ARAB REPUBLIC OF EGYPT

TECHNICAL COOPERATION PROGRAM

TO

PLANNING AND RESEARCH DEPARTMENT,

SUEZ CANAL AUTHORITY

FINAL REPORT
SYSTEMS ANALYSIS

MARCH 1979

JAPAN INTERNATIONAL COOPERATION AGENCY

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PREFACE

In accordance with the agreement between the Governments of Japan and the Arab Republic of Egypt, the Japan International Cooperation Agency (JICA) conducted studies on the organization and functions of the "Economic Unit" which was established in the Planning and Research Department, the Suez Canal Authority.

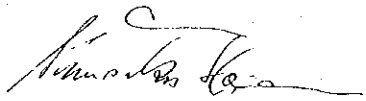
JICA organized a Steering Committee chaired by Professor Yoshimi Nagao of Kyoto University and a survey team comprising experts from the Mitsubishi Research Institute and the Japan Maritime Research Institute, and dispatched it to the Suez Canal Authority in Ismailia. In addition, JICA trained in Japan six staff members of the Suez Canal Authority for a period of three months in order to improve their technical capabilities.

This report deals with the standard techniques and methods of systems analysis and forecast which are necessary for on the management and planning of the Suez Canal.

I hope this report will prove to be useful for the development and expansion of the Suez Canal, the promotion of economic development of Egypt and for the promotion of friendly relations between Egypt and Japan.

I would like to express my heartfelt appreciation to the officials concerned of the Government of Egypt and Suez Canal Authority for their valuable assistance and hospitality they have extended to the Japanese Survey Team.

March 1979



Shinsaku Hogen
President
Japan International Cooperation Agency

TABLE OF CONTENTS

TABLE LIST

PART III ANALYSIS OF CURRENT TRENDS AND TRANSPORTATION COST

PART IV A BASIC SYSTEM FOR SHORT TERM FORECASTING

PART V A BASIC SYSTEM FOR LONG TERM FORECASTING OF TANKER TRAFFIC THROUGH THE SUEZ CANAL

PART VI SUMMARY OF PREVIOUS FEASIBILITY STUDIES

FIGURE LIST

PART IV A BASIC SYSTEM FOR SHORT TERM FORECASTING

PART V A BASIC SYSTEM FOR LONG TERM FORECASTING OF TANKER TRAFFIC THROUGH THE SUEZ CANAL

PART VI SUMMARY OF PREVIOUS FEASIBILITY STUDIES

PART I

SUMMARY

SUMMARY

A technical cooperation program was carried out for the Planning and Research Department, the Suez Canal Authority, according to the basic agreement of the Space of Work which was concluded between the Government of Japan and the Government of the Arab Republic of Egypt. The program studied the organization tasks and systems analysis required for the newly established Economic Unit of the Department (hereinafter referred to as the Unit) and was intended to assist it to achieve the functions expected by the Suez Canal Authority.

This report summarizes the results of systems analysis study. However, the technical cooperation program concerned with training is described in a separate report. The systems analysis study was carried out in order to enable the staff of the Unit to acquire the techniques and knowledge necessary to the performance of its duties. The following study items were included in the first year systems analysis study:

1) Review and analysis of existing models and reports on such problems as maritime economy and transport, feasibility studies, etc.
2) Basic systems for transit forecasting and analysis of maritime transportation costs.
3) Basic study for information system.

The duties of the Unit staff have been studied in close connection with the organizational study which was carried out simultaneously with the systems analysis study.

On the basis of the results of the field survey and training in Japan and also from the viewpoint of systems analysis, the following important and urgent subjects have been selected:

1) Analysis of external situations surrounding the Canal, maritime transportation costs and Canal traffic.
2) Forecasting of Canal traffic.
3) Analysis of feasibility studies.
4) Preparation and management of data necessary for these tasks.

For Item 1), it was intended that such factors as the economic and shipping situations surrounding the Suez Canal, Canal traffic, and transportation costs and all other important factors in forecasting the Canal traffic be analyzed and that the analyses be thoroughly understood by the staff.

These analyses were intended to constitute the basis of the traffic forecasting system. To assist the work of analysis, it was decided that existing reports, centering on maritime economics, be studied from the standpoint of the Suez Canal and that the study results then be summarized.

Item 2) was divided into short term and long term forecasting problems. Short term forecasting is intended to be a part of the basic study for information system. A basic system for the short term forecasting of Canal traffic using current trends and other data was proposed which is considered suitable for operation of the Unit's staff.

It was considered appropriate that the long term forecasting of traffic should be made at an introductory level at this stage of the cooperation program. A basic long term forecasting system was proposed that could be used as a manual for operating procedures of the forecasting by the staff. The forecasting system was designed in such a way that it could be refined and developed further in the future

As far as analysis of feasibility study is concerned, it was considered desirable that the staff members first aquire basic knowledge and skills necessary for understanding how a feasibility study is carried out. For this purpose it was proposed that existing reports on the feasibility studies should be reviewed by them as much as possible for the first step.

For Item 4), studies were to be made of information sources, items and basic data arrangement methods required for the above tasks.

Various studies were made on these subjects, and their results are now being arranged in this report as follows:

The respective parts are outlined below.

III. Analysis of Current Trends and Maritime Transportation Costs

This part deals with the analysis of current trends in the shipping situation surrounding the Suez Canal as well as those involving maritime transportation costs in relation to the investigation on the system analysis.

Chapter 2 "Suez Canal Traffic" makes clear the fields to be emphasized for investigations and analysis of this kind. These are highlighted by analyzing current trends in Canal traffic up to 1977 based on the officially disclosed figures in the "Suez Canal Report" compiled by the Suez Canal Authority and by taking problems relating to the Canal shipping situation into consideration.

It is noted that as a rule, oil, iron ore and grain are transported primarily via the Cape of Good Hope by large ships and that traffic through the Suez Canal will depend on market conditions. With regard to oil, the condition of ports and harbors for receiving oil as well as oil receiving plans expected in the future in Europe and USA should also be taken into consideration.

Chapter 3 "World Economy Resources and Seaborne Trade" describes how to interpret the current trends in the seaborne trade of oil, iron ore, grain and other goods, and lists the types of related statistical data. Simplification of data processing has also been taken into consideration. Analysis of current trends related to the Suez Canal requires an understanding of cargo movements through related routes. Pipeline transportation, the Siberian Land Bridge and the American Land Bridge are mentioned as competitive with sea routes using the Suez Canal. The Land Bridges are compared with the sea routes while introducing information on Land Bridges.

In Chapter 4 "World Fleet", the volume of existing shipping (by type, size, age, beam, and draft), idle tonnage (moored and slow steaming), scrappage and casualty losses, as well as the process of new ships entering the market are listed as items required in any analysis of current trends in ship supply corresponding to seaborne trade (in the previous Chapter). New orders, on order and deliveries are indicated as the process of grasping the existing tonnage and an analysis flow is set forth taking the market conditions (supply-demand balance, variation in market conditions, long term charter contracts, mooring percentage and market adjustment effect of combined carriers) into consideration. In addition, related data are listed.

In relation to the Canal, the movement of ships by types and sizes in the trades involing the Canal have to be considered. In this regard, a continuing survey is now being conducted. However, it is necessary to further investigate the situation of calling ships by sizes at receiving points in Europe and USA.

In Chapter 5 "Maritime Transportation Costs", conducts trial calculation of the three component factors constituting maritime transportation costs (capital, ship and voyage costs) and, based on this calculations have been made for 32 cases:
(1) ship type: tanker; ship capacity: 60,000 tons, 150,000 tons and 250,000 tons; trades; the Middle East/Rotterdam, Genoa and New York; routes: Suez/Suez, Cape/Suez and Cape/Cape, (2) the above three trades (Cape/Cape) for 500,000-ton tankers, and (3) Weipa (Australia)/ Rotterdam (via Suez and Cape) for 60,000-ton bulk carriers. The Suez and Cape routes are compared with each other based on calculated results in terms of freight variations and other factors (Canal toll and fuel cost). A comparison is also made for estimated transport costs on the basis of the estimated freight between the ship capacity, trades and routes.

The freight market described in Chapter 6 provides a clue to the supply-demand relation between the maritime trade and fleet characteristics and is closely related to analyses of current trends, particularly in tanker traffic through the Canal (Chapter 2 and 5).

Thus many markets are introduced, changes in markets during 30 years in the past are reviewed to clarify circulation of brisk and dull shipping conditions, and the interpretation of markets is studied. OECD Maritime Transport is introduced as an example of the analysis of markets conditions (reference is also made to Suez development plans and Middle East pipelines).

IV. A Basic System for Short Term Forecasting

This Part deals with the basic system for short term forecasting of Canal traffic and revenues.

The number of vessels, their net tonnage and goods tonnage are taken as forecast items, and yearly and monthly forecasts are then made. The forecast values are necessary to understand trends in Canal traffic and are of great value in management of the Canal.

Chapter 1, "Introduction" describes the purposes of forecasting and the items to be included.

Chapter 2, "Preparation of Data," explains the kinds of data required, lists data sources and describes how to arrange the data. Main data items include those which can be obtained directly from the Suez Canal Authority (monthly number of vessels, their net tonnage, goods tonnage and revenue from the Canal) as well as data to be obtained from other sources (e. g., gross domestic production in major countries in the world, and world seaborne movements, etc.).

Chapter 3, "Forecasting Methods", explains the procedure for forecasting by using the data collected in Chapter 2. In short term forecasting, it is more important to employ procedure suitable to the data rather than to build large mathematical models. To this end, several typical analyses have been explained. In the first a method is described in which annual forecast values on the number of vessels passing through the Canal are determined by a time series analysis of traffic data, and at the same time, their net tonnage and revenue from the Canal are estimated. In another approach, Canal traffic is determined on the basis of forecasts for world seaborne movements. Then a procedure is described in which the number of vessels expected in the following month is forecast using exponential smoothing models, and the net tonnage of these vessels, revenue from the Canal and goods tonnage are then forecast based on the values for the numbers of vessels.

Chapter 4, "Evaluation of Canal Capacity," describes the process of judging whether or not the Canal capacity is sufficient for the forecast number of vessels to pass through the Canal.

V. A Basic System for Long Term Forecasting of Tanker Traffic through the Suez Canal

This Part summarizes a basic system for long term forecasting of tanker traffic through the Suez Canal.

The ship type dealt with in the forecasting is restricted to tankers for the following reasons: First, tanker traffic is expected to increase once the Suez Canal expansion projects have been carried out. This is because traffic of ships other than tankers will increase to only a small degree since such ships are generally small-sized and the depth of the Canal at present meets the passage demand of these ships. Thus any increase in revenue from the Canal following its expansion will be due largely to tankers. Second, traffic of ships other than tankers can be forecast using a method similar to that for tankers. The procedures for forecasting tanker traffic are divided into six steps.

Chapter 1, "Introduction" clarifies the objectives of long term forecasting for tankers and how to use the forecasting system.

Chapter 2, "World Energy and Oil Trade," describes the forecasting of world economy, energy supply and demand, and the volume of the world oil trade.

Chapter 3, "World Tanker Fleet," describes methods of forecasting the tanker fleet characteristics; e. g., analysis of the current fleet, prospects for future shipbuilding, analyses of scrappage and losses, and forecasting of the world fleet supply.

In Chapter 4, "Tanker Shipping Costs," transportation efficiency indicating the productivity

of vessels is defined, and a method of calculating transport efficiency by route and size is explained. A method of calculating transportation costs is then explained.

Chapter 5, "Tanker Traffic through the Canal," explains a statistic model for forecasting traffic passing through the Suez Canal under varying levels of tariff and given conditions of oil trade volume, transportation costs and fleet characteristics.

Chapter 6, "Canal Revenue from Tanker," clarifies the methods of forecasting Canal revenue at a given level of the tariff per ship. This Chapter also describes methods of determining the demand function indicating the relation between the tariff and number of vessels, as well as of determining the revenue function indicating the relation between tariffs and revenue from the Canal.

The systems analysis technique in this part provides basic knowledge for determining the scope and timing of Canal expansion projects as well as tariffs in the future.

VI. Summary of Previous Feasibility Studies

Part VI describes the existing models and reports related to feasibility studies. These include the feasibility studies made by Maunsell Consultants (1976), Sogreah Consulting Engineers (1976) and Pacific Consultants International (1976), and the Japan International Cooperation Agency on the first stage expansion project.

The various reports are summarized as follows:
(1) Conclusions and recommendations, (2) Alternative projects, (3) Traffic forecasting and (4) Project evaluation.

Respective studies are then compared and analyzed for the following points:
(1) Conclusions, (2) Alternative projects, (3) Traffic forecasting, and (4) Project evaluation.

VII. Reviews of Previous Studies on Shipping

This part, together with Part VI, relates to the review and analysis of existing reports on systems analysis investigation.

investigations and analysis made by prominent agencies in Europe and USA including Westinform, Terminal Operators and Exxon. With regard to liner shipping, it should be noted that the report "Middle East Liner Shipping: An Economic Analysis of Traffic, Services, Ports and Future Prospects" by H.P. Drewry gives very useful information on the Suez Canal.

VIII. Data Handbook

This part consititutes part of the basic information system.

It explains data items to be collected, data sources, centering on the general data required for recognizaing the position of the Suez Canal in the world economy, trade and shipping.

PART II

INTRODUCTION

INTRODUCTION

1. Objectives

A technical cooperation program was carried out for the Planning and Research Department, the Suez Canal Authority, according to the basic agreement of the Scope of Work which was concluded between the Government of Japan and the Government of the Arab Republic of Egypt. The program studied the organization tasks and systems analysis required for the newly established Economic Unit of the Department (hereinafter referred to as the Unit) and was intended to assist it to achieve the functions expected by the Suez Canal Authority.

2. Scope of the Study

This report summarizes the results of systems analysis study. However, the technical cooperation program concerned with training is described in a separate report. The systems analysis study was carried out in order to enable the staff of the Unit to acquire the techniques and knowledge necessary to the performance of its duties. The following study items were included in the first, year systems analysis study:

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The forecasting system was designed in such a way that it could be refined and developed futher in the future.

As far as analysis of feasibility study is concerned, it was considered desirable that the staff members first aquire basic knowledge and skills necessary for understanding how a feasibility study is carried out.

For this purpose it was proposed that existing reports on the feasibility studies should be reviewed by them as much as possible for the first step.

For Item 4), studies were to be made of information sources, items and basic data arrangement methods required for the above tasks.

3. Contents of the study

According to the scope of the study, these subject and their results are now being arranged in this report as follows:

4. Organization for the Implementation of the Technical Cooperation Program

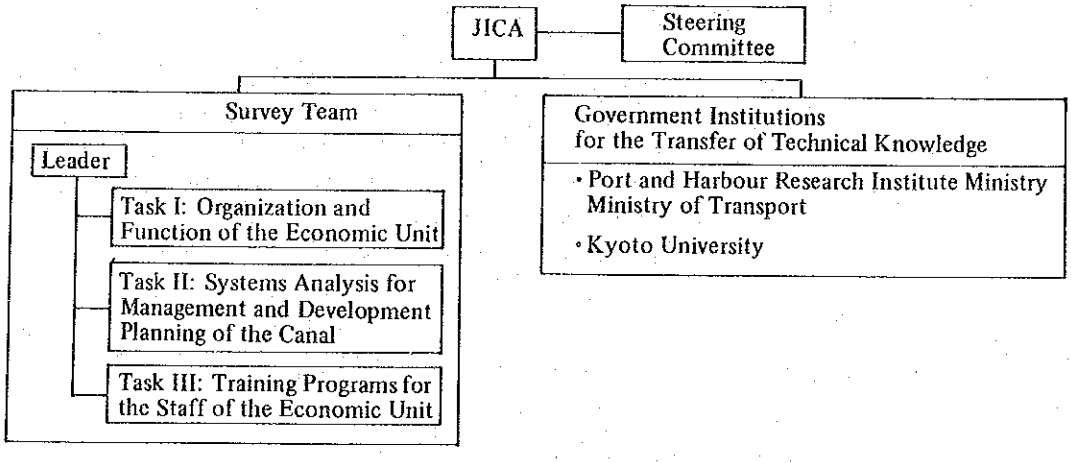
(1) Steering Committee

For the successful implementation of the technical cooperation program to the Planning and Research Department of the Suez Canal Authority (SCA), a Steering Committee was established by Japan International Cooperation Agency (JICA) as an advisory body to the Chairman of JICA. The members of the Committee are of follows.

Members of Steering Committee

Dr. Yoshimi NAGAO Chairman	Professor, Faculty of Engineering, Kyoto University
Mr. Mitsumasa IWATA	Director, International Affairs Division Minister's Secretariat, Ministry of Transport
Mr. Sumio SHIOTA	Director, Overseas Division,Bureau of Shipping, Ministry of Transport
Mr. Shun-ichi ONODERA	Director, Construction Division, Ports and Harbours Bureau Ministry of Transport
Mr. Fumiaki NAGATOMO	Head, Shimonoseki Investigation and Design Office, The Fourth District Port Construction Bureau, Ministry of Transport
Mr. Yasuhide OKUYAMA	Chief, Systems Laboratory, Design Standard Division, Port and Harbour Research Institute, Ministry of Transport
Mr. Hisashi MISHIMA	Deputy-Director, Overseas Division, Bureau of Shipping Ministry of Transport
Mr. Satoshi INOUE	Deputy-Director, Planning Division, Ports and Harbours Bureau Ministry of Transport

The Committee has provided appropriate advices to the Survey Team for the technical cooperation program, composed of the members of Mitsubishi Research Institute and Japan Maritime Research Institute, by inspecting and guiding the plans and products prepared by the Survey Team.
The organization for the implementation of the program is shown below.



