitive pressure between American labor unions may also be adversely impacting safety aboard vessels. In the interest of signing collective bargaining agreements with ship operators, labor unions have resorted to large wage concessions. Moreover, this policy has the adverse affect of driving older, often more experienced, mariners out of the industry.

It may be years before there is conclusive evidence to either support or reject the link between safety and crew reduction. The National Research Council study, "Effective Manning of the U.S. Merchant Fleet" (1984), highlights a concern voiced by one of the U.S. maritime unions. The opinion contends that crew reductions, achieved through automation and technology, should demonstrate clear safety gains aboard ship, and not just the absence of safety slippage (National Research Council, 1984).

Vessel Manning and Safety in the International Forum

International regulation of crew qualifications and crew levels has been the subject of ongoing discussion among many organizations, both within the U.S. and at the international level. As indicated earlier in this paper, U.S. manning levels are a product of statute, regulation, collective bargaining, and to some extent, customary practice. Ships of other nations set manning levels according to similar practices in their respective countries.

Presently, no internationally binding treaty or convention exists that specifically regulates minimum manning levels. This absence should not be interpreted as an indication that no regulations exist; to the contrary, various international conventions do address certain aspects of manning. For example, the Standards of Training, Certification and Watchkeeping (STCW) convention specifies qualifications and minimum training requirements for individuals in the deck, engine, and radio departments (IMO, 1978); however, the STCW is silent on actual crew levels. Furthermore, the Safety of Life at Sea (SOLAS) convention, as amended, gives a somewhat broad interpretation of manning requirements without specifically addressing numbers. Chapter V, regulation 13 maintains:

> "...[F]rom the point of view of safety of life at sea, all ships shall be sufficiently and efficiently manned" (SOLAS convention, in National Research Council, 1990: 81).

Unfortunately, it may take an admiralty court decision in the wake of a casualty to determine if insufficient manning was responsible for the loss of life and property.

The balance of this discussion will address concerns of manning contained within pertinent international conventions and/or embraced by international organizations.

Safety and International Law

The foremost organization in the world concerned with ships, shipping, and pollution of the marine environment by ships is the International Maritime Organization (IMO), located in London, England. Since its founding in 1959, the IMO has spearheaded numerous international treaties and conventions with safety and protection of the marine environment as the primary concerns. U.S. government representation on IMO committees typically includes members of the USCG, maritime academies, and government agencies (IMO Documents, 1990). Almost universally, the IMO is recognized as the appropriate international forum for discussions of manning related issues. Therefore, the stage is set for discussions of two important IMO documents related to manning: (1) the STCW convention; and (2) IMO Resolution A.481(XII), otherwise known as the "Principles of Safe Manning."

In the early 1970s, flag states did not take enough initiative in the regulation of ships under their jurisdiction. An alarming rise in maritime accidents indicated that safety was being traded off for profits, especially due to the growing popularity of FOC vessels (Noll, 1981). The IMO reported:

> "In view of the continuing alarming rise in maritime casualties and pollution, it is necessary for urgent action to be taken, aimed at strengthening and improving standards and professional qualifications of mariners, as a means of securing better guarantees of safety at

> sea and protection of the marine environment" (U.S. Congress, 1991-b).

It was in this posture that the IMO took the initiative to study this international problem. By the summer of 1978, the STCW convention was opened for signature in London, and it entered into force in 1984. STCW was ratified by the U.S. in February of 1992 (IMO News, 1992) which brought the number of ratifications to 90 countries representing over 83 percent of world tonnage.

The STCW may impact manning and personnel issues more than perhaps any other international convention. The convention's name implies exactly what its objectives are: minimum standards of training needed to qualify persons (primarily officers) for certification in the deck, engine, and radio departments, and operational guidance to be observed by ships' officers in carrying out their respective watch duties (IMO, 1978). Safety is undeniably the central theme of this convention, though no specific language sets manning levels. In reference to the keeping of a navigational watch, chapter II regulation II/I sec 4(a) of the STCW states:

> "The composition of the watch shall at all times be adequate and appropriate to the prevailing circumstances and conditions..." (IMO, 1978).

