NO.

JAPAN INTERNATIONAL COOPERATION AGENCY (JICA)
SUEZ CANAL AUTHORITY (SCA)

MAIN REPORT
FINAL

THE STUDY ON THE EFFECTIVE MANAGEMENT SYSTEM OF THE SUEZ CANAL IN THE ARAB REPUBLIC OF EGYPT

AUGUST 2001

THE OVERSEAS COASTAL AREA DEVELOPMENT INSTITUTE OF JAPAN (OCDI)
MITSUBISHI RESEARCH INSTITUTE, INC. (MRI)

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The following foreign exchange rates are applied in this study:

US$1.00=LE(Egyptian Pound)3.50=JP¥109.00

US$1.30= SDR1.00

as of August, 2000

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PREFACE

In response to a request from the Government of the Arab Republic of Egypt, the Government of Japan decided to conduct a study on the Effective Management System of the Suez Canal in the Arab Republic of Egypt and entrusted the study to the Japan International Cooperation Agency (JICA).

JICA dispatched a study team to Egypt three times between August 2000 and June 2001, which was headed by Mr. Hidehiko Kuroda and was composed of members from the Overseas Coastal Area Development Institute of Japan (OCDI) and Mitsubishi Research Institute, Inc. (MRI).

The team held discussions with the officials concerned of the Government of the Arab Republic of Egypt and Suez Canal Authority (SCA) and conducted field surveys at the study area. Upon returning to Japan, the study team conducted further studies and prepared this final report.

I hope that this report will contribute to this project and to the enhancement of friendly relationship between our two countries.

Finally, I wish to express my sincere appreciation to the officials concerned of SCA and other authorities concerned for their close cooperation extended to the study team.

August 2001

Kunihiko Saito
President
Japan International Cooperation Agency

LETTER OF TRANSMITTAL

August 2001

Mr. Kunihiko Saito
President
Japan International Cooperation Agency

Dear Mr. Saito:

It is my great pleasure to submit herewith the Final Report of the Study on the Effective Management System of the Suez Canal in the Arab Republic of Egypt.

The study team of the Overseas Coastal Area Development Institute of Japan (OCDI) and Mitsubishi Research Institute, Inc. (MRI) conducted surveys in Egypt over the period between August 2000 and June 2001 as per the contract with the Japan International Cooperation Agency.

The study team compiled this report, which proposes the Effective Management System of the Suez Canal including the transit forecast model and the tariff setting system, through close consultations with officials of the Suez Canal Authority (SCA).

On behalf of the study team, I would like to express my heartfelt appreciation to SCA and other authorities concerned of the Government of the Arab Republic of Egypt for their diligent cooperation and assistance and for the heartfelt hospitality, which they extended to the study team.

I am also greatly indebted to your Agency, the Ministry of Foreign Affairs, the Ministry of Land, Infrastructure and Transport and the Embassy of Japan in Egypt for valuable suggestions and assistance through this study.

Yours faithfully,

Hidehiko Kuroda
Team Leader
The Study on the Effective Management System
of the Suez Canal in the Arab Republic of Egypt

ABBREVIATION LIST

APA	Alexandria Port Authority
BAF	Banker Adjusting Factor
BIMCO	Baltic and International Maritime Council
BOT	Build, Operate and Transfer
C/B	Charter Base
CBE	Central Bank of Egypt
CEU	Car Equivalent Unit
CFS	Container Freight Station
CHS	Container Handling Surcharge
CIF	Cost, Insurance and Freight
CRF	Capital Recovery Factor
CY	Container Yard
DEM/DES	Demurrage/Dispatch
DO	Diesel Oil
DPA	Damietta Port Authority
DST	Double Stack Train
DWT	Dead Weight Tonnage
ECSA	European Community Ship-owners' Association
EDI	Electronic Data Interchange
EMDB	Egyptian Maritime Data Bank
ENR	Egyptian National Railway
ETA	Estimated Time of Arrival
FAK	Freight All Kinds
FCL	Full Container Load Cargo
FIRR	Financial Internal Rate of Return
FO	Fuel Oil
FOB	Free on Board
GDP	Gross Domestic Product
GARE	Government of Arab Republic of Egypt
GOJ	Government of Japan
GT	Gross Tonnage
H/B	Hire Base
ICS	International Chamber of Shipping
INSROP	International Northern Sea Route Program
INTERCARGO	International Association of Dry Cargo Ship-owners
INTERTANKO	International Association of Independent Tanker Owners
JAMRI	Japan Maritime Research Institute
JICA	Japan International Cooperation Agency
JP¥	Japanese Yen
LB	Land Bridge
LCL	Less than Container Load Cargo
LE	Egyptian Pound

LNG	Liquefied Natural Gas
LOA	Length Overall
LOOP	Louisiana Offshore Oil Port
LPG	Liquefied Petroleum Gas
LUP	Laying-Up Point
MOMT	Ministry of Maritime Transport
MRI	Mitsubishi Research Institute, Inc.
MSL	Maersk-Sealand
MT	Metric Ton
N/P	Net Proceeds
NPV	Net Present Value
NWA	New World Alliance
OCDI	Overseas Coastal Area Development Institute of Japan
O-D	Origin and Destination
OSRA	Ocean Shipping Reform Act
PAE	Petroleum Authority of Egypt
PCC	Pure Car Carrier
P/L	Profit/Loss
PSPA	Port Said Port Authority
QGC	Quay-side Gantry Crane
RGT	Rubber-Tired Gantry
S/C	Service Contract
SCA	Suez Canal Authority
SCCT	Suez Canal Container Terminal
SCGT	Suez Canal Gross Tonnage
SCNT	Suez Canal Net Tonnage
SCVTMS	The Suez Canal Vessel Traffic Management System
SDR	Special Drawing Right
SSA	Stevedoring Services of America
SUMED	Arab Petroleum Pipelines Co.
S/W	Scope of Work
TEU	Twenty-foot Equivalent Unit
ULCC	Ultra Large Crude Carrier
US$	US Dollar
VLCC	Very Large Crude Carrier
WSF	World Scale Flat
WSR	World Scale Rate

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EXECUTIVE SUMMARY

INTRODUCTION

1. In response to a request made by the Government of the Arab Republic of Egypt, the Government of Japan has decided to conduct a study on the Effective Management System of the Suez Canal in the Arab Republic of Egypt.