Organization for the Implementation of the Technical Cooperation Program

(2) Dispatch of Field Survey Teams

In order to meet the specific requirements of the technical cooperation program, field survey teams were dispatched to the SCA for the studies on the organization and function of the Economic Unit, on the systems analysis techniques for the management and development planning of the Canal, and on the training porgrams for the staff of the Economic Unit.

A. Field Survey Team

Period: July 14 ~ August 11, 1978 (28 days)

Purposes:
1) Explanation and discussion of the Inception Report of the program prepared by the Survey Team
2) Information gathering from various departments of the SCA
3) Information gathering from the selected agencies and institutions related to the SCA
4) Orientation of training programs in Japan for the trainee candidates in the Unit

B. Survey Team for the Interim Report

Period: November 18 ~ 28, 1978 (11 days)

Purposes: Explanation and discussion of the Interim Report on the organization and function of the Economic Unit

C. Survey Team for the Draft Final Report

Period: February 11 ~ 23, 1979 (13 days)

Purposes:
1) Explanation and discussion of the Draft Final Report on the organization and function of the Economic Unit
2) Explanation of the results of 1978 training programs in Japan
3) Tests of newly recruited candidates for the staff of the Unit
4) Follow-ups of the systems analysis survey
5) Preparation for the initialization of the Unit's operation

The members of the field survey teams are listed below.

Members of Field Survey Teams

Name	Organization	Responsibilities
Fumiaki NAGATOMO	(MOT)	Member of Steering Committee
Yasuhide OKUYAMA	(MOT)	Member of Steering Committee
Satoshi INOUE	(MOT)	Member of Steering Committee
Yoshio SATO	(MRI)	Leader of the Survey Team
Morimitsu INABA	(MRI)	Assistant to the Leader
Yoshio OSADA	(MRI)	Task I
Tsutomu NISHIMURA	(MRI)	Task I
Toshiki KURASHINA	(MRI)	Task I
Noboru SUGINO	(MRI)	Task III
Yoichi AOKI	(MRI)	Task II
Hisayoshi MORISUGI	(MRI)	Task II
Katsumi AKIBA	(JMRI)	Task II
Saburo TAKAMURA	(JMRI)	Task III

MOT: Ministry of Transport
MRI: Mitsubishi Research Institute
JMRI: Japan Maritime Research Institute

PART III

ANALYSIS OF CURRENT TRENDS AND TRANSPORTATION COST

CHAPTER 1 INTRODUCTION

This part deals with "Analysis of the Maritime Environment relative to the Suez Canal" and "Maritime Transportation Cost Analysis" in connection with "System Analysis".

This part is composed of six chapters, including this one. The others are: 2. Suez Canal Traffic, 3. World Economy/Resources and Seaborne Trade, 4. World Fleet, 5. Maritime Transportation Cost, and 6. Freight Market.

This part is a sequel to the Training Program Text submitted earlier and the documents distributed during Training in Japan. In conducting the analyses, every effort was made to clarify the items for analysis, the analytical procedure and related statistics and documents.

Chapter 2, Suez Canal Traffic, serves as a premise in the analysis of the maritime environment relative to the Suez Canal. The principal aim, thus is to clarify the relationship between the Suez Canal and the external environment. This analysis is based on the officially disclosed figures of the Suez Canal Authority in its "Suez Canal Report".

Chapter 3, World Economy/Resources and Seaborne Trade, clarifies the relationship between seaborne trade and the world economy which is necessary for the analysis. In relation to the Suez Canal, it will involve the compilation of an O/D matrix concerning practical seaborne trade. In this connection, Chapter 3 shows the operational procedure and related data. This chapter also takes up pipeline and landbridge transportation.

Chapter 4, World Fleet, shows the procedure for obtaining a consolidated grasp of the volume of all types of vessels at every stage from existing fleet (including idle tonnage), new order, on order, delivery, demolition and lost. In this connection, reference is made to the fact that, in its relation to the volume of vessels needed by the demand side, the supply of ships moves independently in accordance with market conditions. In connection with the Suez Canal, the grasping of the movements of ships in the routes involving the Suez Canal becomes basic.

Chapter 5, Maritime Transportation Cost, conducts trial calculation of the three component factors of cost (capital cost, ship's cost, voyage cost) and, based on this, the trial calculation of 32 cases of voyage estimates and anticipated freight rates. This makes it possible to understand how the freight market influences the choice between the via Suez Canal and the via Cape routes. In these trial calculations, moreover, comparisons are drawn, using Canal toll and fuel cost as variables.

Chapter 6, Freight Market, is principally aimed at showing how to understand the market and how to analyze it prior to showing the market forecasting method. Many types of markets are introduced. Also a general outline of the freight market's long-term business cycle (past 30 years) is also given and its characteristics explained. As an example of market trend analysis, reference is made to OECD's Maritime Transport 1976.

CHAPTER 2 SUEZ CANAL TRAFFIC

2.1 General

This chapter analyzes the records of canal traffic up to 1977 in order to secure necessary data which will provide a basis for future projections and also points out what should be considered in studying the past records. In this context, this chapter will lead to the analysis of studies in the subsequent chapters.

This chapter analyzes Suez Canal traffic on the basis of Suez Canal Report figures by recapitulating major points of the lecture on same subject in the training in Japan last October.

2.2 Tanker Traffic Decreased Sharply

Canal traffic in 1977 showed a sharp increase of 18% in terms of NRT over the preceding year. However, it was 92% of the level registered in 1966, before the closure of the canal, in terms of the number of vessels, 80% in terms of NRT and 53% in terms of cargo volume. The average size tonnage of ships passing through the Suez Canal became smaller contrary to the world trend toward larger vessels.

North-bound oil traffic sharply fell to around 1/5 from 167 million tons in 1966 to 31 million tons in 1977. Cargo movement from the Middle East to Europe and the East Coast of North America including Canada grew 2.4 times from 242 million tons to 581 million tons (B.P. statistics) in sharp contrast to northbound oil traffic.

Ships of less than 60,000 tons account for about 17% of the world tanker fleet and those of less than 50,000 tons make up about 14.7%. The above-mentioned oil traffic volume of 31 million tons (which is believed to have included some domestic traffic within Egypt) was slightly more than 5% compared with the 581 million tons.

The low level cannot be attributed entirely to the use of large-sized ships and to depressed market, which are generally mentioned as reasons. In the light of seaborne traffic of oil of today, it is considered that increased imports of oil into the United States and conditions of ports in Europe and the United States are also major factors.

The United States imported 437 million tons of oil in 1977 (up 20% from the preceding year). Since most U.S. ports can accommodate tankers of only up to 90,000 tons, the usual practice is that more than 90% of U.S.-bound Middle East oil is carried aboard VLCCs and ULCCs to CTSs in Central America (the Bahamas, the Netherlands Antilles and elsewhere), where the oil is transhipped into smaller vessels. (VLCCs and ULCCs mean ships of more than 150,000 tons and 350,000 tons, respectively, in accordance with the general classification.) Therefore, demand for ships of less than 90,000 tons has increased and their freight rates range from WS 70 to 100 in sharp contrast to about WS 25 for VLCCs. A large number of small tankers are engaged in trade in waters off the United States.

In Europe, Le Harve and Fos in France, Bantry Bay in Ireland and Eurooport in the Netherlands, etc., are used as CTSs capable of accommodating ULCCs. Italy, which is regarded as the best customer for Suez Canal traffic in view of its geographical location and the volume of its

imports, has more than 10 ports, including Genoa, that can accommodate VLCCs. In 1977, out of its total imports of about 100 million tons, Italy imported from the Middle East about 75 millions tons and of these, 7.5 million tons, or 10 percent, were transported through the Suez Canal while the rest came mainly via the cape Cape and some via pipelines.

According to a survey by the J.M.R.I., 90 percent of oil bound for northwest Europe was transported aboard VLCCs and ULCCs.

In view of the fact that ports in Europe and Central America can now accommodate large-sized vessels and that this capability is expected to increase, it is considered that two modes of transportation – the CTS method involving the use of ULCCs and the direct unloading method using VLCCs – can be employed for Middle East oil. To study how the relative shares of the two modes of transportation will change and what will become of the composition of sizes of ships used, we must study and analyze in detail port development plans in various regions and their progress and the distribution of ships entering ports.

The following are some literature on present port conditions:

"Ports of the World"
"International Petroleum Encyclopedia"

2.3 Tanker Traffic and Freight Market

Traffic of tankers in ballast is more than twice that of loaded tankers in terms of NRT. It can be said that, if the tanker market improves gradually hereafter, traffic of VLCCs in ballast will increase. For the long run, southbound traffic of VLCCs in ballast is a matter of major concern to the Canal development plan in view of the state of traffic centering on VLCCs and ULCCs mentioned in the preceding section.

This section examines the relationship between southbound traffic of VLCCs in ballast and the freight market.

Referring to the Table 2.1 showing the number of tankers that used the canal between January 1976 and September 1978 classified by type and the freight market for tankers of more than 150,000 tons, it is noted that, when the world scale is 20, the number of southbound tankers of more than 150,000 tons is around seven a month, and the number exceeds 20 when the WS is 30.

Table 2.1 Relationship between Canal Traffic and Tanker Market

Year	Northbound Loaded Ships				Southbound Ships in Ballast				W S Rate (150,000D/W and above)
	Up to 60,000	60,000– 150,000	150,000 and above	Total	Up to 60,000	60,000– 150,000	150,000 and above	Total	
1976 Jan.	44	3	–	47	41	26	–	67	22.1
Feb.	40	4	–	44	32	30	4	66	27.2
Mar.	55	16	–	71	39	33	4	76	24.2
Apr.	56	14	–	70	51	42	10	103	29.4
May	63	19	–	82	47	51	14	112	32.0
Jun.	53	16	–	69	31	41	14	86	25.3
Jul.	51	14	–	65	53	43	21	117	30.0
Aug.	66	17	–	83	53	74	20	147	31.2
Sep.	60	28	–	88	52	38	25	115	27.7
Oct.	79	25	–	104	57	52	18	127	30.2
Nov.	63	16	–	79	55	74	34	163	33.0
Dec.	69	26	–	95	51	44	17	112	33.6
1977 Jan.	59	15	–	74	39	50	8	97	25.6
Feb.	63	18	–	81	48	41	15	104	24.5
Mar.	68	25	–	93	45	73	15	133	28.8
Apr.	53	20	–	73	49	54	13	116	23.8
May	71	24	–	95	45	51	11	107	22.2
Jun.	52	17	–	69	54	41	7	102	20.4
Jul.	53	15	–	68	27	36	6	69	22.0
Aug.	52	25	–	77	35	50	8	93	23.9
Sep.	46	16	–	62	32	37	8	77	22.6
Oct.	54	14	–	68	38	30	8	76	24.6
Nov.	57	16	–	73	41	50	23	114	28.2
Dec.	65	18	–	83	34	45	20	99	30.2
1978 Jan.	50	19	–	69	35	42	7	84	20.4
Feb.	52	23	–	75	34	32	7	73	20.6
Mar.	60	22	–	82	51	39	4	94	19.5
Apr.	61	19	–	80	45	44	8	97	19.0
May	49	16	–	65	35	35	5	75	20.3
Jun.	45	17	–	62	31	37	6	74	21.2
Jul.	41	12	–	53	27	30	6	63	26.3
Aug.	43	13	–	56	27	28	24	79	31.0
Sep.	51	13	–	64	31	42	20	93	35.9
Oct.									44.9
Nov.									

Note: Ships' size up to 60,000D/W, in full laden, and 60,000 to 150,000D/W in part-cargo are possibly transited the Canal.

Source: (1) WS Rate by Norweigian Shipping News' Tanker Freight Index.
(2) Canal Traffic collated by JMRI from Suez Canal Monthly Report.

Records for January - June 1978 show that most VLCCs that passed through the Suez Canal originated at Fos, Genoa, Rijeka and Trieste. The tanker market soared during the July - December 1978 period, and analysis of the distribution of ports of origin on the basis of statistical data will produce interesting results.

The relationship between the freight market and traffic of VLCCs in ballast is affected by changes in the relative economic merit of either via Suez or via Cape which, in its turn, is determined by a given level of freight. This point is analyzed concretely in Chapter 5. However, such a clear correlation is not observed so far as smaller tankers are concerned.

2.4 Rather Slow Growth of Dry Cargo Traffic

The total volume of northbound and southbound dry cargo traffic grew from 66 million tons in 1966 to 94 million tons in 1977, registering an increase of 1.42 times and an average annual growth rate of 3.3%. U.N. statistics show that, during the same period, the world volume of dry cargo traffic grew at an annual rate of 6.4% (about 5.3% when the volume of Japan's trade, which depends little on the Suez Canal, is not counted). Therefore, the 3.3% growth rate is considered rather low.

Northbound traffic grew at a slightly higher rate – 3.9% – thanks to increased transportation of iron ores, nonferrous ores and steel and metal products compared with southbound traffic, which increased only 2.7% due to a sharp fall in cereals and decreased or stagnant movement of fertilizer, steel and other metal products and machinery, although cement increased. It may be estimated that the greater part of the northbound iron ore and nonferrous ore mentioned above and about half of the southbound cereals were transported via the Cape.

It is possible that these goods will be transported through the Suez Canal if the freight market improves after completion of the First Stage Canal Development.

With the exception of these three items, most other items are industrial products which are unlikely to be sent through the Cape. Liner trade via Suez Canal is likely to be affected more by the Siberian Landbridge, which seems to reflect the changed structure of trade between Europe and Asia, including Japan.

2.5 General Cargo Ships

Canal traffic in 1977 showed that loaded general cargo ships ranked first with 58 million NRT, followed by tankers in ballast totaling 52 million NRT (loaded tankers totaling 24 million NRT, loaded bulk carriers totaling 23 million NRT, container ships totaling 21 million NRT and Ro/Ro ships totaling 10 million NRT, in that order). General cargo ships including container ships and Ro/Ro ships account for 46% of the total volume of Canal traffic and occupy a far important position than bulk carriers (12%) and combination carriers (3%).

However, there are a few points that must be taken into consideration in any analysis of general cargo ships. General cargo ships include conventional liner ships and tramps and the form of their operation is different. Although there is some similarity in goods carried, liners mainly haul sundry goods, while tramps mainly transport steel materials and bulk cargo. For the Suez

Canal, liners constitute comparatively stable traffic, while the traffic of tramps is influenced by cargo movements at a given time. Therefore, it is desirable to distinguish between liners and tramps, but it is difficult to do so in terms of statistics. It is also difficult to distinguish between transport by liners and that by tramps. Itemwise volume of cargo carried is unclear from U.N. Statistics, and it is difficult to ascertain it.

CHAPTER 3 WORLD ECONOMY/RESOURCES AND SEABORNE TRADE

3.1 General

In order to analyze the present state of seaborne trade, an understanding of the world economy and resources which directly influence seaborne trade is indispensable. The world economy and resources are big subjects with tremendous depth. Here, we shall just give the names of the main reports which will assist in understanding the key trends: "OECD Economic Outlook", "GATT (General Agreement on Tariffs and Trade) International Trade", "BIS (Bank for International Settlements) Report" and "IISI (International Iron and Steel Institute) Report".

The analysis is conducted by relating petroleum to the GNP index (in recent years, however, the growth rate of petroleum consumption is lower than the GNP growth rate), iron ore and coal to the Index of Industrial Product (IIP, although it is more realistic in the case of iron ore to relate to the growth rate of raw steel production), grain to the growth curves of FAO and U.S. Department of Agriculture, and other commodities to IIP. The method of analysis and related data are shown under 3.2.

In view of the fact that seaborne trade is affected adversely by competitive means of transportation other than marine transportation, competitive (but also having connecting relations) pipeline and land bridge transportation, too, will be dealt with in this chapter. Regarding pipelines, data are comparatively easy to obtain. Therefore, we shall restrict ourselves to indicating reference materials. With respect to landbridges, in the transportation of sundries, they provide strong competition to the Suez route and data are difficult to get. Consequently, a comparative explanation will be given in this chapter of two landbridges, the Siberian landbridge and the Ameican landbridge.

It is necessary for the Suez Canal to pay close attention to increasing maritime cargo movement attendant to the industrialization of nearby Mideast countries. On this subject, very interesting material is found in H.P. Drewry's "Middle East Liner Shipping: An Economic Analysis of Traffic, Services, Ports and Future Prospects".

3.2 World Economy and Seaborne Trade

In analyzing (also in forecasting) the world economy and seaborne trade, the following methods according to item are used.

Petroleum:

(1) In conducting an economic analysis which will be the base for a market analysis, the real growth rate of GNP is used for reference. In recent years, however, the growth rate of petroleum consumption is lower than that of GNP.

(2) In analyzing the volume of petroleum consumption, the trend of the unit (volume of consumption/GNP) of petroleum consumption is used as reference.

(3) Study of the petroleum production trends in petroleum consuming regions.

(4) The petroleum import volume of each country is classified according to the supplying

petroleum-producing country and an O/D matrix is compiled. The distance between each importing and producing country is taken to compute the ton-mile cargo movement. With respect to the volume of import, it is necessary to take into account imports for stockpiling also.

(5) With respect to products other than oil, one method is to take only the trends in the major consuming regions and project them to the whole. In the case of oil, however, it is probably necessary to study trends in regions other than the three major oil consuming regions of Ameica, Europe and Japan which account for 80% of the whole.

(6) For the Suez Canal, the compilation of O/D matrix for America and Europe will be fundamental.