Functional criteria is used to determine if adequate manpower is available. As long as the necessary tasks and safety parameters, as outlined by the convention, are satisfied the manning levels are deemed satisfactory.

Since being adopted on November 19, 1981, the Principles of Safe Manning (PSM) has attempted to augment the specific requirements of the STCW convention with a more general guide to be used in the determining manning levels aboard ships. Although regulation of minimum manning levels would alleviate many safety concerns raised in this paper, the likelihood of coming to an international consensus is dubious. By accepting the PSM, the international community has adopted a non-binding resolution addressing manning levels through association with a list of functional criteria rather than specific numbers. A partial listing of recommendations taken from the PSM resolution stresses that manning levels must be sufficient to: (1) maintain a safe navigation watch in line with the SOLAS and STCW conventions; (2) have adequate manpower to moor and unmoor the vessel; (3) operate all fire and safety equipment; (4) maintain safe engineering watch and safe condition of machinery: (5) keep the ship in a sanitary condition; and (6) provide good food and adequate medical care (IMCO, 1981).

Although the PSM is considered non-binding, meaning it does not have the force of a treaty, the IMO encourages member states, that are party to the STCW convention, to issue a Safe Manning Document to vessels flying their flag (see Appendix E, p. 144). Other nations exercising rights of Port State Control are encouraged to "regard compliance with such a document as evidence that the ship is safely manned" (IMCO, 1981). The USCG normally checks foreign vessels for compliance with provisions of the Safe Manning Document during routine boardings at U.S. ports (Young, 1992). However, since the guidelines are so broad, they are easily subject to abuse and/or differing interpretation, making enforcement nearly impossible.

Other contemporary issues relevant to manning concerns come under the purview of the International Labor Organization (ILO). The relevant shipping laws are contained in the Merchant Shipping (Minimum Standards) convention of 1976, also known as ILO 147, which was ratified by the U.S. in 1989. ILO 147 requires member nations to set standards which relate to competency, work hours, manning, social security measures, employment conditions, and living arrangements (National Research Council, 1990). Unlike the PSM document, which is non-binding, ILO 147 stipulates that flag states must set national standards with mandatory compliance. Unfortunately, as of 1990, there were only 20 ratifications. Here again there are many opportunities for abuse. The aforementioned standards may directly influence the safety of the ship. For example, sub-standard living conditions and unregulated work hours are known to induce stress and fatigue (Pollard, et. al., 1990).

Achieving Parity Through Politics

The circumvention of labor laws has given FOC ship operators an unfair competitive advantage over commercial U.S.-flag vessels. One effort to ameliorate this condition produced a bill in the U.S. Congress (H.R. 3283), that would extend American labor laws to foreign flag vessels. The bill was first introduced into the House of Representatives by Rep. William Clay of Montana, in 1988. The most recent version of the Bill, sponsored by Senator Claiborne Pell of Rhode Island, appeared in the Senate for the first time near the end of the 102nd Congress, in 1992 (Nautical Magazine, 1992-b). The intent of this legislation is to extend the National Labor Relations Act and the Fair Labor Standards Act to foreign flag vessels (MARAD, 1990). Although the labor bill is primarily directed at cruise ships, it would apply to all foreign vessels owned by American corporations.

Extending U.S. labor law to foreign vessels is a contentious issue at this time. Opponents claim that it is in violation of international law, which gives the flag state control of such matters (Master Mate and Pilot, 1992-c). Certainly, wider international acceptance of ILO 147 and other ILO conventions would be preferable to unilateral actions by the U.S. But, as is often the case, U.S. regulations tend to address technical elements of ships, and/or qualifications of seafarers, rather than issues directly related to manning (Young, 1992).

Despite the fact that the IMO, ILO, and the World Health Organization (WHO) recognize that drug and alcohol abuse aboard ship has the potential to cause tremendous damage and/or loss of life, there are no international regulations, such as those in existence in the U.S., to test seafarers for drug and alcohol use. Since 1988, U.S. seafarers have been required by law to undergo drug and alcohol testing under four conditions: (1) pre-employment; (2) post-accident; (3) reasonable cause; and (4) on a random basis. These rules were further amended in 1989 to cover U.S. seafarers in waters under the jurisdiction of foreign governments (Master Mate and Pilot, 1992-b).