2. The Study objectives are as follows; (i) to prepare a traffic forecasting model of the Canal, (ii) to prepare a tariff setting system in order to maximize the net revenue from the Canal, (iii) to examine previous development plans and management system of the Canal based on the above, (iv) to make any necessary comments and/or recommendations to realize a more efficient management system of the Canal, (v) to transfer relevant technology to Egyptian counterpart personnel in the course of the Study

OUTLINE OF THE RESULTS

FORECAST

3. In this study, the major output is the forecast of Suez transit. As requested by SCA, not only are the results of the forecast presented, but also the operational forecast model that can be easily handled by personal computer has been prepared by the study team within the scope given by JICA.

4. It is, however, difficult to formulate a world trade forecast model which is useful for forecasting the number of vessels and cargo transiting the Suez Canal with a computer of small capacity. Hence, the study team forecast the future world trade firstly using a large scale computer model operated by WEFA (one of the members of Study consortium), and then after adjusting the forecast results to match the current actual data of transit, the study team constructed the forecast model for Suez potential cargo which is operational with a personal computer.

5. In forecasting the future transit, various factors which will affect the mode and route choices of the sea-borne trade cargo in the future such as the progress of containerization, land-bridges, pipelines, world fleet mix, ocean

freight and even the possibility of alternative routes such as the Panama Canal and the Arctic Ocean route are investigated.

6. In estimating the O-D cargo, the world trade zone from/to which the cargo will potentially use the Suez Canal is classified into 12 zones. Total potential tonnage of trade by all transport modes in the year 2020 is estimated as 1,243 million tons (an increase of 88% between 1998 and the year 2020).

7. Suez potential cargo refers to sea-borne trade that will potentially use the Suez Canal. It is a portion of total potential trade. Future Suez Potential cargo is estimated as 1,047million tons.

8. Based on the estimated Suez potential cargo, Suez transit (cargo and vessel) is estimated through the route choice model which is essentially a transport cost comparison between the Suez route and the Cape route.

9. In the comparison of the costs, Suez Canal toll is assumed to be the same as present, and future fleet mix for each type of vessel is estimated based on the present fleet mix and the trends.

10. It is assumed that 300,000DWT full loaded tankers can transit through the Canal in 2020 given the current deepening plan.

11. As a result, total transit cargo is forecast as 851,178 thousand tons in 2020 which is about 2.78 times the cargo transit in 1999, and total number of vessels is 28,657 (78.5 vessels per day on average).

12. After forecast of transits, future revenue is also forecast based on the current tariff. Estimated revenue is 3,339.4 million SDR in 2020 which is 2.52 times the revenue of 1,323.6 million SDR in 1999.

13. An additional case, where the Canal deepening work is delayed is also analyzed. This scenario results in a decrease in the number of laden tanker transit (-124 vessels) and a decrease in revenue (-31.4million SDR).

14. The condition of the maritime transport market is another variable that is studied. If the market condition is such that charter rate will cover only 50% of the capital cost, then number of transit will become 27,239 vessels in 2020 and revenue will become 3,270.8 million SDR. If the market condition is such that charter rate will not cover even the capital cost, then number of transit will become 24,696 vessels (about 86% of normal condition) and revenue will become 2,959.1 million SDR.

15. Another condition is the fleet-mix. If Container Ships and Vehicle

Carriers will become larger at a faster pace, the number of transit will be 26,843 vessels in 2020 (73.5 vessels par day on average). The revenue will be 3,318.7 million SDR.

MANAGEMENT AND OPERATION POLICY

16. Basic policy on management and operation of the Canal is not clearly defined in the existing documents. After evaluating the effects of the past Canal closure and the Canal's role in the world, regional and national economy, the basic policy should be:

- to consider the balance of power in the global politics.
- to play a role as a safety net for the world maritime transport.
- to achieve co-prosperity for both users and SCA.
- to secure transparency and fairness in management and operation.

TOLL STRUCTURE AND RATES

17. Based on the basic policy above, current toll structure and rates are evaluated in comparison with the structure applied at the Panama Canal and the St Lawrence Seaway.

18. Current structure of Suez Canal toll is considered to be the best in terms of maximizing the toll revenue, although some modifications are necessary. In particular, rates should be based on a standard saved distance of around 4,700 miles (or in between 3,300 miles and 4,700 miles). In addition to this point, it is recommended to introduce a fixed rebate rate system regarding saved distance by main O-D pairs.

19. Another major modification involves revising the toll structure for Container Ships to be able to reflect the earning capacity of the ship, mainly for setting SCNT. The Study Team believes that the currently applied weather deck surcharge based on the number of tiers on deck should be replaced with a discount system based on TEUs once the EDI system is introduced.

20. In the short term, the Study Team recommends a slight increase in the current rates for most of the vessel types, and to monitor the effects carefully for the future revision.

21. And it is also recommended that SCA review and assess the results itself, since complete data on transiting vessels have not been provided to the Study Team by SCA from the managerial reason of SCA.

