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The Greek-flagged fleet : a case study with special reference to the importance, the causes and the remedy of its competitive edge

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GREEK-FLAGGED FLEET; A CASE STUDY WITH SPECIAL REFERENCE TO THE IMPORTANCE, THE CAUSE AND THE REMEDY OF ITS COMPETITIVE EDGE

By

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1999

DECLARATION

I certify that all the material in this dissertation that is not my own work has been identified, and that no material is included for which a degree has previously been conferred on me.

The contents of this dissertation reflect my own views, and are not necessarily endorsed by the University.

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ABSTRACT

Title of the dissertation: **Greek-flagged fleet; A case study with special reference to the importance, the cause and the remedy of its competitive edge.**

This dissertation is a study of the loss of the competitiveness of the Greek-flagged fleet and a proposal of how to remedy the situation.

To underline the importance of having the shipping industry run well, Greek shipping is studied to signify the contribution of shipping to the national economy. In view of this, the importance of having the industry competitively run in order to have the cutting edge in global shipping is highlighted.

By presenting pertinent views from people who are directly involved in the business, the problems that are affecting the industry and measures that have been effected lately to improve the situation are shown.

In order to make a proposal for change, the cost of running a vessel over the last 10 years is investigated. The costs which have increased significantly within the period are taken into account to see if there are changes that can be introduced in running the fleet.

The suggested proposals are derived from the above against recent developments in the shipping industry. These include introduction of high level automation and a reduction in level of manning.

A pre-study has been given using a reduced manning -simulated- project on a real vessel and the advantages that would be reaped from such a commitment. This pre-study includes the regulatory framework, an investment appraisal and proposed modifications to the present set up. The author suggests that running this project would be a suitable pre-requisite for any company wishing to change the current status of the Greek flagged fleet.

KEYWORDS: Greek flagged fleet, reduced manning, operating cost, automation, competitiveness.

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LIST OF ABBREVIATION

2/O	Second officer
AAP	Accommodation Alarm Panel
AB	Able Body
AB/GP	General Purpose AB
ACL	Atlantic Container Line
	and Watchkeeping
ARPA	Automatic Radar Plotting Aid
BAP	Basic Alarm Panels
BFI	Baltic Freight Index
b$	Billion US dollars
CCR	Cargo Control Room
C/O	Chief Officer
COLREG	Collision Regulations
COMMOS	Committee On the Modernisation of the Manning System
DCF	Discounted Cash Flow
DIS	Danish International registry
DKK	Danish Kronor
DMA	Danish Maritime Authorities
DMS	Diesel Manoeuvring System
DPS	Diesel Protection System
dwt	Dead Weight Tonnage
ECR	Engine Control Room
EGS	Electronic Governor System
EMU	European Monetary Union
EU	European Union
FO	Fuel Oil

FOC	Flag Of Convenience
FW	Fresh Water
G7	The G7 countries are Canada, France, Germany, Italy, Japan, UK, USA
GBP	British Pound
GDP	Gross Domestic Product
GNP	Gross National Product
GOS	Graphic Operator Station
GPV	Gross Present Value
GRD	Greek Drachma
grt	Gross registered tonnage
GSCC	Greek Shipowners Co-operation Committee
H&M	Hull and Machinery
IBS	Integrated Bridge System
IMO	International Maritime Organisation
INS	Integrated Navigation System
IRR	Internal Rate of Return
ISC	Integrated Ship Control
ISM	Code on International Safety System
ITF	International Transport Federation
JSA	Japanese Shipowners Association
M/E	Main Engine
M/R, R&M	Maintenance and repairs
MARAD	Maritime Administration
MDO	Marine Diesel Oil
MSC	Maritime Safety Committee
m$	Million US dollars
NAT	Greek Seafarers Pension Fund

NIS	Norwegian International Registry
NKK	Nippon Kaiki Kyokai
NPV	Net Present Value
nrt	Net registered tonnage
OECD	Organisation for Economic Co-operation and Development
OOW	Officer On Watch
P&I	Protection and Indemnity
pd	Per day
PV	Present Value
ROI	Return On Investment
ROR	Rate Of Return
RPM	Revolution Per Minute
S&L	Stores and Lubricants
SEK	Swedish Kronor
SMS	Safety Management System
SOLAS	Convention on Safety of Life at Sea
SSA	Swedish Shipowners’ Association
STCW ’95	Convention on Standards of Training, Certification and
STW	Sub-Committee on Standards of Training and Watchkeeping
SW	Salt Water
SWOT	Strengths, Weaknesses, Opportunities and Threats
TCC	Total Crew Cost agreement
TEU	Twenty Foot Equivalent Unit
UCS	Universal Control System
UMS	Universal Monitoring System
UMS	Unmanned Machinery Space
UN	United Nations
USA	United States of America

USD	United States dollar
VLCC	Very Large Crude Carrier

CHAPTER 1
Introduction

It is not anymore a phenomenon not even an issue the fact that the number of vessels under OECD flags has been declined constantly the last 20 years. Although the majority of the world tonnage is yet under the control of these countries, the shipowners/operators have been forced to fly from the national registry in order to stay competitive in the market. The major force of re-flagging has been the high operational cost under the national flag and there are some exceptional cases where one may witness re-flagging due to the shortage of national seafarers.

The Greek-controlled fleet is not an exception from this trend. Admittedly, the Greek controlled fleet has exhibited a significant increase, in terms of number of vessels as well as in terms of dead weight tonnage. However, following the trend of all the OECD countries, the number of Greek-flagged vessels has shown a constant decrease since 1993. Additionally, fears for massive exodus have been expressed due to the constantly increased operating cost under the national registry.

Lots of debate has taken place among the pertinent parties. In addition, measures have been taken such as the option of low Greek compliment on board the Greek flagged vessels in order to lower the daily operational cost. It is noteworthy that the problem has been opposed only through conventional approaches, avoiding thus to introduce any innovative scheme in the Greek shipping industry.

When the same problem arose earlier to other maritime nations, the companies/operators addressed the problem with three options. The first, the easiest and fastest applicable one, was to re-flag the vessels, lowering thus the daily operating cost and ultimately re-gaining the lost competitiveness. The second solution came through the co-operation of their maritime administrations and was the introduction of international registries. Under the regime of an international registry, a FOC manning is allowed and the flag state control acts as the regulatory body. Nonetheless, the companies/operators with strong belief in their national seafarers as part of their success story went a step further; they introduced the concept of minimal crewing.

These shipowners/operators with the co-operation of the appropriate regulatory bodies reduced manning compliments on board their vessels. The approach to achieve the desirable reduction has varied, however not significantly. Additionally, most of these countries, in order to be in line with the demanding expertise required to run these vessels, introduced changes in the educational systems by upgrading their educational programs to the current needs.

However, such projects have not been seen in the Greek shipping industry. The absence of developing such projects and the fact that the loss of the competitiveness has been a major issue in the literature related to Greek shipping were the triggers for the author to make a research on minimal crewing. As a matter of fact, this dissertation aims:

- To identify the root of the problem, which is the loss of the competitiveness of the Greek flagged vessels,
- To economically appraise a possible solution of the problem.

Having had these objectives in mind, the following structure was adopted as appropriate to address the issue of the loss of the competitiveness of the Greek flagged vessels:

Chapter I introduces to the reader the issue and how it will be evolved.

Chapter II describes the problem nowadays the Greek shipping community is facing, the loss of the competitiveness of the Greek-flagged vessels. Moreover, it analyses the importance and the impact of shipping in the Greek economy.

Chapter III aims to detect the reason of the loss of the competitiveness of the Greek-flagged fleet. Albeit the shipowners argue that it has been caused because of the highly paid Greek officers and ratings, this chapter aims to verify this rationale. Therefore, in an effort to detect the “liable” cost for the loss of the competitiveness the cost of operating a vessel is analysed.

Chapter IV presents a selection of case studies. As it was mentioned earlier, similar problems have been faced from other maritime nations, earlier than Greece, due to their faster economic growth. Therefore, they have initialised various projects in order to reduce the manning cost and recover their competitiveness. From all those projects, three have been chosen as the most appropriate to be presented as case studies in this chapter.

Chapter V aims to address the possible pros and cons of implementing a similar project on a Greek-flagged vessel. The chapter serves as a pre-study before communicating the project to the pertinent parties. Therefore, it will introduce to the reader the regulatory framework of the project, the proposed modifications and it will be concluded with an investment appraisal of the project.

Chapter VI concludes this work presenting the most important conclusions drawn out in the previous chapters.

Before closing this chapter and introducing the reader to the problem that the Greek shipping community faces nowadays, it is very important for the author to tell the difficulties had faced during the undertaking of this dissertation:

- Absence of data or research quantifying the impact of Greek shipping in the national economy,
- Unwillingness of ship operators/owners to disclose financial information. Ultimately, another and indirect method was selected to analyse the daily cost of operating a vessel,
- Although the literature related to minimum manning level seems vast is finally shallow, because no financial information is disclosed, resulting in the difficulty to assess the actual outcome of these projects,
- The unwillingness of a few product suppliers to give data and prices about their products.

CHAPTER 2

Greek-flagged fleet; its competitiveness and significance for the national economy

2.1 Shipping Cycles

2.1.1 The “poker” game

Cycles are not only the privilege of the shipping industry but also of many other industries and the economy as a whole. As a shipowner put it….“When I wake up in the morning and the freight rates are high I feel good. When they are low I feel bad”. Additionally, it is not just a problem encountered by the shipowners only. The buyers of their services face the same risks, because the cost of transportation varies significantly during the upturns and the slumps of the market. Therefore, shipping can be considered as a “poker” game. The winner of the game, the shipowner or the shipper, depends heavily on his strategy, philosophy, psychology and luck (Stopford, 1997).

2.1.2 The spot market

Admittedly, the shipping industry can be divided in two sectors; Industrial shipping and freight market. In the first case, the shippers operate their own fleet or they use vessels in time charter chartered from independent shipowners. Shippers either know the quantities they need to transport or believe that transport is too important to be left to chance. In the second case, shippers prefer to rely on independent shipowners for the conveyance of their cargoes. Therefore, they hire vessels when needed.

The latter market is the spot market. About 70% of the volume of goods transported at sea is fixed in this way. The freight situation is mainly influenced by the following factors, among others:

- The general state of the world economy,
- Sudden changes in the demand for specific commodities,

- State of war,
- Crop failure,
- Closure of important routes,
- Oversupply of specific types of ships,
- Extreme congestion in important ports,
- An economic boom within special limited areas (Gorton et all, 1995).

2.1.3 Shipping cycles in short

People involved in shipping have accepted that cycles are part of their business. Lean years will be followed by prosperous years. In short, shipping cycles can be described as following:

A shortage of available capacity increases the freight rates. High level of freight rates attracts new investments in business, which accordingly create an oversupply of tonnage. The oversupply has as result the collapse of the market and the recession in the shipping industry. Reconsidering the shipping cycles, one can conclude that they have a purpose; to force out the weak shipping companies, leaving the strong to survive and prosper (Stopford, 1997).

Interestingly, Clarkson’s Shipping Intelligence Weekly describes, in the first week of March ’99, with chilling conciseness the operation of the entire industry as follows: “You do not need to be rocket scientist to work it out, the formula is dead easy. Rates rise; owners order; demand disappears; sentiment slumps; bankers go bonkers; amnesia sets in and the whole process starts again. This simple sequence explains 98% of shipping market activity over the last century”.

Nonetheless, economic historians have devoted much effort to analyse and classify shipping cycles. They all agree that they are characterised by irregularities and they last as long as it is necessary to bring the demand and supply sides back in black. As a rule of thumb, lean years lasts for 7-8 years while prosperous years last for 1-3 years (Sandervarn, 1999).

2.2 Decision making tools

2.2.1 The subject in brief

It is hardly surprising that the shipping cycles are so prominent, considering the amount of money involved. If we take the transport of grain from US Gulf to Rotterdam as an example, a Panamax bulk carrier trading on the spot market could have earned, after the operating expenses, about 1m$ in 1986, 3,5m$ in 1989, 1,5m$ in 1992 and 2,5m$ in 1995. On the other hand the ship itself, a five year old Panamax, would have cost 6m$ in 1986, 22m$ in 1989 and yet the same price in 1994 (Stopford, 1997).

In an industry where the name of the game is the cost, the people require analytical tools to improve their decision making process. These analytical tools are the various cost/benefit analysis patterns, which, however, have each one a different objective, which is called "key word". For instance, an approach described by the Norwegian maritime economist Sverdsen has as an objective to reveal the minimum level of freight rate, which should be accepted by the shipowner. Below that level, which is equal to the variable costs, the shipowner should lay up the vessel in question. His breakdown analysis is given as follows:

Operating cost
- → Fixed costs → Interests, depreciation, maintenance, Insurance, salary, overhead.
- → Variable Costs → At sea - Bunkers; At ports- port charges, cargo handling.

Source: Ma, 1998

2.2.2 The bottom line

The list of analytical tools is extensive. There are even different methods for the same objective. However, the thesis' objective is to present an alternative way to improve vessel's competitiveness, therefore the employment of a method revealing the cost factors of international competition is the most appropriate. This can be succeeded by singling out the cost elements, which differs from one country to another. The result of the same is the subdivision of cost in national and international cost. Whereas national costs are those varying from country to country, and while international costs are not varying, irrespective of the nationality of the company (Ma, 1998).

Total Cost → National Costs → i. Crew; ii. Overhead and management; iii. Taxes, iv. administrative cost

Total Cost → International Costs → i. Capital cost, ii. Bunker cost, iii. Port costs, iv. cargo handling, v. Insurance, vi. M/R, vii. International crew

Source: Ma, 1998

Considering taxation and overhead expenses as optimised since the formation of the company, the crew costs are revealed as a competitive edge for every shipping company.

2.3 Analysing vessel's related costs

2.3.1 Currency markets

It was said before that shipowners employ their assets in a market being highly volatile. Another aspect not considered during the presentation of the shipping cycles is the fact that shipowners are also exposed to the volatile currency markets. The local currency can weaken and as a result it causes denomination of shipowners' earnings.

2.3.2 Vessel's costs analysis

Assuming that there is a cyclical slump of the market and inflationary cost pressures as well, the immediate results from the market situation will be the erosion of shipowner competitive position. The shipowner has at his disposal two alternatives; either to reduce the costs or to enhance revenues. Of course, he can decide to employ both alternatives simultaneously. However, his ability to boost revenue side is rather limited. Therefore, he will ultimately concentrate his effort in the cost side.

The cost side is further subdivided in two related costs; the financial costs and the operating costs. Getting started from the financial costs, the shipowner has the following options to reduce the pressures of financial costs; the first option available at his disposal is to refinance his debt and the second one is to reschedule his payments in the bank. The concept of refinancing and rescheduling based on the postulate that the market will create better employment opportunities and ultimately higher revenues. Another cost included in the financial cost is the taxes. In the market's slump the shipowner may also look for more tax efficient structures.

Besides the financial costs, there are the vessel's operating costs as well. It is worth noting that the reduction of operating costs is dictated by a number of factors, among them the standard of services which the shipowner must offer in a competitive marketplace. The subdivision of the costs is best described in the diagram 1.

The percentages appeared in the diagram can vary according to the vessel's type, size and age. Especially the age of the vessel is a factor affecting heavily the various costs such as the insurance premium. Nonetheless, the diagram clearly presents that the crew cost is the single biggest cost, therefore it offers a wide scope for cost reduction (Willingale, 1998).

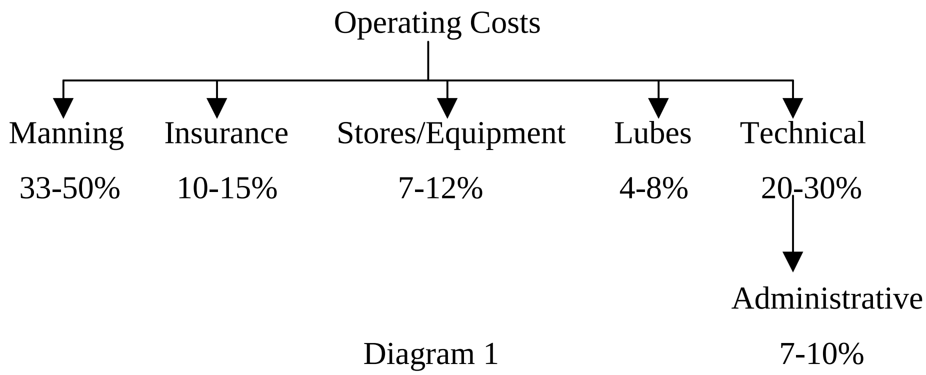


Diagram 1

Source: Willingale, 1998

2.3.3 The available options

The analysis of the operating costs boils down to a reasonable question; *what are the available options to reduce manning costs?* Potential savings can be realised either by reducing the number of crew on board and/or by reducing their wages and the associated benefits paid (Willingale, 1998). The investigation of the first option is the objective of this thesis. The second option can be realised by substituting the current crew with a cheaper alternative. A cheaper alternative is available through flagging out the vessel to a flag State with more flexible manning rules. One may argue that shipowners flag out their vessels for a number of reasons, however the principal reason is to reduce the manning costs.

2.3.4 The shipping registries profile

A. Traditional registries

Examples of traditional registries: USA, UK, Greece and Norway. The operating cost is higher under these registries as shipowners must ensure full compliance with all maritime conventions. In addition, the vessels are crewed solely or largely by national seafarers trained and certified by the flag State. The size of the traditional registries has diminished over the past 20 years (Figure 1).

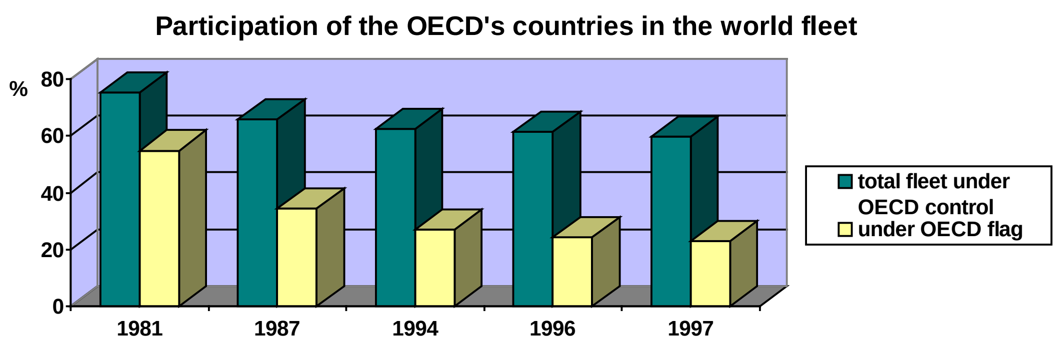


Figure 1.

Source: Lloyds Register of Shipping, 1998

B. Open registries

Owners registering their vessels in one of the open registries are granted with:

- Freedom to select the nationality of their crews,
- Freedom to negotiate the terms and conditions of crew employment,
- Tax exemption,
- Elastic regulatory control,
- Company's disclosure requirements.

The participation of open registries in the world fleet is presented in the figure 2. Examples of open registries: Liberia, Panama, Cyprus, Bahamas.

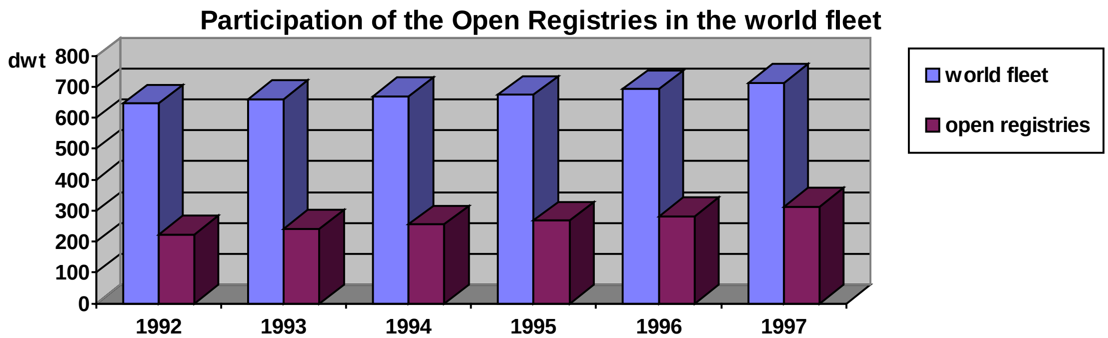


Figure 2.

Source: Lloyds Register of Shipping, 1997

C. Second or parallel registries

These registries were set up to arrest the flight of the national flag shipowners to the open registries or alternatively to attract the shipowners who had already made this move to flag in. The incentive was the less stringent rules than those applied in the national registry. Examples of second registries: Norwegian International Registry, Danish International Registry, German International Registry (Willingale, 1998).

2.3.5 The history of manning

Considerable changes have occurred in international shipping during the last forty years. The early fifties were characterised by stability and growth and the shipping industry was dominated by large integrated companies. At that period greater priority was given to costs such as maintenance, operation and time spent in the building process. The manning costs were by no means the most influential factor.

Large companies under the pressure of the banks were closed during the shipping slump of sixties and seventies. The result was thousands of unemployed seafarers, who accordingly left the maritime industry, many of them through redundancy.

The recession revealed streamlined companies, where the greatest attention was paid to the vessel's operating costs, especially in manning and associated areas. The most significant change incurred on board during that period was the fact that the companies moved from traditional western European crews to Far Eastern crews. The reason of the movement can be seen as twofold; it was, initially, dictated by cost savings and the need for survival, and recently by the shortage of European seafarers. However, it should be mentioned that the shortage of European seafarers was a direct impact of the recession in the early seventies and the policy followed on this matter at the latter stages (Drewry, 1990).

2.4 Greek manning rules; their impact on the national registry

2.4.1 The latest amendments on the Greek manning rules

Actually the manning rules were amended quite recently, in September 2nd 1997. The amendments were introduced, under the pressure of the Union of Greek Shipowners, to improve the competitiveness of the Greek flagged vessels and were focused on the introduction of a manning scheme being able to reduce the manning cost. The amendments were not focused on the reduction of the crew size.

On the contrary, the amendments were focused on the reduction of the required quota of national seafarers. The previous manning rules required a solely Greek crew on Greek registered vessels. Finally, the amendments were not those required by the Greek shipowners. The following table presents the crew size required from the various sizes of vessels flying the Greek flag.

RANK	*3,000-20,000gt*	*20,001-45,000gt*	*45,001gt and over*
Master	1	1	1
Chief Officer	1	1	1
2nd Officer	1*	2	2
Deck Cadet			1
Bosun	1	1	1
AB	3	3	4
Chief Engineer	1	1	1
2nd Engineer	1	1	1
3rd Engineer	1	1	1
Engine Cadet or Electrician		1	
Electrician or 3rd Engineer			1
Oiler or Engine Cadet	3	3	3
Chief Cook	1	1	1
Steward		1	1
Steward's Assistant	1		
TOTAL	**14**	**17**	**19**

Table 1. *Manning Requirements for Conventional Vessels*

Source: Compiled by the Ministry of Mercantile Marine, 1997

(*) For vessels sized from 10,000 to 20,000gt an additional 2nd Officer is required. For tanker vessels, a Pump-man should be calculated as an additional. Furthermore, when the vessel is adequately equipped and able to operate with unattended machinery space, the following crew size is required.

RANK	3000-20000gt	20001-45000gt	45001gt and over
Master	1	1	1
Chief Officer	1	1	1
2nd Officer	1*	2	2
Deck Apprentice			1
Bosun	1	1	1
AB	3	3	4
Chief Engineer	1	1	1
2nd Engineer	1	1	1
3rd Engineer		1	1
Engine Cadet or Electrician		1	1
Wiper			1
Chief Cook	1	1	1
Steward			1
Steward's Assistant	1	1	
TOTAL	**10**	**14**	**17**

Table 2. *Manning Requirements for "Totally Automated" Vessels*

Source: Compiled by the Ministry of Mercantile Marine, 1997

(*) An additional 2nd Officer is required for vessel sized between 10,000 to 20,000gt. A Pump-man should be also added for tanker vessels. However, if the vessel is equipped with centralised Cargo Control Room (CCR) the employment of a Pump-Man is not compulsory.

The Greek manning rules have been through constant changes, following the trends for smaller crew compliments, however always taking into account the international safety requirements. The innovation introduced in the latest amendments did not include any further reduction of the crew size, but the reduction of the required quota of Greek crewmembers that shall be on board. From the required number of crew described above in both cases, conventional and totally automated vessels, the required number of Greek crew is given in the following table. It is worth noting that the Master of the vessel shall always have Greek nationality.

	3000-20000gt	*20001-45000gt*	*45001-100000gt*	*100000gt and over*
Officers	5	6	6	7
Ratings	3	3	4	4
Total	**8**	**9**	**10**	**11**

Table 3. *Required number of Greeks*

Source: Compiled by the Ministry of Mercantile Marine, 1997

2.4.2The abandonment of the Greek Flag

2.4.2.1 The counter proposal

The overhaul of the manning rules in 1997 was dismissed by the industry as ineffectual and unsuccessful by their results. Although there has been a significant gain in the amount of tonnage controlled by Greek shipowners over the last few years, the continuous exodus from the Greek registered fleet has led shipping bodies tirelessly to drum into the Greek Government the need to reduce costs incurred under the home flag. Owners claim that Greek ship’s competitiveness has slumped due to having the lowest foreign crewing allowance of any European Union registry and complained that government’s efforts to safeguard the high quota of Greek jobs on board the fleet are misguided.