U.S. seafaring labor unions have voiced their opinion that something is inherently unfair about U.S. seafarers having to oblige to this procedure while FOC crews go unregulated. The IMO and ILO are presently investigating proposed drug and alcohol testing procedures to be implemented in international shipping. But, based on the experience from gaining consensus on the many nuances of this issue, it will undoubtedly result in delays over implementing the testing. This can be observed from testimony, of other countries and organizations, voiced in the "Draft Report to the Maritime Safety Committee" (IMO Documents, 1992-a).

Another extremely important issue, related to ships' safety, concerns eyesight standards for officers and ratings under the purview of the STCW convention. Currently, there is no international standard--the USCG, as well as other maritime nations, set their own standards, and some are higher than others. In this regard, the IMO Sub-Committee on Standards of Training and Watchkeeping has prepared provisional guidelines that are being considered. Moreover, the opinion was expressed by the IMO Sub-Committee that additional time is needed to achieve consensus, since not even the International Standards Organization currently has eyesight standards (IMO Documents, 1992-a).

The fact that U.S. mariners are regulated to high standards (often higher than international) should not be looked at from the point of view that it imposes additional costs on U.S.-flag operators and therefore makes them non-competitive. When safety of life and property is at stake, ideally no standards lower than the highest achievable should be tolerated, regardless of cost. The fact that the U.S. is a leader in this regard is a laudable attribute. Until such time as international parity in labor policy, drug and alcohol testing, and critical physical standards are achieved, FOC vessel operators will continue to take advantage of their competitive position and potentially contribute to the operation of less-than-safe ships.

CHAPTER ELEVEN

MEETING AMERICA'S MILITARY SEALIFT OBJECTIVES: IS EFFECTIVE MANNING COMPATIBLE

Perhaps nothing exemplifies the inadequacy of America's ability to staff the merchant marine in times of national emergency, as examples from the recent Persian Gulf War. Numerous instances of insufficiently skilled mariners and outright shortages of personnel have clearly indicated that the U.S. merchant marine's manning capabilities need attention. In responding to a question about vessel manning practices during the Gulf War, during a House Merchant Marine and Fisheries Committee hearing, a spokesperson from American President Lines (APL) testified:

> "APL offshore personnel standards were selectively compromised on occasion, which allowed somewhat less qualified and/or desirable offshore personnel to be tolerated on some voyages and in some departments" (U.S. Congress, 1991-c).

Indeed, the shortage of trained seafarers was notable; in many cases, skilled mariners were being called out from retirement, to meet the sudden demand for qualified personnel.

The Ready Reserve Force

The issue of personnel shortages is fundamentally related to the United State's Ready Reserve Force (RRF).

The RRF consists of former commercial merchant vessels laid-up in unmanned status at various coastal cities throughout the U.S. Their primary military utility is to be available in times of national emergency, to supplement the commercial U.S. merchant marine and the Military Sealift Command. RRF vessels are classed by the duration of time necessary to activate them for service (i.e. five days, 10 days, and 20 days). Operations Desert Shield and Desert Storm presented the first opportunity to use these vessels since the inception of the RRF program in 1976 (Ready Reserve Force, 1991). Activation of the first vessels commenced on August 10, 1990 to assist with the transportation of supplies during the surge (initial movement of equipment) phase of the sealift. It was in this initial surge that the shortfall of qualified engineers and radio officers became apparent, if not acute. A joint Department of Defense/Department of Transportation study on the RRF observed: "The variety of skill mismatches was even more significant than the delays in acquiring full crews...some seafaring unions sent diesel engineers to steam-powered ships" (Ready Reserve Force, 1991).

Two other recent studies specifically addressed crewing and manning related issues of the RRF. They are titled: (1) Crewing the Merchant Marine for Mobilization, sponsored by MARAD and published in 1991 and (2) Merchant Marine Manning Analysis: 1988-1994, sponsored by the U.S. Navy and published in 1988. Much of the data utilized throughout the following discussions are derived from the MARAD study.