(7) Among related documents are UN Statistics, OECD Economic Outlook, GATT Report, BIS Report, B.P. Statistics, Exxon Report, the statistics, data and/or review of Fearnley & Egers, J.I. Jacobs and H.P. Drewry.

Iron Ore and Coal:

(1) In the economic analysis to serve as a base for the market analysis, IIP is generally used as reference. With respect to iron ore, however, it is more realistic to take the growth rate of raw steel production.

(2) In analyzing the volume of consumption, as in the case of petroleum, the trend of the unit is used as reference.

(3) Compiling of O/D matrix and computing of ton-mile cargo movement.

(4) The analysis of the consumption region of both iron ore and coal is limited in most cases to the three regions of Japan, Western Europe and the United States which together account for 90 ~ 95% of the total. For the Suez Canal, the two regions of Western Europe and the United States are of particular importance.

(5) Related documents are UN Statistics, OECD Economic Outlook, the reports of GATT, BIS and IISI, and the statistical data of Fearnley & Egers and of H.P. Drewry.

Grain:

(1) The conceivable related data with respect to grain is probably the population growth rate. Grain, however, is easily affected by the weather. Therefore, for the short term, the method of basing the analysis on the data of FAO and of the U.S. Department of Agriculture is used.

(2) In relation to the Suez Canal, a general O/D pattern, such as Australia/Western Europe and U.S./Indian Ocean, could be obtained.

Other Cargoes:

(1) The reference indicators for economic analysis are IIP.

(2) Included in "other cargoes" are alumina/bauxite and phosphates which constitute the main bulk cargo, minor bulk cargo, and general cargo for which there is competition between liners and tramps. In terms of statistical data, it is difficult to get separate figures on general

cargo carried by liners.

(3) "Other cargoes" as referred to here are indicated in a single lump (no segmented classifications) in Fearnley & Egers' statistical data.

3.3 Trades of Routes which Compete with and are Linked with Maritime Transportation

Leaving aside air transportation, the routes which compete with and are linked to marine transportation and which have a big bearing on the Suez Canal are the pipelines and landbridges. Because cargo transported by these routes have the effect of reducing seaborne trade volume, they are taken up in this chapter.

With respect to pipelines, their outline is relatively easy to obtain through existing literature and reports. Therefore, this paper will restrict itself to mentioning the main ones. With respect to landbridges, however, only piecemeal information is available. Therefore, they will be explained in greater detail on the basis of the information we have.

3.3.1 Pipelines

Six pipelines can be listed as having an effect on the Suez Canal. They are SUMED (Gulf of Suez/Mediterranean), ICOO (Iraq/Syria), Tapline (Saudi Arabia/Lebanon), Tipline (Trans-Israel), Iraq/Turkey, and Trans-Saudi. The Trans-Saudi pipeline is scheduled to go into operation in 1981. ICOO is at present closed. Tapline resumed operation in January 1979.

Reference material on pipelines include: Exxon Marine's "The World's Tanker Fleet: Outlook for the Future", "International Petroleum Encyclopedia", E. Stanley Tucker's "Petroleum Economist" and H.P. Drewry's "Crude Oil Pipelines & VLCC Ports".

3.3.2 Landbridges

Two landbridges which could be mentioned here are the Siberian Landbridge (there is also sea-air transport via Soviet Union) and the American Landbridge (there is also sea-air transport via Canada). These landbridges link the Far East, mainly with Japan as the terminal, and Europe and are in competition with the traditional Far East/Europe sea routes.

In distance (Yokohama-Rotterdam), these three routes compare as follows: Siberian Landbridge (one-way monthly transport capacity about 8,000 TEU) approximately 13,000 km, sea route via Suez 20,700 km, sea route via Panama 23,200 km, sea route via Cape 27,000 km, and American Landbridge 20,240 km. The number of service days is Siberian Landbridge 28 ~ 35 days, sea routes 23 ~ 26 days and American Landbridge roughly 35 days. The freightage (taking electrical products/m^3 as an example) compares, in the same order as above, as follows: \$60, \$90 and \$65. The sea route is, thus, in an extremely unfavorable position.

The service areas of these two landbridges are as follows:

Siberian Landbridge:

East: Japan and Hong Kong (covers by transshipment South Korea, Taiwan, Phillippines, Singapore and New Zealand)

West: Europe and Middle East (Iran, Afghanistan, Turkey, Iraq, Syria, Lebanon)

American Landbridge:

Japan: Kobe, Nagoya, Shimizu, Tokyo

Europe: Le Havre, Rotterdam, Bremerhaven, Greenock

As for cargo movement, in 1977 the Siberian Landbridge handled westbound 49,035 TEU and eastbound 21,863 TEU. These figures are roughly 20% of total cargo movement between Japan and Europe. The American Landbridge accounts for only a few percent of the total. As for the sea routes, no figures have been made public, but the volume could be estimated from what remains after the shares of the two landbridges.

CHAPTER 4 WORLD FLEET

4.1 General

The size of the world fleet is correlated to seaborne trade which generates ship demand. On the other hand, seaborne trade is directly linked to world economic trends. Therefore, the world fleet in the long range is closely related to world economic trends. New orders which affect the ship supply are strongly influenced by the freight market which reflects the ship supply-demand relationship. Furthermore, because of speculation on the part of ship suppliers, the ship supply always exceeds the ship demand. Consequently, the ship ordering behavior of ship suppliers cannot be left out of the analysis.

Before going into the details, it is necessary to put into analyzable order the numerous types of ships (refer to Lloyd's Table 2 Principal Types of Ships) which go to make up the world fleet. For our purpose, we shall classify the types of ships into the following four: tankers, combination carriers, bulk carriers and other carriers (also called general cargo ships). The reason for taking up combination carriers here as one type is because they are affected by the tanker and bulk carrier markets but are a different type from the single purpose tanker and bulk carrier. With respect to general cargo ships, it is difficult to separate them strictly into liner and non-liner ships, just as it was difficult to do so under seaborne trade (see preceding chapter).

Regarding the use and processing of data, each data has its merits and demerits. Therefore, in many cases improvisation is necessary depending on the purpose of analysis. Regarding the handling of tonnage, too, expedience is often necessary because there are problems involved in changing into D/T the data which is expressed in G/T.

In relation to Suez trades, the movements of ships by types and sizes have to be considered. Regarding ship movements, a continuing survey is now being conducted. The choice of ship size is a vital economic factor for shipowners. The choice is restricted by the physical conditions of ports and harbors as well as by other factors. Therefore, it is necessary to investigate the situation of ports and harbors at both the export and import points.

4.2 Current Trend of World Fleet

4.2.1 Existing Fleet

Numerous statistical data are available for analyzing the existing fleet from various angles such as by country, by groups of countries, by types, sizes, ages, etc. In the analysis work, the basis point will be to conduct annually the classifications by types, sizes and ages. In relation to the Suez Canal, it will be necessary, particularly in the case of tankers, to classify sizes by draft and beam.

In considering the existing fleet, note should be made of the idle tonnage in relation to the supply-demand gap. Idle tonnage is indicated in statistical data in the form of lay-ups and slow-steaming.

As explained below, the volume of the existing fleet is continuously changing because of new orders, deliveries, scrapping and loss. Therefore, the trends in these areas must be noted in

making the analysis.

In relation to the Suez, the ship movements on the routes involving Suez route are important. Regarding analysis of Suez Canal traffic, a broad outline was explained in Chapter 2. Of particular importance are the two points mentioned below regarding oil and iron ore bulk trades.

Middle East/Europe oil transportation is by tankers bigger than VLCC which cannot pass laden through the Suez Canal. On the other hand, the passage of VLCC in ballast through the Canal is affected by the market. The market relationship will be analyzed in next chapter.

It is necessary to note that most of the Australia/Europe trade of iron ore is via the Cape. It is believed that most of this is by combination carriers. Dry bulk carriers which are capable of transiting the Canals are also taking the Cape route for market reasons.

Regarding ship movements on the Suez routes, a continuing survey should be conducted in order to grasp the actual situation.

Reference material on the world fleet are as follows:

1) Existing Fleet
   Tankers: (1) J. I. Jacobs', "World Tanker Fleet Review"; Year of Build Table
   (2) B.P.; "Statistical Review"; World Tanker Fleet by Age, Size and Propulsion
   (3) Fearnley & Egers; "World Bulk Fleet"; Table 9, Size-Age Distribution
   (4) Lloyd's Table 8; Size and Age of Oil Tanker
   Combination Carriers:
   (1) Fearnley & Egers; Table 9
   (2) Lloyd's Table 10a
   Bulk Carriers:
   (1) Fearnley & Egers; Table 9
   (2) Lloyd's Table 10
   Others: (1) Fearnley & Egers; "Review" Table 3
   (2) Several other sources are conceivable, but it is difficult to obtain accurate statistics.

2) Idle Tonnage: Laid-up and Slow Steaming
   General Council of British Shipping (GCBS); "Laid Up Report"
   The Institute of Shipping Economics Bremen; "Shipping Statistics"
   Fearnley & Egers; "World Bulk Fleet", "Review"
   J.I. Jacobs, "World Tanker Fleet Review"
   H.P. Drewry, "Shipping Statistics and Economics"

4.2.2 New Order, On Order and Delivery

Orders for ships determine the future ship supply and affects the supply-demand balance. Therefore, from the long-range point of view, an analysis of the ordering behavior is necessary. Statistical data on new orders can be obtained from Fearnley & Egers' "World Bulk Fleet" and "Review" and from Fairplay's "World Ships on Order".

The volume of new orders, moreover, can be calculated by the following formula from Lloyd's

Register of Shipping's "Merchant Ship Builidng Return".

Volume of new contract	=	Building on order in current term (t)	–	Building on order in preceding term (t – 1)	+	Delivery in current term (t)

In estimating the world fleet, the buildings on order and deliveries, particularly the latter, are taken as new additions to the fleet. Deliveries are, in some cases, shown in statistical data, but to obtain data on types and sizes, it will be necessary to proceed with an examination of on-order data.

Depending on market conditions, changes are made on ship types, building is postponed, and orders are cancelled. Therefore, attention should be paid to these eventualities in order to obtain delivery figures.

On-order and delivery data can be obtained according to ship type from the following sources:

1) Tankers:
   J.I. Jacobs; "World Tanker Fleet Review", Table 2.5 and Year of Build Table
   Fearley & Egers; "World Bulk Fleet", Table 2, 5, 6, 12 ~ 14 and Survey Tables (page 19, all on order), and Table 15 (year of delivery)
   Lloyd's Statistical Table 18; not divided according to type; only summary of launched and completed ships 1961 ~ 1977 by country; indicated, moreover, in G/T.
   Fairplay International (weekly); "World Ships on Order"; contains detailed data, making possible various kinds of analysis but requires much time and manpower to collate.

2) Combination Carriers:
   J.I. Jacobs; "World Tanker Fleet Review", Table 6.8
   Fearnley & Egers; "World Bulk Fleet", Table 2, 5, 6, 12 ~ 15 and by country 1978 (page 19)
   Fairplay International (weekly)

3) Bulk Carriers:
   Fearnley & Egers
   Lloyd's Statistical Table } Same as for tankers
   Fairplay International

   Note: References for review include:
   OECD Maritime Transport 1977; Table XV(b), (c)
   UNCTAD Review of Maritime Transport 1977; Table on page 9 and Table 5

4.2.3 Demolition and Loss

In general, the ship volume for any given time (t) is obtained by the formula "existing fleet + new ships – demolition and loss". Consequently it is desirable in compiling data to classify by type, size and age. The age trend of ships is helpful in obtaining the residual ship volume.

As statistical data on demolished and lost ships, Bremen's "Shipping Statistics" is convenient because it gives a classification by type (on demolition, dry cargo and tanker, unit D/W).

However, casualty returns are not classified by type. Therefore it will be necessary to devise means to use OECD Maritime Transport 1977; Table XVIII Tonnage Lost and Broken Up (unit G/T uses Lloyd's Table) to learn the distribution by type.

Other statistical data for learning about demolition and loss are as follows:

J.I. Jacob; "World Tanker Fleet Review 1978"; Commercial Tanker Obsolescence
Fearnley & Egers; "Review 1978"; Demolition
Lloyd's Statistical Table; Table 19

4.3 Analysis of Current Trends

The analysis of the world fleet, in the long-term, must be based on an analysis of ship demand referred to in Chapter 3. However, it is only the needed volume of the fleet which can be obtained from this. It is necessary, therefore, to conduct the analysis by taking into account the supply-demand balance, market fluctuations, long-term charter party contract trends, laid-up percentage, the market adjustment effect of combined carriers, and the order and demolition trends which will be influenced by them.

For short-term, particularly for one year ahead, the following formula can be applied in ship analysis:

$$\begin{array}{l}\text{Tonnage in}\\ \text{market a}\\ \text{year later}\end{array} = \begin{array}{l}\text{Existing}\\ \text{fleet}\end{array} + \begin{array}{l}\text{Deliveries}\\ \text{during period}\\ \text{of forecast}\end{array} - \begin{array}{l}\text{Lost and scrapped}\\ \text{during period of}\\ \text{forecast}\end{array}$$

As for statistical data reference material, those listed under 4.2 can be used.

The factor which will determine the broad framework of ship movements in the routes involving Suez Canal route with respect to petroleum trade are the trend of oil consumption in Europe, the U.S., and Canada and, of course, the petroleum production situation in those regions. The main economic factors in determining the composition of carriers by size, on the premise of the physical limitations of the Canal, are the cost (freightage and Canal toll) and port and harbor development trends (this development, too, will be undertaken mainly on the basis of cost analysis).

CHAPTER 5 MARITIME TRANSPORTATION COST

5.1 General

The analysis of maritime transportation cost can be divided broadly into two parts:

(1) Calculation and analysis of voyage estimate;
(2) Calculation and analysis of per ton cost.

Voyage estimate is the calculation of the revenue and expenditure of one voyage of one ship. The profit-and-loss balance is obtained from the freight income of the voyage, the voyage cost (fuel cost, port charges, etc.) and voyage days. The figure resulting from the following formula:

$$\frac{\text{Freight} - \text{Voyage cost}}{\text{Voyage days}} = \text{Daily net income}$$

is used as the standard by the shipping company to make decisions on the charter contract and operation of the vessel. The shipping companies always make it their aim to maximize this figure.

In this chapter, we shall calculate on the basis of this voyage estimate whether it is advantageous or disadvantageous for a ship to use the Suez Canal. We shall also calculate and study the effects in the event the freight rate, fuel cost, and canal toll should change.

The per ton cost is literally the transportation cost per ton of cargo in a specific trade. This is calculated from the voyage cost mentioned above, capital cost and ship cost.

From this calculation, we can, firstly, make a cost comparison of each route for each vessel size and learn whether there is a possibility of a ship using the Canal. The cost comparison, for instance, will be between S/S of 60,000 dwt and C/S or C/C of 250,000 dwt, between S/S of 150,000 dwt and C/S or C/C of 250,000 dwt, between S/S of 250,000 dwt and C/S or C/C of 500,000 dwt (these are typical competitive sizes in the cases of the present state of the Canal, the 1st Stage Development and the 2nd Stage Development). By comparing the respective costs, the difference in the transportation cost of each route for each vessel size can be analyzed. This will give an indication of the size of vessels which mainly have a possibility of using the Canal in the future.

Secondly, from this analysis we shall be able to know the undercurrent of future freight levels. Although the freight market in the short run is determined by the supply-demand balance at each point of time, in the long term the above-mentioned cost becomes the level around which the market fluctuates.

If the freight level can be forecast, it can be used together with the voyage estimate to project the possible Canal traffic and the tolerable Canal toll.

5.2 Cost Analysis of Typical Ship by Sizes and Routes

In relation to the Suez Canal, the typical ship sizes relevant to the present, 1st Stage Develop-

ment and 2nd Stage Development are as follows for maximum drafts of 38 feet, 53 feet and 67 feet respectively.

	Maximum draft	Maximum Size Passable through Canal Laden	In ballast
At present	38'	60,000dwt	250,000dwt
1st Stage Development	53'	150,000	330,000
2nd Stage Development	67'	260,000	700,000

In view of the above, the maximum sizes of 60,000, 150,000, 250,000 and 500,000 dwt were selected for the purposes of analysis in this chapter. (Because 700,000 dwt ships have not yet been built, 500,000 dwt which is near to the largest existing size was selected.) To be more specific, under the current draft limitations, the average size is about 50,000 dwt fully laden and 230,000 dwt in ballast. The average size which will not require extra toll under the 1st and 2nd Stage Development is thought to vary slightly from the selected sizes of ships.

The routes taken up for the purpose of this analysis are Arabian Gulf-Northwest Europe (tipical ports are Ras Tanura-Rotterdam), Arabian Gulf-Mediterranean Sea (Ras Tanura-Genoa) and Arabian Gulf-U.S.A. (Ras Tanura-New York). With the exception of Genoa, these ports at present cannot accommodate 500,000 dwt, but they were chosen because they are representative of tanker routes. For a more detailed analysis, it is necessary to make calculations also for Fos and Rijeka with respect to the Mediterranean.

5.3 Voyage Estimate Data and Method of Calculation

The data for working out the voyage cost is obtained as follows:

The fuel cost is volume of consumption x unit price. For the daily fuel consumption, the figures listed in Lloyd's "Register of Ships" may be used or, alternately, it can be roughly calculated from the maximum output of the main engine.

(In the case of diesel)

Daily consumption = maximum output x 0.85 x 160g/ps.h x 24h.
(For example this works out to 65 t/d in the case of D-20,000ps.)

(In the case of turbine)

Daily consumption = maximum output x 0.9 x 220g/ps.h x 24h.