The Hellenic Chamber of Shipping as well as the Union of Greek Shipowners, during the drafting of the amendments, proposed that the number of Greek officers should be reduced to 4-6 persons, according to the size of the vessel. The junior officers as well as the ratings should be from the international labour market. In the argument that by implementing the proposal the number of jobs that have to be cut will be high, owners replied that since the proposed amendments can not improve the competitiveness they would re-flag their vessel and the result would be a even higher number of lost jobs.

Their proposal was based on the concept to maintain a significant number of Greek officers on board, who accordingly will transfer the know-how to the next generations.

Simultaneously, the free selection of junior officers and ratings would give them the opportunity to stay competitive in the market. Additionally, another competitive edge of the Greek shipping industry is the employment of people with sea going background at shore positions. Their input in the success story of Greek shipping is considerable. Therefore, by flagging out vessels the number of experienced Greek officers to be occupied for these positions is decreasing and the Greek shipping industry is loosing yet another competitive edge (Hellenic Chamber of Shipping, 1998).

2.4.2.2 The impact on the Greek registry

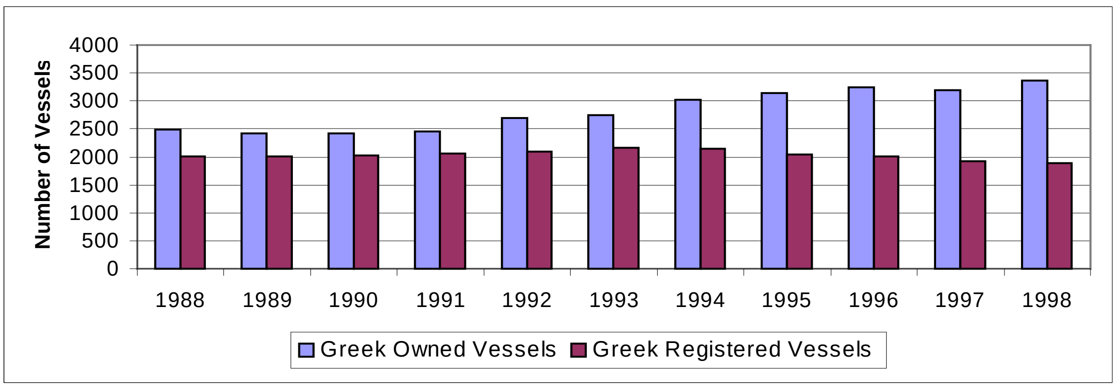


Figure 3. Greek owned vessels/Greek registered vessels 1988-98

Source: Compiled by Hellenic Chamber of Shipping, 1999 and Union of Greek Shipowners, 1999

By analysing the statistics of Greek shipping in the last 10 years, it is revealed that the number of vessels operated under Greek interests has increased by 35%, while at the same time the number of vessels registered under the Greek flag has declined by 6,6%. It is worth noting that the decrease has been accelerated in the last five years, where the percentage of vessels which left the registry was 13,1% (Hellenic Chamber of Shipping, 1999 and Union of Greek Shipowners, 1999).

However, while the number of vessels under the Greek flag decreased through the years, the gross tonnage has steadily increased year by year. In 1988 the gross registered tonnage accounted for 21,3 millions and in 1998 the number has increased to almost 26 millions. According to John Hazipateras, chairman of the Greek Shipowners Co-operation Committee (GSCC), there is a simple explanation for this phenomenon of increasing gross tonnage: " *It is true that we have been screaming that a lot of tonnage would leave the flag. What has happened in recent years is that a number of large ships, particularly newbuildings, have come in and made things look considerably better"*.

The majority of shipowners have no doubt about where to point the figure of blame for this alarming decline of the flag. Nonetheless, the Minister replies… "*We will not allow the Greek flag to become a flag of convenience at an expense to make the social problem even worse*". And he continues saying… "*Ships will carry on leaving the registry not because of the seafarers, but because of the international market reasons*". On the other side the chairman of the GSCC replies as follows… "*The government has done very little to put a stop to ships leaving for other registries, where the owner has the opportunity to operate his vessels with the same responsibility and protection, but viable cheaper*". "*They feel that it is a luxury they simply can not afford, if they are to survive"* he concludes (Lloyd's Shipping Economist, 1999 and Lloyd's Shipping Management, 1999 and Hellenic Chamber of Shipping, 1998).

The government will not be forced to take actions until the time where the decline of the national registry will reach a panic point. This is the general consensus of opinion among the owners (Lloyd's Shipping Economist, 1999).

Interestingly, there are Greek shipowners/companies, for instance Ceres Hellenique, who have committed themselves to the Greek flag. They know that they sound idealistic, however they strongly believe that their successful story has its root in the use of the

Greek flag as well as in the sweat and the blood of the Greek seafarers (Lloyd's Shipping Economist, 1999). Furthermore, there are companies, like Costamare, who have made their calculations of the minimum acceptable freight rate and the period till when they can afford it. If in the pre-calculated period the market situation does not improve, they prefer to send the vessel for scrap than to change the home flag and the nationality of the crew!(Constantakopoulos, 1999)

2.4.3 The importance of shipping in the Greek economy

2.4.3.1 Balance of trade

By citing the world trade evolution, the fluctuations of the world economies, the Greek efforts for being converged with the other EU economies and the contribution of shipping in these efforts during the decade, one can realise the importance of a strong home registry in the Greek national economy.

1990

World trade: In spite of the deceleration in the respective rates of annual increase compared to 1989, the international sea borne trade in 1990 appears to have reached a new record high both in terms of volume and tonne miles. According to Fearnleys, the total tonnage shipments increased in 1990 by 3% and tonne miles by 4%, where the corresponding percentage increases in 1989 were respectively 5% and 7%.

World economy: Undoubtedly the slow down in the world growth and especially in the in the OECD countries had as a result the deceleration of the world sea borne trade growth. The increase of the GNP for the whole of OECD countries was 2,6%, which is lower not only to the 3,3% during the 1989 but also to the 3,1% annual average increase during the period of 1982-1989.

Greek performance: The performance of the Greek economy for 1990 can only be characterised as weak. While the GDP increased by 2,8% during 1989 and the average annual increase of GDP during the period of 1982-1989 was 1,8%, during 1990 the increase of GDP declined in the weak 1,2%. The reflection of the weak performance is the deficit of 12,292m$ in the balance of trade and 3,598m$ in the balance of payments. The deficits during 1989 were 9,120m$ and 2,573m$ respectively.

Greek shipping support: Although the weak performance of the Hellenic economy, the Greek shipping increased its contribution, through direct generation of foreign exchange, to the balance of trade deficit from 1,375m$ during the 1989 to 1,778m$ during this year (Union of Greek Shipowners, 1991).

1991

World Trade: The weak world economy was reflected in the deceleration of the increase of international sea borne trade. According to Fearnlays review, the total tonnage of shipments increased by 1,2% and in terms of tonne-miles the increase was 1,6%.

World economy: The real GDP growth for the whole of the OECD countries in that year was estimated to have been no more than 1%, which implies that the world economy could not manage to be pulled out of recession.

Greek performance: Despite the significant improvement in the balance of payments, the deficit was reduced to 1,459m$, and the small decline in the balance of trade, the recorded deficit was 12,311m$, the whole year could only characterised by the recession which was reflected in the 0,4% increase in the GDP.

Greek shipping support: In spite of the global recession, the Greek shipping continued to play a key role of the country's invisible earnings and in bridging the country's deficit in the balance of trade. The foreign exchange earnings generated during that year were 1,773m$ (Union of Greek Shipowners, 1992).

1992

World trade: During 1992 both the volume of sea borne trade and the tonne-mile indicators were increased by 2,3%. In terms of numbers, the total volume of cargoes transported by the sea reached the 4,110 million tonnes while the tonne-mile demand raised to 18,280 billion. Nonetheless, the percentage of increase in terms of volume and tonne-miles was not reflected in the freight rates. The freight rates were slightly weaker than 1991, because of the increase of the available tonnage, especially in the tanker market.

World economy: A slight economic growth was reflected by an increase of the GDP. The real GDP for the whole of the OECD countries was 1,4%, slightly higher than the 1% of the previous year.

Greek performance: The tight economic policy implemented since 1992 with the objectives of reducing inflation, reducing the public sector borrowing requirements as a percentage of GDP and improving efficiency through privatisation of the state controlled enterprises had as a result the continuation of the recession for the Greek economy. During that year the increase of the GDP was estimated to 1%. Balance of trade and balance of payments were increased by 12,5% and 33,4% respectively and they were accounted for 13,840m$ USD and 2,02m$ respectively.

Greek shipping support: Although the slightly weaker freight rates compared with those of 1991, the foreign exchange earnings generated by shipping reached the 1,994m$ and helped in bridging, once more, the widening deficit in the balance of trade (Union of Greek shipowners, 1993).

1993-1994

World economy: The average combined GDP of the OECD economies was climbed to 2,9%, presenting a big improvement. However, it should be noted that the growth in the key industrialised areas was not synchronised. The USA had been on a growth path since 1992 and reached its peak during 1994, where the GDP increased by 4%. In contrast, the Japanese economy after a long recession enjoyed its first year of recovery during 1994. Additionally, the dynamic Asian economies reached a GDP increase of 7,3%. The growth of the world economy was characterised booming, because of the unsynchronised growth.

World trade: The world growth had a direct impact in the demand for maritime transport and it was directly expressed trough an increase of the freight rates, especially during the second half of 1994.

Greek performance: The restructuring policies introduced during 1993 and the strict stabilisation program resulted in the negative growth of GDP (-0,5%) during 1993 and an increase of 1% during 1994. The balance of trade deficit reached 11,6b$ during 1993 and reduced slightly down to 11b$ during 1994.

Greek shipping support: The foreign exchange earnings from shipping during 1993-1994 were almost reached each year the 2b$, covering the endemic Greek trade deficit. It is noteworthy that this number does not include capital investments of Greek shipowners in other sectors nor the income generated abroad by Greek seafarers (Union of Greek Shipowners, 1995).

1995

World trade: The UN figures showed an increase of 11% in the world trade. That is to say, the deceleration of the world economy had not been yet reflected to the economic activity.

World economy: On one hand, the economies of Asia, excluding Japan, showed a growth of their GDP of 8%. On the other hand, the economies of the developed world, G7 countries, showed a sharp deceleration and their GDP increased on average by 2%. In details, the economy of the USA was kept in a sustainable pace of growth of 2%, while the Japanese GDP increased merely by 0,5% and the German by 1,9%.

Greek performance: The main characteristic of the Greek economy during 1995 was the single digit inflation rate for the first time in the last two decades. The inflation rate, which was 15,8% during 1992, was running less than 9% at the end of 1995. The nominal interest rates in the Greek capital market were followed by the strong decline of the inflation rate and as a result the investments in the private sector were boost by 5%. Nonetheless, the GDP increased only by 1,8% because of the restrictive economic policy. Additionally, the government's anti-inflation policy included a hard drachma policy. The hard drachma policy not only affected the competitiveness of the national economy but also the competitiveness of the shipping sector. The loss of the competitiveness of the national economy partially explain the widening of the balance of trade deficit to 3,5b$ as well as the widening of the balance of payments deficit to 3,3 billion drachmas. Notably, the balance of payments during 1994 was positive with a surplus of 80m$.

Greek shipping support: The foreign exchange earnings from shipping, which are contribute to the bridging of the balance of trade deficit, broke the barrier of 2b$ and actually accounted for 2,2b$, an increase of 14% since 1994. This development was succeeded despite the sharp decline of the world growth and the partially loss of the competitiveness of the Greek shipping due to the hard drachma policy (Union of Greek Shipowners, 1996).

1996

World trade: From 1994 to 1996 the total sea borne trade was increasing steadily. The 4,506 million tonnes of cargo transported by sea during 1994 increased to 4,687 million tonnes during 1995 and it reached the 4,790 million tonnes during 1996. The increasing trend of sea borne was reflecting the prosperity and the trends of growth of the world economy.

World economy: Low inflation rates and steady growth are the two main features of that year for the world economy. The real GDP increased by 3,6% and the inflation rates were 2,4% for the EU countries, 2,9% for USA and 7,5% for Asia. The corresponding inflation rates for the 1995 were 3%, 2,8% and 11,3%.

Greek performance: Although the national economic indices, inflation rate 7,5% and GDP growth 2,6%, were showing a big improvement towards the convergence with the other EU economies, the balance of trade deficit further had widened and reached the 18,4b$. It was the proof that the economy had lost its international competitiveness, underlying the importance of the shipping in the sustainable growth of the national economy. The widening gap in the deficit of balance of trade had resulted in further deterioration of the balance of payments deficit which reached the 4,5b$ (3,3b$ in 1995).

The Greek shipping support: The loss of the competitiveness of the Greek registered vessels and the flagging out resulted in the deceleration of the foreign exchange earnings from shipping. The earnings accounted for 2,3b$ while last year's earnings were 2,2b$, representing an increase of 5% while last year's increase of earnings reached the 14% (Union of Greek Shipowners, 1997).

1997

World trade: The acceleration of the world sea borne trade in 1996 in terms of volume and tonne-miles, 3,7% and 2,4% respectively, continued during 1997 and reached a 4,4% increase in terms of volume carried and a 3,6% increase in terms of tonne-miles.

World economy: Despite the disturbances in the capital markets, the resilient moods of the economic activities around the world had resulted in an increase of 3,8% in the world GDP during the year. The increase was higher than the increase of world GDP during the 1992-1996 period, where the average increase was 3,4%.

Greek performance: The government's efforts to converge the economy with the other EU members economies and to meet the criteria for membership to EMU had resulted an acceleration of the GDP from 2,4% during 1996 to 3,3% in 1997 and simultaneously a deceleration of the inflation to 5,5 %. On the negative side, the balance of payments further deteriorated to 4,8b$, mostly because of reduced international competitiveness of the national economy and partially because of the loss making public sector and the lack of flexibility in the labour markets.

The Greek shipping support: The depressed freight rates and the de-flagging from the home flag resulted in the decrease of contribution of shipping in the balance of trade deficit. The direct foreign exchange earnings from shipping in 1997 accounted for 2,1b$, an 8% decrease compared to 2,26b$ contribution during 1996 (Union of Greek Shipowners, 1998).

2.4.3.2 Employment places

The contribution of Greek shipping to the national economy is not restricted to the bridging of the balance of trade deficit by importing in the country the foreign exchange earnings. Another important sector of the national economy is tourism. However, in order to contribute with the same amount of foreign exchange, like the shipping companies do, another 5 to 6 million tourists have to visit the country each year. Shipping creates, additionally, a significant number of jobs ashore, for instance among others the working staff in shipping companies, in the brokerage companies, in the shipping banks and in the shipping law firms. There are also businesses offering services to shipping not directly related to shipping as such, among others, travel agents and doctors. That is to say, the more vessels are under the Greek flag, the more jobs are created ashore.

One may argue that it is not a matter of the number of vessels under the Greek flag, but it is a matter of how many vessels are under the Greek control. The answer is straightforward that the most important is that the vessel should be under the home flag. It has already been proved that when a vessel is registered under another registry, the crew department will be moved to the country of the crew. Later on the technical department will also be moved to the same country, because the superintendents will be chosen to have the same nationality as the crew.

The impact of foreign exchange earnings form shipping, in the balance of trade, was described above. People involved in Greek shipping know this quite well. However, the impact in the national economy of the earnings generated by the people serving directly or indirectly in shipping has never been studied. It is noteworthy because shipping is the most sizeable and the most successful industry of Greece. In the various major events of Greek shipping they present the researches made by other countries interested in quantifying the question of impact in their national economy.

One of the researches used to present the impact of shipping in the national economy is the one contacted for the American Congress and its results were as follows:

- Each position on board creates additional four positions for the national economy,
- Each dollar generated by shipping generates another one and a half dollar of general income for the national economy.

The other one is a Dutch research, where it is stated that from the total amount of added value generated by shipping, 30% is generated by the vessel, while the remaining 70% is generated by the activities of the offices supporting the vessels and are located in Holland.

The only parameter that has been quantified is the number of people involved, directly and indirectly, in shipping. The following figures are relevant for Greek shipping:

- 30,000 seafarers where half of them sailing in the ocean going vessels,
- 15,000 shore staff,
- 11,000 people are working in indirect shipping activities,
- Several thousands of people in the wider area of shipping (Hellenic Chamber of Shipping, 1999).

In an effort to verify the number of active Greek seafarers raw data was collected from the Ministry of Mercantile Marine, department of statistics, and the author's results are as follows:

Year	A	B	C	Total
1986	4,537	3,136	29,404	37,077
1988	3,146	2,632	26,103	31,881
1990	1,131	2,212	24,554	27,897
1992	314	1,762	23,516	25,592
1994	519	1,652	24,190	26,361
1996	467	1,436	22,556	24,459
			Average	**28,877.83**

Table 4. Number of Greek seafarers 1986-1996.

Source: Compiled by Department of recruitment 1989-99 and Department of Shipping statistics 1987-89.

Where,

A: The number of registered unemployed Greek Seafarers

B: The number of Greek seafarers employed in Greek owned vessels, which are not flying the home flag, however are contracted with the Greek Seafarers Pension Fund (NAT).

C: Number of Greek seafarers employed in Greek registered vessels.

From the table above, it can be seen that the average number of Greek seafarers during the last decade is 28,878, an estimation quite close to the estimation given by the Hellenic Chamber of Shipping. It should be noted that in the above calculation the number of Greek Seafarers employed in Greek owned vessels under foreign flags and not contracted with NAT has not been taken into account. Their sign on and off in these vessels are not registered by the Ministry and/or the Coast Guard, therefore there is no data available. Nevertheless, the number is not considered significant for the calculation.

The most important observation in the table is the acceleration of the decline in the number of Greek seafarers. The percentage of the decline, in only one-decade, accounted for 34%. Another noteworthy fact is that towards 1998 unemployment had increased. It is also remarkable that as the number of seafarers declines, year by year, the number of unemployed seafarers decreases. That is to say, the seafarers left through redundancy or retired, as the number of vessels flown from the registry during 1988-1995 can not be considered as the cause for the reduction of 12,618 seafarers.

In the following table is presented the point where the number of vessels and the number of unemployment seafarers had been found in a balance. The parameter of the conclusion is the point where the number of unemployment decreased to the minimum for the whole decade. During 1995 the number of unemployed reduced to 227, the number of vessels under the Greek flag were 2,051 and the total number of seafarers accounted for about 25,500. The number of seafarers was calculated by interpolation between 1994 and 1996. The Greek statistic department measures the number of active Greek seafarers once every two years.

Year	Number of Greek Owned Vessels	Number of Greek Flagged Vessels	Number of Greek Seafarers	Number of Unemployed Seafarers	Number of foreign seafarers employed on Greek Flagged vessels
1988	2487	2015	31881	3146	5373
1989	2428	2004		1877	
1990	2426	2031	27897	1131	6150
1991	2454	2062		660	
1992	2688	2095	25592	314	8390
1993	2749	2166		360	
1994	3019	2149	26361	519	9183
1995	**3142**	**2051**		**227**	
1996	3246	2013	24459	467	8193
1997	3201	1927		870	
1998	3358	1882		895	

Table 5. Source: Compiled by Department of Shipping Statistics, years 87-97 and Department of Recruitment, years 89-99 and Hellenic Chamber of Shipping, 1999

Additionally, since 1995 where the exodus has commenced, one can clearly identify an acceleration in the level of unemployment. Quantifying the acceleration, the result is an increase of 75% in the level of unemployment for the last three years, while the exodus is only at the beginning with the loss of 169 vessels. Furthermore, in 1990 the percentage of Greek crew on board Greek flagged vessels was 80% and later reduced in 73%. The new amendments allow the Greek compliment to be reduced to 60%.

Taking into account that since 1995 the manning rules have been through changes, the allowable number of foreign crew has been increased and the fact that the number of vessels under the home flag declined, one can draw the conclusion that the number of seafarers will be further reduced. If manning follows the cyclical moods of shipping as well, then one should wait the point where the flight of the vessel from the home flag will be stopped and the new equilibrium between the number of seafarers and the number of vessels will be established.

The problem is that under these circumstances the industry will suffer in the near future for two main reasons. First, the exodus of the seafarers will be continued and probably will be accelerated for the reasons described. Second, the sector will not be attractive for recruitment of new seafarers, therefore in the long term or even in the short term, if the exodus under the prevailing circumstances is massive, the sector will be faced with shortage of seafarers, considering the fact that the government will take measures to attract the vessels back to the home flag when the number of vessels in the registry will reach the bottom. Another fact presented in the above table is the increase of foreign crew on board the Greek flagged vessels, which probably will be accelerated after the 1997 amendments of the manning rules.

2.5 Concluding the chapter

This chapter touched upon a serious problem which today the Greek shipping community is facing, the loss of competitiveness. The importance and the impact of shipping in the national economy has also been analysed. The following chapter will analyse the ship’s related costs in an effort to find out the reason of the loss of competitiveness of Greek flagged vessels.

CHAPTER 3

Analysing the ship's relating costs

Having discussed the problem which the Greek flag is facing nowadays and having analysed the importance of the problem for the national economy, the subsequent step is the detection of the reason which had resulted in the loss of the competitiveness. Although the shipowners argue that it has been caused because of the highly paid Greek crews, this chapter aims to verify this rationale. Therefore, in an effort to detect the "liable" cost for the loss of the competitiveness the cost of operating a vessel will be analysed.

The cost of operating a vessel will be analysed by using the cost division described in Ch.2. In short, the vessel's total cost is subdivided in national and international. The national costs are the vessel's associated costs which their level is depended by the rules of the flying flag, while international costs are those costs which are similar for all the shipowners/operators irrelevant to their nationality.

Therefore, the measurement of tendencies for the international costs will be done according to the provisions of the international statistics and averages of the industry. The costs affected by the rules and requirements of the Greek registry will be measured according to what is valid in the country. Finally, the analysis is focused on tankers and bulkers, which are the two main sectors of interest for the Greek shipowners.

3.1 International costs

3.1.1 Insurance

Hull and Machinery (H&M) and Protection and Indemnity (P&I) insurance markets have different drivers as well as evolution in their own market cycles. Therefore, the analysis of the insurance will be further subdivided in H&M insurance and P&I cover.

Moreover, it should be cited the fact that from all the operating costs of a vessel, insurance is the least amenable cost for generalisation due to the fact that the insurers are looking first at the owner of the vessel and then at the vessel.

3.1.1.1 The H&M insurance

	45,000dwt			95,000dwt			150,000dwt			280,000dwt		
	Cost pd	**A**	**B**	***Cost pd***	**A**	**B**	***Cost pd***	**A**	**B**	***Cost pd***	**A**	**B**
1991	670	12%		810	12%		1,040	14%		1,715	18%	
1992	930	15%	39%	1,125	16%	39%	1,450	18%	39%	2,400	22%	40%
1993	795	13%	-15%	960	14%	-15%	1,235	16%	-15%	2,040	19%	-15%
1994	605	11%	-24%	725	11%	-24%	905	13%	-27%	1,630	17%	-20%
1995	465	9%	-23%	575	9%	-21%	725	11%	-20%	1,300	14%	-20%
1996	450	8%	-3%	560	9%	-3%	715	10%	-1%	1,285	13%	-1%
1997	465	8%	3%	575	9%	3%	725	10%	1%	1,300	13%	1%
1998	480	8%	3%	590	9%	3%	755	10%	4%	1,345	13%	3%
			-19%			-18%			-18%			-12%

A: *the percentage of cost in the total operating cost,*
B: *the annual fluctuation of the cost,*
The cost per day (pd) *is in USD.*

TABLE 6: Daily H&M insurance cost for different tanker sizes, 1991-1998

Source: Compiled by Drewry, 1998b.

By analysing the data cited in the tables 6 and 7, it can be seen that in both tankers and bulkers the daily cost of H&M insurance has declined and averages 17% for the tankers and 35% for bulkers. As a result, while for tankers the H&M insurance accounted for 15% of the daily operating cost of the vessel, it has shrunk down to 10%. In the bulkers the shrinkage is much more impressive because it accounted for 20% of the daily operating cost and during the last years it only accounts for 10%.

The sharp decline in the premiums is the result of the swings in the capacity of the insurance market. More detailed, during 1991-92 the underwriters experienced severe losses, because of the "Piper Alpha" casualty in 1988. The severe losses had resulted in sharp increase in premiums and shrinkage of the market. Nonetheless, as ever with dynamic markets, the shrinkage in the underwriting market was followed by an over capacity, resulting in the sharp decline of the premiums in the late 90s. The only difference is that nowadays the underwriters are entering into a contract more selectively, after the severe losses incurred in the beginning of the 90s (Drewry, 1998a).

	25/50,000dwt			**50/80,000dwt**			**80/150,000dwt**			**150,000dwt+**		
	Cost pd	***A***	***B***	***Cost pd***	***A***	***B***	***Cost pd***	***A***	***B***	***Cost pd***	***A***	***B***
1991	189	17%		248	18%		324	20%		340	22%	
1992	261	21%	38%	347	23%	40%	471	25%	45%	475	26%	40%
1993	217	17%	-17%	295	19%	-15%	425	22%	-10%	415	23%	-13%
1994	148	12%	-32%	186	13%	-37%	301	16%	-29%	286	16%	-31%
1995	127	10%	-14%	148	10%	-20%	242	13%	-20%	230	13%	-20%
1996	110	9%	-13%	125	8%	-16%	236	13%	-2%	212	12%	-8%
1997	101	8%	-8%	113	7%	-10%	201	11%	-15%	181	10%	-15%
1998	109	8%	8%	130	8%	15%	208	11%	3%	208	11%	15%
			-38%			-43%			-27%			-31%

A: *the percentage of cost in the total operating cost,*
B: *the annual fluctuation of the cost expressed in percentage,*
Cost per day *in USD.*

TABLE 7. Daily H&M insurance cost for different bulker sizes, 1991-1998

Source: Compiled by Ocean Shipping Consultants, 1998

3.1.1.2 Protection and Indemnity cover

In converse with the H&M premiums, P&I cover has constantly increased in the last 8 years. A lot of observers say that the increase in premiums can be characterised as permanent, because the world nowadays is more litigious than before. The two main factors which have affected this tendency are the acceleration of the environmental awareness and the ever most costly injury awards (Drewry, 1998a).