22. Currency unit to which the toll is to be pegged is also evaluated from various viewpoints such as foreign currency earning capacity for the national accounting, and users' convenience and ease in assessing changes in behavior of users.

MARKETING SYSTEM

23. Marketing policy and marketing managing system are studied. Considering the behavior and characteristics of the shipping market, new marketing management system is proposed for each of the sub-systems of marketing plan and budgeting, marketing information system and marketing organization.

24. Some ideas on improving marketing activities are proposed. They are:

- to create an inter-net homepage.
- to listen to customers' opinions and reflect them in the management.
- to hold regular seminars on the Canal services at maritime centers.
- to strengthen the functions of marketing, etc.

SOME IDEAS ON IMPROVING MANAGEMENT AND OPERATION

25. Some ideas on the improvement of management and operation in the fields of Canal transit service, business diversification, financial management and the modification of some parts in the rules of navigation are proposed based on the analysis of the current operational procedures.

26. After evaluating available transit capacity, the Study Team recommends some changes in the interval of transiting vessels and starting time of the convoys.

27. For the diversification of business, some ideas are proposed such as maritime construction, consulting works and leasing of equipment. However, more precise assessment based on analyses on productivity and financial viability of each activity is recommended, mainly because of lack of

necessary data in the study team because of the managerial reason of SCA.

28. The same can also be said in the case of the financial management. Major points to be assessed are proposed in this connection.

PROJECT EVALUATION

29. Re-evaluation of the projects is conducted based on the newly forecast data on transits. As the forecast volume of transits is much less than the forecast in the past, it would be premature to evaluate the Second Phase Expansion Plan proposed in the past JICA study at this moment; only the Deversoir By-pass Extension Plan is considered to be financially viable. Based on the forecast transits, the plan should be implemented from around 2010.

30. On the other hand, in case that much larger Container Ships would be used in the future, this project seems to be risky. Accordingly, it is recommended to conduct again the demand forecast and project evaluation before average daily transit reaches around 55 vessels.

I. INTRODUCTION

1. In response to a request made by the Government of the Arab Republic of Egypt, the Government of Japan has decided to conduct a study on the Effective Management System of the Suez Canal in the Arab Republic of Egypt.

2. The Study objectives are as follows; (i) to prepare a traffic forecasting model of the Canal, (ii) to prepare a tariff setting system in order to maximize the net revenue from the Canal, (iii) to examine previous development plans and management system of the Canal based on the above, (iv) to make any necessary comments and/or recommendations to realize a more efficient management system of the Canal, (v) to transfer relevant technology to Egyptian counterpart personnel in the course of the Study.

3. In order to achieve the objectives mentioned above, the Japan International Cooperation Agency (JICA) consigned the Study to a joint venture which consists of the Overseas Coastal Area Development Institute of Japan (OCDI) and Mitsubishi Research Institute, Inc. (MRI).

4. Actual Study work commenced in August 2000 with the arrival of the Study team in Egypt. Since then, the Study was carried out both in Egypt and in Japan including six months of field works in Egypt.

5. In the course of the Study, the Inception Report, the Progress Report I, the Interim Report, the Progress Report II and the Draft Final Report were submitted to A.R.E.. In addition to formal presentations, informal sessions of working groups involving SCA officials and various ad-hoc discussions took place. Comments were given by the SCA Steering Committee. This Final Report incorporates the results of all these surveys and discussions.

6. This report consists of eight volumes: the Summary Report which presents a summary of the study results (Vol. I), the Main Report which presents the general framework, conclusion for all volumes and recommendations (Vol. II), and the rest of the volumes are compiled as the Annexes to the Main Report which present the background situation of the A.R.E. (ANNEX I), present situation of the Suez Canal (ANNEX II), world trade and international shipping (ANNEX III), factor analysis on Suez Canal transit (ANNEX IV), toll policy and issues (ANNEX V), transit forecast model (ANNEX VI).

7. List of counterpart members and related personnel is as follows:

SCA(Planning, Research and Studies Dept.)	Title
(Eng. Aly Abdel-Aziz Ibrahim)	Ex-Director
Dr. Abdel-Tawab Haggag	Director
Eng. Essam El-Din Mohammed Khattb	Vice Director
Eng. Ahmed El-Manakhly	Manager, E.U.
Mr. Mahmoud A. Rizk	Manager, E.U.
Mr. El-Sayed Marei	Manager, E.U.
Mr.Yehia Rushdy	Economic Researcher, E.U.
Mr. Fatehy M. Abdel-Bary	E.R., E.U.
Mr. El-Sayed A. Fetouh El-Sharkawy	E.R., E.U.
Mr. Refaat Saad Mostafa	E.R.,E.U.
Mr. Hossam H. Abdel-Karim.	E.R.,E.U
Mr. Ahmed Abdel Fatah	E.R.,E.U.
Mr. Emad Hamdi Fawaz	E.R.,E.U.
Mr. Hatem Abdel Gawad	E.R.,E.U.
Mr. Wahid Kamel Adly	E.R.,E.U
Study Team	**Institution**
Mr. Hidehiko Kuroda Team	Leader (OCDI)
Mr. Seiji Sato	Sub Team Leader (OCDI)
Mr. Yoshihisa Tateno	(OCDI)
Mr. Masayuki Fujiki	(OCDI)
Capt. Nobuaki Kojima	(OCDI)
Mr. Yoshinobu Shakuto	(OCDI)
Dr. Nobuharu Miyatake	(MRI)
Mr. Yoshiteru Sunago	(MRI)
Dr. Hiroshi Mori	(MRI)
Mr. Paul Bingham	(MRI)
Mr. Mizuki Konno	(MRI)
Mr. Fumiaki Isono	(MRI)