Crew needs for the 96-vessel RRF fleet are 3,253 mariners (Meers and Douglas, 1991: IV-6). This number increases to 4,650 by 1995, with the proposed expansion of the RRF to 142 vessels. The seafarer availability pool was approximately 24,000 in 1990 during the Gulf War--down from 50,000 in 1981. Noting this trend, Meers and Douglas (1991) predict a 3,074 person shortage in 1995, assuming 90 percent seafarer availability and 1.25 persons per billet. This number increases to 4,768 persons at 80 percent availability. It is important to bear in mind that these figures are only estimates; in actuality, the availability pool may be lower and the ratio of seafarers per billet may be higher if the need for vacation relief in a sustained long-term operation is also considered. If the seafarer pool was considered inadequate in 1990, then the predicted decline to 10,000 mariners by the year 2000 must be deemed as critical.

U.S. Military Sealift Policy

Another major effort "to determine whether the nation has access to sufficient sealift resources to carry out the defense strategy, should the need arise" (Meers and Douglas, 1991) was undertaken by the Commission on Merchant Marine and Defense (created by Public Law 98-525 in 1984). Between September 1987 and January 1989, the Commission produced four voluminous reports addressing almost every possible aspect of the merchant marine. The first commission report identified one major problem, among others, as the predicted seafarer shortfall. The second commission report identified solutions and recommendations, which were further enumerated by the third and fourth commission report. Perhaps the following excerpt from the fourth commission's forwarding letter to President George Bush in early 1989, summarizes the U.S.'s posture:

> "The sharpness of the divergence among the players in the American maritime "game" has resulted until now in stalemating any effective coordinated remedial action. Today more than ever before there is a great need for cooperation both among the maritime industries themselves and between the industries and government" (Commission on Merchant Marine and Defence, in Meers and Douglas, 1991: A-22).

Conclusively, the need for all the aforementioned studies has resulted due to the apparent lack of ability of the U.S. merchant marine to meet its stated objectives in various national security polices. For example, pursuant to the statement of policy in the Merchant Marine Act of 1936:

> "It is necessary for the national defense...that the United States shall have a merchant marine...capable of serving as a naval and military auxiliary in time of war or national emergency..." (Merchant Marine Act of 1936, in National Research Council, 1990).

In October 1989, President George Bush declared in his National Security Sealift Policy:

> " The broad purpose of the sealift policy is to insure that the U.S. maintains the capability to meet sealift requirements in the event of crisis

> or war...New programs to enhance [the U.S.'s] ability to meet the National Security Sealift requirements shall compete for resources with other national security programs" (<u>National Security Sealift Policy</u>, in Meers and Douglas, 1991).

The rhetoric exhibited by the U.S. government in light of meeting these objectives continues to be apparent. As a matter of fact, two Congressional bills (H.R. 5627 and S. 3047) known as "The Maritime Reform Act of 1992" specifically addressed the national defence posture of the privately owned merchant marine with the inclusion of a new proposal called the "Contingency Retainer Program (CRP)" (<u>Master Mate and Pilot</u>, 1992-c). This program would provide up to 74 ships operating in foreign trade with direct cash payments in exchange for being made available for national defense if needed. The CRP was intended to augment the present Operating Differential Subsidy (ODS) program; however, the refusal--primarily from the Department of Defense--to fund the program contributed to the overall collapse of the reform bills (<u>Master Mate and Pilot</u>, 1992-c).

Consider the following question from Walter B. Jones, former Chairman of the House Sub-Committee on the Merchant Marine, which was directed at American maritime unions during an oversight hearing on the Persian Gulf War in 1991:

> "Is the pool of American Merchant mariners sufficient to provide crews to the RRF during a period of national emergency--and, at the same time, crew vessels in the domestic and foreign

commerce of the United States?" (U.S. Congress, 1991-d).

The unequivocal answers received from the three largest unions, National MEBA Districts 1 and 2, Seafarers International Union (SIU), and the Masters, Mates, and Pilots Union, was "no, the pool of mariners is not large enough". This response should not be considered a biased opinion of maritime labor unions as similar concerns were frequently echoed by the Department of Defense (Ready Reserve Force, 1991).