	45,000dwt			*95,000dwt*			*150,000dwt*			*280,000dwt*		
	Cost pd	**A**	**B**	**Cost pd**	**A**	**B**	**Cost pd**	**A**	**B**	**Cost pd**	**A**	**B**
1991	165	3%		235	4%		285	4		505	5%	
1992	235	4%	42%	330	5%	40%	425	5	49%	740	7%	47%
1993	275	5%	17%	400	6%	21%	505	6	19%	890	8%	20%
1994	300	5%	9%	440	7%	10%	535	8	6%	975	10%	10%
1995	315	6%	5%	450	7%	2%	550	8	3%	1000	11%	3%
1996	330	6%	5%	480	8%	7%	575	8	5%	1055	11%	6%
1997	345	6%	5%	505	8%	5%	600	8	4%	1110	11%	5%
1998	355	6%	3%	520	8%	3%	615	8	3%	1135	11%	2%
			86%			89%			88%			92%

A: *the percentage of cost in the total operating cost,*
B: *the annual fluctuation of the cost,*
Cost per day *in USD*

TABLE 8. Daily P&I insurance cost for different tanker sizes, 1991-1998

Source: Compiled by Drewry, 1998 (b)

The data of P&I cost for the last 8 years for tankers and bulkers has been visualised in the tables 8 and 9. By examining and analysing the given data one can see that in the non-environmental friendly tankers the premium has increased on average of 89%. The average includes all the sizes of tankers. The increase in the cost had as a result the increase of P&I expense in the contribution of the daily operating cost from 6% to 8%.

In bulkers, the increase was not so sharp as in the case of tankers. However, it averages an increase of 26%. It is noteworthy that the value range of increase is broad in bulkers. In the 150,000dwt+ size of bulkers the total increase, through the last 8 years, accounted for only 12%. On the contrary for the panamax size bulkers, the total increase was accounted for 43%. Therefore, in the bulkers the contribution of P&I premiums in the daily operating costs has slightly declined from 7% to 6%.

	25/50,000dwt			*50/80,000dwt*			*80/150,000dwt*			*150,000dwt+*		
	Cost pd	**A**	**B**	**Cost pd**	**A**	**B**	**Cost pd**	**A**	**B**	**Cost pd**	**A**	**B**
1991	54	5%		66	5%		100	6%		105	7%	
1992	76	6%	41%	95	6%	44%	145	8%	45%	145	8%	38%
1993	81	6%	7%	110	7%	16%	168	9%	16%	165	9%	14%
1994	63	5%	-22%	89	6%	-19%	145	8%	-14%	136	9%	-18%
1995	58	5%	-8%	78	5%	-12%	122	7%	-16%	110	8%	-19%
1996	57	5%	-2%	79	5%	1%	120	6%	-2%	106	6%	-4%
1997	58	4%	2%	82	5%	4%	112	6%	-7%	102	6%	-4%
1998	60	4%	3%	90	6%	10%	115	6%	3%	106	6%	4%
			21%			43%			26%			12%

A: *the percentage of cost in the total operating cost,*
B: *the annual fluctuation of the cost,*
Cost per day *in USD.*

TABLE 9. Daily P&I insurance cost for different bulker sizes, 1991-1998.

Source: Compiled by Ocean Shipping Consultants, 1998

3.1.2 Repairs and maintenance

The repairs and maintenance cost is composed of the running repairs and maintenance as well as of the docking repairs and maintenance. In the bulk carrier sector, in the beginning of 90s the yearly increase was around 5%. However, the rise of the cost has been decelerated since 1995, and as a result the annual increase has been declined to 2% on average. Nonetheless, the total increase in the repairs and maintenance cost since 1991 accounts for 25% (table 10).

Another point is that in total, the repairs and maintenance are representing 27% of the daily operating cost, on average among all sizes of bulkers. Additionally, there is a tendency of a 3% increase in the contribution of repairs and maintenance in the total operating cost in all the sizes of bulkers. Notably, the costs involved in the repairs and maintenance of this type of ships is lower than those of the tankers.

Tankers

	45,000dwt			95,000dwt			150,000dwt			280,000dwt		
	A1	B	C	A2	B	C	A2	B	C	A2	B	C
1991	1,300	23%		1,780	27%		2,150	29%		2,600	27%	
1992	1,315	22%	1%	1,810	26%	2%	2,180	28%	1%	2,685	25%	3%
1993	1,330	22%	1%	1,820	26%	1%	2,190	28%	0%	2,740	26%	2%
1994	1,110	20%	-17%	1,440	23%	-21%	1,820	26%	-17%	2,330	24%	-15%
1995	1,110	21%	0%	1,440	23%	0%	1,835	27%	1%	2,355	25%	1%
1996	1,135	21%	2%	1,480	24%	3%	1,865	27%	2%	2,395	25%	2%
1997	1,165	21%	3%	1,505	24%	2%	1,905	27%	2%	2,450	25%	2%
1998	1,190	21%	2%	1,550	24%	3%	1,975	27%	4%	2,535	25%	3%
			-7%			-11%			-7%			-1%

Bulkers

	25/50,000dwt			50/80,000dwt			80/150,000dwt			150,000dwt		
	A1	B	C	A1	B	C	A1	B	C	A1	B	C
1991	286	26%		368	27%		439	27%		411	26%	
1992	300	24%	5%	386	25%	5%	460	24%	5%	431	24%	5%
1993	308	25%	3%	403	26%	4%	485	25%	5%	451	25%	5%
1994	315	26%	2%	420	28%	4%	510	28%	5%	470	27%	4%
1995	325	27%	3%	443	30%	5%	528	29%	4%	489	29%	4%
1996	335	27%	3%	454	30%	2%	538	29%	2%	508	29%	4%
1997	345	26%	3%	468	30%	3%	555	30%	3%	524	29%	3%
1998	352	26%	2%	475	29%	1%	560	29%	1%	535	29%	2%
			21%			26%			25%			27%

A1: *Daily repair and maintenance cost in USD per day*
A2: *Annual repair and maintenance cost in ,000USD per day*
B: *Percentage of the cost in the daily operating cost*
C: *Annually fluctuation of cost*

Table 10. Repairs and maintenance cost for bulkers and tankers.

Source: Compiled by Drewry, 1998b and Ocean Shipping Consultants.

In tankers, on the other hand, the total amount is higher because of the more stringent operating environment. As a matter of fact, the total amount daily spent for repairs and maintenance has declined and it accounts for -7% during the last 8 years. Looking at the last four years the cost has increased annually at a low rate of about 2%. However, the sharp decline in 1994 and the stable situation in 1995 have resulted in the total negative increase of this cost in tankers. Finally, as a cost, it represents the 25% on average for all the sizes and has declined by 1% since the beginning of the decade.

The increase of this expenditure in the early 90s has an explanation back in the 80s, where both markets had experienced a simultaneous slump. During that period the expenses associated with the repairs and maintenance were minimised as a measure to stay buoyant in the low freight level market of that period. The consequent improvement of the markets, in terms of freight rates, in the beginning of the 90s resulted in the increase of expenditures for this cost category. Later, after the first half of the decade, the rate of increase decelerated as the vessels' maintenance plan was back in black.

Another factor, which had influenced shipowners' eagerness to increase the expenditure associated with repairs and maintenance, was the fact that the rise of the prices in the yards was slower than the demand. Later, when the demand was gone the yards reduced their prices sharply in order to maintain the same utilisation factor. The later resulted in the marginal increase of the repairs and maintenance cost in the second half of the 90s (Drewry, 1998a,b and Ocean Shipping Consultants, 1998).

3.1.3 Supplies and Lubricants

The principal stores and supplies are the marine and deck stores, the engine stores and the steward's stores. The cost of provision of all these supplies and the lubricants in the last 8 years has declined by 6% on average for all the sizes of vessels (see table 11). It is remarkable that one year the increase of the cost is around 2% and when, the following year, the prices decline the decrease is more significant at the level of –5%. The result of the constant decline through the years and the fluctuations, year by year, have resulted in the almost stable contribution of 13% of this cost in the daily operating cost of the vessel.

The bottom line from this decrease is economy for the shipowners. The decrease has its roots in the depressed market of the supplies and the spare parts. On the other hand, luboil market follows the fluctuation of the oil market and its refined products, as lubricants are an oil product. However, leaving aside the short-term distortions of the prices, in the long terms the prices have been stable for almost all the decade (Drewry, 1998a).

	45,000dwt			95,000dwt			150,000dwt			280,000dwt		
	Cost pd	**A**	**B**	**Cost pd**	**A**	**B**	**Cost pd**	**A**	**B**	**Cost pd**	**A**	**B**
1991	810	14%		835	13%		865	12%		1,370	14%	
1992	765	13%	-6%	795	11%	-5%	820	10%	-5%	1,300	12%	-5%
1993	755	13%	-1%	780	11%	-2%	810	10%	-1%	1,275	12%	-2%
1994	810	15%	7%	835	13%	7%	865	12%	7%	1,355	14%	6%
1995	765	14%	-6%	795	13%	-5%	820	12%	-5%	1,300	14%	-4%
1996	780	14%	2%	810	13%	2%	835	12%	2%	1,330	14%	2%
1997	740	13%	-5%	765	12%	-6%	795	11%	-5%	1,260	13%	-5%
1998	755	13%	2%	780	12%	2%	810	11%	2%	1,275	13%	1%
			-6%			-6%			-6%			-7%

A: *the percentage of cost in the total operating cost,*
B: *the annual fluctuation of the cost*,
Cost per day *in USD.*

TABLE 11. Daily stores and lubs cost for different tanker sizes, 1991-1998

Source: Drewry, 1998b

3.1.4 Capital cost

Getting started the analysis with the cost of the newly built bulk carriers, one can observe in the table 12 that their nominal costs have declined almost by 11%. The higher decline of price written down, that is 17%, was for the smaller vessels of 25/50,000dwt. The lowest decline, 5%, was for the bigger bulkers of over 150,000dwt.

The total reduction for the capital charges is higher than the reduction in the price of a newly built bulk carrier and it was on average at 15% for the last 7 years. The highest and the lowest reduction incurred in the same categories of ship sizes as in the case of the price of the newbuildings, where the average reduction accounted for 21% and 9% respectively.

Year	Newbuilding Price	A	Daily Capital Charge	A	Second hand Value	A	Daily Capital Charge	A
25/50000dwt								
1990	23.8		8,280		12.7		5,893	
1992	24.1	1%	8,387	1%	14	10%	6,496	10%
1994	19.8	-18%	6,890	-18%	15.5	11%	7,208	11%
1995	20.4	3%	7,099	3%	17.6	14%	8,184	14%
1996	18.9	-7%	6,314	-11%	14.7	-16%	6,555	-20%
1997	19.6	4%	6,548	4%	13.5	-8%	6,020	-8%
		-17%		-21%		10%		7%
50/80000dwt								
1990	30.3		10,544		19.5		9,048	
1992	30.1	-1%	10,475	-1%	20.5	5%	9,512	5%
1994	27.1	-10%	9,431	-10%	19.2	-6%	8,928	-6%
1995	27.9	3%	9,709	3%	22.7	18%	10,556	18%
1996	28.3	1%	9,454	-3%	25.5	12%	11,147	6%
1997	27.5	-3%	9,187	-3%	19.5	-24%	8,695	-22%
		-9%		-13%		6%		1%
100/150000dwt								
1990	44.8		15,590		29.4		13,642	
1992	43.2	-4%	15,034	-4%	30.5	4%	14,152	4%
1994	39.7	-8%	13,816	-8%	25.7	-16%	11,951	-16%
1995	39.6	0%	13,781	0%	29.1	13%	13,532	13%
1996	40.9	3%	13,663	-1%	23.1	-21%	10,300	-24%
1997	39.7	-3%	13,262	-3%	22.9	-1%	10,211	-1%
		-12%		-16%		-20%		-23%
150000+dwt								
1990	47.5		16,530		30.4		14,106	
1992	45.9	-3%	15,973	-3%	30.9	2%	14,338	2%
1994	42.5	-7%	14,790	-7%	29	-6%	13,485	-6%
1995	42.3	0%	14,720	0%	32	10%	14,880	10%
1996	45.3	7%	15,133	3%	27.5	-14%	12,262	-18%
1997	44.9	-1%	15,000	-1%	27.6	0%	12,307	0%
		-5%		-9%		-8%		-11%

Newbuilding prices in million USD, **Second hand prices** in million USD, **Daily capital charges** *in USD*, **A:** the annual fluctuation.

Table 12. Bulkers' capital cost.

Source: Compiled by Drewry 1998a

The demolition of the prices in bulkers' newbuilding market was due to the world economic slump and the subsequent collapse of the freight rates in the late 1996. The poor returns had forced the shipowners to be reluctant in ordering new capacity, while the yards, in an effort to fill the remaining capacity, had reduced their prices (Ocean Shipping Consultants, 1998).

However, the situation in the second hand market is somehow different. For instance, the price in the 100,000dwt and over has declined by almost 14%, while in the sector of handy to panamax size bulkers the prices have seen an increase of 8% through the years on average. In the latter category the capital charges have been risen, albeit not sharply in all the sizes.

More detailed, in the panamax size vessels the increase in the capital charges accounts for the marginal 1% and in the handy sector the increase is 7%. On the contrary, in the bigger bulkers of 100-150,000dwt, where the nominal prices have fallen, the daily capital charges have declined more sharply than the prices by 23%, while for the vessels of 150,000dwt and over their daily capital charges have declined by 11%.

By analysing the influential factors of the second hand market in bulk carriers, one can clearly see that in the early 90s the situation was buoyant, because of the prevailing circumstances in the end of 80s and the seasonal peaks of the early 90s. Unfortunately, a combination of oversupply and a nosedive of BFI in 1995 resulted in the collapse of the prices in the second hand market (Drewry, 1998a and Ocean Shipping Consultants, 1998).

The tanker market, however, has two different faces; significant decreases in most newbuildings sectors and rise of prices in the second hand market. In details, at the end of 1996 the newly built tankers were costing 15% lower, on average, in comparison with

1991. The lowest written down decrease of 2% was in the VLCC size vessels, while the highest decline was in the suezmax sector, that is 27%.

Year	Newbuilding Price	A	Daily capital Charge	A	Secondhand Value	A	Daily capital Charges	A
PRODUCTS TANKER NEWBUILDING AND SECONDHAND CAPITAL COST								
1991	37		10,713		-		-	
1992	33	-11%	9,555	-11%	-		-	
1993	31	-6%	8,975	-6%	-		-	
1994	32.5	5%	9,410	5%	23		7,225	
1995	33.9	4%	9,815	4%	22.5	-2%	7,068	-2%
1996	33	-3%	9,555	-3%	24.5	9%	7,696	9%
		-10%		-10%		7%		7%
AFRAMAX NEWBUILDING AND SECONDHAND CAPITAL COST								
1991	52		15,056		-		-	
1992	47	-10%	13,068	-13%	-		-	
1993	44.3	-6%	12,826	-2%	-		-	
1994	41.1	-7%	11,900	-7%	33.2		10,429	
1995	43.5	6%	12,595	6%	34.5	4%	10,838	4%
1996	42	-3%	12,160	-3%	35	1%	10,995	1%
		-20%		-20%		5%		5%
SUEZMAX NEWBUILDING AND SECONDHAND CAPITAL COST								
1991	70		20,267		37		11,623	
1992	62	-11%	17,951	-11%	36	-3%	11,309	-3%
1993	56	-10%	16,214	-10%	34.5	-4%	10,838	-4%
1994	53	-5%	15,345	-5%	34	-1%	10,681	-1%
1995	54.3	2%	15,722	2%	35.5	4%	11,152	4%
1996	52.5	-3%	15,200	-3%	42	18%	13,194	18%
		-27%		-27%		14%		14%
150000dwt NEWBUILDING AND SECONDHAND CAPITAL COST								
1994	84.3		24,407		50		15,707	
1995	84.5	0%	24,465	0%	52	4%	16,335	4%
1996	83	-2%	24,031	-2%	58	12%	18,220	12%
		-2%		-2%		16%		16%

***Newbuilding prices** in million USD,*
***Secondhand values** in million USD,*
***Daily capital charge** in USD,*
***A:** the annual fluctuation.*

Table 13. Tankers' capital cost.

Source: Compiled by Drewry, 1998a.

The daily capital charge follows, in percentage, the reduction of the prices (see table 13). The reduction in the price is the result of the increased capacity in the South Korean yards as well as because of the severe competition among the yards in the Far East (Drewry, 1998a).

On the contrary, the second hand market of tankers has increased by 11% and the highest increase, that is 16%, was noticed in the VLCCs, while the lowest was noticed in the aframax size tanker vessels. The percentage of increase in the price of second hand tankers coincides with the percentage of the increase in the daily capital cost for these vessels (see table 13). The written down increase was a reflection of firmer rates and expectations for even greater potential earnings (Drewry, 1998a).

3.1.5 Bunkering cost

In the long terms, the bunker prices follow the evolution of prices in the crude oil and other petroleum products. However, in the short terms the local prevailing circumstances can lead to a situation where the bunker prices and the crude oil prices are out of step. The local prevailing circumstances means the regional supply and demand equation, where the bargaining power of the supply side is dependent on the availability of crude oil in the region and the refining capacity of the local refineries.

The level of prices is also affected locally by the competition among local players and consequently by the number of them. Another important influential factor in the local competition and ultimately in the local pricing is the mean of delivering the bunkers. Is it done off shore or in the port? If the bunkers are delivered in a port, is the port designated only for bunkering purposes? (Drewry, 1998a).

All these factors described above influenced the regional markets and as a result the price of fuel oil has fluctuated significantly since 1990. During the period 1990-1993 the prices were falling, reaching the trough of the period studied. Since 1993 the prices have constantly risen. Therefore, the average fluctuation of prices is positive and accounts for 7%.

Arabian Gulf						*NW Europe*			
	FO	***A***	***MDO***	***A***		***FO***	***A***	***MDO***	***A***
1990	115		212			105		191	
1991	102	-11%	209	-1%		87	-17%	174	-9%
1992	90	-12%	207	-1%		88	1%	161	-7%
1993	80	-11%	208	0%		73	-17%	151	-6%
1994	90	13%	204	-2%		88	21%	133	-12%
1995	100	11%	182	-11%		100	14%	141	6%
1996	111	11%	211	16%		111	11%	178	26%
		0%		1%			12%		-2%
US Gulf						*SE Asia*			
1990	104		201			112		213	
1991	78	-25%	174	-13%		96	-14%	196	-8%
1992	81	4%	163	-6%		87	-9%	204	4%
1993	75	-7%	160	-2%		78	-10%	157	-23%
1994	83	11%	148	-8%		88	13%	142	-10%
1995	96	16%	149	1%		100	14%	148	4%
1996	109	14%	188	26%		111	11%	193	30%
		11%		-2%			3%		-2%

FO: *fuel oil,* **MDO:** *marine diesel oil,* **A:** *annual fluctuation,*
Figures *in USD per ton.*

Table 14. Fuel oil and diesel oil prices in selected areas.

Source: Compiled by Drewry, 1998a.

The price evolution of the more expensive marine diesel oil (mdo) follows the same pattern as the fuel oil, the only difference is that the trough in the mdo prices was recorded in 1994. Since then the prices have risen, however the total average fluctuation of mdo is negative and it accounts for 1%.

In the analysed period, the savings in the bunker expenses do not come from the price evolution. During the last decade the vessels are equipped with engines with drastically lower consumption in fuel oil. In comparison with the vessels built in the 70s the reduction in the daily consumption of fuel oil for the vessels built in the 90s, is more than 20% in all the size and type of vessel categories (examples are given in table 15). Moreover, comparing the consumption of fuel oil between a VLCC built in the 70s and a VLCC built in the 90s the difference reaches the astonishing 62%. However, it should be cited the fact that the earlier VLCCs were turbine powered.

Bulk Carriers				**Tankers**			
Panamax	***FO pd***	***A***	***Service Speed***	***VLCC***	***FO pd***	***A***	***Service Speed***
Mid 1970s type	45		14,5	260,000dwt-1970s built	170		12
B&W Mk.V (1990s)	34	-24%	14	280,000dwt-1990s built	64	-62%	14
Cape				***Clean***			
1970s built, 120,000dwt	65		14,5	40,000dwt-1980s built	35		14
1990s built, 150,000dwt	52	-20%	14,5	40,000dwt-1999s built	27	-23%	14
Daily consumption *in tones*, ***A:*** *the percentage of change*, ***Speed:*** *in knots*							

Table 15: Comparison of daily consumption.

Source: Compiled by Drewry, 1998a.

3.1.6 Port costs and canal charges

Port and canal dues are a fundamental consideration for any shipowner attempting to define voyage costs. The recently environmental pressure and the infrastructure development in the ports resulted in the rise of the associated charges. On the other hand, the major canals, Suez and Panama, have experienced mixed fortunes in terms of traffic figures and as a consequence tolls have been reduced or frozen. Explicitly, the Suez Canal authority in an effort to revive demand reduced the tolls, while in Panama the reverse was true (Drewry, 1998a).

3.1.7 Summing up the international costs

25/50,000dwt	H&M	P&I	R&M	Fuel oil	Capital Cost	Total pd	A
1991	518	148	784	2,318			
1992	715	208	822	2,744	8,387	12,876	
1993	595	222	844	2,672			
1994	405	173	863	2,504	6,890	10,835	-16%
1995	348	159	890	3,005	7,099	11,501	6%
1996	301	156	918	3,354	6,314	11,043	-4%
1997	277	159	945	2,563	6,548	10,492	-5%
1998	299	164	964	2,260			-19%
50/80,000dwt							
1991	679	181	1,008	2,815			
1992	951	260	1,058	3,346	1,0475	16,089	
1993	808	301	1,104	3,253			
1994	510	244	1,151	3,063	9,431	14,398	-11%
1995	405	214	1,214	3,676	9,709	15,218	6%
1996	342	216	1,244	4,096	9,454	15,353	1%
1997	310	225	1,282	3,162	9,187	14,165	-8%
1998	356	247	1,301	2,785			-12%
100/150,000dwt							
1991	888	274	1,203	3,880			
1992	1290	397	1,260	4,636	15,034	22,618	
1993	1164	460	1,329	4,498			
1994	825	397	1,397	4,261	13,816	20,696	-8%
1995	663	334	1,447	5,115	13,781	21,340	3%
1996	647	329	1,474	5,686	13,663	21,798	2%
1997	551	307	1,521	4,188	13,262	19,828	-9%
1998	570	315	1,534	3,685			-12%
150,000dwt+							
1991	932	288	1,126	5,158			
1992	1301	397	1,181	6,184	15,973	25,036	
1993	1137	452	1,236	5,992			
1994	784	373	1,288	5,700	14,790	22,934	-8%
1995	630	301	1,340	6,841	14,720	23,832	4%
1996	581	290	1,392	7,594	15,133	24,990	5%
1997	496	279	1,436	6,069	15,000	23,280	-7%
1998	570	290	1,466	5,335			-6%

Figures *in USDpd*, **Capital cost** *has been calculated for a newbuilding*,
A: *the percentage of change.*

Table 16. Total international cost for newly built Bulk carrier per day.

Source: Compiled by Drewry 1998 b, Ocean Shipping Consultants 1998

Without considering the stores and lubricants expenses, where the former have declined and the latter are stable, during the analysed period, nor the port and canal dues, where the former have increased and the latter have experienced mixed fortunes, the sum up of all the international costs, associated with the operation of bulk carriers, gives us the following results (see table 16):

- An average decrease of the costs of 12% on average for all the size of bulk carriers.
- The decline of the international cost was greater in the smaller bulkers and was accounted for 16%.
- The international cost for the bigger bulk carriers has declined to a level lower than the average of all sizes and accounts for 9%.

In tankers, the same was repeated, but this time from all the international costs were not taken into consideration not only the port and canal dues but also the bunkers. For the port and canal dues is valid what had been written for the bulkers, while it shall be mentioned the fact that the bunkers have seen an increase of 7% during the analysed period. The results can be summed up as follows (see also table 17):

- As the size of the analysed vessels is getting bigger the percentage of decline in the total international cost is getting higher, where in the Suezmax size vessels the decline in the total international cost reaches the 24%. In this conclusion the VLCCs are not considered, because of the short available data.
- On average the total international cost has declined by 14%.