II. MAJOR FINDINGS OF THE STUDY

A. OUTLINE OF THE RESULTS

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B. COMPOSITION OF THE REPORTS

36. Final Report of this study consists of (1) SUMMARY REPORT, (2) MAIN REPORT, and (3) Annexes to this main report.

37. Annexes provide details of data and information as well as theoretical explanations on the techniques applied in the study. They are as follows:

ANNEX I : BACKGROUND SITUATION OF ARAB REPUBLIC OF EGYPT
ANNEX II : PRESENT SITUATION OF THE SUEZ CANAL
ANNEX III: WORLD TRADE AND INTERNATIONAL SHIPPING
ANNEX IV: FACTOR ANALYSIS ON SUEZ CANAL TRANSIT
ANNEX V: TOLL POLICY AND ISSUES
ANNEX VI: TRANSIT FORECAST MODEL

38. For those who are interested only in the outline of methodologies and results, Main Report provides sufficient information. For those who are interested in the detailed techniques which the study team used, and in following up and applying them by themselves, detailed models and manuals together with the applied data and theoretical derivations are explained in the Annexes.

III. WORLD TRADE AND SUEZ TRANSIT

A. OUTLOOK ON WORLD ECONOMY AND TRADE

TRENDS OF ECONOMY

39. The short-term outlook for world economic growth is still positive, with broad agreement by many of the international institutions, including the OECD, the IMF and the World Bank. Both the European and the Japanese economies showed improvement in 2000, while the United States and its neighbors stayed strong for the year.

40. The baseline forecast for world growth is for a decline in the rate of growth in world GDP to around 4.2 percent for 2001, but avoiding a fall into a global recession. The growth in trade will not be as rapid in 2001 as it was last year, but trade will still increase in absolute terms. Unemployment will increase slightly in many developed and developing countries and government budget surpluses will decline in many developing countries.

41. In the baseline world macroeconomic forecasts, a weaker growth scenario, caused by much higher real oil prices and/or a sharper decline in stock markets has a probability of about 20%. This means that there exists a risk of the global economy falling into recession, but that the risk is still considered relatively low. Longer run economic growth returns to the trend of nearly four percent growth in output per year. This will translate to a long-term average increase in the value of commodity trade of about six percent per year.

42. Globalization has been heralded as the great unifier of the world's economies and equalizer of opportunities. Reputably it would generate wealth, free trade and democratic tendencies. The World Bank and the IMF heralded the concept of sustainable growth as the key, but at the same time prescribed medicines that virtually ran counter to this philosophy. Growth does not always equate with a reduction in poverty and democracy.

43. Is the clash between economic growth of the global economy and the geo-political forces of those resisting globalization important? Perhaps, given the changes in the price of oil and the decline in some stock markets. Over the long term, global trade remains vulnerable to issues beyond the wealth seeking aspirations of globalization and the mutual dependence of national economies.

SCENARIO OF FUTURE ECONOMY

44. There are several significant assumptions and conditions that can be highlighted from the underlying macroeconomic forecasts behind the trade models. These include the future characteristics of many macroeconomic factors, which can be summarized as follows:

45. Population and labor force growth will gradually slow down, especially in developed countries, from historic and current rates. This is a reflection of the historical trend observed where as countries become wealthier, their birth rates decline. As population growth rates slow, the rate of increase in the labor force slows as well. The slowing in population growth will be mild however, with growth rates slowing by an average of much less than one tenth of one percent per year.

46. Overall potential world output growth will slow relative to historical rates due to slower growth in the world labor force and the maturing of more developing economies, while productivity growth will remain steady, but with wide variations country-to-country.

47. As has been observed over a long time period, the share of real consumption devoted to services will continue to rise in developed countries, while the share devoted to goods consumption will fall. Over the longer term, this pattern will appear in developing countries as they move through stages of development as well.

TRENDS OF MAJOR COMMODITIES

48. The longer-term growth in international trade will see the most rapid increases in the trade of higher value manufactured goods such as electronics and more expensive consumer goods. The highest value goods will be shipped by air or land for trades of any considerable distance, leading to an increase in the air cargo and land transport share of total world trade, in value terms.

49. But international sea-borne trade will remain inconsequential when measured in weight terms. Sea-borne trade will continue to be the primary transportation mode used to carry the majority of traded goods, although the highest growing portion of sea-borne trade will continue to be in container traffic.

50. The healthy economic performance of the last few years has

resulted in increased consumption of imports, especially in developed economies such as the United States. Some global commodity prices have started to increase in real terms, which has led to increases in the value of trade that is increasing more slowly when measured in weight terms.

(i) Crude Oil

51. Overall crude oil trade demand will follow economic growth, but with a long-term trend towards slightly less OPEC crude oil consumption. The industry consolidation of the major oil companies will continue the global trend towards efficiencies of scale and production.

(ii) Oil Products

52. Following right along with the increase in crude oil prices, oil product prices have increased recently. The growth in demand for oil products falls when its relative price increases in comparison with alternative forms of energy. This has been observed recently and restricts the long-term growth in product trade demand.

(iii) LNG/LPG

53. The shift of Western Europe towards consumption of gas via pipeline from Eastern Europe and Russia will continue to dampen demand for European and Mediterranean LNG/LPG imports.
Latin America is similarly shifting energy production and import growth to other sources of gas as technology gives other supply a relative cost advantage over deep sea LNG/LPG transit.

(iv) Chemicals

54. As chemicals are inputs to a large number of other manufacturing industries, demand will continue to increase along with increases in the manufactured products share of goods consumption. This means the growth in chemicals trade will be higher over the long term than for the average of total trade.

(v) Grains

55. International trade in cereal grains is growing slowly with expansions in population and world agricultural trades. However, large global supplies of cereals, grains and oilseeds exist, and prices, though improving, are projected to remain relatively low for the near term. Production costs have increased due to higher oil prices.