The figures shown in "Petroleum Economist", "Lloyds' List", etc. are used for the fuel price. The reference for distance is the "Distance Table".

Port charge is calculated from actual payments made by shipping companies or from "Ports of the World".

In the Table 5.1 (Voyage Estimate -- Summary) and same table (1) ~ (32), the results of calculation of a total of 32 cases are given. They include 27 cases pertaining to three ship sizes of 60,000

Table 5.1 SUMMARY OF VOYAGE ESTIMATE

Dis. Port	Route	DWT	Days	Cargo Tons	Port Chg.	Bunkers	Total Voyage Cost
Rotterdam	S/S	60,000	42.8	57,157	171,795	194,060	365,855
Rotterdam	C/S	60,000	53.3	56,509	100,795	246,950	347,745
Rotterdam	C/C	60,000	63.0	55,909	43,795	295,900	339,695
Rotterdam	S/S	150,000	43.3	145,323	441,935	330,750	742,685
Rotterdam	C/S	150,000	53.8	144,214	231,935	420,520	652,455
Rotterdam	C/C	150,000	63.5	143,185	86,435	503,790	590,225
Rotterdam	S/S	250,000	43.8	242,424	686,980	542,000	1,228,980
Rotterdam	C/S	250,000	54.3	240,587	386,980	688,960	1,075,940
Rotterdam	C/C	250,000	64.0	238,884	143,980	825,200	969,180
Genova	S/S	60,000	31.4	57,830	173,295	139,070	312,365
Genova	C/S	60,000	46.5	56,911	101,295	214,090	315,385
Genova	C/C	60,000	60.5	56,057	43,795	283,810	327,605
Genova	S/S	150,000	31.9	146,498	414,435	235,600	650,035
Genova	C/S	150,000	47.0	144,901	232,935	364,860	597,795
Genova	C/C	150,000	61.0	143,437	86,435	483,300	569,735
Genova	S/S	250,000	32.4	244,328	691,280	389,680	1,080,960
Genova	C/S	250,000	47.5	241,723	388,180	598,080	986,260
Genova	C/C	250,000	61.5	239,302	143,980	791,760	935,740
New York	S/S	60,000	50.7	56,692	170,795	232,010	402,805
New York	C/S	60,000	58.1	56,227	100,595	269,960	370,555
New York	C/C	60,000	65.0	55,791	43,795	305,540	349,335
New York	S/S	150,000	51.2	144,526	410,235	395,260	805,495
New York	C/S	150,000	58.6	143,730	231,635	459,690	691,325
New York	C/C	150,000	65.5	142,983	86,435	520,150	606,585
New York	S/S	250,000	51.7	241,105	684,080	647,520	1,331,600
New York	C/S	250,000	59.1	239,786	386,180	753,040	1,139,220
New York	C/C	250,000	66.0	238,550	143,980	851,920	995,900
Rotterdam	C/C	500,000	65.9	484,903	253,800	1,130,480	1,384,280
Genova	C/C	500,000	63.4	485,458	253,800	1,086,080	1,339,880
New York	C/C	500,000	68.0	484,437	253,800	1,167,760	1,421,560
Weipa/	S	60,000	40.9	58,510	127,800	134,510	262,310
Rotterdam	C	60,000	47.6	58,582	64,000	155,800	219,800

Table 5.1 (1) VOYAGE ESTIMATE

No.
Date

M/S, ~~S/S~~ 60,000 (S/S)
(D/W) Speed 15.5 k't (laden)
16.5 k't (in ballast)

Cargo	Tons	rate	Freight	
Crude Oil	57,157			
			Des/Dem	$

Port	Distance (mile)	at Sea (day)	in Port (day)	Port charges $
Ras Tanura			1.5	8,355
	6,755	18.2		
Suez			1.0	71,000
		1.0		
Rotterdam			2.0	35,440
		1.0		
Suez			1.0	57,000
	6,755	17.1		
Ras Tanura				
(spare)				
Total		37.3	5.5	
	Total		42.8 days	

Cargo expense
$
Commission
$
Sundries
$

Fuel consumption

C-F.O.	at Sea	57	~~$~~/d	2,126	~~$~~	
	in Port	29	~~$~~/d	160	~~$~~	
	Total			2,286	~~$~~ @$ 80	$ 182,880
A-F.O.	at Sea	2	~~$~~/d		~~$~~	
	in Port		~~$~~/d	86	~~$~~	
	Total			86	~~$~~ @$ 130	$ 11,180

D/W	60,000		Total expense	$	365,855
Fuel	2,372	Total cost $ 948,320	Net proceed	$	
Spare	171		Hire cost	$	582,465
Water	300		Net profit	$	
Others		Cost per ton $ 16.59	(C/B)	$	
Cargo	57,157		(H/B)	$	

Table 5.1 (2) VOYAGE ESTIMATE

No.
Date

M/S, ~~S/S~~ 60,000 (C/S)
(D/W) Speed 15.5 k't (laden)
16.5 k't (in ballast)

Cargo	Tons	rate	Freight	
Crude Oil	56,509			
			Des/Dem	$

Port	Distance (mile)	at Sea (day)	in Port (day)	Port charges $
Ras Tanura			1.5	8,355
Cape	11,422	30.7		
Rotterdam			2.0	35,440
Suez		1.0	1.0	57,000
Ras Tanura	6,755	17.1		
				Cargo expense $
				Commission $
				Sundries $
(spare)				
Total		48.8	4.5	
	Total	53.3	days	

Fuel consumption

C-F.O.	at Sea	57	₹/d	2,782	₹
	in Port	29	₹/d	131	₹
	Total			2,913	₹ @$ 80
					$ 233,040
A-F.O.	at Sea	2	₹/d	107	₹
	in Port		₹/d		₹
	Total			107	₹ @$ 130
					$ 13,910

D/W	60,000			Total expense	$ 347,745
Fuel	3,020	Total cost		Net proceed	$
Spare	171	$ 1,073,105		Hire cost	$ 725,360
Water	300			Net profit	$
Others		Cost per ton		(C/B)	$
Cargo	56,509	$ 18.99		(H/B)	$

Table 5.1 (3) VOYAGE ESTIMATE

No.
Date

M/S, ~~S/S~~ 60,000 (C/C)
(D/W) Speed 15.5 k't (laden)
16.5 k't (in ballast)

Cargo	Tons	rate	Freight	
Crude Oil	55,909			
			Des/Dem	$

Port	Distance (mile)	at Sea (day)	in Port (day)	Port charges $	
Ras Tanura			1.5	8,355	
Cape	11,422	30.7			
Rotterdam			2.0	35,440	
Cape	11,422	28.8			
Ras Tanura					Cargo expense $
					Commission $
					Sundries $
(spare)					
Total		59.5	3.5		
Total		63.0	days		

Fuel consumption

C-F.O.	at Sea	57	$/d	3,392	$	
	in Port	29	$/d	102	$	
	Total			3,494	$ @$ 80	$ 279,520
A-F.O.	at Sea	2	$/d	126	$	
	in Port		$/d		$	
	Total			130	$ @$ 130	$ 16,380

D/W	60,000	Total cost $ 1,197,062	Total expense	$ 339,695
Fuel	3,620		Net proceed	$
Spare	171		Hire cost	$ 857,367
Water	300		Net profit	$
Others		Cost per ton $ 21.41	(C/B)	$
Cargo	55,909		(H/B)	$

Table 5.1 (4) VOYAGE ESTIMATE

No.
Date

M/S, ~~S/S~~ 150,000 (S/S)
(D/W) Speed 15.5 k't (laden)
16.5 k't (in ballast)

Cargo	Tons	rate	Freight	
Crude Oil	145,323			
			Des/Dem	$

Port	Distance (mile)	at Sea (day)	in Port (day)	Port charges $
Ras Tanura			2.0	16,600
Suez	6,755	18.2	1.0	180,000
Rotterdam		1.0	2.0	69,835
Suez		1.0		
Ras Tanura	6,755	17.1		
(spare)				
Total		37.3	6.0	
Total		43.3	days	

Cargo expense
$
Commission
$
Sundries
$

Fuel consumption

C-F.O.	at Sea	99 ₮/d	3,693	₮	
	in Port	50 ₮/d	300	₮	
	Total		3,993	₮ @$ 80	$ 319,440
A-F.O.	at Sea	₮/d		₮	
	in Port	2 ₮/d	87	₮	
	Total		87	₮ @$ 130	$ 11,310

D/W	150,000			Total expense	$ 742,685
Fuel	4,080	Total cost		Net proceed	$
Spare	297	$ 1,640,424		Hire cost	$ 897,739
Water	300			Net profit	$
Others		Cost per ton		(C/B)	$
Cargo	145,323	$ 11.29		(H/B)	$

Table 5.1 (5) VOYAGE ESTIMATE

No.
Date

M/S, ~~S/S~~ 150,000 (C/S)
(D/W) Speed 15.5 k't (laden)
16.5 k't (in ballast)

Cargo	Tons	rate	Freight	
Crude Oil	144,214			
			Des/Dem	$

Port	Distance (mile)	at Sea (day)	in Port (day)	Port charges $	
Ras Tanura			2.0	16,600	
Cape	11,422	30.7			
Rotterdam			2.0	69,835	
Suez		1.0	1.0	145,500	
Ras Tanura	6,755	17.1			
					Cargo expense $
					Commission $
					Sundries $
(spare)					
Total		48.8	5.0		
	Total	53.8	days		

Fuel consumption

C-F.O.	at Sea	99 ₤/d	4,831	₤	
	in Port	50 ₤/d	250	₤	
	Total		5,081	₤ @$ 80	$ 406,480
A-F.O.	at Sea	₤/d		₤	
	in Port	2 ₤/d	108	₤	
	Total		108	₤ @$ 130	$ 14,040

D/W	150,000		Total expense	$ 652,455
Fuel	5,189	Total cost $ 1,871,455	Net proceed	$
Spare	297		Hire cost	$ 1,219,100
Water	300		Net profit	$
Others		Cost per ton $ 12.98	(C/B)	$
Cargo	144,214		(H/B)	$

Table 5.1 (6) VOYAGE ESTIMATE

No.
Date

M/S, ~~S/S~~ 150,000 (C/C)
(D/W) Speed 15.5 k't (laden)
16.5 k't (in ballast)

Cargo	Tons	rate	Freight	
Crude Oil	143,185			
			Des/Dem	$

Port	Distance (mile)	at Sea (day)	in Port (day)	Port charges $	
Ras Tanura			2.0	16,600	
	11,422	30.7			
Cape					
Rotterdam			2.0	69,835	
Cape					
	11,422	28.8			
Ras Tanura					
				Cargo expense $	
				Commission $	
				Sundries $	
(spare)					
Total		59.5	4.0		
	Total		63.5 days		

Fuel consumption

C-F.O.	at Sea	99	₤/d	5,891	₤	
	in Port	50	₤/d	200	₤	
	Total			6,091	₤ @$ 80	$ 487,290
A-F.O.	at Sea		₤/d		₤	
	in Port	2	₤/d	127	₤	
	Total			127	₤ @$ 130	$ 16,510

D/W	150,000		Total expense	$ 590,225
Fuel	6,218	Total cost $ 1,906,771	Net proceed	$
Spare	297		Hire cost	$ 1,316,546
Water	300		Net profit	$
Others			(C/B)	$
Cargo	143,185	Cost per ton $ 13.32	(H/B)	$

Table 5.1 (7) **VOYAGE ESTIMATE**

No.
Date

~~M/S~~, S/S 250,000 (S/S)
(D/W) Speed 15.5 k't (laden)
16.5 k't (in ballast)

Cargo	Tons	rate	Freight	
Crude Oil	242,424			
			Des/Dem	$

Port	Distance (mile)	at Sea (day)	in Port (day)	Port charges $
Ras Tanura			2.0	25,755
Suez	6,755	18.2	1.0	300,000
Rotterdam		1.0	2.5	118,225
Suez		1.0		243,000
Ras Tanura	6,755	17.1		
				Cargo expense $
				Commission $
				Sundries $
(spare)				
Total		37.3	6.5	
	Total	43.8	days	

Fuel consumption

C-F.O.	at Sea	167 ₤/d	6,229	₤	
	in Port	84 ₤/d	546	₤	
	Total		6,775	₤ @$ 80	$ 542,000
A-F.O.	at Sea	₤/d		₤	
	in Port	₤/d		₤	
	Total			₤ @$	$

D/W	250,000		Total expense	$	1,228,980
Fuel	6,775	Total cost	Net proceed	$	
Spare	501	$ 2,284,735	Hire cost	$	1,055,755
Water	300		Net profit	$	
Others		Cost per ton	(C/B)	$	
Cargo	242,424	$ 9.42	(H/B)	$	

Table 5.1 (8) VOYAGE ESTIMATE

No.
Date

~~M/S~~, S/S 250,000 (C/S)
(D/W) Speed 15.5 k't (laden)
16.5 k't (in ballast)

Cargo	Tons	rate	Freight	
Crude Oil	240,587			
			Des/Dem	$

Port	Distance (mile)	at Sea (day)	in Port (day)	Port charges $
Ras Tanura			2.0	25,755
	11,422	30.7		
Cape				
Rotterdam			2.5	118,225
		1.0		
Suez			1.0	243,000
	6,755	17.1		
Ras Tanura				
				Cargo expense $
				Commission $
				Sundries $
(spare)				
Total		48.8	5.5	
	Total		54.3 days	

Fuel consumption

C-F.O.	at Sea	167 ~~$~~/d	8,150	~~$~~	
	in Port	84 ~~$~~/d	462	~~$~~	
	Total		8,612	~~$~~ @$ 80	$ 688,960
A-F.O.	at Sea	~~$~~/d		~~$~~	
	in Port	~~$~~/d		~~$~~	
	Total			~~$~~ @$	$

D/W	250,000			Total expense	$ 1,075,940
Fuel	8,612	Total cost		Net proceed	$
Spare	501	$ 2,384,787		Hire cost	$ 1,308,847
Water	300			Net profit	$
Others		Cost per ton		(C/B)	$
Cargo	240,587	$ 9.91		(H/B)	$

Table 5.1 (9) **VOYAGE ESTIMATE**

No.
Date

~~M/S,~~ S/S 250,000 (C/C)
(D/W) Speed 15.5 k't (laden)
16.5 k't (in ballast)

Cargo	Tons	rate	Freight	
Crude Oil	238,884			
			Des/Dem	$

Port	Distance (mile)	at Sea (day)	in Port (day)	Port charges $
Ras Tanura			2.0	25,755
Cape	11,422	30.7		
Rotterdam			2.5	118,225
Cape	11,422	28.8		
Ras Tanura				
				Cargo expense $
				Commission $
				Sundries $
(spare)				
Total		59.5	4.5	
Total			64.0 days	

Fuel consumption

C-F.O.	at Sea	167	~~$~~/d	9,937	~~$~~
	in Port	84	~~$~~/d	378	~~$~~
	Total			10,315	~~$~~ @$ 80

$ 825,200

A-F.O.	at Sea		~~$~~/d		~~$~~
	in Port		~~$~~/d		~~$~~
	Total				~~$~~ @$

$

D/W	250,000	Total cost $ 2,511,836	Total expense	$	969,180
Fuel	10,315		Net proceed	$	
Spare	501		Hire cost	$	1,542,656
Water	300		Net profit	$	
Others		Cost per ton $ 10.51	(C/B)	$	
Cargo	238,884		(H/B)	$	

Table 5.1 (10) VOYAGE ESTIMATE

No.
Date

M/S, ~~S/S~~ 60,000 (S/S)
(D/W) Speed 15.5 k't (laden)
16.5 k't (in ballast)

Cargo	Tons	rate	Freight	
Crude Oil	57,830			
			Des/Dem	$

Port	Distance (mile)	at Sea (day)	in Port (day)	Port charges $
Ras Tanura			1.5	8,355
Suez	4,585	12.3	1.0	72,000
Genova		1.0	2.0	35,440
Suez		1.0	1.0	57,500
Ras Tanura	4,585	11.6		
				Cargo expense $
				Commission $
				Sundries $
(spare)				
Total		25.9	5.5	
	Total		31.4 days	

Fuel consumption

C-F.O.	at Sea	57 ₤/d	1,476	₤	
	in Port	29 ₤/d	160	₤	
	Total		1,636	₤ @$ 80	$ 130,880
A-F.O.	at Sea	₤/d		₤	
	in Port	2 ₤/d	63	₤	
	Total		63	₤ @$ 130	$ 8,190

D/W	60,000			Total expense	$ 312,365
Fuel	1,699	Total cost		Net proceed	$
Spare	171	$ 739,688		Hire cost	$ 427,323
Water	300			Net profit	$
Others		Cost per ton		(C/B)	$
Cargo	57,830	$ 12.79		(H/B)	$

Table 5.1 (11) VOYAGE ESTIMATE

No.
Date

M/S, ~~S/S~~ 60,000 (C/S)
(D/W) Speed 15.5 k't (laden)
16.5 k't (in ballast)

Cargo	Tons	rate	Freight	
Crude Oil	56,911			
			Des/Dem	$

Port	Distance (mile)	at Sea (day)	in Port (day)	Port charges $
Ras Tanura			1.5	8,355
Cape	10,945	29.4		
Genova			2.0	35,440
Suez		1.0	1.0	57,500
Ras Tanura	4,585	11.6		
(spare)				
Total		42.0	4.5	
	Total		46.5 days	

Cargo expense
$
Commission
$
Sundries
$

Fuel consumption

C-F.O.	at Sea	57 $/d	2,394	$	
	in Port	29 $/d	131	$	
	Total		2,525	$ @$ 80	$ 202,000
A-F.O.	at Sea	$/d		$	
	in Port	2 $/d	93	$	
	Total		93	$ @$ 130	$ 12,090