"45,000dwt" H&M		P&I	R&M	S&L	Capital Charges	Total pd	A
1991	670	165	1,300	810	10,713	13,658	
1992	930	235	1,315	765	9,555	12,800	-6%
1993	795	275	1,330	755	8,975	12,130	-5%
1994	605	300	1,110	810	9,410	12,235	1%
1995	465	315	1,110	765	9,815	12,470	2%
1996	450	330	1,135	780	9,555	12,250	-2%
1997	465	345	1,165	740			-10%
1998	480	355	1,190	755			
"95,000dwt"							
1991	810	235	1,780	835	15,056	18,716	
1992	1125	330	1,810	795	13,068	17,128	-8%
1993	960	400	1,820	780	12,826	16,786	-2%
1994	725	440	1,440	835	11,900	15,340	-9%
1995	575	450	1,440	795	12,595	15,855	3%
1996	560	480	1,480	810	12,160	15,490	-2%
1997	575	505	1,505	765			-18%
1998	590	520	1,550	780			
"150,000dwt"							
1991	1040	285	2,150	865	20,267	24,607	
1992	1450	425	2,180	820	17,951	22,826	-7%
1993	1235	505	2,190	810	16,214	20,954	-8%
1994	905	535	1,820	865	15,345	19,470	-7%
1995	725	550	1,835	820	15,722	19,652	1%
1996	715	575	1,865	835	15,200	19,190	-2%
1997	725	600	1,905	795			-24%
1998	755	615	1,975	810			
"280,000dwt"							
1991	1715	505	2,600	1,370			
1992	2400	740	2,685	1,300			
1993	2040	890	2,740	1,275			
1994	1630	975	2,330	1,355	24,407	30,697	
1995	1300	1000	2,355	1,300	24,465	30,420	-1%
1996	1285	1055	2,395	1,330	24,031	30,096	-1%
1997	1300	1110	2,450	1,260			-2%
1998	1345	1135	2,535	1,275			

***Figures** in USD**, A:** the percentage of change, **Capital charges** were calculated*
For a newly built vessel.

Table 17. Total international cost for newly built tanker per day.

Source: Compiled by Drewry 1998a,b.

3.2 National Costs

In this part, the costs influenced by the flying flag will be cited and analysed. The objective is to discover the most influential cost to the total national cost. In other words, the cost which has forced the shipowners to flag out their vessels, searching a more economical and inexpensive flag than the Greek. The analysis commences by analysing the cost of manning with national seafarers and continues by analysing the registry cost. Finally, this is concluded with the presentation of the administrative expenses.

3.2.1 Manning cost

Before going into the analysis of the Greek seafarers cost, it is important to cite what is the perception about the cost of manning in international level for the decade of 90s. The commencement of the 90s coincides with the collapse of the former Eastern Block. The collapse resulted in the release of a large number of qualified personnel in the labour market and the subsequent decline of the crewing cost.

In the mid 90s while the shipping market was recovering, the crewing cost began to show real increase. However, the increasingly supply of seafarers in the market served to restrain the acceleration of the nominal rates. A good example of increasing supply is the case of Filipino crews, where in 1993 the registered Filipino seafarers were 316.501 and until 1996 that number had increased by 31,7%. In 1996 the number of registered Filipino seafarers was 416.882, placing a downward pressure in the average crewing cost (Ocean Shipping Consultants, 1998).

Despite the aforementioned negative factors the crewing cost has exhibited a stable increase during the whole period. In the tankers the total increase during the period 1991-1998 accounts for 11%, with an annual increase of 1,5% on average (see table 13).

On the other hand, the increase in the bulkers can not be characterised marginal as it is in the case of the tankers, because the cost was increasing annually by 5,5% and finally it accounts for 39% during the analysed period (see table 18).

Manning cost for tankers

	45,000dwt			95,000dwt			150,000dwt			280,000dwt		
	A1	***B***	***C***	***A1***	***B***	***C***	***A1***	***B***	***C***	***A1***	***B***	***C***
1991	2050	36%		2100	32%		2100	29%		2140	22%	
1992	2100	35%	2%	2150	31%	2%	2150	27%	2%	2190	20%	2%
1993	2130	36%	1%	2180	31%	1%	2180	28%	1%	2225	21%	2%
1994	2145	38%	1%	2195	34%	1%	2195	31%	1%	2240	23%	1%
1995	2175	40%	1%	2210	36%	1%	2210	32%	1%	2260	24%	1%
1996	2205	40%	1%	2230	36%	1%	2230	32%	1%	2280	24%	1%
1997	2260	41%	2%	2285	36%	2%	2285	32%	2%	2335	24%	2%
1998	2315	41%	2%	2345	36%	3%	2345	32%	3%	2395	24%	3%
			12%			11%			11%			11%

Manning cost for bulkers

	25/50000dwt			50/80000dwt			80/15000dwt			150000dwt+		
	A2	***B***	***C***	***A2***	***B***	***C***	***A2***	***B***	***C***	***A2***	***B***	***C***
1991	476	42%		550	40%		629	38%		581	37%	
1992	501	40%	5%	579	38%	5%	662	35%	5%	612	34%	5%
1993	529	42%	6%	611	39%	6%	698	36%	5%	660	36%	8%
1994	563	47%	6%	649	44%	6%	741	40%	6%	695	40%	5%
1995	583	48%	4%	673	46%	4%	767	42%	4%	730	43%	5%
1996	630	50%	8%	727	48%	8%	831	44%	8%	799	45%	9%
1997	690	52%	10%	768	49%	6%	856	46%	3%	827	46%	4%
1998	715	52%	4%	795	49%	4%	885	46%	3%	860	46%	4%
			42%			38%			35%			40%

A1: the daily manning cost in USD
A2: The annual manning cost in thousands of USD
B: The manning cost as a percentage of the operating cost
C: Annual increase of the manning cost

Table 18. Manning cost for bulkers and tankers.

Source: Compiled by Drewry 1998b and Ocean Shipping Consultants, 1998.

On the other hand, during the same period the increase of the Greek seafarers follows a different or to be more accurate, a faster track of rise. During the period 1991-1995 the annual rise of salaries was higher than 10%. The sharp growth of salaries during the first five years of the decade was granted as a motivation to attract people back in the seafaring profession after the large redundancies of the 80s. Additionally, the inflation rate in the country was high. Therefore, there was a need for annual increase of salaries, higher than the inflation rate, in order that they remain attractive.

Since 1995 a deceleration in the rise of salaries has been noticed. The acceleration was eased off because of three main reasons. First, the harmonisation of the Greek economy with the other European economies has resulted in the constant decline of the inflation rate. As a result, the salary rises have been following the level of the inflation rate. Second, the salaries reached the required attractive level and simultaneously became very costly for the shipowners. Finally, the rate of entrance in the maritime profession was considered sufficient for the shipowners needs.

Chief Officer; Basic wage

	GRD	GRD/1 USD	USD
1998	287.130	277	1036.57
	6%		4%
1997	270.875	271	999.5387
	8%		-2%
1996	251.390	247	1017.773
	9%		5%
1995	230.635	237	973.1435
	11%		12%
1994	207.780	240	865.75
	14%		18%
1993	182.265	249	731.988
	30%		-9%
1991	140.245	175	801.4
Total	78%		29%

Table 19. Chief officer's basic wage during 1991-99 and its exchange in USD.

Source: Compiled by Syllogiki Symvassi Ergassias 1991-1998 and Nordstedts Tryckeri AB, 1999.

However, by exchanging the Greek drachma to US dollar (table 19) one can have some very interesting observations:

- Only in 1994 and 1995 the increase in dollars was higher than the increase in drachmas.
- In the two-year period of 1991-93, while the increase in drachmas was 30%, expressing the salaries in dollars, there was a decrease of the cost by 9%.
- Another year of negative increase, in dollars, was in 1997, where in drachmas the increase accounts for 8%.
- Lastly, in the years 1996 and 1998 the nominal increase in dollars was lower than the nominal increase in drachmas.

Therefore, albeit in Greek drachma the total increase of the salaries accounts for 78%, expressing the salaries in US dollars the nominal increase is 29%.

However, the 29% increase in salaries is much higher than the increase in the salaries of the cheaper crews. During the same period the International Transport Federation (ITF) has given only an increase of 19% in the Total Crew Cost agreements (Holmer, 1999). The observation is that the rate of increase for the vessels flying the home flag is much higher than the one of their competitor flying flags of convenience.

	Master	C/O	2nd Off	Ch. Eng	2nd Eng	3rd Eng	Bosun	AB	Ch. Cook	
Greek	8,558	5,620	4,347	8,304	5,821	4,558	3,553	2,847	4,294	
	156%	159%	159%	164%	168%	171%	199%	187%	262%	181%
Filipino	3,345	2,168	1,678	3,149	2,168	1,678	1,187	991	1,187	

Table 20. Contrasting the salaries of Greek seafarers with the Filipino seafarers.

Source: Drewry, 1998a and four major Greek shipowning companies, 1999.

Moreover, in the table 20 a comparison between the salaries of Greek seafarers and their Filipino counterparts is exhibited schematically. The result of the comparison is that the Greek seafarers are on average 181% more expensive than the Filipinos. Bearing this fact and the higher rate of increase in the Greek salaries in mind one can conclude that the pre-existing cost difference has been further enlarged during this decade. Ultimately the total manning cost for the vessels flying the home flag has increased.

Furthermore, the table 21 is an effort to visualise the difference in the total cost between the Greek seafarers and their Filipino counterparts. The monthly total cost of a fully Greek crew is 71,093$. On the other hand, the total cost for fully Filipino crew is 26,614$ monthly and comparable with a fully Greek crew is 167% less expensive.

However, according to the latest amendments of the Greek manning rules, there is no requirement for a fully Greek crew. The last column of the table 21 presents the total cost of a mixed Greek and Filipino crew. The results are that the mixed crew is more expensive by 114% than a fully Filipino crew compliment. Admittedly, the difference is still high, despite the partially use of Filipinos, because the Greek compliment accounts, in the total amount, 86% of the total crew cost.

	Filipino	Greek	9Greeks+8Filipino		
Master	3,345	8,558	8,558	0	
C/O	2,168	5,620	5,620	0	
2nd Off(2)	3,356	8,694	4,347	1,678	
Bosun	1,187	3,553	3,553	0	
AB(3)	2,973	8,541	2,847	1,982	
Ch.Eng	3,149	8,304	8,304	0	
2nd Eng	2,168	5,821	5,821	0	
3rd Eng	1,678	4,548	4,558	0	
Electrician	1,678	4,619	0	1,678	
Oiler(3)	2,973	8,541	0	2,973	
Ch.Cook	1,187	4,294	4,294	0	
Steward	752	0	0	752	Total
Total	26,614	71,093	47,902	9063	=56,965
Salaries *in USD. (for 1998)*		167%	84%	16%	114%

Table 21. Various total crew cost calculations.

Source: Drewry, 1998a and four major Greek Shipowning companies, 1999.

3.2.2 The cost of Greek registry

The cost of a registry is measured according to the manning requirements, the taxation regime and the level of annual fees. The manning cost under the Greek flag has already been exhibited and analysed. The remaining cost will be calculated in this part. However, by comparing only the annual fees and all the other related cost, the comparison is meaningless, because the actual size of the cost is not either obvious or straightforward, as it is usually expressed in dollars per gross tonnage or net tonnage.

Therefore, by chance a vessel was selected and its annual registry cost under the Greek flag was calculated. For your guidance, the vessel is a 17.000gt/10.500nt product tanker employed in worldwide trade. In addition, the comparison of the cost under the Greek flag with other flags was necessary. For this comparison the three major choices of the Greek shipowners when they fly from the home registry were selected. Those are the Cypriot, the Liberian and the Panamanian registries.

The results, which are exhibited with details in table 22, are presenting that under the Greek flag the annual tonnage taxes are much higher than the second more expensive flag. The second most expensive flag, in the comparison, is the Liberian. It is 276% less expensive than the Greek. The cheapest flag of the comparison is the Cypriot flag and it is 537% less expensive than the Greek.

Furthermore, in the introductory paragraph of this part, it was mentioned that except the annual fees and the other charges, there is another important factor in the selection of the flag. This factor is the taxation regime of the country. The taxation regimes of the registries that were selected to be compared with the Greek, including the Greek, is as follows:

Registry	***Tax Form***	***Annual taxes depend upon***	***Amount in USD (for the specific vessel)***	***Total payment in USD***	***Other payments***
Greek	Tonnage taxes	Age of the vessel	0,93 per grt	15,810	No registration fees. There are only minimal documentation dues and other small charges.
Cypriot	Tonnage taxes	Grt	770+1,709	2,479	Registration fees 1,800$, plus other small charges.
Liberian	Tonnage taxes	Nrt	O,4per nrt	4,200	Registration from foreign registry 2,500$, plus documentation dues and other small charges.
Panamanian	Tonnage taxes	nrt/grt	O,10/nrt+ 3,000	4,050	3,OOO$ registration fee, plus documentation dues and other charges.

Table 22. Cost comparison among registries

Source: Compiled by Lucca, 1997.

- Cyprus: profits generated by Cypriot vessel or dividends received from Cypriot Shipping companies are exempted from taxation. A Cypriot shipping company is any shipping company registered in Cyprus belonging exclusively to non-residents. The company is registered as a private company with limited liability under the provisions of the Cypriot Shipping Law.
- Liberia: there are no corporate or individual taxes in Liberia to non-resident corporations, including shipowning companies.
- Panama: The fiscal legislation in Panama taxes only persons and companies whose sources of income arise or derive from activities within the territory of Panama, and therefore there are no income or withholding taxes to non resident companies.
- Greece: Any foreign enterprise engaged in the administration, operation, chartering, insurance, average adjusting, or ship brokerage of ships over 1,000grt under the

Greek or foreign flag is exempted from any taxes on their income, provided they cover their operation expenses in Greece by the equivalent of at least 50,000$ annually (Lucca, 1997).

3.2.3 Administration and overheads

Tankers												
	45000dwt			**95000dwt**			**150000dwt**			**280000dwt**		
	A1	**B**	**C**	**A1**	**B**	**C**	**A1**	**B**	**C**	**A1**	**B**	**C**
1991	660	11%		755	12%		890	12%		1415	15%	
1992	660	11%	0%	755	11%	0%	890	11%	0%	1445	13%	2%
1993	685	10%	4%	820	12%	9%	960	12%	8%	1370	13%	-5%
1994	615	11%	-10%	755	12%	-8%	810	11%	-16%	1300	13%	-5%
1995	550	10%	-11%	660	11%	-13%	700	10%	-14%	1205	13%	-7%
1996	590	11%	7%	700	11%	6%	750	11%	7%	1235	13%	2%
1997	605	11%	3%	720	11%	3%	770	11%	3%	1265	13%	2%
1998	620	11%	2%	735	11%	2%	785	11%	2%	1295	13%	2%
			-5%			-1%			-10%			-8%
Bulkers												
	25/50000dwt			**50/80000dwt**			**80/150000dwt**			**150000+dwt**		
	A2	**B**	**C**	**A2**	**B**	**C**	**A2**	**B**	**C**	**A2**	**B**	**C**
1991	116	10%		132	10%		143	9%		140	9%	
1992	117	9%	1%	133	9%	1%	145	8%	1%	141	8%	1%
1993	118	9%	1%	134	9%	1%	148	8%	2%	145	8%	3%
1994	120	10%	2%	135	9%	1%	150	8%	1%	150	9%	3%
1995	121	10%	1%	135	9%	0%	150	8%	0%	150	9%	0%
1996	122	10%	1%	135	9%	0%	151	8%	1%	151	9%	1%
1997	125	9%	2%	139	9%	3%	155	8%	3%	156	9%	3%
1998	130	10%	4%	145	9%	4%	160	8%	3%	161	9%	3%
			12%			10%			11%			14%

A1: Daily cost of administration in USD
A2: Annual cost of administration in USD
B: The administration cost as a percentage of the total operating cost
C: Annual fluctuation of the administration cost

Table 23. Administration cost for tankers and bulkers.

Source: Compiled by Drewry, 1998b and Ocean Shipping Consultants, 1998.

It becomes virtually impossible to derive an average historical data series on administration and overheads for different ship types without effectively tailoring to the results of an individual company. Therefore, the yardstick will be once more the average cost indices of the industry, where there is a far from clear pattern of the current market.

In the table 23 it is cited the total cost of administration for both bulkers and tankers and for various sizes of each type of vessels. The observations are as follows:

a. **Tankers:**
    - The average total decrease of the administration cost in all the sizes is 6%,
    - Since 1996 there is a tendency for increase in the administration cost, albeit marginal,
    - The highest decrease was observed in the two-year period 1994-95.

b. **Bulkers**
    - The total average increase of the administration cost in all the sizes of bulkers is 12%,
    - In all the categories, there is an annual marginal increase of the administration cost of about 2%.

3.2.4 A sum up of the national cost

Although the national cost can not be summarised in a table as in the case of the international cost, conclusions can be drawn. Getting started from the cost which has the biggest share in the pie of cost, the manning cost, one can conclude that the vessels manned with cheaper crews have a competitive advantage over the Greek flagged vessels during the periods of recession of the shipping market, which are, notably, longer than the periods of prosperity.

Secondly, the results of the analysis related to the administrative cost have mixed fortunes. In tankers there is a decline, while in the bulkers there is a stable increase.

However, as a cost, it is not the one that will offer the competitive advantage in a company during the recessions, because it accounts only for 10% of the total operating cost.

Finally, the Greek Law give a chance to the Greek Shipping companies to avoid corporate taxation. However, the Greek tonnage taxation is much higher than the tonnage taxation of the flags of convenience. At a first glance the total amount which is accrued is small, because the vessel used in the comparison has small dead weight. The amount that shall be paid for a bigger vessel is a considerable one.

3.3 Concluding the chapter

To conclude, the analysis of the vessel’s associated costs reveals that the most expensive cost for the Greek flagged vessels is the manning. The international cost has been declined on average for both types of vessels by 13%, while in the national costs the manning, which is the single biggest operating cost, has shown higher rate of increase than the cost of manning with cheaper crews. The result is that the pre-existing difference has been further increased. Therefore, the use of Greek seafarers is nowadays a luxury that they can not simply afford during the market slumps.

Similar cost manning problems have been faced from all the major maritime nations with strong economies, among others Denmark, Japan and Sweden. Shipowning companies based in these countries and with belief in the usage of their national seafarers have taken actions in order to make their vessels competitive in the market and simultaneously to use chiefly national seafarers. The next chapter aims to present these individual efforts, which have been done with the co-operation of their national MARADs.

CHAPTER 4

Case studies

Chapter 3 was aiming to reveal the cause of the loss of competitiveness of the Greek flagged vessels and the figure of blame was pointed to the crewing cost. Similar problems have been faced from other maritime nations, earlier than Greece, due to their faster economic growth. Therefore, they have initialised various projects in order to reduce the manning cost and recover the competitiveness of their fleets in the international market where they compete. From all those projects, three have been chosen to be presented as case studies in this chapter and each one has its uniqueness.

The first project, the Project Ship, was selected because the development of high technology during the project resulted in the sharp reduction of manning level and the subsequent reduction in manning cost. Furthermore, the 12-man crew concept was selected because it suggests another way of crew reduction; through scrutiny of the organisation and the working patterns on board. The final selected project, the Pioneer Vessel, was chosen because of the introduction of the dual-purpose crew as a concept to reduce manning level.

4.1 The Project ship

4.1.1 Project's launch

In 1987 the Danish Ministry of Industry initiated a project with a two fold aim; the improvement and strength of the competitiveness not only of Danish shipping, but also of Danish shipbuilding industry. The mean of accomplishment of this aim was through the incorporation of all the latest technological conquests in a newly designed vessel.

The project's participants were a considerable number of Danish companies and international classification societies. However, the final project was approved by the

Danish Maritime Authorities (DMA). A year after the initialisation, the project was concluded and the results were the design of four different types of vessels. They were designated as A, B, C and D and they were one 7,500dwt chemical tanker, one 7,500dwt bulk cargo/container vessel and two 10,000dwt bulk cargo/container vessels respectively.

All of the designs were approved by DMA to be manned with crew of six, while the minimum requirement for this size of vessels was 18 crewmembers. The main features of these vessels were in short the one-man port-to-port ship control, vessel's ability to be moored alongside with only three men and a range of work savings features.

Nonetheless, the question arisen shortly after the completion of the project was who was going to undertake to put the project from the desk and drawers to the sea. The answer came from the Lauritzen Reefers and the Danyard, which both were belonged to the same group of companies.

On one hand, Danyard had three decades shipbuilding experience by building the STANDARD FLEX-300 for the Royal Danish Navy. They had delivered 'til then 40 vessels. Therefore, the shipyard, by building navy vessels, had long experience in incorporating high technology, and especially electronics, on vessels.

On the other hand, Lauritzen Reefers, as one of the oldest reefer operators, had been in the forefront of many shipping activities. Therefore, the involvement in the Project Ship came naturally to the board of directors. In December 1998, they placed confidently the order to the Danyard for four reefers to be built according to the Project ship concept (Hansen, 91).

4.1.2 The realisation of the project and its cost

The favoured size of vessels among the reefer owners at that period was vessels with capacity of 400,000 cubic feet. On the contrary, Lauritzen decided to build the vessels as the biggest in their kind with capacity of 765,000 cubic feet. To meet this requirement Type C had to be enlarged and modified in order to become dedicated reefer vessel. As a result, Alternative Type C was designed and developed.

Two and a half year after the signing of the contract all of the four vessels were sailing at the oceans. That is to say, four and a half years after the launch of the programme from the Ministry of Industry. The lead ship was the “Ditlev Lauritzen”, which was launched in August 1990. In November of the same year “Ivan Lauritzen” was launched. The third vessel “Knud Lauritzen” was launched in February, the following year, and the order was completed in May 1991 with the delivery of “Jorgen Lauritzen”.

The final dimensions of the vessels, the Alternative Type C, were as follows:

- Length Overall: 164,33m
- Length Between Perpendiculars: 150,6m
- Breadth Moulded: 24m
- Depth Upper Deck, Moulded: 15,7m
- Draught at Summer Load Line: 10m.

Other ship’s particulars were the single screw, the diesel powered engine and the accommodation in the aft. All holds could alternatively take containers, instead of pallets, and the total capacity bellow deck was 236 TEU. The deck capacity of containers was 244 TEU.

The first of the four vessels, “Ditlev Lauritzen”, had a cost of around 50m$ and was financed by the Denmark’s traditional way of private shares issue, where each investor had a minimum of 8,330$. Additionally, part of the cost for the development of the reefer was covered by the Project Ship research programme (Hansen, 1991 and the Motor Ship, 1990).

4.1.3 Technologies applied

Although manning reduction is not regulated with international rules and conventions, a traditional crew in order to be minimised, certain conditions shall be fulfilled. First, the vessel shall be equipped and designed in such manner as to minimise not only the workload for the crew but also the risk of accidents and breakdown of equipment. Second, operational procedures shall be established in order to optimise the efficiency of the ship and the crew. Accordingly the crew shall be trained adequately, and last but not least the safety shall not be compromised (Monk, 1991).

In order to fulfil the above conditions, the following technologies, innovations and features were applied into the Project ship:

Manoeuvrability of the vessel: Due to the fact that arrival and departure from the ports was considered as one of the most labour intensive operations, because of the use of tugs, it was necessary to design a vessel capable of entering, berthing and leaving a port, without the need of harbour tugs. This was succeeded with the combination of a controllable pitch propeller, bow and stern thrusters and a 25,2 m^2 rudder operated through a 2x35° angle. This combination has given it the possibility to arrive, berth and depart from the port without the assistance of tugs in winds up to 12m/sec.

Mooring arrangement: Although that the previously described arrangement gives plenty time for mooring, it would be more advantageous to make the mooring equipment easy to handle. Therefore, in the Project ship all the drums were tension controlled, so that the hawsers were automatically adjusted with the changing tide and the load conditions of the vessel. Moreover, all the winches were remotely controlled from positions on either side of the vessel, allowing mooring to be performed with one man at each end. Pilot ladders and gangways were one man controlled. Anchor handling could be executed remotely from the bridge by the officer on watch.

Propulsion: there was a need for a robust and reliable engine, where planning and execution of maintenance should be simple. In addition, it could be valuable if the engine could run even with one of the cylinders out of order. Therefore, it was selected a single slow speed, two strokes engine with six cylinders. However, by using a single engine there was a need for a redundancy in the case of engine break down. This was solved with the use of a shaft generator, which was connected with the auxiliary generators and might be driven by them. Hence, it could be used as an alternative propulsion.

Automation: the most important feature of these vessels was the Integrated Ship Control (ISC), a system which was developed and manufactured by the Danish company Lyngsoe Marine a/s. It integrates not only the monitoring and the control of the machinery, but also the navigation and the manoeuvring of the ship.

Functions, which were carried out ordinarily from the engine control room, could be carried out from the bridge. The software controlling all the functions was menu orientated, therefore there was no need for detailed technical knowledge.

Moreover, the pre-planning of the voyage was carried out in a special computer and at the beginning of each voyage the planned route was loaded to the system and the execution of the voyage was entrusted to the ISC.

Furthermore, the system also monitored the reactions of the officer on watch (OOW) and was giving an alarm every time that the OOW did not touch any lever or button of the console for a specific time period. If the officer on watch did not acknowledge the alarm, the system was activated an alarm to render assistance. This alarm system is called dead man’s alarm.

Finally, the ISC operated on a dual data bus and redundancy had been further enhanced by hard wire back up of essential connections, such as those necessary for manoeuvring.

Fire detection and extinguishing: the Project vessels are not more dangerous than other vessels. However, the low manning level may result in the delayed detection of fire. Therefore, as a measure to increase safety, fire detectors have been placed in all rooms as well as manually operated sprinkler system in all living rooms and in the galley.

Training: all crewmembers had an introductory course in order to be familiarised with the vessel and its equipment. All officers had courses in general computer knowledge and courses in the computer applications that would be found on board. Finally, deck officers had received bridge simulator courses at the Danish Maritime Institute. It is noteworthy that part of the training was requested by the authorities, while the company initiated the rest.

Maintenance: the officer responsible for the maintenance of the vessel is the Chief Engineer. Maintenance was planned to be carried out by maintenance companies, therefore a number of agreements for such services were concluded. Paintwork was planned to be done in the dry-docking because the applied paint system needed not require maintenance (Monk, 1991 and Hansen, 1991 and The Motor Ship, 1990).