(vi) Fabricated Metal

56. Fabricated Metals and Steel production and trade are closely tied to international economic development and directly related to GDP growth. With higher real energy prices, the decline in the growth of purchases of automobiles, the metals commodities are affected.

(vii) Coal and Coke

57. Steady historical growth in coal and coke traffic is forecast to continue out to 2020. The bulk of the trade demand growth is coming from the Asia-Pacific region and in the latter stages from newer Asian developing economies.

(viii) Ores

58. Production and shipments of ores follow, as with steel, world GDP growth. Steel trade has been strong in recent years, resulting in more trade in ores and metals. Increasingly in the world, steel made by electric arc furnaces has replaced steel made with older technologies.

59. As a result, ore trade patterns are changing with both Brazil and Australia becoming big exporters of directly reduced iron ore pellets. Large volumes of trade will therefore occur between the location of steel and metal producing facilities and ore production areas.

(ix) Fertilizers

60. International trade in fertilizers will continue to increase along with global agricultural production. Continued long-term economic growth around the world, stronger Asian economies and improved economic performance in Europe are positive factors that will continue to push demand for agricultural commodities higher, and consequently also increasing the demand for fertilizers.

(x) Automobiles

61. The production of automobiles will shift to the developing economies and the developed countries will see increases in auto imports. The long-term outlook for trade in vehicles is for steady volumes, with more and more of the vehicles moving on shorter trade routes such as North America-Latin America and Eastern Europe-Western Europe.

(xi) General Cargo

62. General cargo remains an important category in ocean shipping; however, as some types of specialized cargoes are still difficult to ship using container vessels. Over the long-term however, containerization has such a strong cost and service advantage that continued containership cargo handling innovations such as flat racks and temperature controlled containers will continue to erode the remaining traditional general cargo markets.

B. OUTLOOK OF SEA-BORNE TRADE AND COMPETITIVE MODES

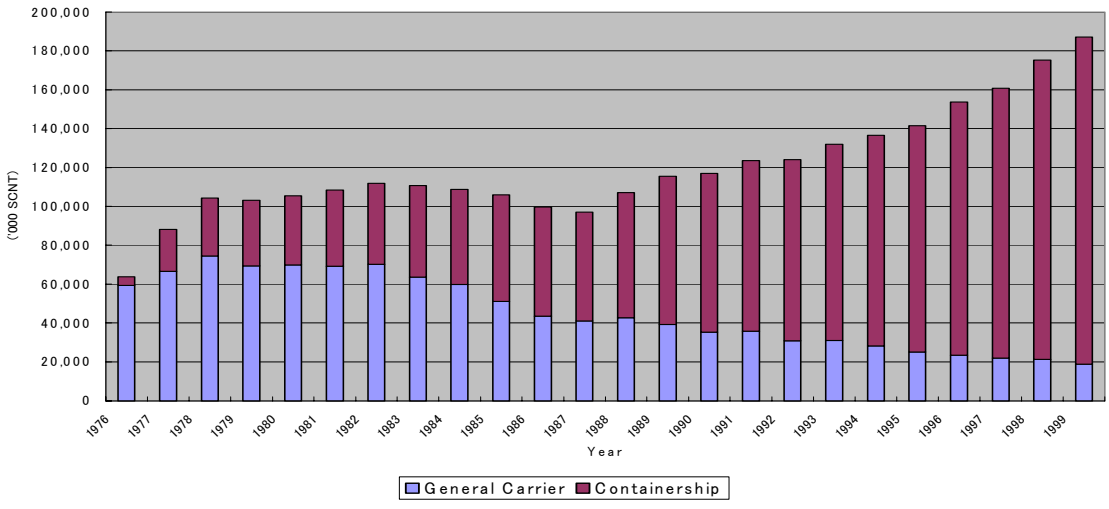
CONTAINERIZATION

63. There are several general cargo commodities experiencing a continued loss of market share to containers. Break bulk refrigerated commodities are still in decline, despite the overall growth in refrigerated trades. The increased capacity of new container ships for refrigerated containers combined with the increased trade route services of strings of larger containerships has further reduced the future potential growth for refrigerated general cargo moving in conventional refrigerated vessels.

64. Strength of demand for imported higher value goods moving in containers is forecast to continue as recovery from the Asian economic crisis of two years ago proceeds. With the prospect of additional increases in container trade, the industry has responded with new orders for significant numbers of new container vessels.

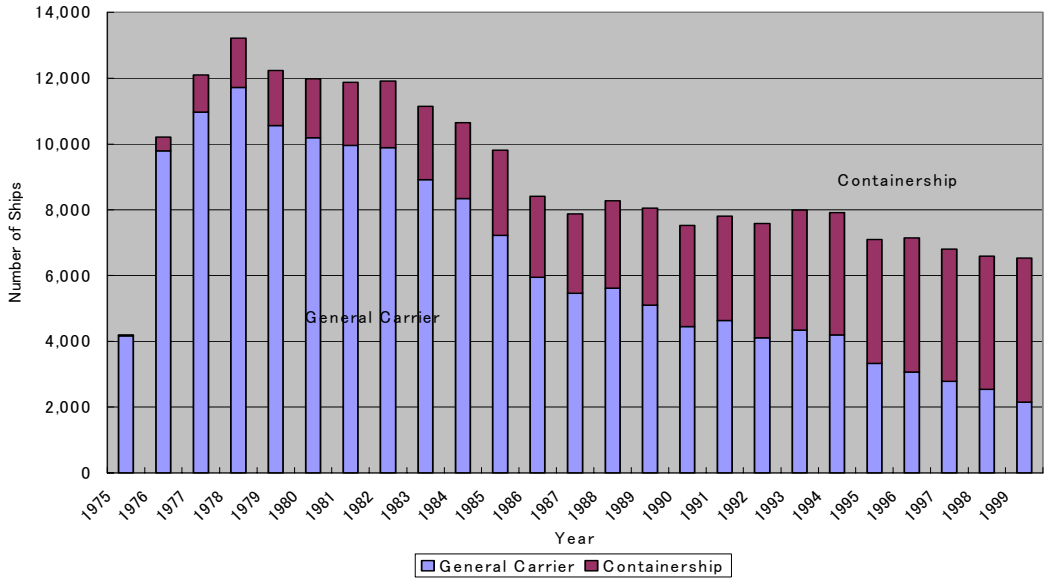
65. The container shipping company alliances and mergers continue to affect the market through newly optimized service patterns and joint service arrangements.