Proposed Solutions

Faced with the virtual extinction of the American merchant marine, both the MARAD and the U.S. Navy manning studies arrived at various proposed solutions to the manpower issue. Among the most acceptable of those solutions proposed are: (1) the formation of a merchant marine reserve, similar to other branches of the armed services; (2) converting domestic mariners (i.e. commercial fishermen, tugboat crews, and mobile offshore drilling unit crews) to deep-sea personnel; (3) converting military and former military personnel from the Navy, USCG, NOAA, and the Army Corps of Engineers; (4) implementing accelerated training at the maritime academies; and (5) instituting a merchant marine draft (Meers and Douglas, 1991). However, the only solution ever empirically tested was the accelerated training proposal which was implemented at the U.S. Merchant Marine Academy during the Vietnam War.

Meers and Douglas (1991) are perceptive of effective manning attributes as potential solutions to the RRF manning problem. Indeed, they advocate that "[w]aivers and/or changes to some government merchant marine regulations will decrease mobilization requirements." Not surprisingly, among the proposed solutions to meeting the manpower shortage, they describe changing regulations related to the three watch system, the cross-over rule, radio officers, one man bride operation, and USCG approval procedures for unattended engine room status.

In the interest of national security or emergency, the Secretary of Defense may request a waiver of navigation and inspection laws, as applied to merchant vessels, from the Secretary of Transportation (Meers and Douglas, 1991). Such was the case in the mid-1980s when 12 Kuwaiti oil tankers were "re-flagged" to carry the U.S.-flag, but without the required U.S. crews (see title 46 USC sec. 8103). Initially, only the masters and radio officers were U.S. citizens; lobbying by the union (MMP), eventually secured berths for all the officers.

Summary Remark

In some respects, advocating effective manning--and smaller crews--seems dichotomous to the perceived need of maintaining an abundant supply of qualified personnel to man the RRF ships in times of national emergency. Most of the RRF vessels are older steamships cast off by their previous owners because they were too inefficient to operate competitively; they burned copious amounts of fuel and required large crews. However, any proposed measures--including effective manning--that have the potential to make the U.S. merchant marine more competitive should be considered worthwhile. The consequences of maintaining the status quo are far worse--the nation's commercial sealift capacity will continue to decline and there will be an associated decline in manpower availability.

CHAPTER TWELVE

SUMMARY AND CONCLUSIONS

It has been amply demonstrated that traditional methods of operating ships are undergoing a transition throughout the world at this time. Indeed, the science of naval architecture has produced vessels capable of operating efficiently with very small crews. These modern vessels have so far demonstrated their advantageous ability to reduce operating costs and therefore increase competitiveness.

This paper's hypothesis stated that legislative and regulatory changes were needed to amend manning laws that retard innovation from occurring in the U.S. fleet. Otherwise, it is predicted ship operators will lack a major incentive to encourage investment in U.S.-flag ships and the overall decline of the U.S. merchant marine will continue. Indeed, the "Maritime Reform Act of 1992," which died in the 102nd Congress, addressed issues related to increasing the competitiveness of the U.S. merchant marine; however, topics concerning crew size and shipboard organization were not addressed. Moreover, manning issues were considered by both ship operators and maritime labor unions to be wholly within the scope of collective bargaining and not a matter for government regulation (Master Mate and Pilot, 1992-c).

Therefore, the hypothesis as stated can neither be accepted nor refuted at this time. However, the principal issues pertaining to the hypothesis have been tested; and, it has been demonstrated through examples of Japanese and German effective manning programs that innovations in ships' manning, reducing crew size, and application of automation can increase competitiveness. Although there is no certainty that embracing effective manning will increase the competitive posture of the U.S.-flag merchant marine, or for that matter, preclude its continued decline, not amending manning laws and regulations impedes the U.S.-flag fleet, both present and future, from benefiting to the fullest possible extent from effective manning's possibilities.