4.1.4 Evaluation of the Project Ship

The Danish Shipowners' representative, Mr Damkjaer, says among others in a letter sent to Lloyd's List about the Project Ship:

- *"…Lauritzen people were the only ones who presented solutions already carried out to many of the problems which shipping, and in particular West European shipping, is facing"*
- *"With the size of the crew of the Project Ship there is a basis for operating shipping under a national register with a full national crew"*
- *"The smaller Project Ship crew, which is an operation crew only, reduces the pressure for the demand for seafarers"*

- *"The crews in these ships are confronted with much more challenging tasks, and to a large extent decisions concerning the daily operations are entrusted to those on board"* (Lloyd's List, 1991b).

From an economic point of view, in another article of Lloyd's List the following comment was found:

- *"…While the ships were expensive to build, they are yielding benefits to Lauritzen in terms of lower operating cost…"* (Lloyd's List, 1991a).

However, these are the evaluations of third parties regarding the success of the Project Ships. Therefore, the author approached J. Lauritzen a/s, the owner of the Project Ships, to request their own evaluation for their project. Mr. Claus Pavar, fleet manager in Lauritzen reefers reverted as follows: *"Although very expensive ships to build, the Project Ships – our 'Family Class' – have proved to be efficient with an excellent performance even with the low manning concept introduced at that time"* (Pavar, 1999).

4.2 The 12-man crew project

4.2.1 Rationale of undertaking the crewing project

During 1987 the Transatlantic Ship Management undertook a crew reduction project, which was aiming to reduce the cost of manning under the Swedish flag. In the presentation of the project from the Transatlantic Ship Management, the company presented the followings as the rationale to undertake the project:

- The large scale re-registration of ships to other flags,
- No other advanced Swedish project since 1978 (it was also undertaken by the same company),
- Several project in progress around them,
- Sweden formerly a leader in the development field,
- Previous projects very successful,

- The situation in shipping at that period,
- The increased competition,
- The recently introduction of parallel registers (NIS, DIS etc),
- The advanced expertise of Swedish marine personnel,
- The need for changes in crewing regulations,
- Survival (Transatlantic Ship Management AB, 1989a).

However, it was not surprising that Sweden had decided to undertake a crewing reduction project. It had even considered that the project was undertaken later than it was expected, since operating cost under the national flag was a longstanding concern (Seaways, 1989).

The ship chosen for the project was Companion Express, one of the G3-class ro-ro/container liners operating in the ACL consortium. She was built at Kockum shipyard and subsequently lengthen in 1987 by 42m to 292m. Companion Express was (and still is) operating on a liner trade across the North Atlantic Ocean. That is to say, she was (and still is) involved in voyages with regular port of calls. Some special features for the Companion Express were (and still are):

- Cargo access arrangement with fully automated hydraulic operation,
- Cell guides on weather deck giving a fully automated lashing free container handling,
- One man operated mooring equipment fore and aft,
- Powerful thrusters fore and aft with fully automated start-up from the bridge,
- Bridge layout permitting an one man operation also in locks and during docking manoeuvres,
- All mechanical equipment from engines and on, arranged for optimal accessibility,

- Administrative computer based systems for both ship's internal use and for cargo (Transatlantic Ship Management AB, 1989b and Seaways, 1989).

4.2.2 Objective and uniqueness of the project

There was a need for reduction of the crewing cost in order to make the Swedish flagged vessels competitive in the international market. The required reduction in cost was quantified and set as an objective. The aim was to lower the cost under the Swedish flag at a level where it would be equal to the cost under the Norwegian International Registry (NIS).

The mean to lower the crewing cost was the sharp reduction of crew size. Therefore, the reduction of crew size by 40% was set as the objective of the project. This number was calculated taking on account the cost under the Swedish flag with crew of 20, 10million SEK, the cost of the same crew size under the NIS, 4.5 million SEK and the governmental support package of 2,4 million SEK.This was not possible to be introduced unconditionally. There was an obligation that safety would not be compromised and that the operational performance and the social life of the crew would be maintained at high standards.

The uniqueness of this project was the fact that the reduction in crew was not because of the extensive use of high tech and the subsequent substitution of manpower by automation. High tech may has been used, however the 40% reduction was succeeded after analysing all the tasks which were performed on board. The proposed and accordingly implemented size of crew was as follows:

Master	1
Chief Officer	1
2nd Officer	1
3rd Officer	1
Chief Engineer	1
2nd Engineer	1
3rd Engineer	1
AB GP	3
Motorman GP	1
Cook Steward	1
Sum	12

The analysis, which was performed, was the following:

- Calculation of workload,
- Definition of crew core task,
- Definition of crew service tasks,
- Scrutinising of the working methods on board.

It is obvious that every single task on board was put under scrutiny in order to optimise the use and the results of a small but well trained crew. The results of the analysis were:

- Establishment of a new manning model,
- Operational manual for every defined task,
- Operational manual for a specific round trip.

These manuals were aiming to introduce new organisational patterns and procedures, where their implementation has resulted in the safe and efficient operation of the vessel with crew size of 12 (Transatlantic Ship Management 1989 a and b).

4.2.3 Cost/Benefits analysis of the project

The 12-man concept was borne as an internal project in the Transatlantic Ship Management AB, however months later became a major input in the "The ship operation and manning study" project. The latter was a project organised and financed by the Swedish Shipowners' Association (SSA). The cost of the internal project was

GBP40,000 and was later covered by the participation of the company's experts in the project launched by the SSA.

The investments in equipment were covered by the normal operating costs of the vessel. The total amount spent for this purpose was GBP10,000; an extra helm was bought for the wheelhouse as well as an extra remote control station for the aft mooring winches to allow only two men to connect tug lines safely.

The following gives an exact picture of the costs and benefits in GBP per year from the implementation of the project:

Gross savings in crew cost	**400,000**
• *Increased wages and allowances*	*40,000*
• *Improved relief system*	*5,000*
• *General Operator certificates*	*15,000*
• *Cost of temporarily support crew*	*20,000*
Net savings in crew costs	**320,000**
• *Extra ordinary cost for repairs and maintenance including cost for external service companies*	*20,000*
Net savings in total cost	**300,000**

It is noteworthy that Transatlantic was even able to negotiate lower hull insurance rates between 15 and 20% from the Swedish and the Atlantica Clubs (Transatlantic Ship Management 1989a and b and Seaways, 1989).

4.2.4 Appraisal of the project

Eleven years after its launch the project still runs, therefore one can conclude that the project has fulfilled its expectations and objectives. The company currently operates five vessels in the cross Atlantic trade. Two of these vessels are manned with the 12-man crew concept. The other three vessels are manned with a crew of 24 and their nationality is Filipino.

In an effort to investigate the future of the project, the superintendent of the company was interviewed. Having discussed all the details of the project, its evolution and success, he concluded by saying that the project is still running because the concept still fulfils its initial objective. He supported his statement by saying that the total operating cost of the vessels manned with 12 Swedish seafarers is equal to the vessels manned with 24 Filipino seafarers.

4.3 The Pioneer Vessel

4.3.1 Project's motivators

The project was initiated for two reasons; the rise of the Japanese yen and the preference of the Japanese shipowners to their national crews. In details, in mid 80s the Japanese yen rose greatly against the major currencies and as a result, the cost of the Japanese crew became extremely high. However, the Japanese shipowners were not willing to flag out their vessels and use cheaper foreign crews, because of their preference to their national crews.

Hence, under the pressure of the high operating cost and the preference for national crews the Committee on the Modernisation of the Manning System (COMMOS) was borne. The aim of the committee was to find an answer to the high cost of the Japanese crews. The regulatory bodies of that effort were the Ministry of Transport and the Japanese classification society, Nippon Kaiki Kyokai (NKK).

The Committee’s answer to the problem was the “modernised vessels” project which could only be applied to newly built vessels. The concept of the project was the gradual reduction of the manning level. It was projected initially that the project would have three stages. In the first stage the number of crew would be decreased from 22 to 18, the second stage to 16 and finally in the third stage to 14.

However, due to the increasing cost of manning and the need for further reduction, another stage was added in late 1988. In this stage the manning level would be decreased to 11 crewmembers. The vessels that participated in this stage were called “Pioneer Vessels” and were the highest-grade modernised vessels operated by 6 officers and 5 ratings. Some typical crew costs for an all Japanese crewed vessel with reduced manning levels were as follows:

Complement	**Annual Cost**
18	US$2,08 million
16	US$1,84 million
14	US$1,74 million
11	US$1,27 million

Source: The Motor Ship, 1989.

In the first three stages tanker vessels had also participated in the project. In the last stage, however, not even one tanker had participated in the project. By making this observation the author had requested to learn by the Deputy Manager of the Japanese Shipowners Association (JSA) whether there was any specific rationale behind the absence of tankers from the participation in the “Pioneer Vessel” stage. His reply is quoted and it is as follows: “…*Pioneer tanker ship has never came up in Japan. There is no legal restriction to make Pioneer tanker ship, but it is required that the high level cargo operation for tanker and also there is the possibility of serious disasters such as* *an oil pollution in case of accidents. I guess that the 'SAFETY FIRST' is the reason why Pioneer tanker ship has never been made"* (Nakahara, 1999a and b and The Motor Ship, 1989).

4.3.2 Special features of "Pioneer Vessel"

REQUIREMENT FOR EQUIPMENT FOR PIONEER VESSEL, more then 5,000 GT (Ocean Going)
1. Remote control system for valves fitted in fuel oil supply lines
2. Level remote monitoring system and high level alarm system for fuel oil tank (except them in engine room)
3. Automatic record system for operating condition of main engine
4. Satellite navigation system
5. Auto pilot system
6. Remote control system for mooring winch on fore and aft
7. Remote control system for cargo operation
8. Remote control system for ballast operation
9. Powered opening system for side port, lampway and steel hatch cover
10. Satellite communication system
11. Centralised monitoring system for machinery on bridge
12. ARPA
13. Cargo hose handling system
14. Powered winch for emergency towing rope
15. Centralised monitoring system for reefer container
16. Centralised control system for machinery on the bridge
17. Power winch for pilot ladder
18. Fixed wash deck system (for bulkers)
19. Remote control system for main engine and steering on both bridge wing

Table 24. Source: Nakahara, 1999a.

Except the technical requirements described with details in table 24, another special feature of "Pioneer Vessels" is the introduction of the dual-purpose crew. The crew employed in those vessels has extended education in order to undertake alternative roles. The officers have been trained and certified to stand not only as deck but also as engine officers. The same has been applied for ratings and they can perform duties as deck and as engine crew.

Moreover, the "Pioneer Vessels" are routed around the world and in order to make these vessels more attractive to the crews, a special supporting system has been introduced. This system is described by the Deputy Manager of the JSA as follows: "…*When the vessel calls Japanese ports, the suitable number of alternative crew (for supporting) should be dispatched for giving rest to original crew. If the vessel does not call any Japanese ports more than 7 months, additional crew should be served on board her within 7 months. This supporting system is stated in the collecting bargaining agreement with union. The cost of the supporting system is not calculated as part of the crewing cost*" (Nakahara, 1999a and b and the Motor Ship, 1989).

4.3.3 Appraisal of the Project

Even during the implementation of the stage three of the project, the shipowners were complaining for the slow process of implementation of the project. Their main concern was that the rate of increase in the cost could not balance the savings from the reduction in the crew level. Aside from the slow process of implementation, another obstacle was raised during the implementation of the stage four, the introduction of the mixed crew.

As a result, the total number of "Pioneer vessels" during the 11 years of implementation of the project was only 32 vessels and it was in the period 1992-94. Since then, the number of participating vessels has constantly decreased and on 28th February 1999 they were only 14 vessels. However, judging the number of vessels involved, the first stages of the project were more successful. In the stage one, the number of vessels participated in the crew reduction were 71, while they were 114 in the stage two. In the stage three the participating vessels were reduced to 27.

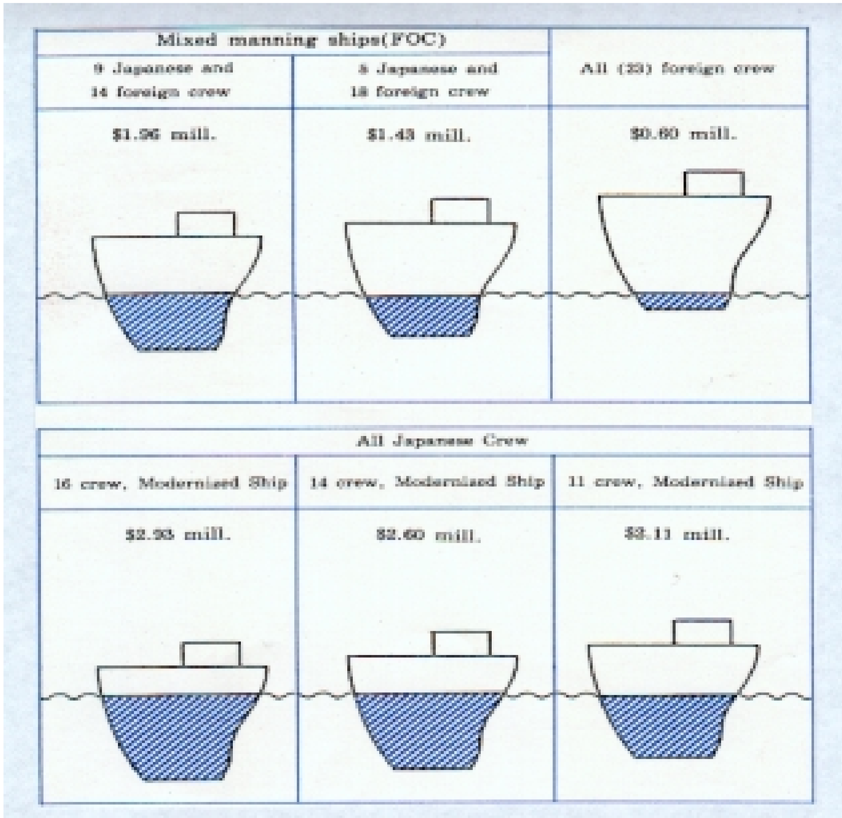


Figure 4. Source: Japanese Shipowners' Association, 1998.

Accordingly, the question arising is about the future of the project. Therefore, the author set this question to the JSA and they replied through their Deputy Manager as follows: *"…However, firstly I say from the point of view of the international competitiveness of merchant fleet, Japanese Pioneer Vessel is no longer competitive in comparison with the Flag of Convenience vessel.* -Quantification of this argument is given in the graph 4- *…Due to have international competitiveness of merchant fleet, <u>we are now going to enforce the regulations regarding "International Ships" with new mixed manning system on 20th May 1999</u>. …The concept of this new system is not reducing the manning levels by means of automation and modernisation of equipment, but the mixed manning together with foreign seafarers employed with low wages. That is to say, <u>in Japan, we are in the process of losing interest in the Pioneer Ship</u>".*

4.4 Concluding the chapter

This chapter had as an objective to present various projects that have been undertaken around the world from major maritime nations, in order to reduce the manning cost and ultimately to stop the fly of vessels from their national registries. The following chapter aims to investigate an alternative solution for the Greek fleet by analysing the costs and benefits, if any, with the implementation of the proposed solution. It is noteworthy that the proposal is based on the fact that the Greek shipowners are chiefly purchasing vessels from the second hand market as well as on the fact that it can be implemented immediately.

CHAPTER 5
The pre-study of the proposed solution

Chapter 4 presents a selection of projects, which have been undertaken by three major maritime nations. As it was explicitly presented, these projects had two main concerns; the reduction of the daily operating cost and the employment of national seafarers on board these vessels. Since the loss of the competitiveness of the Greek-flagged vessels has not yet come to a solution, this chapter aims to address the possible pros and cons of implementing a similar project on a Greek-flagged vessel.

As a matter of fact, the whole research is a pre-study required before such a project is fully launched, implemented and communicated to the pertinent parties. The investigation is limited to a pre-study because of limited available time to conclude the study and because such a project requires a big manpower team. In this specific case the team is consisted of only one person.

Consequently, the chapter will introduce to the reader the regulatory framework of such a project, the activities that shall be further considered and analysed, the automation that at this stage is considered to be applied and finally a primary cost/benefit analysis will be cited. The latter may serve as signal for a further and full implementation of the project.

5.1 Objectives of the project

The objective of the proposed project/solution is to reduce the manning compliment on board a Greek-flagged vessel and concurrently to introduce a higher level of automation, if so is required. The desirable result is a reduction of the daily manning cost and ultimately the daily operating cost of the vessel. It is desirable because conceptually, by reducing the manning compliment, the manning cost will be reduced. However, the cost of the required modifications and the activities that shall be performed require time and money. Therefore, the concept is tested on a real vessel. The level of reduction in manning size is set, the required modification is calculated in terms of cost and finally the costs and benefits are measured.

As a matter of fact, the pre-study is based on the objective to man a panamax tanker with 10 crewmembers. She is currently manned with 21 crewmembers.

Presentation of the vessel

Since the operator has requested not to disclose the name of the vessel, not any single detail of the vessel will be presented. The following basic information were chosen to be disclosed:

- Vessel type: Product tanker,
- Date delivered: 1995,
- Length Overall: 242 m/Extreme breadth: 32,2 m/Deadweight: 68,000 tonnes,
- Segregated ballast tanks; double bottom and double sides,
- Two stroke, slow speed main engine with single propeller,
- And it is traded around the world.

Full information about the vessel has been provided to the companies that have contributed in the modification of the vessel as well as to the experts that were consulted for the application of all the features. A great advantage for the discussions related to the feature that will be applied has been the experience of the author on sister vessels.

The idea behind the 10-man concept is that this number is initially considered to be satisfactory to run the vessel efficiently and effectively, having had:

- 3 Navigators, excluding Master,

- 2 Engineers for handling repairs,
- 3 GP/AB for essential deck and engine maintenance as well as for bridge watch keeping in the period of darkness,
- Master free of watch duty, but responsible for the administration of the vessel,
- 3 crewmembers at each end of the vessel during mooring and unmooring,
- Sufficient manning level for manual fire fighting of the vessel, at first glance.

As a result, the initially proposed manning compliment is as follows:

Rank	
Master	1
Chief Officer	1
2nd Officer	2
Chief Engineer	1
2nd Engineer	1
AB/GP	3
Cook/Steward	1
Total	**10**

In addition, it has been proved that the concepts of 12, 11 and 6-man as a manning compliment can safely, efficiently and effectively operate even bigger sized vessels. The main idea was the establishment of a manning level close to the requirements for a Greek compliment for this size of vessel. Such a vessel requires, according to the rules, a manning compliment of 14, where 9 crewmembers shall be of Greek nationality.

According to Greek requirements the crew compliment will be reduced by 4 crewmembers, since the vessel is permitted to run with 14 crewmembers. However, the vessel is currently manned with 21 persons, so the actual reduction accounts for 11 crewmembers.

5.2 Regulatory framework of the proposed project

The following part of this chapter will cite the regulatory framework of the project. The regulatory framework presents explicitly the postulates and the international principles that shall be borne in mind by companies intending to be involved in such a project. It was served as well, as an instrument for the author to analyse the project, resulting thus in proposing some changes and pointing out the areas that would be further considered if the project goes from theory to practice.

The regulatory framework additionally cites the procedures that the company intending to be involved shall go through before the issue of the Safe Manning Certificate. Finally, it is concluded by briefly describing the actual approach of this kind of project, the sociotechnical approach.

5.2.1 Crew size; evolution and changes since the early 60s

The concept of reduced manning level through automation can be traced to the 60s. Undoubtedly, the pioneers of the concept were the west European nations. Since the introduction of the concept the manning level has been reduced significantly, however the reduction can be considered as a steady and slow process.

During this period, some of the projects introduced radical reductions in manning level and generally speaking, they are considered as the pilot projects of the consequent reductions noticed since their launch. It was the shipping recession of 70s the motivator for the shipowners/operators to take advantage of the technological changes in order to make their vessels more efficient and chiefly cost effective in the face of the next serious shipping recession (National Research Council, 1990).

The first momentous project found in the shipping literature, was the 16-man concept. The project was launched in 1978 by the Swedish Trans Ship Management. Ten years later the Japanese introduced the 11-man concept with their Pioneer vessels. Soon after, early 90s, the Danish reefer operator Lauritzen introduced the lowest manning ever, the 6-man concept (The Motor Ship, 1989 and The Motor Ship, 1990 and Transatlantic Shipmanagement, 1989a).

In the meantime, countries like Germany, Holland and France introduced the dual purpose certification for officers and ratings. Dual purpose certification was served as an alternative and/or a complement to the automation concept of reducing manning compliment on board ships.

The United States of America (USA) has not been comparatively alert in adopting innovative schemes in this respect. The Americans dealt with similar projects in the early 80s. Additionally, in an effort to further the cause in this field dual certification was introduced at the U.S Merchant Marine Academy, Kings Point. However, shortly after, the dual certification was discarded because it attracted fewer and fewer enrolees (National Research Council, 1990).

Albeit not a new trend in shipping, no specific rules have been established that shall be complied by shipowners/operators in order to attract reduction in the manning levels. Regulation 13, Chapter V, SOLAS 1974 requires the contracting Governments to adopt measures to assure that the vessels flying the flag of the State are sufficiently and efficiently manned.

Hence, each flag State must develop rules applicable to a specific case and to verify that the safety is not compromised in the favour of saving operating costs. This fact, however, is not considered by the industry as a drawback, because internationally dictated rules may impose inappropriate standards on some ship operators and could hinder innovation for some others.

It is pertinent to note that reductions in the manning level were the subsequent result of a considerable study, review and experimentation by governments, operating companies and labour organisations. The proof of this statement is that, although during the last 40 years the crew size has been substantially reduced, yet there is a measurable and substantial reduction in vessel accidents, and this trend is consistent world-wide. (National Research Council, 1990).

The period of reductions in manning level coincides with the break down of the departmental distinction on board ships. The manning reductions during the 60s can be attributed to the introduction of more sophisticated deck machinery and to the introduction of the bridge engine control. The modernisation of vessels’ equipment and the subsequent reduction in manning resulted in the re-allocation of the duties and responsibilities between the deck and engine officers.

Before the introduction of any innovative automation, officers and the ratings of each department were responsible for the operation, administration, maintenance and repairs of their department respectively. The introduction of the engine bridge control brought about a shift in the traditional departmental distinction. Deck officers undertook part of the operational responsibilities from the engine officers, whereas the more sophisticated deck machinery resulted in the participation of engine officers in the repairs and maintenance of the deck machinery. This was the beginning of the break down of the departmental distinction on board the vessels.

Later on, with the introduction of dual qualified officers and/or the centralised bridge control, further skewed departmental distinction was noticed. Deck officers became responsible not only for the operation of the main engine but also partly for its administration. Simultaneously, engine officers became totally responsible for the deck repairs and partly for the maintenance of the deck machinery. At the same time the ratings on board were trained to have appropriate skills, so as to offer their services not only in the engine but also on the deck department. Therefore, one can say that nowadays the departmental distinction in the technologically advanced vessels is highly skewed and the trend is towards ship management officers instead deck and engine officers (Munk and Pavar).

5.2.2 Postulates for Safe Manning

Having briefly discussed the evolution of the concept, a reasonable question may arise. The question of how an operator may achieve lower manning level than the currently required by the flag-State. As a matter of fact, the reductions in the manning level are based chiefly on studies and experimentation by operating companies and appropriate regulatory bodies. The final outcome of such an experiment shall result in a vessel with reduced manning compliment and safety equal to the safety of a fully manned vessel.

Before presenting the international principles which are dictated by the international instruments, i.e. SOLAS 1974, the postulates that shall be borne in mind will be cited primary. Lots of similarities have been found in the postulates, which are dictating such projects, in nations where such projects have been developed. Chapter 23 of United States Coast Guard Rules describes comprehensively the general features that shall be addressed in reduced manning proposals under the title “Manning requirements for automated vessels”. The most important features have been quoted and are as follows:

a. Fire Equipment: Installed fire protection equipment shall be adequate for the reduced complement to deal effectively with a fire emergency
b. Station Bill: The station Bill shall provide for the effective use of the personnel during emergency situations
c. Lifesaving equipment: The design and installation of life saving equipment shall be adequate for the effective operation by the complement
d. Vital Systems: Redundancy of vital systems or machinery shall be required
e. Operational limit: Scenarios of the vessel’s contemplated operation shall be provided
f. Accommodations: Quarters shall be sufficient to accommodate the designated complement and any additional personnel needed during initial operation or during periods when additional manning is required, such as the result of an automation failure.
g. Messing: Coffee service, drinking water and sanitary facilities in the immediate bridge area are necessary for the functioning of the bridge watch without the relief service traditionally provided by an ordinary seaman.
h. Call system from the bridge: This system, running to each mate and AB’s quarters, general spaces, such as the mess room and recreation areas, and line handling stations, enable the summoning of crewmembers for the oncoming watch and in emergencies, and allow better co-ordination in the mooring/unmooring of the vessel.
i. Constant tension mooring winches: These devices enable the reduced deck force to moor/unmoor the vessel safely, without unreasonable physical effort.
j. Engine department: Automation of the engine department is the most common method of reducing manning levels. A review of automated vessel experiences show varying degrees of reliability in engineering automation. Accordingly, manning reductions in the engine department shall be made only after a system has been operated for a sufficient period of time to demonstrate its reliability (United States Coast Guard, 1999).

Moreover, the most common approach in considering reduction in manning level projects is the man-machine trade off analysis. This method was followed in the Swedish 12-man concept, the Pioneer vessels and the crew reductions in US flagged ships in the beginning of 80’s, among others (National Research Council, 1990 and Wikstrom, 1999 and Motor Ship, 1989).