66. In the Suez Canal, the cargo volume loaded in General Carrier has been decreasing and general cargo is shifting to Containership. As vessel size of container is increased to almost double from 1980, Containership and containerized cargo has become major transit of the Suez Canal.



Source: SCA Yearly Reports

Figure 1 SCNT of Containership and General Carrier



Source: SCA Yearly Reports

Figure 2 Number of Ships of Containership and General Carrier

LAND BRIDGES

(i) Euro-Asia Land Bridge

67. There are several alternative routes under consideration.

- Siberia Land bridge route: This route takes shorter time than the route through The Suez Canal, but the use of this route is not popular. The problem of this route is the poor equipment and the uncertainty of schedule.
- China Land bridge route: The operation of this route started at the end of 1992, but no train has connected China with Europe. International transportation agreement is said to be in confusion in CIS countries.
- Silk Road Land bridge route: This route has a steep mountain section in Iran and Turkey. It is required to construct a new line with tunnels and bridges for faster service in this mountain area.
- South Asia route; This route is typically between London and Bangkok through Moscow, Tashkent, Kabul, New Delhi, Dhaka, and Yangon. It is about 12,600km long. There is no direct railroad service now because of the railroad gauge difference.

68. Land bridge has an advantage over sea-borne trade in that it is faster, but has a disadvantage in that it has less capacity and costs much

more consequently.

69. Moreover there are severe condition areas for surface transportation on the middle of the continent, such as Tibetan Mountains, Gov Desert, Siberia Highlands. This physical restriction is also one of the big disadvantages for the Land bridge.

70. Furthermore some borders are unable to be crossed because of the political or religious confrontations among countries, or if possible to cross, only with complicated procedures. There are some restrictions other than physical aspects within the present circumstances.

71. As mentioned above, all routes from Europe or West Asia to Southeast Asia or East Asia have currently severe restrictions.

72. The most possible route will be Trans-Siberian Land Bridge(TSR). Compared to US Land bridges, TSR has some issues. US Land Bridge has many destinations and origins along the route. It supports the stability of the management of the route. The origins and destinations along TSR are limited. It means that the profitability of TSR is relatively poor. The cooperation with other modes is also a big issue. US land bridge is not a competitor of ship operators but a co-operator. US land bridge is one of the links of sea-borne trade. TSR, however, will be a competitor of ship operators. TSR has to survive in the competition with the strong ship operators.

73. The Land bridges should be paid attention to, but they will not be strong competitors of the Canal in the future.

(ii) Egyptian Inland Route

74. For the Suez Canal, ENR (Egyptian National Railway) is a neighbor organization, but the relationship between SCA and ENR has not been very close. In August 1998, ENR started a new campaign to improve freight transport by introducing weekly/daily freight train with an accurate time schedule. An organization called CCA (Commercial Central Administration) is taking the lead in customer contact and marketing is being done by Business Managers in Business Management & Marketing Units. The current container businesses by ENR are to be investigated.

75. The containers from the Red Sea to Europe have to be transferred twice at a port of the Red Sea and a port of the Mediterranean. These transfers are the weak point of this route. US land bridge functions in a similar way. It is used only for transportation whose origin or destination is in Central

America or East Coast of America. Few containers are transported from Asia to Europe across America.

76. In conclusion, the Egyptian Inland Route will be limited to domestic transportation and will not be used as a bypass route.

PIPELINES

(i) Crude Oil pipeline

77. Pipeline is one of the strongest competitive transportation modes of the Suez Canal. Most crude oil passing through the Canal comes from the Arabian Gulf to Europe. Competitive pipeline will be ones that run between the Arabian Gulf to the Mediterranean or Suez Gulf to the Mediterranean.

78. The pipelines, having a major impact on the transit of the Canal are as follows:

- Pipelines connecting Red Sea and Mediterranean
  - SUMED
  - TIP Line
- Pipelines for Saudi Oil
  - TAP Line
  - Petroline (from the Gulf to Red Sea)
- Pipelines for Iraq Oil
  - Iraq – Turkey Line
  - Iraq – Banyans Line
  - Iraq – Tripoli Line

79. Information on SUMED was obtained interviews with SUMED. Most of the other information comes from the following data book.

- "Arab Oil & Gas Directory 2000", Arab Petroleum Research Center
- "Oil & Gas Journal"

(a) SUMED

80. SUMED has a complementary role to the Suez Canal. Operation started in 1977. The capacity of SUMED is now 2,400,000b/day following expansion works. SUMED's main users are Saudi Arabia, Iran, and Iraq. Tariff of SUMED is flexible and automatically indexed on monthly changes in spot rate

of VLCCs.

(b) TIP Line

81. TIP Line connects the point of Elat in the Gulf of Aqaba and the port of Ashkelon in the Mediterranean. A governmental company "KATZ" operates this line. Information on this line is very limited. At present the line is estimated to carry only a small portion of crude oil compared to its capacity.