D/W	60,000		Total expense	$	315,385
Fuel	2,618	Total cost $ 948,204	Net proceed	$	
Spare	171		Hire cost	$	632,819
Water	300		Net profit	$	
Others		Cost per ton $ 16.66	(C/B)	$	
Cargo	56,911		(H/B)	$	

Table 5.1 (12) VOYAGE ESTIMATE

No.
Date

M/S, ~~S/S~~ 60,000 (C/C)
(D/W) Speed 15.5 k't (laden)
16.5 k't (in ballast)

Cargo	Tons	rate	Freight	
Crude Oil	56,057			
			Des/Dem	$

Port	Distance (mile)	at Sea (day)	in Port (day)	Port charges $
Ras Tanura			1.5	8,355
Cape	10,945	29.4		
Genova				35,440
Cape				
Ras Tanura	10,945	27.6		
(spare)				
Total		57.0	3.5	
	Total		60.5 days	

Cargo expense $
Commission $
Sundries $

Fuel consumption

C-F.O.	at Sea	57 ₤/d	3,249	₤	
	in Port	29 ₤/d	102	₤	
	Total		3,351	₤ @$ 80	$ 268,080
A-F.O.	at Sea	2 ₤/d	121	₤	
	in Port			₤	
	Total		121	₤ @$ 130	$ 15,730

D/W	60,000	Total cost $ 1,150,950		Total expense	$ 327,605
Fuel	3,472			Net proceed	$
Spare	171			Hire cost	$ 823,345
Water	300			Net profit	$
Others		Cost per ton $ 20.53		(C/B)	$
Cargo	56,057			(H/B)	$

Table 5.1 (13) VOYAGE ESTIMATE

No.
Date

M/S, ~~S/S~~ 150,000 (S/S)
(D/W) Speed 15.5 k't (laden)
16.5 k't (in ballast)

Cargo	Tons	rate	Freight	
Crude Oil	146,498			
			Des/Dem	$

Port	Distance (mile)	at Sea (day)	in Port (day)	Port charges $
Ras Tanura			2.0	16,600
Suez	4,585	12.3	1.0	181,500
Genova		1.0	2.0	69,835
Suez		1.0	1.0	146,500
Ras Tanura	4,585	11.6		
(spare)				
Total		25.9	6.0	
	Total		31.9 days	

Cargo expense
$
Commission
$
Sundries
$

Fuel consumption

C-F.O.	at Sea	99	₤/d	2,541	₤	
	in Port	50	₤/d	300	₤	
	Total			2,841	₤	@$ 80
A-F.O.	at Sea		₤/d		₤	
	in Port	2	₤/d	64	₤	
	Total			64	₤	@$ 130

$ 227,280

$ 8,320

D/W	150,000	Total cost $ 1,311,418	Total expense	$ 650,035
Fuel	2,905		Net proceed	$
Spare	297		Hire cost	$ 661,383
Water	300		Net profit	$
Others		Cost per ton $ 8.95	(C/B)	$
Cargo	146,498		(H/B)	$

Table 5.1 (14) VOYAGE ESTIMATE

No.
Date

M/S, ~~S/S~~ 150,000 (C/S)
(D/W) Speed 15.5 k't (laden)
16.5 k't (in ballast)

Cargo	Tons	rate	Freight	
Crude Oil	144,901			
			Des/Dem	$

Port	Distance (mile)	at Sea (day)	in Port (day)	Port charges $
Ras Tanura			2.0	16,600
	10,945	29.4		
Cape				
Genova			2.0	69,835
		1.0		
Suez			1.0	146,500
	4,585	11.6		
Ras Tanura				
				Cargo expense $
				Commission $
				Sundries $
(spare)				
Total		42.0	5.0	
	Total		47.0 days	

Fuel consumption

C-F.O.	at Sea	99 ~~$~~/d	4,158	~~$~~	
	in Port	50 ~~$~~/d	250	~~$~~	
	Total		4,408	~~$~~ @$ 80	$ 352,640
A-F.O.	at Sea	~~$~~/d		~~$~~	
	in Port	2 ~~$~~/d	94	~~$~~	
	Total		94	~~$~~ @$ 130	$ 12,220

D/W	150,000			Total expense	$ 597,795
Fuel	4,502	Total cost		Net proceed	$
Spare	297	$ 1,572,246		Hire cost	$ 974,451
Water	300			Net profit	$
Others		Cost per ton		(C/B)	$
Cargo	144,901	$ 10.85		(H/B)	$

Table 5.1 (15) VOYAGE ESTIMATE

No.
Date

M/S, ~~S/S~~ 150,000 (C/C)
(D/W) Speed 15.5 k't (laden)
16.5 k't (in ballast)

Cargo	Tons	rate	Freight	
Crude Oil	143,437			
			Des/Dem	$

Port	Distance (mile)	at Sea (day)	in Port (day)	Port charges $
Ras Tanura			2.0	16,600
Cape	10,945	29.4		
Genova			2.0	69,835
Cape				
Ras Tanura	10,945	27.6		
(spare)				
Total		57.0	4.0	
	Total		61.0 days	

Cargo expense $
Commission $
Sundries $

Fuel consumption

C-F.O.	at Sea	99 ₮/d	5,643	₮	
	in Port	50 ₮/d	200	₮	
	Total		5,843	₮ @$ 80	$ 467,440
A-F.O.	at Sea	₮/d		₮	
	in Port	2 ₮/d	122	₮	
	Total		122	₮ @$ 130	$ 15,860

D/W	150,000			Total expense	$ 569,735
Fuel	5,966	Total cost		Net proceed	$
Spare	297	$ 1,834,448		Hire cost	$ 1,264,713
Water	300			Net profit	$
Others		Cost per ton		(C/B)	$
Cargo	143,437	$ 12.79		(H/B)	$

Table5.1 (16) VOYAGE ESTIMATE

No.
Date

~~M/S,~~ S/S 250,000 (S/S)
(D/W) Speed 15.5 k't (laden)
16.5 k't (in ballast)

Cargo	Tons	rate	Freight	
Crude Oil	244,328			
			Des/Dem	$

Port	Distance (mile)	at Sea (day)	in Port (day)	Port charges $
Ras Tanura			2.0	25,755
Suez	4,585	12.3	1.0	303,100
Genova		1.0	2.5	118,225
Suez		1.0	1.0	244,200
Ras Tanura	4,585	11.6		
				Cargo expense $
				Commission $
				Sundries $
(spare)				
Total		25.9	6.5	
	Total		32.4 days	

Fuel consumption

C-F.O.	at Sea	167 ₤/d	4,325	₤	
	in Port	84 ₤/d	546	₤	
	Total		4,871	₤ @$ 80	$ 389,680
A-F.O.	at Sea	₤/d		₤	
	in Port	₤/d		₤	
	Total			₤ @$	$

D/W	250,000		Total expense	$	1,080,960
Fuel	4,871	Total cost $ 1,861,930	Net proceed	$	
Spare	501		Hire cost	$	780,970
Water	300		Net profit	$	
Others		Cost per ton $ 7.62	(C/B)	$	
Cargo	244,328		(H/B)	$	

Table 5.1 (17) VOYAGE ESTIMATE

No.
Date

~~M/S~~, S/S 250,000 (C/S)
(D/W) Speed 15.5 k't (laden)
16.5 k't (in ballast)

Cargo	Tons	rate	Freight	
Crude Oil	241,723			
			Des/Dem	$

Port	Distance (mile)	at Sea (day)	in Port (day)	Port charges $
Ras Tanura			2.0	25,755
Cape	10,945	29.4		
Genova			2.5	118,225
Suez		1.0	1.0	244,200
Ras Tanura	4,585	11.6		
(spare)				
Total		42.0	5.5	
Total		47.5 days		

Cargo expense $
Commission $
Sundries $

Fuel consumption

C-F.O.	at Sea	167	₮/d	7,014	₮
	in Port	84	₮/d	462	₮
	Total			7,476	₮ @$ 80

$ 598,080

A-F.O.	at Sea		₮/d		₮
	in Port		₮/d		₮
	Total				₮ @$

$

D/W	250,000	Total cost $ 2,131,200	Total expense	$ 986,260
Fuel	7,476		Net proceed	$
Spare	501		Hire cost	$ 1,144,940
Water	300		Net profit	$
Others		Cost per ton $ 8.82	(C/B)	$
Cargo	241,723		(H/B)	$

Table 5.1 (18) VOYAGE ESTIMATE

No.
Date

M/S, S/S 250,000 (C/C)
(D/W) Speed 15.5 k't (laden)
16.5 k't (in ballast)

Cargo	Tons	rate	Freight	
Crude Oil	239,302			
			Des/Dem	$

Port	Distance (mile)	at Sea (day)	in Port (day)	Port charges $
Ras Tanura			2.0	25,755
Cape	10,945	29.4		
Genova			2.0	118,225
Cape				
Ras Tanura	10,945	27.6		
				Cargo expense $
				Commission $
				Sundries $
(spare)				
Total		57.0	4.5	
Total		61.5	days	

Fuel consumption

C-F.O.	at Sea	167	₤/d	9,519	₤
	in Port	84	₤/d	378	₤
	Total			9,897	₤ @$ 80

$ 791,760

A-F.O.	at Sea		₤/d		₤
	in Port		₤/d		₤
	Total				₤ @$

$

D/W	250,000		Total expense	$	935,740
Fuel	9,897	Total cost $ 2,418,136	Net proceed	$	
Spare	501		Hire cost	$	1,482,396
Water	300		Net profit	$	
Others		Cost per ton $ 10.10	(C/B)	$	
Cargo	239,302		(H/B)	$	

Table 5.1 (19) VOYAGE ESTIMATE

No.
Date

M/S, ~~S/S~~ 60,000 (S/S)
(D/W) Speed 15.5 k't (laden)
16.5 k't (in ballast)

Cargo	Tons	rate	Freight	
Crude Oil	56,692			
			Des/Dem	$

Port	Distance (mile)	at Sea (day)	in Port (day)	Port charges $
Ras Tanura			1.5	8,355
Suez	8,281	22.3	1.0	70,200
New York		1.0	2.0	35,440
Suez		1.0	1.0	56,800
Ras Tanura	8,281	20.9		
(spare)				
Total		45.2	5.5	
	Total		50.7 days	

Cargo expense
$
Commission
$
Sundries
$

Fuel consumption

C-F.O.	at Sea	57 ₮/d	2,576	₮	
	in Port	29 ₮/d	160	₮	
	Total		2,736	₮ @$ 80	$ 218,880
A-F.O.	at Sea	2 ₮/d	101	₮	
	in Port	₮/d		₮	
	Total		101	₮ @$ 130	$ 13,130

D/W	60,000			Total expense	$ 402,805
Fuel	2,837	Total cost		Net proceed	$
Spare	171	$ 1,092,781		Hire cost	$ 689,976
Water	300			Net profit	$
Others		Cost per ton		(C/B)	$
Cargo	56,692	$ 19.28		(H/B)	$

Table 5.1 (20) VOYAGE ESTIMATE

No.
Date

M/S, ~~S/S~~ 60,000 (C/S)
(D/W) Speed 15.5 k't (laden)
16.5 k't (in ballast)

Cargo	Tons	rate	Freight	
Crude Oil	56,227			
			Des/Dem	$

Port	Distance (mile)	at Sea (day)	in Port (day)	Port charges $
Ras Tanura			1.5	8,355
Cape	11,794	31.7		
New York			2.0	35,440
Suez		1.0	1.0	56,800
Ras Tanura	8,281	20.9		
(spare)				
Total		53.6	4.5	
Total		58.1	days	

Cargo expense
$
Commission
$
Sundries
$

Fuel consumption

C-F.O.	at Sea	57 ₮/d	3,055	₮	
	in Port	29 ₮/d	131	₮	
	Total		3,186	₮ @$ 80	$ 254,880
A-F.O.	at Sea	2 ₮/d	116	₮	
	in Port	₮/d		₮	
	Total		116	₮ @$ 130	$ 15,080

D/W	60,000	Total cost $ 1,161,238	Total expense	$ 370,555
Fuel	3,302		Net proceed	$
Spare	171		Hire cost	$ 790,683
Water	300		Net profit	$
Others		Cost per ton $ 20.65	(C/B)	$
Cargo	56,227		(H/B)	$

Table 5.1 (21) VOYAGE ESTIMATE

No.
Date

M/S, ~~S/S~~ 60,000 (C/C)
(D/W) Speed 15.5 k't (laden)
16.5 k't (in ballast)

Cargo	Tons	rate	Freight
Crude Oil	55,791		
		Des/Dem	$

Port	Distance (mile)	at Sea (day)	in Port (day)	Port charges $
Ras Tanura			1.5	8,355
Cape	11,794	31.7		
New York			2.0	35,440
Cape	11,794	29.8		
Ras Tanura				
				Cargo expense $
				Commission $
				Sundries $
(spare)				
Total		61.5	3.5	
Total		65.0	days	

Fuel consumption

C-F.O.	at Sea	57	₤/d	3,506	₤	
	in Port	29	₤/d	102	₤	
	Total			3,608	₤ @$ 80	$ 288,640
A-F.O.	at Sea		₤/d		₤	
	in Port	2	₤/d	130	₤	
	Total			130	₤ @$ 130	$ 16,900

D/W	60,000	Total cost $ 1,233,920	Total expense	$	349,335
Fuel	3,738		Net proceed	$	
Spare	171		Hire cost	$	884,585
Water	300		Net profit	$	
Others		Cost per ton $ 22.12	(C/B)	$	
Cargo	55,791		(H/B)	$	

Table 5.1 (22) VOYAGE ESTIMATE

No.
Date

M/S, ~~S/S~~ 150,000 (S/S)
(D/W) Speed 15.5 k't (laden)
16.5 k't (in ballast)

Cargo	Tons	rate	Freight	
Crude Oil	144,526			
			Des/Dem	$

Port	Distance (mile)	at Sea (day)	in Port (day)	Port charges $
Ras Tanura			2.0	16,600
	8,281	22.3		
Suez			1.0	178,600
		1.0		
New York			2.0	69,835
		1.0		
Suez			1.0	145,200
	8,281	20.9		
Ras Tanura				
(spare)				
Total		45.2	6.0	
	Total		51.2 days	

Cargo expense $
Commission $
Sundries $

Fuel consumption

C-F.O.	at Sea	99	₮/d	4.475	₮	
	in Port	50	₮/d	300	₮	
	Total			4,775	₮ @$ 80	$ 382,000
A-F.O.	at Sea		₮/d		₮	
	in Port	2	₮/d	102	₮	
	Total			102	₮ @$ 130	$ 13,260

D/W	150,000		Total expense	$ 805,495
Fuel	4,877	Total cost $ 1,867,025	Net proceed	$
Spare	297		Hire cost	$ 1,061,530
Water	300		Net profit	$
Others		Cost per ton $ 12.92	(C/B)	$
Cargo	144,526		(H/B)	$

Table 5.1 (23) VOYAGE ESTIMATE

No.
Date

M/S, ~~S/S~~ 150,000 (C/S)
(D/W) Speed 15.5 k't (laden)
16.5 k't (in ballast)

Cargo	Tons	rate	Freight	
Crude Oil	143,730			
			Des/Dem	$

Port	Distance (mile)	at Sea (day)	in Port (day)	Port charges $
Ras Tanura			2.0	16,600
Cape	11,794	31.7		
New York			2.0	69,835
Suez		1.0	1.0	145,200
Ras Tanura	8,281	20.9		
(spare)				
Total		53.6	5.0	

Total 58.6 days

Cargo expense $
Commission $
Sundries $

Fuel consumption

C-F.O.	at Sea	99	₮/d	5,306	₮	
	in Port	50	₮/d	250	₮	
	Total			5,556	₮ @$	80
						$ 444,480
A-F.O.	at Sea	2	₮/d	117	₮	
	in Port		₮/d		₮	
	Total			117	₮ @$	130
						$ 15,210

D/W	150,000		
Fuel	5,673	Total cost $ 1,906,279	
Spare	297		
Water	300		
Others		Cost per ton $ 13.26	
Cargo	143,730		

Total expense	$ 691,325
Net proceed	$
Hire cost	$ 1,214,954
Net profit	$
(C/B)	$
(H/B)	$

Table 5.1 (24) VOYAGE ESTIMATE

No.
Date

M/S, ~~S/S~~ 150,000 (C/C)
(D/W) Speed 15.5 k't (laden)
16.5 k't (in ballast)

Cargo	Tons	rate	Freight	
Crude Oil	142,983			
			Des/Dem	$

Port	Distance (mile)	at Sea (day)	in Port (day)	Port charges $
Ras Tanura			2.0	16,600
Cape	11,794	31.7		
New York			2.0	69,835
Cape				
Ras Tanura	11,794	29.8		
(spare)				
Total		61.5	4.0	
Total		65.5	days	

Cargo expense
$
Commission
$
Sundries
$

Fuel consumption

C-F.O.	at Sea	99	₹/d	6,089	₹	
	in Port	50	₹/d	200	₹	
	Total			6,289	₹ @$	80
A-F.O.	at Sea		₹/d		₹	
	in Port	2	₹/d	131	₹	
	Total			131	₹ @$	130

$ 503,120

$ 17,030

D/W	150,000			Total expense	$ 606,585
Fuel	6,420	Total cost		Net proceed	$
Spare	297	$ 1,964,597		Hire cost	$ 1,358,012
Water	300			Net profit	$
Others				(C/B)	$
Cargo	142,983	Cost per ton		(H/B)	$
		$ 13.74			