The central issues discussed within this paper: OMBO, GMDSS, integrated and dual-purpose crews, shipboard automation, innovative management practices, maritime union policies, and military requirements, all bear significantly on the U.S. merchant marine's posture toward further introduction of effective manning fundamentals, especially crew reduction. However, many valid concerns about the safety of operating ships with small crews are presently under investigation on both the domestic and international level (IMO Documents, 1990, 1991, 1992-a, and 1992-b).

These concerns include the ability of small crews to handle emergency situations, particularly fires, and the potential detrimental effects of fatigue and boredom on human performance. The present non-regulated (international) manning environment is fundamentally unsafe. Captain Richard Cahill, a noted author and retired master mariner, maintains:

> "What the international shipping industry seems incapable of doing is coming to grips with the manning problem. It is obvious that the shipowner is not always the best judge of how his ship should be manned if the interests of safety are to be accorded their rightful place. His attitude to safe manning is too often colored by the standards of his competitors. Government agencies who are entrusted to regulate such things, are too vulnerable to political and commercial pressures to be trusted in such a delicate matter" (Cahill, 1990).

This insightful view supports the need for an international manning standard to be established before the trend to smaller ships' crews progresses to substantially unsafe levels. In this regard all ship operators will benefit, not only from a safety posture but from a competitive one as well.

The diverse groups that comprise the U.S. maritime community are capable of solving the problems that currently impede the merchant marine. There is already a consensus on the importance of solving the problems; what is really needed is an agreement on the methodology.

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APPENDIX A

MICOI MARINE INSPECTION CERTIFICATE OF INSPECTION 16NOV92

ISSUED/ 27JAN92

EXPIRED/ 27JAN94

IMO NUM/ 5173981

VESSEL NAME:	VIN: CALL: SERVICE:
JOHN LYKES	D282772 KIHD FREIGHT SHIP
HOME PORT:	HULL MATL: HP: PROPULSION:
MIAMI, FL	STEEL 9000 STEAM TURBINE
PLACE BUILT:	DATE: GTON: NTON: DWT: LENGTH:
PASCAGOULA MS	15DEC60 8762 5046 571.20
OWNER:	OPERATOR:
LYKES BROS STEAMSHIP CO INC	LYKES BROS STEAMSHIP CO INC
300 POYDRAS ST	300 POYDRAS ST
NEW ORLEANS, LA 70130	NEW ORLEANS, LA 70130

LIFEBOATMEN/ 8 TANKERMEN/ 0

1 /MASTER	/1ST PILOT	6 /AB. SEAMEN	1 /CHIEF ENG'R	3 /FIREMEN
1 /CH. MATE	PIL.	3 /OR. SEAMEN	1 /1ST ENG'R	3 /OILERS
1 /2ND MATE	1 /RADIO OFF.	/DECKHANDS	1 /2ND ENG'R	
1 THIRD MATE	OPER		1 THIRD ENG'R	

OTHER REQUIRED CREW/ DESCRIBE/

PASSENGERS/ 0 OTHER CREW/ 17 PERSONS IN ADDITION TO CREW/ 12

TOTAL PERSONS/ 53

OCEANS

FUEL TANKS

TANK ID	EXAM DATE	TANK ID	EXAM DATE	TANK ID	EXAM DATE
#1 PDBT	28FEB86	#1 SDBT	UNK	#2 PDBT	28FEB86
#2 SDBT	26APR90	#3 PIBDBT	26APR90	#3 SIBDBT	UNK
#3 POBDBT	28FEB86	#3 SOBDBT	UNK	#4 PIBDBT	UNK
#4 SIBDBT	18JUL88	#4 POBDBT	26APR90	4 SOBDBT	28FEB86
#5A PDBT	26APR90	#5A SDBT	UNK	#5 CDBT	UNK
#6 PDBT	18JUL88	#6 SDBT	26APR90	#7 CDBT	28FEB86
#II CDT	26APR90	#IIA PDT	UNK	#IIA SDT	UNK
#III PIBDT	UNK	#III SIBDT	UNK	#III POBDT	UNK
#III SOBDT	UNK	#IV PDT	UNK	#IV SDT	UNK

*** SEE NEXT PAGE FOR ADDITIONAL CERTIFICATE INFORMATION ***

Source: USCG, Marine Safety Office Providence, Rhode Island.