The man-machine trade off analysis aims to identify the tasks which previously were performed by crewmembers and which can be substituted after the modification by automation. In addition, it aims to identify the features which shall be applied in order to reduce the labour requirements to perform certain activities on board. The appendix 1 gives a sample of tasks that shall be evaluated in the man-machinery trade off analysis. Detailed job descriptions for each crewmember is also required. The job description of each crewmember includes, in addition, the newly undertaken responsibilities (Wikstrom, 1999).

Ultimately, the shipowner/operator has to decide and allocate the responsibility of the management of the vessel. Since minimal manning projects have been undertaken, two main models have been followed, either transferring of the management of the vessel to the shore or transferring of the management to the ship.

In the first case, the crew is only responsible for the safe operation of the vessel between the port A and port B. Maintenance is carried out from “riding gangs” and all the arrangements are made from the company according to the maintenance plan set up.

In the second case, the company sets at the beginning of each year the budget of the ship and then the budget is accomplished by the crew. For the planning and the carrying out of the maintenance, the onboard manning compliment is fully liable, taking into consideration the budget set by the headquarters. (National Research Council, 1990 and Wikstrom, 1999 and Carl, 1994).

To sum up, the shipowner/operator, before addressing the international principles which are dictated by the international mandatory instruments, shall consider the general features required by the flag-State. The following step is the man-machine trade off analysis where labour savings features will be applied. Finally, the allocation of the ship's management shall be considered. Hence, having clearly defined with the use of postulates the new model, the working team, with the application of the international principles, can identify the constraints of the model and apply the necessary improvements or modifications.

5.2.3 Principles of Safe Manning

Since the postulates facilitate the establishment of the new manning model, the consequent step is the identification of the constraints of the proposed model. Therefore, after establishing the new manning level the shipowner/operator shall additionally consider the requirements of the principles of safe manning, which are the followings:

a. STCW '95, Section A-VIII/2 part 3-1 paragraph 15 states that the officer in charge of the navigational watch may be the sole look-out in daylight provided that on each such an occasion:
    - The situation has been carefully assessed and it has been established without doubt that it is safe to do so,
    - Full account has been taken of all relevant factors, including but not limited, to:
        - state of the weather,
        - visibility,
        - traffic density,
        - proximity of dangers to navigation,

- the necessary attention when navigating in or near traffic separation schemes, and
- assistance immediately available to be summoned to the bridge when any change in the situation so requires.

b. The Maritime Safety Committee in its sixty fifth session, January 1996, decided to discontinue the trials with the officer of the navigational watch acting as the sole look-out in periods of darkness (MSC 66/7/1, 1st March 1996).

c. Regulation 13, Chapter V, SOLAS 1974 states, among others, that the Contracting Governments undertake, each for its national ships, to maintain, or, if it is necessary, to adopt, measures for the purpose of ensuring that, from the point of view of safety of life at sea, all ships shall be sufficiently and efficiently manned.

d. Resolution A.481 (XII), which is referred to the Principles of safe manning adopted by the IMO.

e. Rule 5, part B, Section 1, COLREG states that every vessel shall at all times maintain proper look-out by sight and hearing as well as by all available means, appropriate in the prevailing circumstances and conditions, so as to make a full appraisal of the situation and of the risk of collision.

f. Chapter II-2, SOLAS; Fire protection, fire detection and fire extinction & Chapter III, SOLAS; Life saving appliances and arrangements. Although not stated, it is indirectly implied that sufficient manning is required to permit manual fire fighting as well as to efficiently maintain the life saving appliances and to execute routine inspections and drills. The same is clearly mentioned in the Principles of safe manning, resolution A.481(XII).

g. In cases where either Integrated Navigation System (INS) or Integrated Bridge System (IBS) may be selected as bridge instrumentation and layout, the following mandatory instruments shall be applied:

   -Recommendations on performance standards for an INS; Resolution MSC.86(70) (IMO, 1998)

-Recommendations on performance standards for an IBS; Resolution A.694(17) provides the general requirements while the recommendations describes the performance standards (IMO, 1996)

In addition, a working group on Comprehensive review of resolution A.481(XII), which was instructed by the Sub-Committee on Standards of Training and Watchkeeping (STW) in its 29th session, prepared a draft Assembly resolution for consideration and approval at the seventy-first session of the Maritime Safety Committee (MSC). On January 27th 1999 the working group came up with a draft proposal for reviewing the Assembly resolution, which accordingly has forwarded for approval in the 71st MSC session. After consideration and approval in 71st MSC session, the draft will be forwarded for adoption in the 21st Assembly.

During the 30th session of the Sub-Committee on STW, when the issue of the revised Assembly resolution A.481(XII) was discussed for the adoption of the draft, some delegations supported the idea that a standard model shall be created. However, it was agreed that it was premature to consider further work on this issue until experience had been gained in the use of the principles of safe manning in the revised solution.

Finally, in establishing crew compliment the following international mandatory instruments shall be considered, regarding watch keeping and prevention of fatigue on establishing safe manning level:

a. STCW Code Section A Chapter VIII; Standards regarding watch keeping (navigational and engineering watch),
b. STCW Code Section A Chapter VIII/1; Fitness for duty. It describes the work hour limits,
c. STCW Code Section B Chapter VIII/1; Guidance regarding fitness for duty. It is related to the prevention of fatigue.

5.2.4 Procedures for the Safe Manning Certification

Except the rules required by the national and international regulatory bodies, there are procedures that the maritime nations follow when the shipowner/operator applies for reduction in manning level. These procedures are not supported directly by international rules and regulations. However, the principles of safe manning dictate their existence indirectly. In countries where such projects have been carried out, the following procedures are required before the issue of safe manning certification:

a. Conceptual approval: Before any modification may take place, the owner/operator shall request for the national maritime administration to evaluate his proposed modification and crew size. At this stage the national maritime administration (MARAD) evaluates only whether the proposed manning scheme is sufficient for the safe operation of the vessel.
b. Trial period: The trial period is the period where the proposed schemes and introduced automations are examined in order that the viability of the minimal crewing as well as the reliability of automations is verified.
c. Observation trip: Once the vessel is in operation a MARAD inspector shall sail with the vessel for a sufficient period to assess the reliability of the system. It is also recommended to the inspectors prior to their embarkation to have studied the engine logs, maintenance records and overtime logs in order not only to prepare an inspection plan but also to identify areas where special attention shall be taken. Having conducted his inspection, the inspector shall submit a detailed report where he evaluates the scheme. Finally, this inspection shall be performed periodically, aiming to ascertain the performance of the scheme. In the appendix 2 an observation trip report is attached. The report was written for the Atlantic Container Lines' (ACL) 12-man concept ship (United States Coast Guard, 1999 and Transatlantic Ship Management, 1989a, Wikstrom, 1999 and National Research Council, 1990).

5.2.5 ISM Code and crew reduction projects

On July 1st 1998 the ISM Code came in force for passenger ships, tankers, gas carriers, bulk carriers and mobile offshore units. The code is not related to minimal crewing, however the author feels that companies which have implemented the code, have an advantage to undertake minimal crewing schemes.

Explicitly, the code requires the company to develop plans for shipboard operations, emergency preparedness, maintenance of the ship and equipment and finally plans to control all documents and data which are relevant to a Safety Management System (SMS). That is to say, the companies have a description of each task performed on board, the number of people required to perform each task, the number of people required for each emergency situation, among others.

Having had all these descriptions, the evaluator can assess the number of people actually required to perform each task. Therefore, he can identify the areas of duplication and re-assess the number of people actually required for the proper performance of each task. Then, the next step of the evaluator is a man-machine trade off analysis, where he can further reduce the crew size by substituting crewmembers with appropriate automation. The whole task of re-assessment through the use of the implemented ISM can give them the answer to the actual crew size required to perform the safe operation of their vessels.

The idea was discussed with a considerable number of people from the industry. The validity of the idea has been accepted by the majority of them. The only drawback is the fact that the implementation of the Code has its first anniversary in a few days. Consequently, the drawbacks of the implementation have not yet been measured and actually it will take a decade for the appropriate beneficial analysis of the Code.

5.2.6 The human element

A company intending to undertake a minimal crewing project shall also consider how to manage the human element in the overall scenario. Smaller crew size may give rise to problems such as fatigue and boredom, shipboard living conditions and also alcohol and drug abuse.

Getting started from the fatigue and boredom, it is a fact that the crew reduction can raise questions about the workload. One can overcome this argument by re-organising and re-assigning the workload structure and the duties of the crewmwmbers. The ultimate aim of this effort is to maintain safety at the standards comparable to a full crew compliment.

Another problem that shall be overcome is the shipboard living conditions for a small sized crew. Low manning level gives rise to problems such as social interaction among crewmembers. This can be tackled by enhancing living conditions through careful ergonomic attention to the design of living areas. On the other hand, a smaller crew size by itself results in the breakdown of the departmental distinctions. A factor that significantly will enhance the social aspects of shipboard living.

Last but not least, there is the problem of the drug and alcohol abuse. Drug and alcohol abuse can severely affect the safety of operations. Therefore, the whole project requires careful management of the alcohol availability and close monitoring of the physical and emotional health of crew members (National Research Council, 1990 and Monk, 1991and The Motor Ship, 1989).

5.2.7 A sociotechnical approach

The applicable rules as well as the procedures required for the implementation of a reduction project were discussed. The required measures that shall be considered to manage the human element were also discussed. Hence, one can clearly see that the whole project is a sociotechnical system built up by:

a. the technologies that will be applied,
b. the crewmembers,
c. the required organisational structure and
d. the external environment, safety in this case, which may be affected from the implementation of the project.

It is also clear that all these factors are interdependent. As a result, a change in one of the elements results and/or necessitates changes in other elements. Therefore, with the appropriate actions, which are

a. introduction of new technology,
b. appropriate training of the crewmembers,
c. refining organisational structure on board and
d. ergonomic design of spaces and applicable technology

safety, the external environment, will not be degraded. Because of this fundamental interdependence, the introduction of technological change can not be viewed in isolation, but it must be viewed from a true system perspective (National Research Council, 1990).

5.3 Proposed modifications

5.3.1 Engine department

The project has as an objective for the engine department to man it with two engineer officers; one Chief Engineer and one Second Engineer. Moreover, assistance to them will be provided by the 3 GP/ABs. With such a small manning compliment for this department, the engineers shall only be occupied in planning maintenance, which shall be very limited, and to handle the unscheduled repairs. Therefore, there is a need to transfer the daily operation and administration of the M/E to the navigators and concurrently increase the reliability and the maintainability of the M/E and the auxiliary equipment.

MAN B&W, the manufacturer of the engine, is considered to be the most appropriate company for assuring the reliability and maintainability of the M/E. Therefore, a line of communication was established with them, aiming to upgrade the M/E and ultimately its reliability. The final outcome of this research was poor, because the engine model was considered rather new and they did not have upgrading packages (Thostrup, 1999).

The other consideration was the transferring of the daily administration and operation of the M/E and auxiliary equipment from the engineers to the navigators. In order to achieve this objective, the level of existing automation was considered and an automation specialist was consulted. The selected vessel for this study is certified for unmanned machinery operation (UMS), which means that the level of automation is high.

Lynsgoe Marine a/s having considered the objectives and the available automation of the vessel, reverted with the following proposal(Wind-Jensen, 1999):

A. Universal Control System/Universal Monitoring System UCS/UMS 2100

It is a fully integrated system allowing the monitoring and handling of all the alarms. It consists of the following elements (Figure 5):

a. Outstations: They are independent units, collecting and processing data retrieved from the process they are monitoring,
b. Graphic Operator Stations (GOS): It displays information from several systems and units simultaneously,
c. Operator panels: They are divided in two kinds; Basic Alarm Panels (BAP) and Accommodation Alarm Panel (AAP). These panels provide the duty

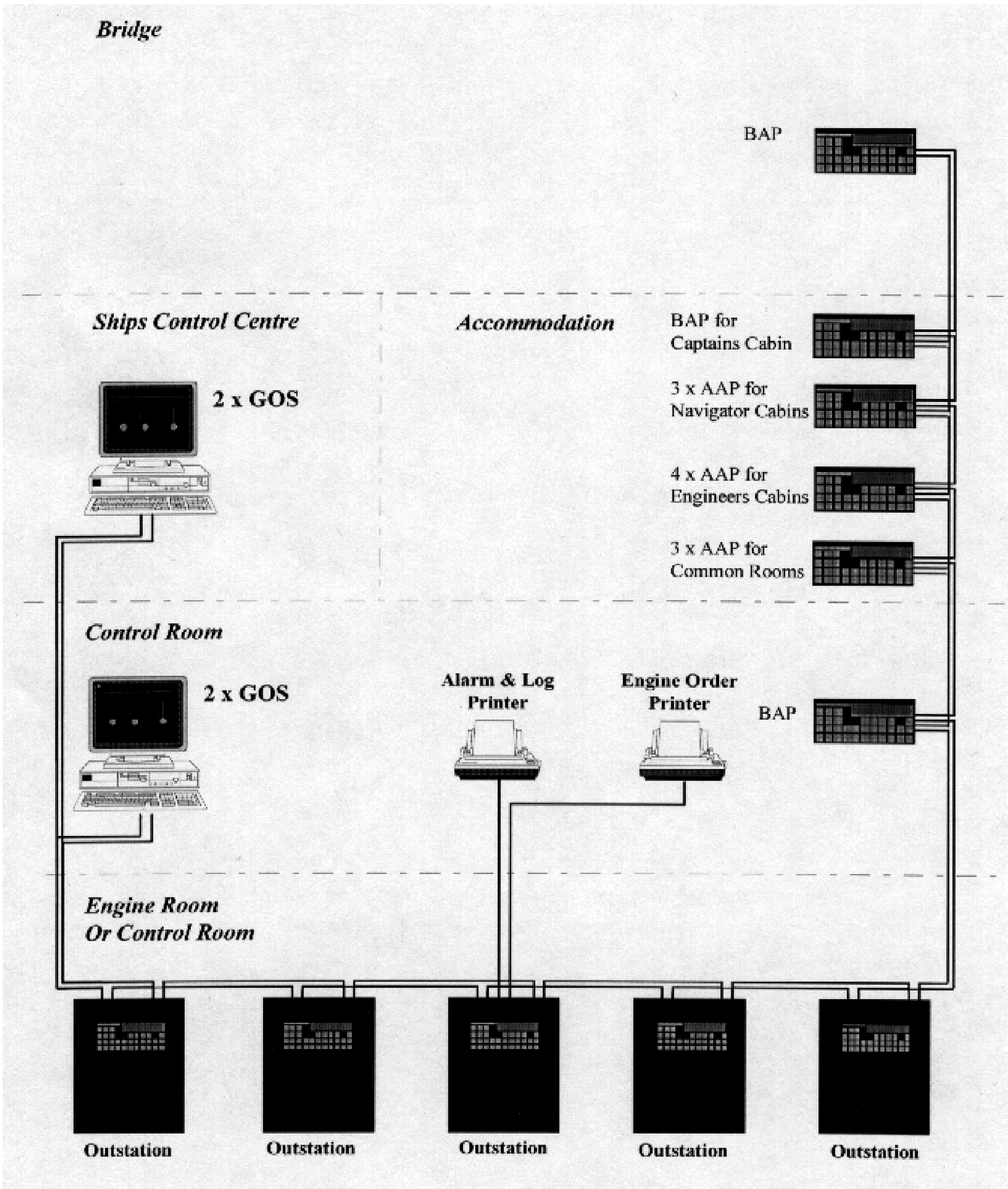


Figure 5. UMS/UCS 2100, System lay-out Drawing.

officer with instant information in clear readable text. The operator can communicate with the system to obtain more information.

d. Printers: Printers can print out alarm and data logs as well as generate manoeuvre logs.

The system will have an effect on the following areas:

a. Propulsion Control:
    - Main engine start/stop system,
    - Diesel engine safety system,
    - Exhaust gas temperature deviation alarms,
    - Bearing temperature deviation alarm,
    - Propulsion mode selection with engine mode and clutch display,

b. Generating plant:
    - Power management system,
    - Auxiliary engine start/stop system,
    - Auxiliary engine monitoring system,
    - Exhaust gas temperature deviation alarms,

c. Damage Control:
    - Control of fire fighting system with fire alarm indication,
    - Fire damper control.

d. Ancillary systems:
    - Ventilation system,
    - S.W cooling system,
    - F.W cooling system,

- Lub-oil system,
- Compressed air system.

e. Auxiliary systems:
   - F.O transfer and services system,
   - Fuel consumption calculations,
   - Bilge control,
   - Ballast control,
   - Air conditioning system.

f. Tanks:
   - Remote tank level gauging
   - Tank contents calculations
   - Tank level alarms
   - Interface to loading calculator

In addition to the above, the system will have the following features as well:

a. Dead man alarm; Engine room: if the alarm is not acknowledged in the predefined time, an alarm is released on the bridge, in all duty engineers' cabins and in public rooms.
b. Calling system for engineers: from any alarm panel of the system, the engineers can be called individually or generally.
c. Bridge alarm system: in cases where a bridge alarm is not acknowledged from the officer on watch (OOW) or when the OOW does not reset the "fitness check" alarm, which shall be acknowledged in pre-defined time intervals, an alarm is raised in captain's cabin and in the selected back up navigator.

B. Diesel Manoeuvring System DMS 2100

This system offers a fully automatic remote control of the main engine from the bridge and the engine control room (ECR). The access to the data is ensured by the intelligent operator panels. The proposed system offers the following features:

- Fully automatic control from the bridge and the ECR,
- Change-over from automatic to manual control from the ECR,
- Step-less speed control,
- RPM limitation from the ECR,
- Fine adjustment of set point, digital display of RPM and set point on the bridge and in the ECR,
- Redudant speed sensing and indication.

In addition, the engine protection is assured by:

- Automatic load program,
- Automatic avoidance of critical speed range,
- Slow down functions,
- Start blockings.

The basic elements of the system are shown in the Figure 6.

C. Diesel Protection System DPS 2100

This system protects the engine against critical parameters such as over speed, low lubrication oil pressure and high cooling water temperature. It is independent of the main engine remote control for automatic and manual shut down as well as for emergency shut down or automatic power reduction to protect the propulsion system against damaging operating conditions. Intelligent operator panels enable simple access to all data.

The features of the system are as follows:

- Fully automatic handling of slow downs and shut downs,
- Protection against over speed,
- Supervision of inputs against cable break,
- Redudant speed sensing and indication.

The Figure 6 also shows the basic elements of the system.

D. Electronic Governor System EGS 2000

The EGS controls the speed of the rotation of the output shaft according to a given speed-setting input. By doing this, it ensures the best running conditions in any given situation. This provides maximum engine efficiency and optimum fuel consumption. At the same time, it minimizes wear and tear on the fuel rack and the risk of the thermal overloading of the engine. The basic elements of the system are exhibited in the Figure 6 as well.

5.3.1.1 Cost of ship's automation

The total cost of automations excluding cost of retrofitting was DKK 2,700,000 (374,521$, 1USD=7,2092 DKK - 04/06/99). The cost of retrofitting could not be calculated without surveying the vessel, however the worst case which was 80% of the cost of automations was calculated. That is to say, the cost of retrofitting was 299,617$. The total cost for the introduction of the automations was 674,139$.

5.3.1.2 Evaluation of the automation

A review of automated vessels experiences show varying degrees of reliability in engineering automation. Accordingly, manning reductions in the engine department shall be made only after a system has been operated for sufficient period of time to demonstrate its reliability. Therefore, the results of the proposed system can only be evaluated in the trial period of the concept.

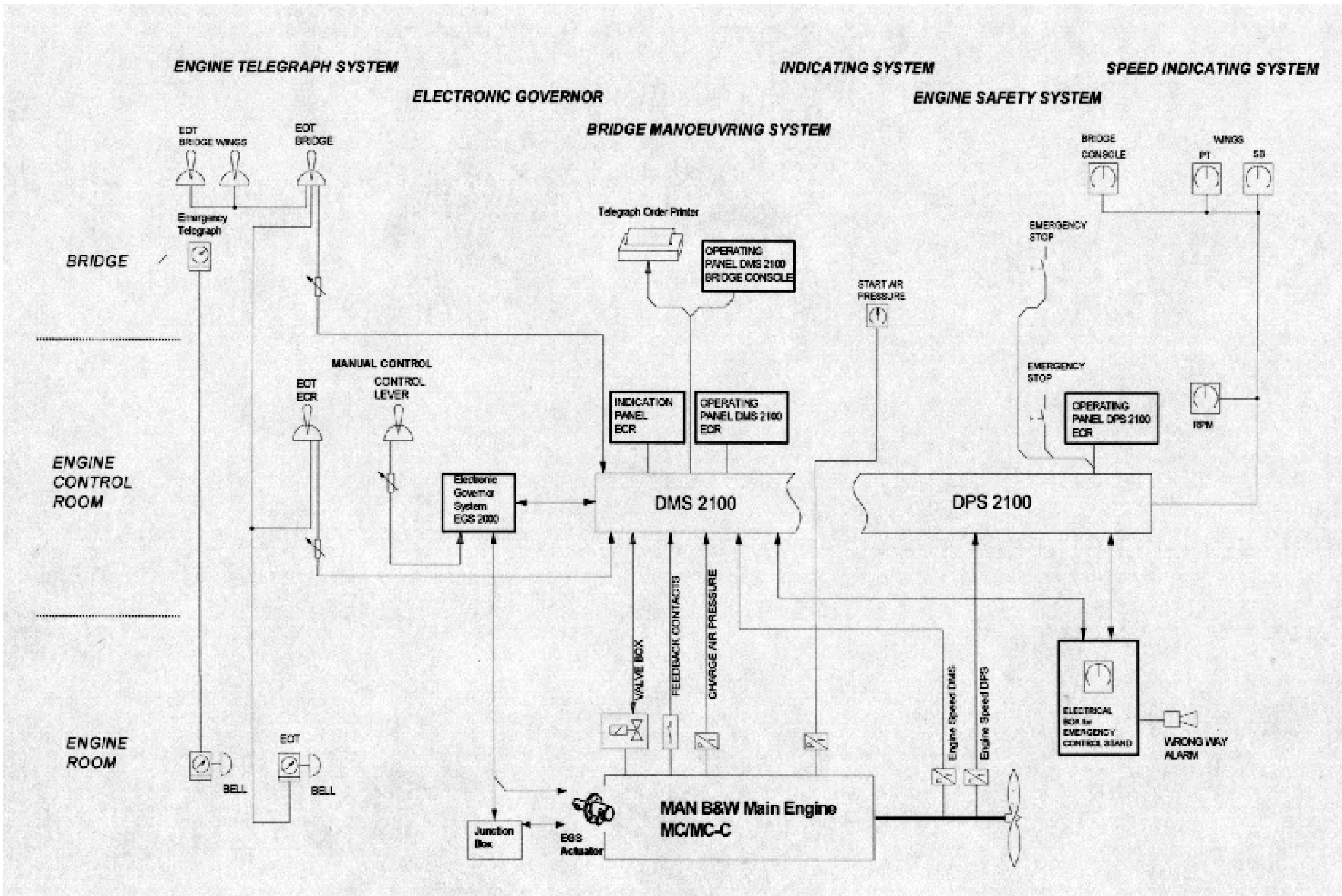


Figure 6. DMS 2100/DPS 2100/EGS 2000; System layout drawing.

In addition, since man-machinery trade off analysis can not answer the question of reliability and maintainability of the M/E and auxiliary equipment, the current maintenance plan shall be re-viewed. Re-visiting and re-scheduling the maintenance plans can give an answer not only to the required reliability but also to the need and frequency of riding gangs to assist the engine compliment.

5.3.2 Deck department

Another objective of the project is to reduce the ratings to only 3 AB/GP. Therefore, there is a need to reduce as much as possible the maintenance required on the deck department, because their new duties will be limited to:

- Watch keeping in the period of darkness,
- Preparation of the vessel for the next port of call,
- Essential maintenance for both departments,
- Assistance to engineer officers for engine repairs.

Considering these facts, it was decided to introduce a new paint system for the vessel. The introduction of a new paint system aims to minimize the work hours required for the maintenance of the steel construction and the cosmetic appearance of the vessel. In co-operation with a paint manufacturer, it was decided that the vessel shall be blast cleaned initially and accordingly repainted with long lasting paints. The whole proposed plan is as follows:

A. Blast cleaning

The areas that will be sand blasted are the following:

- Underwater parts: approximately 15,000 m^2,
- Topsides: approximately 2,000 m^2,
- Main deck: approximately 9,000 m^2,
- Accommodation: approximately 1,800 m^2.