(c) TAP Line

82. The Trans-Arabian Pipeline Company constructed TAP Line in 1950. It is 1,213km long from oil fields in Saudi Arabia to Zahrani on the Mediterranean seashore in Lebanon. The line passes through Jordan, Syria as well as Saudi Arabia and Lebanon.

The original capacity was planned to send the oil only to refineries in Lebanon and Jordan, The reason of stopping exports is said be lower tanker rate. Direct shipping from the Gulf was some 2$/b less at that time. Lebanese section was handed to Lebanese government in 1983 and has been closed. Furthermore, after the Iraq invasion of Kuwait, Saudi Arabia stopped supplying oil to Jordan. But Saudi Arabia is said to be considering reopening it for the purpose of delivering Saudi Crude to Jordan, Lebanon, and the Pakistan Territories.

(d) Petroline

83. Petroline transports Saudi crude oil from oil fields to Yanbu terminal of the Red Sea. It is 1,200km long and was opened in 1981 with the original capacity of 1.85mb/day. After 2 expansions, its capacity has been 4.8mb/day since 1993. The end of the line is Yanbu terminal. The crude oil terminal in Yanbu has 4 berths but only 2 berths can used simultaneously. The maximum size of vessels at the terminals is 500,000DWT.

(e) Iraq – Turkey Line

84. Under the UN's supervision, Iraq can export their crude oil only through the Iraq –Turkey pipeline and the port of Mina al-Bakr in Arabian Gulf. The Iraq – Turkey pipeline receives crude oil from oil fields near Kirkuk and Baghdad and transports it to the Port of Ceyhan.

The design capacity is 1,600,000b/day, but due to damage to facilities, current capacity is said to be around 1,000,000b/day. Though Iraq is trying to increase the capacity, it is said that repairs will take time to complete. The storage facilities at Ceyhan in Turkey have the smaller capacity than the designed level.

(f) Iraq – Banias Line

85. This line links Iraq Oil fields around Kirkuk to Banias in the Mediterranean seashore in Syria. This line was built by the Iraq Petroleum Company in the 1950s, the Syrian part of which was nationalized by Syria in 1972. But in 1982, Syria closed the Syrian section because of political conflicts with Iraq. Since then, this pipeline has not transported Iraq crude oil. This pipeline is now used for domestic transport.
In 1998, Syria and Iraq agreed to open the line, but the timing of the reopening is still not unclear. Iraq announced in 2000 that the pipeline was completely rehabilitated. It is said the line could probably transport up to 1mb/day.
The export terminal at Banias has 3 berths and can handle up to 210,000DWT tankers.

(g) Iraq – Tripoli Line

86. From the oil fields around Kirkuk, Iraq Petroleum Company built a pipeline to the Mediterranean port of Tripoli in Lebanon in1934. This pipeline ran across Syria. The capacity of this line was 450,000 b/day. And Tripoli oil terminal had 4 berth accommodating up to 250,000 DWT vessels.
However, since 1982, when Syria closed the pipeline in their territory, Tripoli terminal has not carried Iraq crude oil.

87. Almost all existing pipelines are operated by state owned enterprises. Accordingly, they can set the pipeline dues from the standpoint of their national policy on exports of crude oil, ignoring the financial balance in the pipeline operation,. Moreover, the price of crude oil is surely expected to increase in future, resulting in a relative decrease in the transportation cost share of the price.

88. Consequently, the pipeline dues over the transportation volume become relatively small. In the extreme case, the pipeline due will be negligible to customers. This will work favorably for pipeline transportation rather than for tanker transportation.

89. On an actual payment cost basis, not an accounting cost basis, there is a strong possibility that the transportation cost by tanker will become greater than that by pipeline. As a result, the ratio of potential transportation volume of the crude oil by tanker from the Gulf countries to the Mediterranean will decrease.

(ii) Gas pipeline

90. Pipelines from Algeria are competitors at present. If the capacity of these pipelines and plants were to be increased, the volume through the

Suez Canal would decrease.

91. The most serious competitors exist in Egypt. The facilities are still in the planning, and it is not clear when they will be constructed. But once these facilities are open, the Suez Canal will be less attractive as a route of LNG. There is little possibility of increasing liquid gas as Suez Potential Cargo except through economic growth.

C. SUEZ CANAL TRANSIT & FACTORS AFFECTING CANAL TRANSIT

INTERNATIONAL MARITIME TRANSPORTATION ACCOUNTING

(i) Ocean Freight of Container Ships

92. Freight rates are fixed by conferences and are published in their tariff books. The general level of these rates is usually held unchanged for a minimum period of 6 months. When the conference announces a change in the level of rates, i.e. the general level of rates will be raised equally for all commodities.

93. Tariff book contains different rates for 30-40 items, although in day to day transactions only a limited number of items such as Electrical Goods, Auto Parts are actually quoted since these cargoes move in big lots and represent the major portion of FCL containers. As a matter of fact, the conference tariff book is used only for LCL cargo, where consolidation operation is carried out, and ocean freight for small volumes of cargo is quoted according to the conference tariff. In other words, ocean freight for FCL cargo is essentially the FAK rate (Freight All Kinds) while tariff rates are applied to LCL cargo.

94. In most cases, FCL cargo is shipped on a Service Contract Cargo in which ocean freight rates are agreed upon bilaterally between a shipper and a shipping line. The contents of the Service Contract are kept confidential, but it is easily imagined that discounted rates from the tariff books are applied.