Table 5.1 (25) **VOYAGE ESTIMATE**

No.
Date

-M/S; S/S 250,000 (S/S)
(D/W) Speed 15.5 k't (laden)
16.5 k't (in ballast)

Cargo	Tons	rate	Freight	
Crude Oil	241,105			
			Des/Dem	$

Port	Distance (mile)	at Sea (day)	in Port (day)	Port charges $
Ras Tanura			2.0	25,755
Suez	8,281	22.3	1.0	297,900
New York		1.0	2.5	118,225
Suez		1.0	1.0	242,200
Ras Tanura	8,281	20.9		
(spare)				
Total		45.2	6.5	
Total			51.7 days	

Fuel consumption

C-F.O.	at Sea	167	₹/d	7,548	₹	
	in Port	84	₹/d	546	₹	
	Total			8,094	₹ @$	80
A-F.O.	at Sea		₹/d		₹	
	in Port		₹/d		₹	
	Total				₹ @$	

Cargo expense
$
Commission
$
Sundries
$

$ 647,520

$

D/W	250,000
Fuel	8,094
Spare	501
Water	300
Others	
Cargo	241,105

Total cost
$ 2,577,777

Cost per ton
$ 10.69

Total expense	$ 1,331,600
Net proceed	$
Hire cost	$ 1,246,177
Net profit	$
(C/B)	$
(H/B)	$

Table 5.1 (26) VOYAGE ESTIMATE

No.
Date

M/S, S/S 250,000 (C/S)
(D/W) Speed 15.5 k't (laden)
16.5 k't (in ballast)

Cargo	Tons	rate	Freight	
Crude Oil	239,786			
			Des/Dem	$

Port	Distance (mile)	at Sea (day)	in Port (day)	Port charges $
Ras Tanura			2.0	25,755
Cape	11,794	31.7		
New York			2.5	118,225
Suez		1.0	1.0	242,200
Ras Tanura	8,281	20.9		
				Cargo expense $
				Commission $
				Sundries $
(spare)				
Total		53.6	5.5	
	Total		59.1 days	

Fuel consumption

C-F.O.	at Sea	167 $/d	8,951	$	
	in Port	84 $/d	462	$	
	Total		9,413	$ @$ 80	$ 753,040
A-F.O.	at Sea	$/d		$	
	in Port	$/d		$	
	Total			$ @$	$

D/W	250,000		Total expense	$	1,139,220
Fuel	9,413	Total cost $ 2,563,766	Net proceed	$	
Spare	501		Hire cost	$	1,424,546
Water	300		Net profit	$	
Others		Cost per ton $ 10.69	(C/B)	$	
Cargo	239,786		(H/B)	$	

Table 5.1 (27) VOYAGE ESTIMATE

No.
Date

M/S, S/S 250,000 (C/C)
(D/W) Speed 15.5 k't (laden)
16.5 k't (in ballast)

Cargo	Tons	rate	Freight	
Crude Oil	238,550			
			Des/Dem	$

Port	Distance (mile)	at Sea (day)	in Port (day)	Port charges $
Ras Tanura			2.0	25,755
Cape	11,794	31.7		
New York			2.5	118,225
Cape				
Ras Tanura	11,794	29.8		
(spare)				
Total		61.5	4.5	
Total			66.0 days	

Cargo expense
$
Commission
$
Sundries
$

Fuel consumption

C-F.O.	at Sea	167	₤/d	10,271	₤
	in Port	84	₤/d	378	₤
	Total			10,649	₤ @$ 80

$ 851,920

A-F.O.	at Sea		₤/d	₤
	in Port		₤/d	₤
	Total			₤ @$

$

D/W	250,000		Total expense	$	995,900
Fuel	10,649	Total cost $ 2,586,764	Net proceed	$	
Spare	501		Hire cost	$	1,590,864
Water	300		Net profit	$	
Others		Cost per ton $ 10.84	(C/B)	$	
Cargo	238,550		(H/B)	$	

Table 5.1 (28) VOYAGE ESTIMATE

No.
Date

~~M/S,~~ S/S 500,000 (C/C)
(D/W) Speed 15 k't (laden)
16 k't (in ballast)

Cargo	Tons	rate	Freight	
Crude Oil	484,903			
			Des/Dem	$

Port	Distance (mile)	at Sea (day)	in Port (day)	Port charges $
Ras Tanura			2.0	44,800
Cape	11,422	31.7		
Rotterdam			2.5	209,000
Cape	11,422	29.7		
Ras Tanura				
(spare)				
Total		61.4	4.5	
	Total	65.9	days	

Cargo expense
$
Commission
$
Sundries
$

Fuel consumption
C-F.O. at Sea 222 ₹/d 13,631 ₹
in Port 111 ₹/d 500 ₹
Total 14,131 ₹ @$ 80 $ 1,130,480

A-F.O. at Sea ₹/d ₹
in Port ₹/d ₹
Total ₹ @$ $

D/W	500,000		Total expense	$ 1,384,280
Fuel	14,131	Total cost $ 3,637,665	Net proceed	$
Spare	666		Hire cost	$ 2,253,385
Water	300		Net profit	$
Others		Cost per ton $ 7.50	(C/B)	$
Cargo	484,903		(H/B)	$

Table 5.1 (29) VOYAGE ESTIMATE

No.
Date

~~M/S~~; S/S 500,000 (C/C)
(D/W) Speed 15 k't (laden)
16 k't (in ballast)

Cargo	Tons	rate	Freight	
Crude Oil	485,458			
			Des/Dem	$

Port	Distance (mile)	at Sea (day)	in Port (day)	Port charges $
Ras Tanura			2.0	44,800
Cape	10,945	30.4		
Genova			2.5	209,000
Cape				
Ras Tanura	10,945	28.5		
(spare)				
Total		58.9	4.5	
	Total	63.4	days	

Cargo expense
$
Commission
$
Sundries
$

Fuel consumption

C-F.O.	at Sea	222	₹/d	13,076	₹
	in Port	111	₹/d	500	₹
	Total			13,576	₹ @$ 80

$ 1,086,080

A-F.O.	at Sea		₹/d		₹
	in Port		₹/d		₹
	Total				₹ @$

$

D/W	500,000		Total expense	$	1,339,880
Fuel	13,576	Total cost $ 3,507,780	Net proceed	$	
Spare	666		Hire cost	$	2,167,900
Water	300		Net profit	$	
Others		Cost per ton $ 7.23	(C/B)	$	
Cargo	485,458		(H/B)	$	

Table 5.1 (30) VOYAGE ESTIMATE

No.
Date

~~M/S~~, S/S 500,000 (C/C)
(D/W) Speed 15 k't (laden)
16 k't (in ballast)

Cargo	Tons	rate	Freight	
Crude Oil	484,437			
			Des/Dem	$

Port	Distance (mile)	at Sea (day)	in Port (day)	Port charges $
Ras Tanura			2.0	44,800
Cape	11,794	32.8		
New York			2.5	209,000
Cape				
Ras Tanura	11,794	30.7		
				Cargo expense $
				Commission $
				Sundries $
(spare)				
Total		63.5	4.5	
Total		68.0	days	

Fuel consumption

C-F.O.	at Sea	222	₹/d	14,097	₹
	in Port	111	₹/d	500	₹
	Total			14,597	₹ @$ 80
A-F.O.	at Sea		₹/d		₹
	in Port		₹/d		₹
	Total				₹ @$

$ 1,167,760

$

D/W	500,000	Total cost $ 3,746,752		Total expense	$ 1,421,560
Fuel	14,597			Net proceed	$
Spare	666			Hire cost	$ 2,325,192
Water	300			Net profit	$
Others		Cost per ton $ 7.73		(C/B)	$
Cargo	484,437			(H/B)	$

Table 5.1 (31) VOYAGE ESTIMATE

No.
Date

M/S, ~~S/S~~ Bulk Carrier(Suez)
(D/W 60,000 L/T) Speed 14.0 k't (laden)
15.0 k't (in ballast)

Cargo	Tons	rate	Freight	
Bauxite	58,510			
			Des/Dem	$

Port	Distance (mile)	at Sea (day)	in Port (day)	Port charges $
Weipa			5.0	30,000
Suez	7,320	21.8	1.0	70,800
Rotterdam	3,400	10.1	3.0	27,000
(spare)				
Total		31.9	9.0	
Total		40.9	days	

Cargo expense
$
Commission
$
Sundries
$

Fuel consumption

C-F.O.	at Sea	46 ₮/d	1,531	₮	
	in Port	1 ₮/d	9	₮	
	Total		1,540	₮ @$ 80	$ 123,200
A-F.O.	at Sea	2 ₮/d	64	₮	
	in Port	2.5 ₮/d	23	₮	
	Total		87	₮ @$ 130	$ 11,310

D/W	60,000		Total expense	$ 262,310
Fuel	1,046	Total cost $	Net proceed	$
Spare	144		Hire cost	$
Water	300		Net profit	$
Others			(C/B)	$
Cargo	58,510	Cost per ton $	(H/B)	$

Table 5.1 (32) VOYAGE ESTIMATE

No.
Date

M/S, ~~S/S~~ Bulk Carrier(Cape)
(D/W 60,000 L/T) Speed 14.0 k't (laden)
15.0 k't (in ballast)

Cargo	Tons	rate	Freight	
Bauxite	58,582			
			Des/Dem	$

Port	Distance (mile)	at Sea (day)	in Port (day)	Port charges $
Weipa			5.0	30,000
Cape Town	6,830	20.3	1.0	7,000
Rotterdam	6,163	18.3	3.0	27,000
(spare)				
Total		38.6	9.0	
	Total	47.6	days	

Cargo expense
$
Commission
$
Sundries
$

Fuel consumption

C-F.O.	at Sea	46	₮/d	1,776	₮	
	in Port	1	₮/d	9	₮	
	Total			1,785	₮ @$	80
A-F.O.	at Sea	2	₮/d	77	₮	
	in Port	2.5	₮/d	23	₮	
	Total			100	₮ @$	130

$ 142,800

$ 13,000

D/W	60,000	Total cost $	Total expense	$ 219,800
Fuel	974		Net proceed	$
Spare	144		Hire cost	$
Water	300		Net profit	$
Others		Cost per ton $	(C/B)	$
Cargo	58,582		(H/B)	$

dwt, 150,000 dwt and 250,000 dwt for the three routes of Ras Tanura/Rotterdam,/Genoa and / New York each by S/S, C/S and C/C (assuming that passage through the Canal is possible and that all tolls will be those currently in effect) and three cases pertaining to 500,000 dwt for the above three routes by C/C only. Aside from these, two other cases for Weipa (Aust.)/Rotterdam via Suez and via Cape pertaining to 60,000 dwt bulk carrier were added.

5.4 Comparison of Profitability of S/S, C/S, C/C

On the basis of the results of the above calculations, S/S, C/S and C/C are compared. In the case of a 250,000 dwt tanker taking the C/S and C/C Ras Tanura-Rotterdam routes, the C/C is in general more advantageous if the freight rate is low but the C/S is more advantageous if the freight is high. The equation for obtaining a dividing point is as follows:

$$\frac{240{,}587X - 1{,}075{,}940}{54.3} = \frac{238{,}884X - 969{,}180}{64.0}$$

Thus, the freight rates at which the daily net income of C/S and C/C obtained by dividing with the number of voyage days the net income resulting after the voyage cost (fuel cost and port charge) is subtracted from the freight revenue (cargo ton x freight rate) become equal is

$$X = \$6.69.$$

Expressed in terms of the World Scale rate (effective July 1, 1978, see Table 5.2), this is equivalent to WS40* in the case of C/S and to WS38* in the case of C/C. Therefore, it becomes clear that for this ship size C/S is more advantageous than C/C to the shipowner at around WS40.

In the latter half of 1978, the tanker rate went up and caused an increase in southbound traffic of VLCC in ballast. It is believed that, if the distributions of the last port of call of these VLCCs are studied against the above calculation results, a very interesting fact would become evident.

5.5 The Effect of Slow Steaming

The above cases of calculation are based on full steaming. In the case of slow steaming, which is general these days, a comparison between C/S and C/C of 250,000 dwt will be made as follows on the assumption that

Speed: laden 12.5 knots, in ballast 13.5 knots
Fuel consumption: F.O. 100 T/d at sea.

$$\frac{242{,}948X - 903{,}140}{65.4} = \frac{241{,}682X - 761{,}420}{77.9}$$

making X= \$6.58.

---

* (\$6.69 –\$0.93)/\$14.28 = WS40
\$6.69/\$17.65 = WS38

It becomes evident that the dividing point of the advantageousness of C/S and C/C shows very little difference between slow steaming and full steaming.

5.6 The Effect of Canal Toll Increase

A calculation of the dividing point of advantageousness of C/S and C/C of 250,000 dwt in the case the Canal toll is raised by 20% would be as follows:

$$\frac{240{,}587X - 1{,}075{,}940 - 243{,}000 \times 20\%}{54.3} = \frac{238{,}884X - 969{,}180}{64.0}$$

$$X = \$7.98.$$

This is equivalent to WS49 in the case of C/S and to WS45 in the case of C/C, higher than the current tariff by 9 points in the case of C/S and by 7 points in the case of C/C. This means that, in comparison with the dividing points calculated under the current tariff in section 5.4, the ship will not use the Canal unless the freight is that much higher.

5.7 The Effect of Increase in Fuel Cost

Compared to other transportation costs, the proportion of fuel is very large and the fuel price is thought to fluctuate violently in future. Therefore, it is analyzed.

It will be assumed that the bunker price increases 10%. Comparison of C/S and C/C for 250,000 dwt Ras Tanura-Rotterdam gives the result

$$X = \$6.66.$$

There is hardly any difference. At first galance, this appears strange. It is due perhaps to the fact that, for the shipping company, the value of using the Canal is influenced greatly by the freight revenue rather than by the expenditures such as fuel cost and ship cost.

5.8 In the Case of Contract at WS Rate

The World Scale tariff (see Table 5.2) is in the three forms of S/S, C/S and C/C to which is added an amount equivalent to the toll which is $2.06 for S/S and $0.93 for C/S. If the contract is based on World Scale (July 1, 1978), the freight which the shipper has to actually pay will differ for the three routes. For instance, in the case of WS50 for Ras Tanura/Rotterdam, the rates would be:

S/S	$10.98 x WS50 + $2.06	= $7.55
C/S	$14.28 x WS50 + $0.93	= $8.07
C/C	$17.65 x WS50	= $8.25

The shipper will prefer the cheapest S/S.

Table 5.2 PG/Miscellaneous Main Route Worldscale Rate ('78.7.1)

LOADING PORT	RAS TANURA			M.A. AHMADI			KHARG ISLAND		
DISCHARGE PORT		S	CS		S	CS		S	CS
MILFORD HAVEN	17.04	10.30	13.64	17.41	10.67	14.01	17.71	10.97	14.31
FALMOUTH	16.87	10.14	13.47	17.24	10.51	13.84	17.54	10.81	14.14
LAVERA	16.71	8.07	12.33	17.08	8.44	12.70	17.38	8.74	13.00
VENICE	18.04	7.65	12.76	18.41	8.02	13.13	18.71	8.32	13.43
GENOA	16.70	7.79	12.18	17.07	8.16	12.55	17.37	8.46	12.85
ROTTERDAM	17.65	10.98	14.28	18.02	11.35	14.65	18.32	11.65	14.95
WILHELMSHAVEN	17.77	11.02	14.36	18.14	11.39	14.73	18.44	11.69	15.03
HAMBURG	18.02	11.27	14.61	18.39	11.64	14.98	18.69	11.94	15.28
STOCKHOLM	19.60	12.71	16.12	19.97	13.08	16.49	20.27	13.38	16.79
NEW YORK	17.48	12.74	15.09	17.85	13.11	15.46	18.15	13.41	15.76
NEW ORLEANS	17.58	14.18	15.87	17.95	14.55	16.24	18.25	14.85	16.54
SAN FRANCISCO	15.88			16.25			16.55		
LOS ANGELES	16.33			16.70			17.00		
TRINIDAD	15.19	12.92	14.05	15.56	13.29	14.42	15.86	13.59	14.72
SANTOS	12.60			12.97			13.27		
MELBOURNE	11.33			11.70			12.00		
KEELUNG	8.50			8.87			9.17		
YOKOHAMA	10.14			10.51			10.81		

Note: S = Via Suez in both direction
CS = Via Cape Horn in laden voyage and Via Canal in ballast
Ras Tanura/Rotterdam case, fare should be added $2.06 in S and $0.93 in CS.

On the basis of calculation, the actual amount of the freightage is lowest in the case of S/S at the rate above WS34.2, in the case of C/S at between WS34.2 and WS27.6, and in the case of C/C at WS27.6. Therefore, the shipper seeks the lowest rate.

On the other hand, the shipping company, as stated earlier, seeks to maximize $\frac{\text{Freight} - \text{Voyage cost}}{\text{Voyage days}}$. Therefore, the two parties have to negotiate. This point, too, comes into play in the choice between via Suez or via Cape.

5.9 Reasons for Withdrawal of 60,000 dwt Tankers from Suez Canal

A comparison of the economies of 60,000 dwt S/S and 250,000 dwt C/C in the most typical of trades, Ras Tanura/Genoa, shows that the voyage cost per cargo ton is $5.40 and $3.91 respectively. The latter is 28% less than the former. This is believed to be one of the reasons for the decrease on this route of 50,000 ~ 60,000 dwt tankers.