APPENDIX B

MICQI MARINE INSPECTION CERTIFICATE OF INSPECTION 28OCT92

ISSUED/ 13JUN91

EXPIRED/ 25MAR93

IMO NUM/ 8414532

VESSEL NAME:
EXXON LONG BEACH
HOME PORT:
PHILADELPHIA, PA
PLACE BUILT:
SAN DIEGO, CA
OWNER:
EXXON SHIPPING CO
1207 ORANGE STREET
WILMINGTON, DE 19801

VIN:	CALL:	SERVICE:		
D692967	WHCA	TANK SHIP		
HULL MATL:	HP:	PROPULSION:		
HS STEEL	31650	DIESEL DIRECT		
DATE:	GTON:	NTON:	DWT:	LENGTH:
02APR87	94999	77814	211469	949.90

OPERATOR:
EXXON SHIPPING COMPANY
OCEAN FLEET OFFICE
150 W. INDUSTRIAL WAY
BENICIA, CA 94510-1016

LIFEBOATMEN/ 7 TANKERMEN/ 3

1 /MASTER	/1ST PILOT	3 /AB. SEAMEN	1 /CHIEF ENG'R	/FIREMEN
1 /CH. MATE	PIL.	/OR. SEAMEN	1 /1ST ENG'R	/OILERS
1 /2ND MATE	1 /RADIO OFF.	/DECKHANDS	1 /2ND ENG'R	
1 THIRD MATE	OPER	3 MAINT.PERS*	1 THIRD ENG'R	

OTHER REQUIRED CREW/ DESCRIBE/
PASSENGERS/ 0 OTHER CREW/ 4 PERSONS IN ADDITION TO CREW/ 14
TOTAL PERSONS/ 33

OCEANS

RADIO OFFICER: THE DETERMINATION OF WHEN A RADIO OFFICER IS REQUIRED IS BASED ON THE FEDERAL COMMUNICATIONS COMMISSION REQUIREMENTS

THE MINIMUM MANNING LEVEL SPECIFIED ON THIS CERTIFICATE OF INSPECTION IS CONTINGENT UPON THE PROPER OPERATION OF THE MACHINERY AUTOMATION SYSTEM. ANY MAJOR ALTERATION OR PROTRACTED SYSTEM/ESSENTIAL COMPONENT FAILURE MUST BE REPORTED IMMEDIATELY TO THE OCMI WHO ISSUED THE VESSEL'S CERTIFICATE OF INSPECTION.

*ALL THREE MAINTENANCE PERSONS MUST HOLD THE ENDORSEMENT FOR ABLE SEAMAN; HOWEVER, UP TO TWO SPECIALLY TRAINED ORDINARY SEAMEN MAY BE SUBSTITUTED FOR TWO OF THESE ABLE SEAMEN.

THE ABOVE MANNING IS CONTINGENT UPON THE UTILIZATION OF A MAINTENANCE DEPARTMENT AS INDICATED IN THE VESSEL'S OPERATIONS MANUAL. ANY SUBSTANTIAL CHANGE IN THE OPERATION OF THIS DEPARTMENT MUST, PRIOR TO IMPLEMENTATION, BE REPORTED TO THE OCMI WHO ISSUED THE VESSEL'S CERTIFICATE OF INSPECTIONS.

Source: USCG, Marine Safety Office Providence, Rhode Island.