Table 25a. Jotun's proposal

Topsides						*2 000*	*sqm. tot.*				*Based on calculated loss factor
Anticorrosive protection / **Product:**	Solid vol (%)	Theo. spr. rate (sqm/lt)	Pract spr. rate (sqm/lt)	Loss fact. (%)	Sur-face prep.	Applic. of area (in %)	DFT (mic)	WFT (mic)	Type of Thinner	Theo. consump. (lt/coat)	*Pract. consump. (lt/coat)
Jotamastic 87 Aluminium	87	5,80	4,06	30%	B/C	10%	150	172	17	34	49
Jotamastic 87 Aluminium RT	87	4,35	3,05	30%		100%	200	230	17	460	657
Penguard TC Black	50	10,00	7,00	30%		100%	50	100	17	200	286
						TOTAL	**400**			**694**	**992**

Underwater Area						*15 000*	*sqm. tot.*				*Based on calculated loss factor
Anticorrosive protection / **Product:**	Solid vol (%)	Theo. spr. rate (sqm/lt)	Pract spr. rate (sqm/lt)	Loss fact. (%)	Sur-face prep.	Applic. of area (in %)	DFT (mic)	WFT (mic)	Type of Thinner	Theo. consump. (lt/coat)	*Pract. consump. (lt/coat)
Jotamastic 87 Aluminium	87	5,80	4,06	30%	B/C	10%	150	172	17	259	369
Jotamastic 87 Aluminium RT	87	5,80	4,06	30%		100%	150	172	17	2 586	3 695
AF Seamate SB33 Light Red	52	5,20	3,64	30%		100%	100	192	7	2 885	4 121
AF Seamate SB 33 Dark red	52	5,20	3,64	30%		100%	100	192	7	2 885	4 121
						TOTAL	**500**			**8 614**	**12 306**

Main Deck						*9 500*	*sqm. tot.*				*Based on calculated loss factor
Anticorrosive protection / **Product:**	Solid vol (%)	Theo. spr. rate (sqm/lt)	Pract spr. rate (sqm/lt)	Loss fact. (%)	Sur-face prep.	Applic. of area (in %)	DFT (mic)	WFT (mic)	Type of Thinner	Theo. consump. (lt/coat)	*Pract. consump. (lt/coat)
Jotamastic 87 Aluminium	87	5,80	4,06	30%	B/C	10%	150	172	17	164	234
Jotamastic 87 Aluminium RT	87	5,80	4,06	30%		100%	150	172	17	1 638	2 340
Penguard TC Green 257	50	10,00	7,00	30%		100%	50	100	17	950	1 357
						TOTAL	**350**			**2 752**	**3 931**

Table 25b. Jotun's proposal

Accomodation ***1 800 sqm. tot.*** *Based on calculated loss factor

Anticorrosive protection **Product:**	Solid vol (%)	Theo. spr. rate (sqm/lt)	Pract spr. rate (sqm/lt)	Loss fact. (%)	Sur-face prep.	Applic. of area (in %)	DFT (mic)	WFT (mic)	Type of **Thinner**	Theo. consump. **(lt/coat)**	*Pract. consump. **(lt/coat)**
Jotamastic 87 Aluminium	87	5,80	4,06	30%	B/C	10%	150	172	17	31	44
Jotamastic 87 Aluminium RT	87	5,80	4,06	30%		100%	150	172	17	310	443
Hardtop AS White	50	10,00	7,00	30%		100%	50	100	10	180	257
						TOTAL	**350**			**521**	**745**

An approximate cost is 220,000$ (prices of June 1999), and it can vary significantly since it is dependent upon the following factors:

- The shipyard that will undertake to perform the task,
- The condition of the vessel's plates.

However, the 220,000$ is considered the worst case.

B. Vessel's coating

Accordingly, the paint system called JOTAMASTIC 87 ALLUMINIUM produced by JOTUN will be applied on the vessel. The product description is as follows (Andersson, 1999):

Jotamastic 87 Alluminium is a two-pack surface tolerant, high solids epoxy-based coating, for use in cases where optimum pretreatment is not feasible. It may be applied in high film thickness. This product is part of a complete system which is certified not to spread surface flames.

Moreover, some technical information about the product:

- Gloss retention: fair,
- Water resistance: excellent,
- Chemical resistance: good,
- Solvent resistance: good,
- Abrasion resistance: very good.

Furthermore, the properties of the selected system are:

- Penetration: Jotamastic 87 penetrates and adheres to blast cleaned steel and seals the surface,
- Adhesion: Superior adhesion is a key feature of the Jotamastic 87 preventing flaking and delamination and reducing undercutting if damage occurs,

- Durability: the surface tolerance, excellent penetration and superior adhesion properties of Jotamastic 87 provide exceptional mechanical strength. These benefits combined with high film thickness, provide excellent resistance to abrasion, mechanical damage, stress and exposure to the elements.

Although blast cleaning is not required, it was decided that sand blasting will improve the performance of the system. In co-operation with Jotun the following program was decided to be applied on the vessel:

In all areas, one coat of Jotamastic 87 will be applied on bare spots after spot blasting. At that time, the whole surface will be covered by a coat of Jotamastic 87 Alluminium RT. Accordingly, each area will have the following treatment:

- Topsides: For an enhanced cosmetic appearance Jotamastic 87 can be over-coated with Penguard top coat.
- Underwater area; The Jotamastic 87 Alluminium RT will be followed by two coats of anti fouling. Hence, the building up of thick film is avoided. A thick film results in the crack and flaking of the anti fouling,
- Main deck: For enhanced cosmetic appearance and due to the fact that main deck is subjected to the most severe operating conditions, the Jotamastic 87 Alluminium RT was decided to be covered by an Penguard epoxy topcoat.
- Accommodation: The final coat over the Jotamastic 87 Alluminium RT will be a Penguard epoxy topcoat.

The full description of the applied system is given in the tables 25a and 25b. The tables 25a and b describe in details the theoritical spreading rate (Theo. Spr. Rate), the practical speading rate (Pract. Spr. Rate), the application of area in percentage, the dry film thickness (DFT), the wet film thickness (WFT), the theoritical and practical consumption and finally the total quantity of paint required to be applied in each area.

The total cost of the paint system is as follows:

Topsides:	992 lt,
Underwater parts:	12,306 lt,
Main deck:	3,931 lt,
Accommodation:	745 lt
Total:	17,974 lt x 10,75$ per/lt = 193,220$.

5.4 Other areas of consideration

The introduction of the automation and the new paint system are neither a guarantee that the vessel can be manned with only 10 crewmembers nor the solution to the problems of reduced manning level. They are only some tools to reduce work hours required for the performance of some activities, which are time consuming, permitting thus the shifting of the workload in other activities.

Therefore, man-machine trade off analysis shall be further investigated. However, merely substituting tasks performed by the crewmembers is not the solution to all the problems. An extensive man-machine trade off analysis may result in zero manning, but this is not the point. One shall consider as well the constraints imposed by situations such as:

- Peak work load conditions,
- Mooring and unmooring related to the requirements at calling ports,
- Manual fire fighting,
- Frequency of port call in relation to rest hours, maintenance and duties that are required,

in addition to the international and national regulations related to the subject, i.e. the permitting working hours for each crew member. Considering all these parameters, the viability of the 10-man concept or the need for higher manning level will be revealed.

Finally, an important instrument is the job description for each crewmember. Job description provides in details the newly assigned tasks and responsibilities. Newly undertaken tasks reveal the needs for training and newly undertaken responsibilities.

5.5 Comparing levels of automation

REQUIREMENT FOR EQUIPMENT FOR PIONEER VESSEL, more then 5,000 GT (Ocean Going)	**Available in the vessel in question**
1. Remote control system for valves fitted in fuel oil supply lines	●
2. Level remote monitoring system and high level alarm system for fuel oil tank (except them in engine room)	●
3. Automatic record system for operating condition of main engine	●
4. Satellite navigation system	●
5. Auto pilot system	●
6. Remote control system for mooring winch on fore and aft	●
7. Remote control system for cargo operation	●
8. Remote control system for ballast operation	●
9. Powered opening system for side port, lampway and steel hatch cover	**Not applicable**
10. Satellite communication system	●
11. Centralised monitoring system for machinery on bridge	●
12. ARPA	●
13. Cargo hose handling system	●
14. Powered winch for emergency towing rope	**Not available**
15. Centralised monitoring system for reefer container	**Not applicable**
16. Centralised control system for machinery on the bridge	●
17. Power winch for pilot ladder	**Not available**
18. Fixed wash deck system (for bulkers)	**Not applicable**
19. Remote control system for main engine and steering on both bridge wing	**Only for M/E**

Table 26. Comparing level of automation

The required level of automation to efficiently and effectively run the Japanese Pioneer vessels is cited in chapter 4. The required level of automation for the aforementioned vessels was compared with the level of automation of the vessel in question, including the automation that is proposed to be applied. As it is clearly viewed by the table 26, the vessel in question has almost identical automation with the Pioneer vessels. This comparison is cited to present to the reader that the automation existing on board and the proposed additional one can be considered sufficient to man the vessel with lower manning compliment. Therefore, a company intending to undertake such a project shall focus its effort in the organisational structure of the vessel and re-organise the activities of the manning compliment.

5.6 Total cost of the proposed modification

Before the appraisal of the project as an investment, the following subjects shall be addressed:

- Total cost to modify the vessel,
- The incentives that will be provided to the participating officers and ratings,
- The costs which are not included in the calculation,
- The impact of the modification to the depreciation of the vessel,
- And a way to reduce the cost of the project.

The aim is to clearly present to the reader the items that will be considered in the investment appraisal of the project.

A. Cost of modification

The proposed modifications are fully described in the 5.3 and their total cost is as follows:

Automation: 674,139$

Paint system: 193,220$

Blast Cleaning:220,000$

Total Cost: 1,087,359$

B. Cost of the incentives

Since the project is dependent not only upon the level of automation and the re-establishment of the organisational structure of the vessel, but also upon the participating officers and ratings, there is a need for incentives that shall be provided to them. Therefore, it was decided to reduce the contract period from 6 to 4 months. Monetary incentives were also decided to be provided. The monetary incentive will be a 10% increase in the salaries required by the collective agreements. Both incentives are subjected to changes with the unions of seafarers. However, the pre-establishment of these costs will assist in the investment appraisal of the project.

C. Costs which are not included

In the pre-study it was not possible to calculate the cost of maintenance by "riding gangs". In addition, the cost of training the officers and the ratings in their new duties has not been calculated. Moreover, the cost for dry-docking and the off-hire period for the modification is not taken into account. The cost for dry-docking is not considered because not only the prices can vary significantly from day to day and from company to company, but also in similar projects an investment appraisal was not conducted. Similar rationale is valid for the off-hire period as well. Another view is that the required dry-docking and the consequent off-hire period can be performed in the 1st special survey of the vessel and thus exclude these costs from the total cost of the modification.

D. Depreciation

By investing on the vessel, the vessel shall be re-valued resulting in the rescheduling of the depreciation. The rescheduling of the depreciation will not affect the net cash flows, however it will affect the profit which will be generated by the vessel. Because of the fact that there is no available freight forecasting beyond 2005 in order to make a full appraisal of the effect on rescheduled depreciation, a simple method is employed to cite its effect.

The actual purchased price of the vessel in question can not be disclosed and in order to make the calculation, the average price of similar vessels contracted to be built in 1994 will be used, which is 40m$. In addition, the value of the vessel at the end of its economical life is its scrap value, which, according to the present prices, is for the vessel in discussion 1,760,000$.

Moreover, the operator of the vessel uses straight-line method of depreciation. Therefore, he depreciates the vessel annually by 1,529m$. As a result the book value of the vessel at the beginning of the 5^{th} year is 33,8m$. By investing 1,1m$, the new book value will be 34,9m$. The calculation of the rescheduled depreciation gives 1,58m$ per annum, which means 52,000$ lower annual profit due to the investment.

E. Savings

The implementation of the project requires the formation of a team that will handle the project. The use of external source may be costly, therefore a considerable amount of savings can come by forming a team from the shore and sea personnel of the company. Cross-functional responsibilities can be a source of delays for the project, however careful formation of the working groups with the right people as well as appropriate scheduling of activities and well balanced workload among the members of the group can overcome the problem.

5. 7 Investment appraisal of the project

Having already discussed the initially required modifications of the vessel, the consequent step is the appraisal of the project as an investment. The appraisal aims to assess the attractiveness of the project as an investment, whether this is the only criterion for the company to be involved in the project. Nevertheless, before proceeding to the appraisal, as a separate issue, the cost of the crewing solutions for the vessel, will be discussed.

5.7.1 Daily crewing cost

Reduced manning	1$=277drachma (1998)	
100% Greek Crew (Greek flag)	**Number of crewmembers**	***Total payment In $ (monthly)***
Master	1	8,558
C/O	1	5,620
2/O	2	8,694
Ch. Eng.	1	8,304
2nd Eng	1	5,821
AB/Motorman	3	8,542
Ch.Cook	1	4,294
Total	10	49,833
	pd (365)	1,638
	Plus 10%	1,802
	Travelling cost	74
	New cost pd	1,876
	Plus 2%	37.52
	TOTAL COST pd	1,914

Table 27. Crewing cost with reduced manning.

As it was described in 5.6.B, the participating officers and ratings will be provided with an increase in their salaries over their collective agreements accounting for 10%. In addition, their contract length will be reduced by 6 to 4 months. Taking into account the cost of these incentives, the daily manning cost of the vessel, if it will be manned with 10 crewmembers, is 1,914$. Table 27 reveals in detail the calculation of the cost of the reduced manning concept.

In parallel, another calculation was concluded, the cost of manning under a flag of convenience, which can be viewed in table 28. The calculation was concluded having in mind the Greek approach of manning under a flag of convenience (FOC). It is commonly found that on Greek–controlled vessels flying a FOC the Master and the Chief Engineer are Greeks, while the remaining crewmembers are of mixed foreign nationalities. In this specific case the calculation was concluded by assuming that the rest of the crewmembers are chiefly from Philippines.

FOC	1$=277drachma (1998)	
Hellenic crew	**Number of crewmembers**	***Total payment In $ (monthly)***
Master	1	7,893
Chief Officer	1	7,671
Filipino Crew		
Deck officers	3	5,524
Engine Officers	3	5,524
Deck ratings	7	7,133
Catering ratings	4	3,856
Engine ratings	2	1,830
Other nationality crew		
Electrician	1	1,300
TOTAL	22	40,731
	pd	1,339.10
	Travelling cost	91.00
	Plus 2%	28.60
	Total cost	42,161.10
	Total cost pd	1,405,37

Table 28. Daily manning cost under a FOC.

The purpose of these calculations is to cite the differences in cost among the current manning, the proposed manning and the manning under a FOC. The first comparison, between the current manning cost and the 10-man concept, serves to calculate the savings, if it will be decided to man the vessel with the 10-man concept instead of the present manning. The total annual savings will be named later cash flows that the investment generates.

According to the operator of the vessel, the manning cost of the vessel is currently 2.600$ per day. Therefore, the annual savings, manning-wise, will be the difference of the current manning cost with the manning cost of the 10-man concept, multiplied by 365. That is to say, 2,600$ - 1,914$ = 686$pd x 365 = 250.390$ annual savings or cash flows annually generating by the investment.

The second comparison aims to cite the level of improvement achieved by implementing the project. Manning the vessel under a FOC is 46% less expensive than the manning under the Greek flag, whereas the 10-man concept reduces this gap to 27%. Hence, the manning cost is reduced by 26%, resulting in a lower daily operating cost of the vessel.

5.7.2 Methods of appraisal (based on Mottram, 1998 and Mott, 1989)

The investment will be appraised using two methods; a conventional method and a discounted cash flow method. The first method consists of three calculations, nonetheless not interrelated among each other. Each of these calculations serves a different objective of the appraisal and they are considered as the initial filters of an investment. The second method, the discounted cash flow, takes on account an important element not considered in the conventional methods, the time value of money.

5.7.2.1 Conventional methods

5.7.2.1.1 Payback time

The payback time is an appraisal based on the concept that the earlier the investment pays back the original investment, the safer the investment is. As it was aforementioned, the cash flows that this investment generates are the savings from the reduced manning compliment that are accounted for 250,390$ annually.

Year	Annual cash flows	Cumulative cash flows
0	-1,500,000	-1,500,000
1	+250,390	-1,249,610
2	+250,390	-999,220
3	+250,390	-748,830
4	+250,390	-498,440
5	+250,390	-248,050
6	+250,390	+2,340

Table 29. Payback time calculation.

Therefore, according to the calculation, which can be seen in the above table, the cash flows generated by the investment pays back the initial investment in less than 6 years. Considering the fact that the remaining economical life of the vessel is 21 years, since it is 4 years old, there is a remaining of 15 years for the investment to generate a profit as well.

5.7.2.1.2 Rate of return (ROR)

The rate of return is another conventional method of appraising an investment. The concept behind this conventional method of appraising an investment, is that it measures the annual return of the investment in terms of percentage on the average value of the investment. The average value of the investment in the entire economical life of the project is considered to be the average investment. Accordingly, Average investment = (Value of the original investment - Value at the end) / 2=

= (1.087.359$ - 0$) / 2 = 543,680$

Before proceeding to the calculation of the ROR, it is required, additionally, the calculation of the average profit per annum, which is equal to the total cash inflow generated by the investment less the total cash outflows. The remaining economical life of the vessel is 21 years and it is expected to generate annual cash flow of 250,390$, which is the savings from the manning reduction. Moreover, the cost of modification accounts for 1,087,359$. Therefore,

Total cash inflow = 21years x 250,390$ = 5,258,190$

Total cash outflow = 1,087,359$

Total profit = 4,170,831$

The total profit divided by the remaining economical life of the vessel produces the average profit per annum, which is generated by the project.

Average profit per annum = Total profit / Economical life of the project =

= 4,170,831$ / 21 years = 198,611$

Having calculated the average profit per annum and the average value of the investment, the final phase is the calculation of the ROR.

ROR = Average Profit pa / Average Investment = 198,611$ / 543,679$ = 37%

As a number, the result of the calculation is very attractive. However, each company has its own economical targets when it decides to invest. It also considers factors such as effort required to achieve the specific target and the profits generated in terms of volume of money. The reason of mentioning these two factors is to underline that an investment may be attractive in terms of results extracted of the analytical tools, however if the volume of money generated is lower than the effort required, the investment may be rejected.

5.7.2.1.3 Return on investment (ROI)

Last but not least, a method of conventional appraisal was selected to be presented, the return on the investment due to similarities with the ROR. ROI shows the relation of the annual profit as a percentage of the original investment, instead of the average investment. Therefore,

Total cash inflow = 21years x 250,390$ = 5,258,190$

<u>Total cash outflow = 1,087,359$</u>

Total profit = 4,170,831$

Furthermore, the total profit divided by the remaining economical life of the vessel produces the average profit per annum, which is generated by the project.

Average profit per annum = Total profit / Economical life of the project =

= 4,170,831$ / 21 years = 198,611$

Finally,

ROI = Average profit pa / Original investment =

= 198,611$ / 1,087,359$ = 18%

Expressing the views of the result, it shall be said that the concluding comments on the ROR are valid for the ROI as well.

5.7.2.2 Discounted cash flow method; The time cost of money

Having discussed the conventional methods of investment appraisal, it is noteworthy to mention that the major drawback of these methods is the fact that the time value of money is not taken into account. In order to measure the impact of this factor in this investment, the discounted cash flow method will be employed. Using the cost of capital as a discounted cash flow factor, the method projects the future value of cash flows as present values. Hence, they can be compared with the original investment, so as to draw conclusions.

The discounted cash flow is the weighted average cost of capital of the vessel's operator being 10%. The savings due to the reduced manning compliment will be the benefit from the investment and they will be discounted by 10% (the cost of capital). Their sum will be the Gross Present Value (GPV) of the investment. GPV less the original investment will produce the Net Present Value (NPV) of the investment, which can be used to draw conclusions. In table 30 the calculation of the NPV for this investment can be viewed.

As it can be seen in table 30, there is a surplus in the NPV, which is the surplus that the investment generates comparing with the value of the investment today. In this table, another important element of investment appraisal is presented, the Internal Rate of Return (IRR). IRR works out the DCF giving NPV=0. In this specific case, it means that in the cases that the cost of capital is higher than 11% the NPV of the investment will have a negative surplus and the project will most probably be characterised not worth investing.

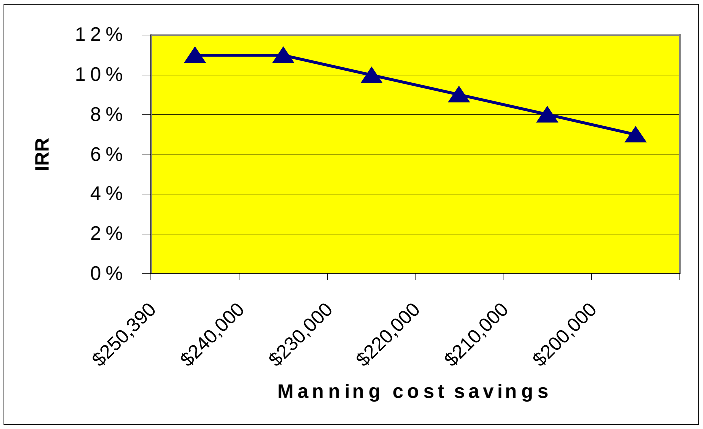
	Cash Outflow	Benefit from the investment	DCF 10%	PV	GPV	NPV	IRR
1999	-1,087,359			-1,087,359	2,157,846	1,070,487	11%
1999		250,390	1,1000	227,627			
2000		250,390	1,2100	206,934			
2001		250,390	1,3300	188,263			
2002		250,390	1,4641	171,020			
2003		250,390	1,6105	155,472			
2004		250,390	1,8758	133,484			
2005		250,390	1,9487	128,491			
2006		250,390	2,1436	116,808			
2007		250,390	2,3579	106,192			
2008		250,390	2,5937	96,538			
2009		250,390	2,8531	87,761			
2010		250,390	3,1384	79,783			
2011		250,390	3,4522	72,531			
2012		250,390	3,7974	65,937			
2013		250,390	4,1772	59,942			
2014		250,390	4,5949	54,493			
2015		250,390	5,0544	49,539			
2016		250,390	5,5599	45,035			
2017		250,390	6,1159	40,941			
2018		250,390	6,7274	37,219			
2019		250,390	7,4002	33,836			

Figures in USD.
Cost of Capitals 10%, which equals to the DCF.
DCF: Discounted Cash Flow, ***PV:*** Present Value, ***GPV:*** Gross Present Value,
NPV: Net Present Value, ***IRR:*** Internal Rate of Return.

Table 30. Discounted Cash Flow calculation

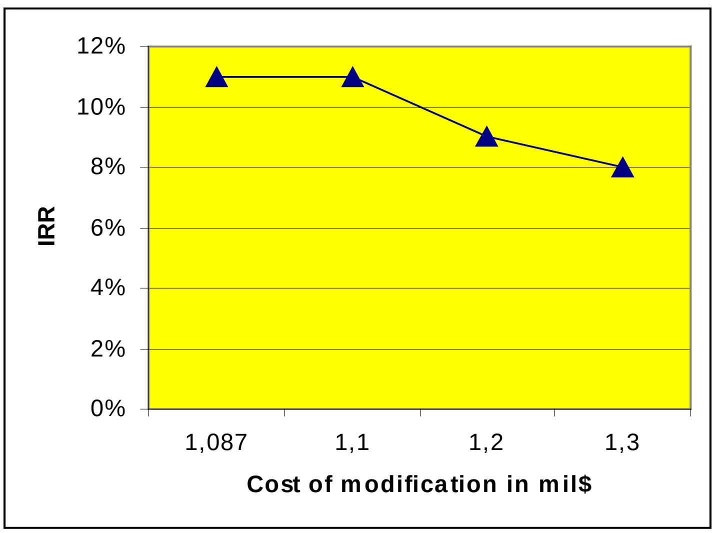
5.7.2.2.1 Sensitivity analysis

Since this research is a pre-study, the possibility of a change in one of the figures of the calculation is quite high, shortly after the completion of this research. Therefore, the analysis needs to be re-concluded by changing the basic elements of the calculation in order to measure the sensitivity of the initial calculation.



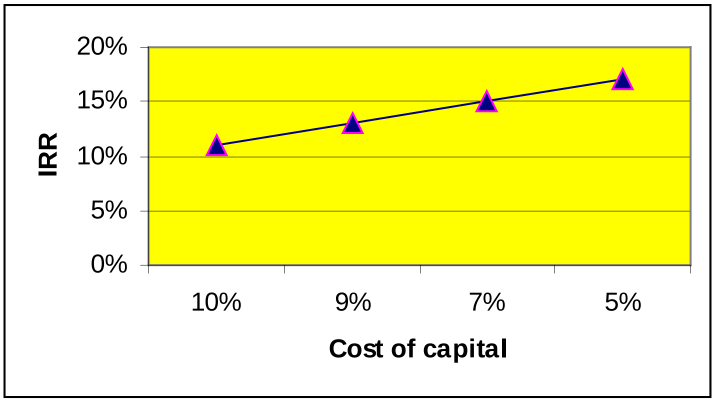
Graph 7. IRR and Manning cost savings

Three scenarios were considered to test the sensitivity of the analysis; lower savings from the reduced manning, higher cost of modification and finally lower capital cost of the investment. Graphs 7,8 and 9 reveal in detail the results.



Graph 8. IRR and Cost of modification.

In brief, little lower savings from the manning cost result in an unattractive IRR. The same was noticed for higher cost of modification. Finally, the impact of higher cost of capital was not measured, since the initial 11% IRR is the indication of the cost of capital, where the NPV=0. However, the initial result was tested against lower cost of capital and the results were very attractive, since a 9% cost of capital results in an IRR of 13%.



Graph 9. IRR and Cost of capital.

5.8 Concluding the project

A SWOT analysis has been performed in order to summarise the strengths, weaknesses, opportunities and threats of the proposal. It serves as a concluding paragraph as well.

	OPPORTUNITIES	ThREATS
Strengths	• Similar projects have been successfully implemented, • It improves competitiveness, • Level of required modifications is low for new vessels, • It will stabilize the required number of Greek Officers, • It assures the continuation of the Greek knowledge of seamanship, • It improves loyalty and continuation of crews, • A 1OO% Greek manning compliment.	• It is a possible solution to the loss of the competitiveness, • Positive, at first glance, investment appraisal, however very sensitive to changes, • A Large number of Greek officers is required in order to be applied in a large fleet.
WEAKNESSES	• Additionally crew training is required, • Necessitates a genuine willingness of the pertinent parties to participate in the project, • A matrix organisational structure is required to decrease the cost of the project.	• Postulates and principles regulate the project, • Long effort before the implementation of the project (Appendix 3), • It is less competitive than the FOC vessels, • The benefit generated is probably lower than the effort required, • It is applicable only to modern vessels, • It is not applied to asset players, • It can be applied only to companies with long strategic planning and with strong belief to the Greek seafarers.