The average 1977 freight level according to ship size was about WS25 for VLCC and about WS85 for 60,000 dwt and less. In other words, the level for 60,000 dwt was 3.4 times that of VLCC. The main reason for this is believed to be the fact that America's vigorous crude oil imports had to be carried out on ships of this smaller size because of the situation of ports in the U.S.. In using the Suez Canal, the 60,000 dwt class cannot compete against the VLCC even in

the most favorable Middle East/Mediterranean route. On the other hand, these tankers could demand high rates if they run on America's nearseas routes such as Caribbean/U.S.. For these reasons, it is believed that the 60,000 tonners withdrew from the Suez routes.

This situation is not expected to change unless American crude oil imports decrease or American ports are rapidly expanded. Furthermore, the 60,000 dwt class ships are mostly old and their number is decreasing. Consequently, there are indications of new buildings in the 60,000 ~ 80,000 dwt range becoming active.

5.10 Ship Size Choice of Oil Companies

The above analysis of the voyage estimate makes clear the economies of ship sizes and routes. With this it will be possible to find out the economic reason for the oil companies' selection of ship size and route. However, the oil companies' actual choice of ship size cannot be forecast from an analysis of voyage estimate alone.

In addition to the economic reason, the oil companies decide on the ship size by taking into consideration a great many other factors. They include, for example, the situation of storage tanks at the loading and unloading ports, the situation of berths, the connection between the volume of each type of oil and the conditions at the loading and unloading ports, the urgency of need at the unloading port, the general political and economic situation relating to oil, etc. When the ship size composition of the oil company's vessels on hand is not appropriate, it would enter into a temporary swapping arrangement with another company or in the case of ship shortage it would charter in the spot market.

It would be profitable to interview oil company officers to learn about the actual situation regarding their selection of ship size.

The surest way to learn in quantitative terms the actual state of size selection by the oil companies is to examine past records of voyages by ship size. A possible way of doing this at present is to use Lloyd's "Shipping Index" (published weekly) which lists arrivals and departures at every port. From the names of ships on this list the record of voyages can be learned.

This data is most valuable for the SCA because it shows the ships which have a possibility of passing through the Suez Canal. It will be most rewarding for SCA to start studying and analyzing in detail this data as soon as possible.

5.11 Data On and Calculation of Capital Cost and Ship Cost

Published data on the item-by-item costs of ship cost are very scarce. The actual situation is not known because it differs from one shipping company to another and figures are not disclosed. It can be said that publications carrying statistics on this which can be used in cost analysis are not obtained. Therefore, the only way is to arrive at an overall judgement by collecting information and data on each cost item from various sources.

As an example of calculation, we have attached a chart compiled by computer on four ship sizes (see Table 5.4 (1) ~ (8) and Table 5.5 (1) ~ (4)). The data used for these were mainly those available in Japan.

Reflecting the freight market, ship prices reached a high level in 1973 and 1974 and then fell to their present level. With newbuilding orders being very few at present, it is difficult to figure out ship prices. The present newbuilding prices, moreover, do not necessarily indicate the reasonable level. Useable for reference are Fearnley & Egers Chartering Co., Ltd.'s "Review 1977", Fairplay and Platou Report.

The calculation example has been worked out by taking as the base the level to which ship prices had recovered slightly from the low of 1976 ~ 77 (Case I). However, as stated before, it is difficult to say whether this is appropriate or not. For comparison, ship prices were estimated at an assumed level reached when prices have recovered somewhat (a situation in which orders begin to be issued for all sizes ranging from small vessels to ULCCs) (Case II). With this, a comparison can be made of a case in which the ship prices change.

Interest and repayment terms are according to the OECD understanding: 70%, 7 years, interest 8%. These terms are used as basis the credit for new buildings. As for the remaining 30%, 7 years' deferment and 3 years repayment, the premise is that actually bridge finance will be used. The example of computer calculation (Table 5.5 (1) ~ (4) adopts the method of incorporating the interest on the deficit or surplus after the repayment.

Because of a lack of compiled data, the crew cost can be estimated only on the basis of scattered information. The ITF tariff serves as a reference. Depending on the nationality, the disparity in the crew cost is very great, ranging from $400,000 to $1,200,000 annually. Consequently, in the sample calculation the medium crew cost of $800,000 was used. In actuality, however, it is believed that the crew cost is averaged generally at a level lower than this figure.

The repair cost is strongly influenced by such factors as the inspection standard and the rules of conventions. In the sample calculation, the price inflation is taken as 5% and the increase in repair cost due to ageing is taken as 7%.

The insurance cost, too, varies widely from shipowner to shipowner, depending on past loss ratio, volume of contracts with insurance companies, etc. Values regarded as average were used in the sample calculation. P.I. insurance is included.

5.12 Per Ton Cost Calculation and Comparison of Ship Size

The per ton cost is calculated by putting together the voyage estimate, capital cost and ship cost explained in preceding sections. In this case, the daily values of capital cost and ship cost are obtained by taking the total annual cost and dividing by the number of operating days in the year (345 days in the case of the sample calculation). The per voyage figure is then calculated by multiplying the answer by the number of voyage days. The voyage cost of the particular voyage is then added to give the total cost. This is then divided by load tonnage to give the per ton cost.

$$\text{Per ton cost} = \frac{\text{Capital cost} + \text{Ship cost} + \text{Voyage cost}}{\text{Load tonnage}}$$

The per ton cost by ship size, trade and route obtained from this calculation is shown in Table 5.3. Various analysis can be carried out on the basis of this table, the main ones being:

(1) The advantages of transit through the Suez are high for Genoa, low for New York, and medium for Rotterdam.

(2) In Case I, large size vessels are more advantageous. For example, with regards to Rotterdam, 250,000 dwt C/C is more advantageous than 150,000 dwt S/S and 500,000 dwt C/C is far more advantageous than 250,000 dwt S/S. In Case II, the advantage of the large size vessels diminish and, instead, passage through the Canal becomes increasingly advantageous. For example, 150,000 dwt S/S becomes more advantageous than 250,000 dwt C/C.

(3) Even in Case I, the cost of 250,000 dwt is double or more than the current market. (Refer to WS rate.)

Here, we would like to touch once more on the difference between Case I and Case II.

Case I is based on a rather low ship price. In the case particularly of large size vessels, this price is not very realistic. Even so, it is higher than the value calculated back from the price of second-hand ships. And, as noted above, this cost is more than double that prevailing in the market.

In Case II, the condition assumed is a slight recovery towards normal. However, it probably is not a level which will bring profit to shipbuilders.

In view of the present surplus in shipbuilding capacity, the buyer's market is expected to continue for quite some time (for example during the 1980s). It is believed that the subsidy policy of all nations will aggravate this trend.

The realtionship between cost and freight market explained in section 5.1 shows that the market will gradually catch up with these costs. However, the thinking that is common at present among shipowners throughout the world is to make a profit by either building vessels now when the ship price is so exceedingly low or to buy second-hand ships and, when the market rises, to make charter contracts or to sell the ships. It is believed that this speculative thinking will obstruct the alleviation of the ship surplus situation. In fact, this kind of speculative behaviour is already beginning to be seen in the field of small tankers.

In other words, the results of the above cost analyses do not at once become a forecast of the freight market. An analysis from an entirely different angle becomes necessary. On this point, refer to Chapter 6.

Table 5.3 Summary of Transportation Cost Estimates (per ton cost): Ras Tanura to;

Case (I) Lower ship price

Unit: US$ per ton

to	Rotterdam			Genoa			New York		
route	S/S	C/S	C/C	S/S	C/S	C/C	S/S	C/S	C/C
DWT									
60,000	16.59	18.99	21.41	12.79	16.66	20.53	19.28	20.65	22.12
150,000	11.29	12.26	13.32	8.95	10.85	12.79	12.92	13.26	13.74
250,000	9.42	9.91	10.51	7.62	8.82	10.10	10.69	10.69	10.84
	(W67)	(W63)	(W60)	(W71)	(W64)	(W60)	(W68)	(W65)	(W62)
500,000			7.50			7.23			7.73

Case (II) Higher ship price

60,000	17.65	20.32	23.00	13.55	17.82	22.06	20.54	22.11	23.77
150,000	12.42	13.67	15.00	9.77	12.08	14.40	14.26	14.80	15.47
250,000	11.15	12.05	13.06	8.88	10.69	12.55	12.73	13.03	13.48
	(W83)	(W78)	(W74)	(W88)	(W80)	(W75)	(W84)	(W80)	(W77)
500,000			11.07			10.66			11.42

Table 5.4 (1) 60,000 DWT (Diesel) (Case I)

Unit: US$

Contract Price	17,000,000	
Fitting Out Exp. (5%)	850,000	
Total	17,850,000	
	First year	10 years average
Repayment (10 years)	1,785,000	1,785,000
Interest (8%)	1,392,300	749,700
Capital Cost Total	3,177,300	2,534,700
Crew Expense	800,000	1,006,231
Stores	50,000	62,890
Lubricating Oil	90,000	113,201
Maintenance & Repair	60,000	544,552
Insurance	232,000	232,000
Miscellaneous	30,000	37,733
Administration	130,000	163,513
Ship Cost Total	1,392,000	2,160,120
Grand Total	4,569,300	4,694,820
Daily Cost (345 days)	13,244	13,609
Time Charter Hire (11.33 Month)	6.72	6.91

Table 5.4 (2) 60,000 DWT (Diesel) (Case II)

Unit: US$

Contract Price	20,000,000	
Fitting Out Exp. (5%)	1,000,000	
Total	21,000,000	
	First year	10 years average
Repayment (10 years)	2,100,000	2,100,000
Interest (8%)	1,638,000	882,000
Capital Cost Total	3,738,000	2,982,000
Crew Expense	800,000	1,006,231
Stores	50,000	62,890
Lubricating Oil	90,000	113,201
Maintenance & Repair	60,000	544,552
Insurance	273,000	273,000
Miscellaneous	30,000	37,733
Administration	130,000	163,513
Ship Cost Total	1,433,000	2,201,120
Grand Total	5,171,000	5,183,120
Daily Cost (345 days)	14,988	15,024
Time Charter Hire (11.33 Month)	7.61	7.62

Table 5.4 (3) 150,000 DWT (Diesel) (Case I)

Unit: US$

Contract Price	30,000,000	
Fitting Out Exp. (5%)	1,500,000	
Total	31,500,000	
	First year	10 years average
Repayment (10 years)	3,150,000	3,150,000
Interest (8%)	2,457,000	1,323,000
Capital Cost Total	5,607,000	4,473,000
Crew Expense	820,000	1,031,388
Stores	70,000	88,045
Lubricating Oil	150,000	188,668
Maintenance & Repair	78,000	707,917
Insurance	425,000	425,000
Miscellaneous	40,000	50,312
Administration	150,000	188,668
Ship Cost Total	1,733,000	2,679,999
Grand Total	7,340,000	7,152,999
Daily Cost (345 days)	21,275	20,733
Time Charter Hire (11.33 Month)	4.32	4.21

Table 5.4 (4) 150,000 DWT (Diesel) (Case II)

Unit: US$

Contract Price	38,000,000	
Fitting Out Exp. (5%)	1,900,000	
Total	39,900,000	
	First year	10 years average
Repayment (10 years)	3,990,000	3,990,000
Interest (8%)	3,112,200	1,675,800
Capital Cost Total	7,102,200	5,665,800
Crew Expense	820,000	1,031,388
Stores	70,000	88,045
Lubricating Oil	150,000	188,668
Maintenance & Repair	78,000	707,917
Insurance	538,000	538,000
Miscellaneous	40,000	50,312
Administration	150,000	188,668
Ship Cost Total	1,846,000	2,792,998
Grand Total	8,948,200	8,458,798
Daily Cost (345 days)	25,937	24,518
Time Charter Hire (11.33 Month)	5.27	4.98

Table 5.4 (5) 250,000 DWT (Turbine) (Case I)

Unit: US$

Contract Price	37,000,000	
Fitting Out Exp. (5%)	1,850,000	
Total	38,850,000	
	First year	10 years average
Repayment (10 years)	3,885,000	3,885,000
Interest (8%)	3,030,300	1,631,700
Capital Cost Total	6,915,300	5,516,700
Crew Expense	840,000	1,056,543
Stores	85,000	106,913
Lubricating Oil	8,500	10,692
Maintenance & Repair	89,000	807,752
Insurance	544,000	544,000
Miscellaneous	47,000	59,116
Administration	170,000	213,824
Ship Cost Total	1,783,500	2,798,839
Grand Total	8,698,800	8,315,539
Daily Cost (345 days)	25,214	24,104
Time Charter Hire (11.33 Month)	3.07	2.94

Table 5.4 (6) 250,000 DWT (Turbine) (Case II)

Unit: US$

Contract Price	57,000,000	
Fitting.Out Exp. (5%)	2,850,000	
Total	59,850,000	
	First year	10 years average
Repayment (10 years)	5,985,000	5,985,000
Interest (8%)	4,668,300	2,513,700
Capital Cost Total	10,653,300	8,498,700
Crew Expense	840,000	1,056,543
Stores	85,000	106,913
Lubricating Oil	8,500	10,692
Maintenance & Repair	89,000	807,752
Insurance	838,000	838,000
Miscellaneous	47,000	59,116
Administration	170,000	213,824
Ship Cost Total	2,077,500	3,092,840
Grand Total	12,730,800	11,591,540
Daily Cost (345 days)	36,901	33,599
Time Charter Hire (11.33 Month)	4.50	4.09

Table 5.4 (7) 500,000 DWT (Turbine) (Case I)

Unit: US$

Contract Price	55,000,000	
Fitting Out Exp. (5%)	2,750,000	
Total	57,750,000	
	First year	10 years average
Repayment (10 years)	5,775,000	5,775,000
Interest (8%)	4,504,500	2,425,500
Capital Cost Total	10,279,500	8,200,500
Crew Expense	880,000	1,106,854
Stores	120,000	150,935
Lubricating Oil	10,000	12,578
Maintenance & Repair	122,000	1,107,256
Insurance	866,000	866,000
Miscellaneous	80,000	100,623
Administration	200,000	251,558
Ship Cost Total	2,278,000	3,595,804
Grand Total	12,557,500	11,796,304
Daily Cost (345 days)	36,399	34,194
Time Charter Hire (11.33 Month)	2.22	2.08

Table 5.4 (8) 500,000 DWT (Turbine) (Case II)

Unit: US$

Contract Price	110,000,000	
Fitting Out Exp. (5%)	5,500,000	
Total	115,500,000	
	First year	10 years average
Repayment (10 years)	11,550,000	11,550,000
Interest (8%)	9,009,000	4,851,000
Capital Cost Total	20,559,000	16,401,000
Crew Expense	880,000	1,106,854
Stores	120,000	150,935
Lubricating Oil	10,000	12,578
Maintenance & Repair	122,000	1,107,256
Insurance	1,732,000	1,732,000
Miscellaneous	80,000	100,623
Administration	200,000	251,558
Ship Cost Total	3,144,000	4,461,804
Grand Total	23,703,000	20,862,804
Daily Cost (345 days)	68,704	60,472
Time Charter Hire	4.18	3.68

Table 5.5 (1) SCA MT 60000 10 YEARS SHIP COSTS DETAIL LIST

OIL TANKER — OPE = 79/02/10 — NECESSARY CRG = 4,692,994 UD — PAGE = 1

		01	02	03	04	05	06	07	08	09	10	GRDTTL
WORKING TONNAGE	A	680,400	680,400	680,400	680,400	680,400	680,400	680,400	680,400	680,400	680,400	6,804,000
HIRE PER YEAR	B	4,692,994	4,692,994	4,692,994	4,692,994	4,692,994	4,692,994	4,692,994	4,692,994	4,692,994	4,692,994	46,929,940
C/R (C. MONTH)		6.8974	6.8974	6.8974	6.8974	6.8974	6.8974	6.8974	6.8974	6.8974	6.8974	6.8974
C/R (30 DAYS)		6.8029	6.8029	6.8029	6.8029	6.8029	6.8029	6.8029	6.8029	6.8029	6.8029	6.8029
CREW EXPENSE		800,000	840,000	882,000	926,100	972,405	1,021,025	1,072,076	1,125,680	1,181,964	1,241,062	10,062,312
STORES		50,000	52,500	55,125	57,881	60,775	63,814	67,005	70,355	73,873	77,567	628,895
LUBRICATING OIL		90,000	94,500	99,225	104,186	109,395	114,865	120,608	126,638	132,970	139,619	1,132,006
INSURANCE		232,000	232,000	232,000	232,000	232,000	232,000	232,000	232,000	232,000	232,000	2,320,000
MAINT. & REPAIR		60,000	337,050	378,676	553,075	477,984	537,015	603,337	881,203	761,563	855,616	5,445,519
MISC.		30,000	31,500	33,075	34,729	36,465	38,288	40,202	42,212	44,323	46,539	377,333
(SUB TOTAL)		1,262,000	1,587,550	1,680,101	1,907,971	1,889,024	2,007,007	2,135,228	2,478,088	2,426,693	2,592,403	19,966,065
ADMINISTRATION		130,000	136,500	143,325	150,491	158,016	165,917	174,213	182,924	192,070	201,674	1,635,130
(TOTAL)	C	1,392,000	1,724,050	1,823,426	2,058,462	2,047,040	2,172,924	2,309,441	2,661,012	2,618,763	2,794,077	21,601,195
INTEREST		1,392,300	1,249,500	1,106,700	963,900	821,100	678,300	535,500	392,700	249,900	107,100	7,497,000
– " – (DEF/SURP)			-9,896	-5,443	-4,108	4,713	1,902	-2,488	-7,731	3,308	426	-19,317
(SUB TOTAL)	D	1,392,300	1,239,604	1,101,257	959,792	825,813	680,202	533,012	384,969	253,208	107,526	7,477,683
(C + D)	E	2,784,300	2,963,654	2,924,683	3,018,254	2,872,853	2,853,126	2,842,453	3,045,981	2,871,971	2,901,603	29,078,878
(E/A)		4.0922	4.3558	4.2985	4.4360	4.2223	4.1933	4.1776	4.4768	4.2210	4.2646	4.2738
(B – E)	F	1,908,694	1,729,340	1,768,311	1,674,740	1,820,141	1,839,868	1,850,541	1,647,013	1,821,023	1,791,391	17,851,062
– " – ACCUM.	G	1,908,694	3,638,034	5,406,345	7,081,085	8,901,226	10,741,094	12,591,635	14,238,648	16,059,671	17,851,062	
REPAYMENT	H	1,785,000	1,785,000	1,785,000	1,785,000	1,785,000	1,785,000	1,785,000	1,785,000	1,785,000	1,785,000	17,850,000
– " –		1,785,000	1,785,000	1,785,000	1,785,000	1,785,000	1,785,000	1,785,000	1,785,000	1,785,000	1,785,000	17,850,000
LOAN REMAINDER		17,850,000	16,065,000	14,280,000	12,495,000	10,710,000	8,925,000	7,140,000	5,355,000	3,570,000	1,785,000	
DEFICIT/SURPLUS (F-H)		123,694	-55,660	-16,689	-110,260	35,141	54,868	65,541	-137,987	36,023	6,391	1,062
– " – ACCUM.		123,694	68,034	51,345	-58,915	-23,774	31,094	96,635	-41,352	-5,329	1,062	
DEPRECIATION (13YR.)	J	2,891,700	2,423,245	2,030,679	1,701,709	1,426,032	1,195,015	1,001,422	839,192	703,243	589,318	14,801,555
(F – J)		-983,006	-693,905	-262,368	-26,969	394,109	644,853	849,119	807,821	1,117,780	1,202,073	3,049,507
– " – ACCUM.		-983,006	-1,676,911	-1,939,279	-1,966,248	-1,572,139	-927,286	-78,167	729,654	1,847,434	3,049,507	
G/SHIP PRICE	K	10.69	20.38	30.29	39.67	49.87	60.17	70.54	79.77	89.97	100.01	
YEARS (K = 100%)		10.00										