APPENDIX C

DAILY OPERATING COSTS OF LINER VESSELS
VOYAGES TERMINATED DURING THE PERIOD JANUARY 1 TO DECEMBER 31, 1991

	RECAPITULATION	BREAKBULK/ LASH/RORO TOTAL VOYAGES		CONTAINER TOTAL VOYAGES
1	Total Number of Voyages	322.5		793.0
2	Nautical Miles/Voyage	6,045		6,938
3	Voyage Days/Voyage	21		21
4	Sea Days/Voyage	13		15
5	DWT	17,893		25,851
6	TEU One-Way Capacity	872	1/	1,694
7	TEUs Carried/Voyage	N.A.		2,345
8	FPTs Carried/Voyage	31,666	2/	49,664
	AVERAGE MANNING:			
9	Deck	13		13
10	Engine	12		11
11	Steward	5		5
12	Cadet & Other	1		1
13	TOTAL AVERAGE MANNING	31		30
	WAGES PER VOYAGE DAY:			
14	Straight Time	3,024	2/	3,133
15	Fixed Benefits	4,978	2/	4,952
16	Overtime	2,717	2/	2,691
17	Other	1,019	2/	1,056
	--REVENUE & EXPENSES PER VOYAGE DAY--			
18	OPERATING REVENUE	91,263		133,264
	VESSEL EXPENSE:			
19	Wages	11,737		11,833
20	Subsistence	298		283
21	Stores, Supplies, & Equipment	663		637
22	Maintenance and Repairs	3,077		3,176
23	Insurance	2,933		2,180
24	Fuel	7,415		7,903
25	Other Vessel Expense	441		1,345
26	TOTAL VESSEL EXPENSE	26,564		27,357
27	Less ODS	6,915		7,316
28	NET VESSEL EXPENSE	19,649		20,041
29	Port Call Expense	5,443		4,376
	CARGO EXPENSE:			
30	Equipment	6,425		14,396
31	Cargo Handling	21,727		22,904
32	Cargo Freight Stations	1,615		10,394
33	Cargo Transportation	3,983		33,904
34	TOTAL CARGO EXPENSE	33,750		81,598
	CAPITAL EXPENSE:			
35	Vessel Depreciation	4,305		3,008
36	Vessel Interest Cost	2,409		2,711
37	Charter Hire	952		1,885
38	TOTAL CAPITAL EXPENSE	7,666		7,604
39	TOTAL EXPENSES PER VOYAGE DAY	66,508		113,619
40	GROSS OPERATING PROFIT	24,755		19,645

1/ LASH not included - quoted in barges. 2/ Due to insufficient data ROROs are excluded.

Source: MARAD, Division of ship operating costs.

APPENDIX D

INTERNATIONAL MARITIME ORGANIZATION

IMO

STW 23/WP.3
26 February 1992
Original: ENGLISH

SUB-COMMITTEE ON STANDARDS OF TRAINING AND WATCHKEEPING
23rd session
Agenda item 4

3.1.1 Management ashore and aboard ship, and responsibilities of Administrations:

- scheduling of work and rest periods;
- manning levels;
- assignment of duties;
- shore-ship-shore support and communication;
- standardisation of work procedures;
- voyage planning;
- watch keeping practices;
- management policy;
- in-port operations;
- recreational facilities;
- administrative duties.

3.1.2 Ship-specific factors:

- level of automation;
- reliability of equipment;
- motion characteristics;
- vibration, heat and noise levels;
- quality of working and living environment;
- cargo characteristics/requirements;
- ship design.

3.1.3 Crew-specific factors:

- thoroughness of training;
- experience;
- crew composition - cohesiveness;
- crew competency and quality.

3.1.4 External environmental factors:

- weather;
- port conditions;
- ice conditions;
- density of vessel traffic.

Source: International Maritime Organization, London, England.

APPENDIX E

CONTENTS OF MINIMUM SAFE MANNING DOCUMENT

The following information should be stated in the document, in whatever form, which is issued by the Administration specifying minimum safe manning. If the language used is not English the information given should include a translation into English:

.1 a clear statement of the ship's name, its port of registry and its distinctive number or letters;

.2 a table showing the numbers and grades of the personnel required to be carried, together with any special conditions or other remarks;

.3 a formal statement by the Administration that, having regard to the principles and guidelines set out in this resolution and in Annex 2, the ship named in the document is considered to be safely manned if, whenever it proceeds to sea, it carries not less than the numbers and grades of personnel shown in the document, subject to any special conditions stated therein;

.4 a statement as to any limitations on the validity of the document by reference to particulars of the individual ship and the nature of service upon which it is engaged;

.5 the date of issue and any expiry date of the document together with a signature for and the seal of the Administration.

Source: IMO Resolution A.481 (XII)
International Maritime Organization, London England.