Table 31. SWOT analysis.

CHAPTER 6

Conclusions and recommendations

Based on the discussion in the previous chapters, the following conclusions have been drawn:

- Potential savings in the daily operating cost can be realised either by reducing the number of crew on board or by substituting the current crew with a cheaper alternative.
- The latest amendments in Greek manning rules reduced the quota of Greek seafarers to 60%. Higher reduction was expected by the shipowners.
- The increase of the Greek-controlled fleet is not in line with the increase of the Greek-flagged fleet, because the former has exhibited an increase of 35% and the latter has been decreased by 6,6%.
- The decline of the Greek-flagged fleet has been accelerated the last 5 years and accounts for 13%.
- Athough the Greek-flagged fleet declines in terms of number of vessels, the gross tonnage has increased because large vessels have been registered, particularly new-buildings.
- The contribution of the Greek shipping industry to the endemic balance of trade accounts for more than 2 billion $ per annum.
- In order that tourism, which is a very important sector of the national economy, contributes with the same amount of foreign exchange, like shipping does, another 5 to 6 million tourists have to visit Greece each year.
- The more vessels are under the Greek flag, the more jobs are created ashore, since Greek-flagged shipping creates a significant number of jobs ashore.

- Each position on board creates four additional positions for the national economy, and each dollar generated by shipping generates another one and a half dollar of general income for the national economy.
- From the total amount of added value generated by shipping, 30% is generated by the vessel, while the remaining 70%, is generated by activities in the offices supporting the vessels.
- During the last decade the number of Greek seafarers has declined by 34%. Concurrently, the level of unemployment has increased and during the period 1995-1998 the increase accounts for 75%.
- The level of unemployment of Greek seafarers will be increased, since the latest amendments reduced the quota of Greek seafarers to 60% of the full manning compliment.
- A reduction of Greek seafarers is expected due to the re-flagging of Greek flagged vessels as well as due the higher allowable quota of foreign crewmembers on board Greek flagged vessels.
- The fact that the existing number of seafarers declines and that the shipping sector is not attractive to new seafarers, causes a worry that the Greek shipping industry will shortly face the problem of shortage of Greek seafarers.
- In tankers and bulkers, the daily cost of H&M insurance has declined. In the 90s, the decrease accounts for 17% and 35% respectively.
- For tankers, the P&I premium has increased by 89% since 1991. On the other hand, for bulkers the increase accounts for 26%.
- The total cost increase in the R&M for bulk carriers, since 1991, accounts for 25%. In tankers, the same cost is higher, because of the more stringent operating environment. However, the cost of repairs and maintenance has decreased 7%.
- The cost of provision of supplies and lubricants, in the last 8 years, has declined by 6%, on average, for all sizes of vessels.

- The nominal cost of newly built bulk carriers has declined by11% in the 90s. The total reduction for the capital charges is higher than the reduction in the price of a newly built bulk carrier and it was, on average, for the last 7 years, 15%.
- Mixed fortunes have been experienced in the second hand market for bulkers during the period 1991-1998. The capital charges for second hand acquisitions has been risen, albeit not sharply.
- Newly built tankers were costing 15% lower, on average, at the end of 1996, in comparison with those of 1991. The daily capital charge follows, in percentage, the reduction of the prices.
- The second hand market prices of tankers has increased by 11% since 1991. The percentage of increase in the price of second hand tankers coincides with the percentage in the increase of the daily capital cost for these vessels.
- The price of fuel oil has increased since 1990 by 7%.
- Port and canal dues have risen in the 90s. On the other hand, the major canals, Suez and Panama, have experienced mixed fortunes in terms of traffic figures and as a consequence tolls have been reduced or frozen.
- On one hand, the international cost associated with the operation of bulk carriers has decreased by 12%. On the other hand, the international cost associated with the operation of tankers has declined by 14%. Both conclusions refer to the period 1991-1998.
- In the 90s, the manning cost on tankers has increased by 11%. The increase in the bulkers accounts for 39% for the same period.
- In Greek drachma, the total increase of the Greek salaries accounts for 78% since 1991. However, expressing the salaries in US dollars the nominal increase is only 29%.
- The 29% increase in Greek salaries is higher, in comparison with the 19% increase in the Total Crew Cost agreement given by ITF for the period 1991-1998.

- Under the Greek flag, the annual tonnage taxes are 276% higher, compared to the second most expensive flag.
- In the 90s, the total administration cost related to tankers has decreased by 6%, while the similar cost related to bulkers has increased by 12%.
- Vessels manned with cheaper manning compliments than a Greek one, have a competitive advantage over the Greek flagged vessels during the periods of recession of the shipping market.
- Although manning reduction is not a new trend in shipping, no specific rules have been established that shall be complied by shipowners/operators in order to attract reduction in the manning levels.
- Reductions in manning level were the subsequent result of a considerable study, review and experimentation by governments, operating companies and labour organisations.
- The departmental distinction in the advanced vessels is highly skewed and the trend is toward ship management officers rather than deck and engine officers.
- Shipowners/operators intending to undertake minimum manning level project shall initially consider the general postulates of the flag-State related to the subject, followed by a man-machinery trade off analysis. The allocation of ship management shall accordingly be decided, before addressing the international principles where the constraints of the model and the required modifications will be applied.
- The ISM Code is not related to minimal crewing, however the companies which have implemented the Code, have a very important tool, if they intend to undertake such project.
- By re-organising and re-assigning the workload structure and the duties, the problems of fatigue and boredom in vessels with low manning level can be overcome.

- Enhanced living conditions through careful ergonomic attention to the design of living areas and the fact that the smaller crew size by itself results in the breakdown of the departmental distinctions, can overcome the problem of social interaction among crew members in minimum manning level projects.
- The drug and alcohol abuse in minimum manning level projects requires careful management of the alcohol availability and close monitoring of the physical and emotional health of crew members.
- Since the level of automation in modern vessels is high, a company intending to undertake minimal crewing projects shall focus its effort in the organisational structure of the vessel and in re-organising the activities of the manning compliment.
- Manning the vessel under a FOC is 46% less expensive than the manning under the Greek flag, whereas the 10-man concept reduces this gap down to 27%. Hence, the manning cost is reduced by 26%, resulting in the lower daily operating cost of the vessel.
- The project of low manning level, as an investment, gives attractive figures; Payback time 6 years, ROR 37%, ROI 18% and IRR 11%.
- The results of the investment appraisal are not the only criteria for a company to undertake a project. It also considers factors such as effort required to achieve the specific target and the profits generated in terms of volume of money.
- The sensitivity analysis of the IRR shows that the project as an investment can generate unattractive figures in the cases when either savings from manning cost are a little lower or the cost of modification or the cost of capital is higher.

Additionally, the following is recommended to the Greek MARAD:

- The minimum manning level project has two objectives; not only to reduce manning cost but also to employ only national seafarers on board the vessel. Therefore, since the high quota of national seafarers is of great importance for the MARAD and considering the fact that a FOC and the international registries result in the severe reduction of the use of national seafarers, the MARAD should encourage innovation.

- The pre-study has revealed that a minimum manning project, as an investment, is very sensitive. The cost required to build a vessel in order to be run with a minimum manning level has not been discussed in this paper, since it was beyond the scope of this research. However, the appropriate fittings of the vessel at the stage of a new-building may be less costly than a modification of an existing vessel. Therefore, the MARAD should encourage companies to consider such manning as an alternative at the stage of ordering a vessel at a shipyard.
- As it was mentioned in the main body of this research, the full implementation of modifying a vessel to be run with a minimum manning level requires time. It was also explained that time is needed, because such projects are based on research from shipping companies, governments and labor organisations. Therefore, the MARAD, in order to make this idea attractive to shipping companies, should prepare a more specified regulatory framework for such projects and educate, accordingly, the national seafarers as well. These measures can result in considerable savings for shipowners.

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Apppendix 1

TASKS TO BE EVALUATED

1.0 CARGO
- 1.1 On-load
- 1.2 Off-load
- 1.3 Maintenance of cargo, equipment/deck stores/wares and ballast tank cleaning and repairs of cargo, desk equipment, stores and wares.
- 1.4 Record keeping (port logs)
- 1.5 Repair
  - 1.5.1 Reefer-maintenance
  - 1.5.2 Inspection

2.0 BALLAST
- 2.1 On-load
- 2.2 Off-load

3.0 NAVIGATION
- 3.1 Track keeping
  - 3.1.1 Day-good visibility
  - 3.1.2 Night-good visibility
  - 3.1.3 Restricted visibility
- 3.2 Manoeuvring
  - 3.2.1 Chart Correction
- 3.3 Collision avoidance
- 3.4 Voyage/passage planning
- 3.5 Record/chart keeping and update/bridge logs/charts and navigation information
- 3.6 Maintenance
  - 3.6.1 PMS
  - 3.6.2 Unscheduled
- 3.7 Test vital systems
  - 3.7.1 Prior to leaving port
  - 3.7.2 Prior to entering port
- 3.8 Bridge housekeeping
- 3.9 Weather monitoring
  - 3.9.1 Reporting
  - 3.9.2 Planning
- 3.10 Hull performance
  - 3.10.1 Monitoring
  - 3.10.2 Manoeuvring
  - 3.10.3 Planning
- 3.11 Training (equipment operations, procedure review, standard operations)

4.0 ENGINE OPERATIONS
- 4.1 Operations-routine and watch standing
- 4.2 Maintenance
  - 4.2.1 Unscheduled
  - 4.2.2 PMS
- 4.3 Record keeping
  - 4.3.1 Records and record keeping
  - 4.3.2 Soundings

5.0 AUXILIARY EQUIPMENT (all non-main engine propulsion equipment)
- 5.1 Generators
  - 5.1.1 Operations
  - 5.1.2 Unscheduled maintenance
  - 5.1.3 PMS
- 5.2 Fuel oil systems
  - 5.2.1 Operations
  - 5.2.2 Unscheduled maintenance
  - 5.2.3 PMS
- 5.3 Boilers
  - 5.3.1 Operations
  - 5.3.2 Unscheduled maintenance

- 5.3.3 PMS
- 5.4 Evaporators
  - 5.4.1 Operations
  - 5.4.2 Unscheduled maintenance
  - 5.4.3 PMS
- 5.5 Refrigerator/air conditioning
  - 5.5.1 Operations
  - 5.5.2 Unscheduled maintenance
  - 5.5.3 PMS
- 5.6 Sewage system
  - 5.6.1 Operations
  - 5.6.2 Unscheduled maintenance
  - 5.6.3 PMS
- 5.7 Inert gas system
  - 5.7.1 Operations
  - 5.7.2 Unscheduled maintenance
  - 5.7.3 PMS
- 5.8 Electrical/electrical control systems
  - 5.8.1 Operations
  - 5.8.2 Unscheduled maintenance
  - 5.8.3 PMS
- 5.9 Tools and test equipment
  - 5.9.1 Operations
  - 5.9.2 Unscheduled maintenance
  - 5.9.3 PMS
- 5.10 Pumps
  - 5.10.1 Operations
  - 5.10.2 Unscheduled maintenance
  - 5.10.3 PMS
- 5.11 Fuel transfer
- 5.12 Record keeping

6.0 LONG RANGE RADIO OPERATIONS

7.0 DECK OPERATIONS
- 7.1 Docking/undocking
- 7.2 Mooring/unmooring (offshore)
- 7.3 Anchoring/heaving-in
- 7.4 Helicopter operations
- 7.5 Underwater lighting
- 7.6 Tugs/crane using
- 7.7 Preparation for going into yard/dry dock

8.0 GENERAL OPERATIONS
- 8.1 Drills (lifeboat, fire fighting, etc.)
- 8.2 Maintenance (lifeboats)
- 8.3 Safety tours
- 8.4 Vessel fabric maintenance (paint, chip, grease, coat)
- 8.5 Deck equipment maintenance (lights, structure, mooring equipment, anchor, bow transfer)
- 8.6 Line and wire maintenance
- 8.7 Stores and supplies
  - 8.7.1 Handling
  - 8.7.2 Storage
  - 8.7.3 Ordering
- 8.8 Other training
- 8.9 Medical
- 8.10 Bunkering
- 8.11 Safety equipment maintenance, gas test meters and gauging equipment
- 8.12 Vessel structure maintenance/repair
- 8.13 Steering gear maintenance
- 8.14 Cleaning/wash down
  - 8.14.1 Deck

- 8.14.2 Engine room housekeeping
- 8.15 Supervise shore personnel/gangs
- 8.16 Stability and cargo planning

9.0 GENERAL ADMINISTRATION
- 9.1 Financial
- 9.2 Labour relations
- 9.3 Meetings
  - 9.3.1 Shipboard management
  - 9.3.2 Safety
- 9.4 Payroll
- 9.5 Regulatory requirement, monitoring/inspections/walk arounds with inspection regulatory authorities
- 9.6 Special projects

10.0 HOTEL FUNCTIONS
- 10.1 Catering
- 10.2 Accommodation and space clearing
- 10.3 Management
- 10.4 Provisioning
- 10.5 Maintenance

APPENDIX 2

Report on inspection on board MS COMPANION EXPRESS in connection with the current reduced crewing project

In accordance with a resolution made on 2nd September, 1988, the National Swedish Administration of Shipping & Navigation has given permission for MS COMPANION EXPRESS to be manned for a trial period of nine months by a crew of twelve on the liner service operated by the ship between ports on the US East Coast and ports in Northern Europe.

As a part of our monitoring of these trial activities, we accompanied the ship from 5th November to 8th November, 1988 on the voyage Rotterdam - Bremerhaven - Gothenburg. At the time of our visit, the ship had almost completed two round trips between the United States and Europe with a reduced crew. A radio operator had been on board on the first voyage, however, making a crew of thirteen. The latest voyage was made with a crew of only twelve, as the ship had been granted an exemption from the insistence on radio telegraphy, which meant that the radio operator could be dispensed with.

Two extra seamen were on board on the European part of this voyage in order to carry out some planned lubrication work in accordance with scheduled maintenance routines. Because of the increase in crew, an extra messman accompanied the ship on this part of the voyage.

During the visit on board, we had the opportunity of studying several different activities, such as: moorings, lock operations, coupling of tug-boats, loading/discharging, the boarding of pilots, routines on the bridge, administrative routines, maintenance routines, the inspection of some cargoes, minor engine break-downs, fire alarm routines, routines at meal-times, cleaning routines, etc.

There was plenty of time for thorough interviews with the crew about the project as a whole and about details in the day-to-day work on board.

Mooring operations seem to work well, with two persons on the forecastle and two on the poop on arrival and at departure. The ship is equipped with large capacity thrusters both fore and astern, which make it easy to keep the ship in the right position in relation to the quayside during the time required to set the lines ashore. The work with mooring proceeded without problems. The seamen and the officers regarded mooring as an undramatic operation. The motorman can assist in mooring operations, but this has not yet been necessary. In this connection, it should be added that the coupling of tug-boats at present requires three persons if the tug-boats are to be coupled in the way which is recognized here in Northern Europe, i.e. with the long tug-wire/cable in the panama chokes. Well-organized routines have been drawn up for this on board, however. We have also been informed that the shipping company intends to arrange an extra control unit for mooring winches on the poop. We are informed that this will be placed far astern on the port side, which would give complete supervision from the control unit over both tug-boat and winch when heaving tow-cables during connecting operations. This would mean that the coupling of tug-boats can be performed safely by only two persons on the poop. Some small alterations to the equipment on the poop will also be necessary. For example, it is intended to weld rings over certain hatches on the poop deck which would otherwise prevent the cables from running free in some situations.

Routines for loading and discharging have not had to be altered following the reduction in crew. Everything works approximately as it did previously, according to both officers and seamen.

Cargo inspection at sea, on the one hand checking that reefers are in working order and on the other hand checking the lashing of some cargoes, is now performed by the watch instead of day crew. Depending on the weather conditions, time of day, the placing of the cargo, etc, the inspection is sometimes carried out during the ordinary watch and sometimes on overtime. Repairs to damaged reefers are occasionally carried out by the Chief Engineer or one of the engineers. This does not constitute any deviation from previous routines.

Routines on the bridge have not had to be altered as a result of the reduced crew. Everything seemed to work well. The work on the bridge gave the impression of being well-organized.

The administrative routines have been altered owing to the fact that a radio operator is no longer included in the crew. The captain has therefore taken upon himself a considerable amount of extra work. The captain informed us, however, that at that particular time he did not consider the extra work to be any special burden. At the beginning of our visit, a fault arose in the maritex equipment. Despite repeated reminders from the ship and the shipping company, the contracted service company did not provide service for the equipment until the ship called at Gothenburg. This was considered extremely unsatisfactory by both the ships' officers and the shipping company. The shipping company has, since then, reported that the matter will be taken up for discussion with the service company.

Cleaning routines have been altered. For example, the crew now clean their own cabins. No-one on board regarded this as any great burden, but some emphasized, however, that it was a "social step back" to have to clean their own cabins. We have been informed that the crew has received financial compensation for this extra work. Cleaning routines have also been altered in that the various watches are responsible for the cleaning of certain sections of the interior according to a schedule which is posted on the bridge.

Routines at mealtimes have changed in that a self-service system now applies where everyone collects his meal at the counter in the cafeteria. After the meal everyone tidies up after himself and rinses the crockery before placing it in dishwasher trays. No-one on board regarded this procedure as difficult or a burden.

The cook does a lot of overtime but states that he finds the work stimulating.

It should be pointed out that the standard of the food on board is high and that cleanliness and tidiness in the kitchen areas and accommodation are excellent.

The following can be pointed out as regards operational routines, etc in the engine room.

Everyone in the four-man engine crew participates in the practical work and they consider that up to now they have easily had time to keep the machinery in good condition.

The two engineers are on stand-by duty every alternate night and the engineer who has been on stand-by duty during the night takes care of operations until noon the next day. These routines are the same as before. The alarm frequency can be considered low.

During manoeuvering in rivers and ports, the engine control room is manned by the Chief Engineer. If any breakdowns occur during these periods, the engineer on stand-by duty is called and, in such a case, is down in the engine room in a few minutes.

Maintenance work on the auxiliary engines has now been transferred to a service company and this has thus reduced the engine crew's work. The main engine's maintenance is already taken care of by a service company.

To sum up, it can be pointed out that the crew on board consider the project to be fairly undramatic and that the attention it has aroused in the mass media, etc, is not in proportion to the real conditions.

Kjell Eliasson, Captain
Ship Operations Section

Thure Gellerbrant, Marine Engineer
Technical Section

APPENDIX 3

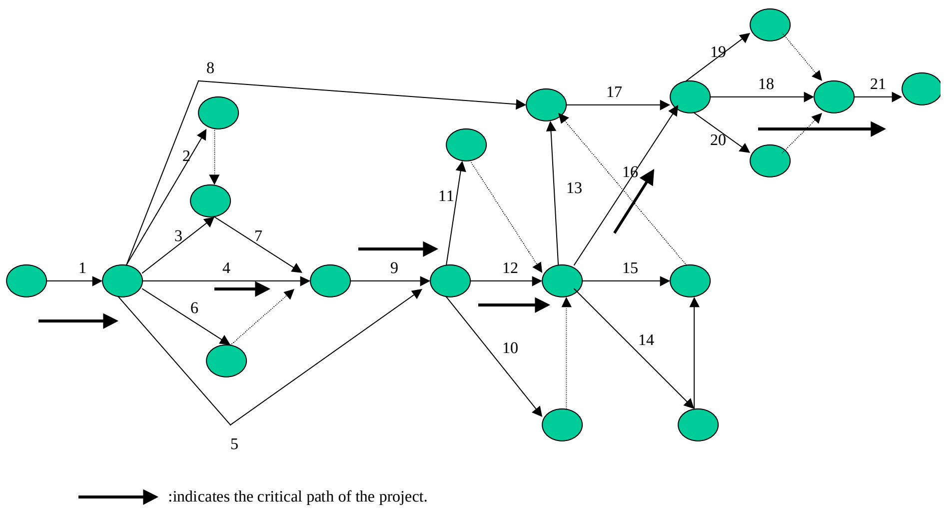
Activities Table

Act	Description	Successive activity	Craft[1]	Original duration
1.	Pre-study	2,3,4,5,6,8	T,C	2M
2.	Define core tasks	7	T,C	1M
3.	Define service tasks	7	T,C	1M
4.	Analyse work methods	9	T,C	2M
5.	Select equipment and suppliers	10,11,12	T	[2]
6.	Communicate to MARAD/Unions/In-house crews	9	GM	1M
7.	Calculate workload	9	T,C	1M
8.	Co-operate with class society	17	T	[3]
9.	Establish new manning model	10,11,12	T,C	2M
10.	Cost/benefit analysis	13,14,15,16	F	1W
11.	Inspect the vessel	13,14,15,16	T	1W
12.	Conceptual approval by MARAD	13,14,15,16	T	1M
13.	Negotiate with MARAD	17	GM	1M
14.	Negotiate with unions	17	GM	1M
15.	Modify vessel	17	T,C	1½M
16.	Educate and train the crew	18,19,20	C	1½M
17.	Interim manning certificate	18,19,20	T	1W
18.	Trial period	21	Ma	3M
19.	Observation trip	21	Ma,T,C	2W
20.	Evaluation and seminars to all parties involved	21	C	1W
21.	New manning certificate	Completion		1W

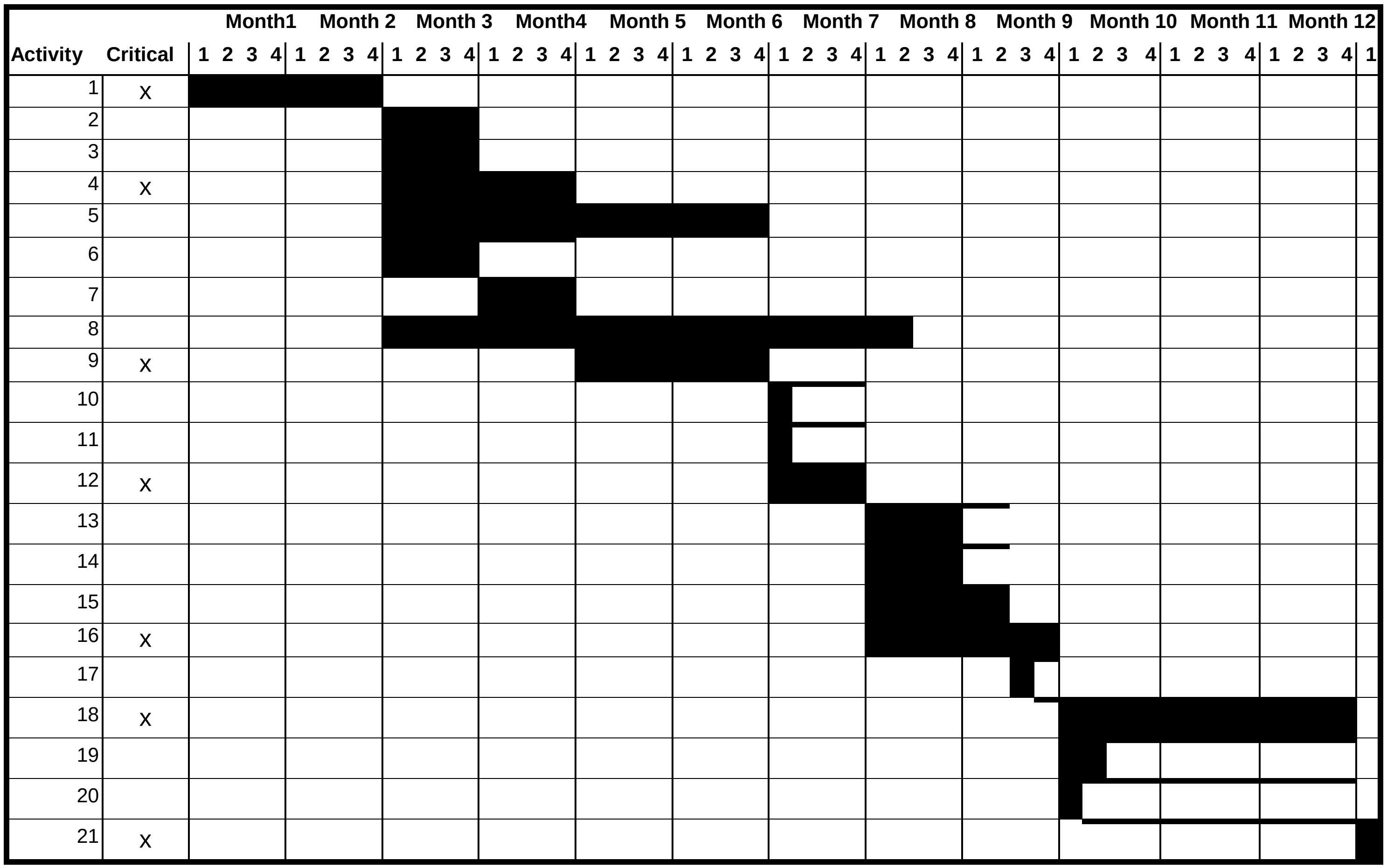
Abbreviations:
GM: General manager,
C: Crew department,
T: Technical department,
F: Finance department,
Ma: Master,
M: month, **W:** week.

[1] Departments or individuals of the company that will undertake the described activities.
[2] The activity will last until the establishment of new manning level.
[3] The inter-change of information with the classification society will last until the interim manning certificate will be issued.

Arrow Diagram of the project



Project's Gantt Chart



:indicates the slack time.