Table 5.5 (2) SCA MT 150000 10 YEARS SHIP COSTS DETAIL LIST

OIL TANKER — OPE = 79/02/10 — NECESSARY CRG = 7,200,929 UD — PAGE = 1

		01	02	03	04	05	06	07	08	09	10	GRDTTL
WORKING TONNAGE	A	1,701,000	1,701,000	1,701,000	1,701,000	1,701,000	1,701,000	1,701,000	1,701,000	1,701,000	1,701,000	17,010,000
HIRE PER YEAR	B	7,200,929	7,200,929	7,200,929	7,200,929	7,200,929	7,200,929	7,200,929	7,200,929	7,200,929	7,200,929	72,009,290
C/R (C. MONTH)		4.2334	4.2334	4.2334	4.2334	4.2334	4.2334	4.2334	4.2334	4.2334	4.2334	4.2334
C/R (30 DAYS)		4.1754	4.1754	4.1754	4.1754	4.1754	4.1754	4.1754	4.1754	4.1754	4.1754	4.1754
CREW EXPENSE		820,000	861,000	904,050	949,253	996,716	1,046,552	1,098,880	1,153,824	1,211,515	1,272,091	10,313,881
STORES		70,000	73,500	77,175	81,034	85,086	89,340	93,807	98,497	103,422	108,593	880,454
LUBRICATING OIL		150,000	157,500	165,375	173,644	182,326	191,442	201,014	211,065	221,618	232,699	1,886,683
INSURANCE		425,000	425,000	425,000	425,000	425,000	425,000	425,000	425,000	425,000	425,000	4,250,000
MAINT. & REPAIR		78,000	438,165	492,278	718,997	621,379	698,120	784,338	1,145,564	990,032	1,112,301	7,079,174
MISC.		40,000	42,000	44,100	46,305	48,620	51,051	53,604	56,284	59,098	62,053	503,115
(SUB TOTAL)		1,583,000	1,997,165	2,107,978	2,394,233	2,359,127	2,501,505	2,656,643	3,090,234	3,010,685	3,212,737	24,913,307
ADMINISTRATION		150,000	157,500	165,375	173,644	182,326	191,442	201,014	211,065	221,618	232,699	1,886,683
(TOTAL)	C	1,733,000	2,154,665	2,273,353	2,567,877	2,541,453	2,692,947	2,857,657	3,301,299	3,232,303	3,445,436	26,799,990
INTEREST		2,457,000	2,205,000	1,953,000	1,701,000	1,449,000	1,197,000	945,000	693,000	441,000	189,000	13,230,000
– " – (DEF/SURP)			11,126	36,715	53,686	75,416	76,612	69,862	55,589	55,506	29,736	464,248
(SUB TOTAL)	D	2,457,000	2,216,126	1,989,715	1,754,686	1,524,416	1,273,612	1,014,862	748,589	496,506	218,736	13,694,248
(C + D)	E	4,190,000	4,370,791	4,263,068	4,322,563	4,065,869	3,966,559	3,872,519	4,049,888	3,728,809	3,664,172	40,494,238
(E/A)		2.4633	2.5695	2.5062	2.5412	2.3903	2.3319	2.2766	2.3809	2.1921	2.1541	2.3806
(B – E)	F	3,010,929	2,830,138	2,937,861	2,878,366	3,135,060	3,234,370	3,328,410	3,151,041	3,472,120	3,536,757	31,515,052
– " – ACCUM.	G	3,010,929	5,841,067	8,778,928	11,657,294	14,792,354	18,026,724	21,355,134	24,506,175	27,978,295	31,515,052	
REPAYMENT	H	3,150,000	3,150,000	3,150,000	3,150,000	3,150,000	3,150,000	3,150,000	3,150,000	3,150,000	3,150,000	31,500,000
– " –		3,150,000	3,150,000	3,150,000	3,150,000	3,150,000	3,150,000	3,150,000	3,150,000	3,150,000	3,150,000	31,500,000
LOAN REMAINDER		31,500,000	28,350,000	25,200,000	22,050,000	18,900,000	15,750,000	12,600,000	9,450,000	6,300,000	3,150,000	
DEFICIT/SURPLUS (F–H)		-139,071	-319,862	-212,139	-271,634	-14,940	84,370	178,410	1,041	322,120	386,757	15,052
– " – ACCUM.		-139,071	-458,933	-671,072	-942,706	-957,646	-873,276	-694,866	-693,825	-371,705	15,052	
DEPRECIATION (13YR.)	J	5,103,000	4,276,314	3,583,551	3,003,016	2,516,527	2,108,850	1,767,216	1,480,927	1,241,017	1,039,972	26,120,390
(F – J)		-2,092,071	-1,446,176	-645,690	-124,650	618,533	1,125,520	1,561,194	1,670,114	2,231,103	2,496,785	5,394,662
– " – ACCUM.		-2,092,071	-3,538,247	-4,183,937	-4,308,587	-3,690,054	-2,564,534	-1,003,340	666,774	2,897,877	5,394,662	
G/SHIP PRICE	K	9.56	18.54	27.87	37.01	46.96	57.23	67.79	77.80	88.82	100.05	
YEARS (K = 100%)		10.00										

Table 5.5 (3) SCA ST 25000 10 YEARS SHIP COSTS DETAIL LIST

OIL TANKER — OPE = 79/02/10 — NECESSARY CRG = 8,393,556 UD — PAGE = 1

		01	02	03	04	05	06	07	08	09	10	GRDTTL
WORKING TONNAGE	A	2,835,000	2,835,000	2,835,000	2,835,000	2,835,000	2,835,000	2,835,000	2,835,000	2,835,000	2,835,000	28,350,000
HIRE PER YEAR	B	8,393,556	8,393,556	8,393,556	8,393,556	8,393,556	8,393,556	8,393,556	8,393,556	8,393,556	8,393,556	83,935,560
C/R (C. MONTH)		2.9607	2.9607	2.9607	2.9607	2.9607	2.9607	2.9607	2.9607	2.9607	2.9607	2.9607
C/R (30 DAYS)		2.9201	2.9201	2.9201	2.9201	2.9201	2.9201	2.9201	2.9201	2.9201	2.9201	2.9201
CREW EXPENSE		840,000	882,000	926,100	972,405	1,021,025	1,072,076	1,125,680	1,181,964	1,241,062	1,303,115	10,565,427
STORES		85,000	89,250	93,713	98,399	103,319	108,485	113,909	119,604	125,584	131,863	1,069,126
LUBRICATING OIL		8,500	8,925	9,371	9,840	10,332	10,849	11,391	11,961	12,559	13,187	106,915
INSURANCE		544,000	544,000	544,000	544,000	544,000	544,000	544,000	544,000	544,000	544,000	5,440,000
MAINT. & REPAIR		89,000	499,958	561,702	820,394	709,010	796,573	894,949	1,307,118	1,129,652	1,269,164	8,077,520
MISC.		47,000	49,350	51,818	54,409	57.129	59,985	62,984	66,133	69,440	72,912	591,160
(SUB TOTAL)		1,613,500	2,073,483	2,186,704	2,499,447	2,444,815	2,591,968	2,752,913	3,230,780	3,122,297	3,334,241	25,850,148
ADMINISTRATION		170,000	178,500	187,425	196,796	206,636	216,968	227,816	239,207	251,167	263,725	2,138,240
(TOTAL)	C	1,783,500	2,251,983	2,374,129	2,696,243	2,651,451	2,808,936	2,980,729	3,469,987	3,373,464	3,597,966	27,988,388
INTEREST		3,030,300	2,719,500	2,408,700	2,097,900	1,787,100	1,476,300	1,165,500	854,700	543,900	233,100	16,317,000
– 〃 – (DEF/SURP)			24,420	63,407	90,422	120,502	124,542	116,640	96,985	90,034	49,942	776,894
(SUB TOTAL)	D	3,030,300	2,743,920	2,472,107	2,188,322	1,907,602	1,600,842	1,282,140	951,685	633,934	283,042	17,093,894
(C + D)	E	4,813,800	4,995,903	4,846,236	4,884,565	4,559,053	4,409,778	4,262,869	4,421,672	4,007,398	3,881,008	45,082,282
(E/A)		1.6980	1.7622	1.7094	1.7230	1.6081	1.5555	1.5037	1.5597	1.4135	1.3690	1.5902
(B – E)	F	3,579,756	3,397,653	3,547,320	3,508,991	3,834,503	3,983,778	4,130,687	3,971,884	4,386,158	4,512,548	38,853,278
– 〃 – ACCUM.	G	3,579,756	6,977,409	10,524,729	14,033,720	17,868,223	21,852,001	25,982,688	29,954,572	34,340,730	38,853,278	
REPAYMENT	H	3,885,000	3,885,000	3,885,000	3,885,000	3,885,000	3,885,000	3,885,000	3,885,000	3,885,000	3,885,000	38,850,000
– 〃 –		3,885,000	3,885,000	3,885,000	3,885,000	3,885,000	3,885,000	3,885,000	3,885,000	3,885,000	3,885,000	38,850,000
LOAN REMAINDER		38,850,000	34,965,000	31,080,000	27,195,000	23,310,000	19,425,000	15,540,000	11,655,000	7,770,000	3,885,000	
DEFICIT/SURPLUS (F–H)		-305,244	-487,347	-337,680	-376,009	-50,497	98,778	245,687	86,884	501,158	627,548	3,278
– 〃 – ACCUM.		-305,244	-792,591	-1,130,271	-1,506,280	-1,556,777	-1,457,999	-1,212,312	-1,125,428	-624,270	3,278	
DEPRECIATION (13 YR.)	J	6,293,700	5,274,121	4,419,713	3,703,719	3,103,717	2,600,915	2,179,567	1,826,477	1,530,588	1,282,632	32,215,149
(F–J)		-2,713,944	-1,876,468	-872,393	-194,728	730,786	1,382,863	1,951,120	2,145,407	2,855,570	3,229,916	6,638,129
– 〃 – ACCUM.		-2,713,944	-4,590,412	-5,462,805	-5,657,533	-4,926,747	-3,543,884	-1,592,764	552,643	3,408,213	6,638,129	
G/SHIP PRICE	K	9.21	17.96	27.09	36.12	45.99	56.25	66.88	77.10	88.39	100.01	
YEARS (K = 100%)		10.00										

Table 5.5 (4) SCA ST 500000 10 YEARS SHIP COSTS DETAIL LIST

OIL TANKER — OPE = 79/02/10 — NECESSARY CRG = 999,999,999 UD — PAGE = 1

		01	02	03	04	05	06	07	08	09	10	GRDTTL
WORKING TONNAGE	A	5,670,000	5,670,000	5,670,000	5,670,000	5,670,000	5,670,000	5,670,000	5,670,000	5,670,000	5,670,000	56,700,000
HIRE PER YEAR	B	9,999,999	9,999,999	9,999,999	9,999,999	9,999,999	9,999,999	9,999,999	9,999,999	9,999,999	9,999,999	99,999,999
C/R (C. MONTH)		1.7637	1.7637	1.7637	1.7637	1.7637	1.7637	1.7637	1.7637	1.7637	1.7637	1.7637
C/R (30 DAYS)		1.7395	1.7395	1.7395	1.7395	1.7395	1.7395	1.7395	1.7395	1.7395	1.7395	1.7395
CREW EXPENSE		880,000	924,000	970,200	1,018,710	1,069,646	1,123,128	1,179,284	1,238,248	1,300,160	1,365,168	11,068,544
STORES		120,000	126,000	132,300	138,915	145,861	153,154	160,812	168,853	177,296	186,161	1,509,352
LUBRICATING OIL		10,000	10,500	11,025	11,576	12,155	12,763	13,401	14,071	14,775	15,514	125,780
INSURANCE		866,000	866,000	866,000	866,000	866,000	866,000	866,000	866,000	866,000	866,000	8,660,000
MAINT. & REPAIR		122,000	685,335	769,974	1,124,585	971,901	1,091,931	1,226,785	1,791,780	1,548,512	1,729,753	11,072,556
MISC.		80,000	84,000	88,200	92,610	97,241	102,103	107,208	112,568	118,196	124,106	1,006,232
(SUB TOTAL)		2,078,000	2,695,835	2,837,699	3,252,396	3,162,804	3,349,079	3,553,490	4,191,520	4,024,939	4,296,702	33,442,464
ADMINISTRATION		200,000	210,000	220,500	231,525	243,101	255,256	268,019	281,420	295,491	310,266	2,515,578
(TOTAL)	C	2,278,000	2,905,835	3,058,199	3,483,921	3,405,905	3,604,335	3,821,509	4,472,940	4,320,430	4,606,968	35,958,042
INTEREST		4,505,500	4,042,500	3,580,500	3,118,500	2,656,500	2,194,500	1,732,500	1,270,500	808,500	346,500	24,255,090
— " — (DEF/SURP)			204,600	438,835	667,038	910,595	1,130,435	1,346,776	1,560,839	1,807,182	2,024,071	10,090,371
(SUB TOTAL)	D	4,504,500	4,247,100	4,019,335	3,785,538	3,567,095	3,324,935	3,079,276	2,831,339	2,615,682	2,370,571	34,345,371
(C + D)	E	6,782,500	7,152,935	7,077,534	7,269,459	6,973,000	6,929,270	6,900,785	7,304,279	6,936,112	6,977,539	70,303,413
(E/A)		1.1962	1.2615	1.2482	1.2821	1.2298	1.2221	1.2171	1.2882	1.2233	1.2306	1.2399
(B – E)	F	3,217,499	2,847,064	2,922,465	2,730,540	3,026,999	3,070,729	3,099,214	2,695,720	3,063,887	3,022,460	29,696,577
— " — ACCUM.	G	3,217,499	6,064,563	8,987,028	11,717,568	14,744,567	17,815,296	20,914,510	23,610,230	26,674,117	29,696,577	
REPAYMENT	H	5,775,000	5,775,000	5,775,000	5,775,000	5,775,000	5,775,000	5,775,000	5,775,000	5,775,000	5,775,000	57,750,000
— " —		5,775,000	5,775,000	5,775,000	5,775,000	5,775,000	5,775,000	5,775,000	5,775,000	5,775,000	5,775,000	57,750,000
LOAN REMAINDER		57,750,000	51,975,000	46,200,000	40,425,000	34,650,000	28,875,000	23,100,000	17,325,000	11,550,000	5,775,000	
DEFICIT/SURPLUS (F–H)		-2,557,501	-2,927,936	-2,852,535	-3,044,460	-2,748,001	-2,704,271	-2,675,786	-3,079,280	-2,711,113	-2,752,540	-28,053,423
— " — ACCUM.		-2,557,501	-5,485,437	-8,337,972	11,382,432	14,130,433	16,834,704	19,510,490	22,589,770	25,300,883	28,053,423	
DEPRECIATION (13 YR.)	J	9,355,500	7,839,909	6,569,844	5,505,529	4,613,633	3,866,225	3,239,896	2,715,033	2,275,198	1,906,616	47,887,383
(F–J)		-6,138,001	-4,992,845	-3,647,379	-2,774,989	-1,586,634	-795,496	-140,682	-19,313	788,689	1,115,844	-18,190,806
— " — ACCUM.		-6,138,001	11,130,846	14,778,225	17,553,214	19,139,848	19,935,344	20,076,026	20,095,339	19,306,650	18,190,806	
G/SHIP PRICE	K	5.57	10.50	15.56	20.29	25.53	30.85	36.22	40.88	46.19	51.42	
YEARS (K = 100%)												