95. On the other hand, most of the rates applied to LCL cargo reflect the tariff level because LCL cargo shippers are in a weaker negotiating position. As a result, the consolidation business is more profitable than FCL cargo forwarding. It is not rare that a total ocean freight for one 40' LCL container exceeds US$ 7,000, while an average box rate for a 40' FCL container is well below US$ 2,000.

96. Statistics on container freight are difficult to obtain nowadays because container operators do not wish to disclose contents of contract rates with their customers. In the past when main trades were governed by reliable and established conferences, it was easy to grasp the average freight level and cargo volume. One of the few sources available is the data from Containerization International (see Table 1).

Table 1 Container Freight Rates Indicators (US$ per TEU)

	Asia/Europe		Asia/US		Europe/US	
	EB	WB	EB	WB	EB	WB
1994 Q1	1,057	1,651	1,758	1,246	1,408	1,298
Q2	1,087	1,622	1,718	1,255	1,395	1,305
Q3	1,142	1,596	1,727	1,315	1,374	1,333
Q4	1,181	1,581	1,726	1,302	1,382	1,377
1995 QI	1,217	1,544	1,698	1,323	1,403	1,434
Q2	1,320	1,532	1,826	1,356	1,412	1,388
Q3	1,309	1,493	1,870	1,571	1,386	1,374
Q4	1,257	1,455	1,865	1,473	1,442	1,349
1996 Q1	1,219	1,369	1,746	1,339	1,480	1,384
Q2	1,218	1,346	1,628	1,428	1,495	1,342
Q3	1,172	1,134	1,629	1,504	1,474	1,341
Q4	1,137	1,281	1,548	1,384	1,621	1,341
1997 Q1	995	1,112	1,473	1,280	1,456	1,302
Q2	1,036	1,156	1,407	1,277	1,441	1,246
Q3	1,067	1,187	1,370	1,428	1,600	1,308
Q4	1,056	1,155	1,362	1,182	1,471	1,288
1998 Q1	1,040	1,183	1,345	1,119	1,472	1,284
Q2	869	1,227	1,459	1,015	1,477	1,210
Q3	873	1,353	1,561	999	1,397	1,221
Q4	807	1,465	1,614	842	1,308	1,188
1999 Q1	716	1,512	1,619	832	1,165	1,100
Q2	723	1,525	2,018	871	1,111	1,045
Q3	730	1,568	2,203	818	1,040	1,054
Q4	775	1,612	2,195	733	1,033	1,129
2000 Q1	664	1,594	2,125	751	939	1,148
Q2	829	1,597	1,953	852	1,008	1,148

Source: Containerization International Data processed by MOL Research Co-Operation Office.

97. It is observed that the freight level of Asia/US EB is generally higher than those rates of the other three trades. Especially for the period from 1999 Q1 to 2000 Q1, rates are US$ 500 – 750 higher. This reflects supply and demand of space in the Trans-Pacific container trade due to a booming US economy.

98. On the other hand, the average freight level of Asia/US WB shows a steep decline during the same period because of the Asian economic crisis. The freight trends of Asia/Europe trade generally follow those of Asia/US.

99. Table 2 shows the earning power of a container ship per voyage by size on assumption that an average turn round of onboard containers is five times per leg of one round voyage (= 2.5 times for one way) and an average loaded container parity is 70 percent all through one round.

Table 2 Total Earning Capacity of Container Ship in Asia/Europe Trade

Vessel Size Nominal TEU (GT)	Turn Round Containers (x 2.5) for One Way	Paying Containers (70%) One Way	EB Total (@US800)	WB Total (@US1600)	SC Dues One Way	EB SC Dues %	WB SC Dues %
3,500 (40,000)	8,750	6,125	4,900,000	9,800,000	196,799	4.0	2.0
5,000 (50,000)	12,500	8,750	7,000,000	14,000,000	230,033	3.3	1.6
5,500 (60,000)	13,750	9,625	7,700,000	15,400,000	263,268	3.4	1.7
6,000 (80,000)	15,000	10,500	8,400,000	16,800,000	327,937	3.9	1.9
7,000 (100,000)	17,500	12,250	9,800,000	19,600,000	378,201	3.9	1.9
8,000 (110,000)	20,000	14,000	11,200,000	22,400,000	403,333	3.6	1.8
10,000 (120,000)	25,000	17,500	14,000,000	28,000,000	428,465	3.1	1.5

Notes: SCNT=GT x 0.9, On Deck Surcharge=9.7%, Other Charges=7%
Turn Round containers for one way = 2.5*(Nominal TEU of a Container Ship)
Source: JICA Study Team

(ii) Ocean Freight of Tankers

100. The ocean freight for tankers is decided according to the following formula in accordance with the commercial negotiation system which is standard throughout the world.

F = WSF x WSR x C

Where F is Gross Freight, WSF is World Scale Flat, WSR is World Scale Rate, and C is cargo quantity in MT (Metric Ton).

101. Examples of ocean freight by tanker size are given in the following table:

Table 3 Ocean Freight of Tanker

Size	WSF (US$/MT)	WSR	Cargo (MT)	Gross Freight (US$)
VLCC (1)	9.86	75	255,000	1,885,725
SUEZMAX (2)	9.00	120	130,000	1,404,000
SUEZMAX (3)	8.55	155	130,000	1,722,825
AFRAMAX (4)	3.86	195	80,000	602,160
AFRAMAX (5)	4.10	240	80,000	787,200

Notes) (1) A. Gulf - Far East, 2000, (2) W. Africa - N. America (E. Coast), May 2000
(3) W. Africa - NW. Med., September. 2000, (4) UK - NW. Med., June 2000
(5) SW. Med. - NW. Med., November 2000

Source) JICA Study Team

(iii) Ocean Freight of Car Carriers

102. Generally, ocean freight of a car carrier is charged for the space of one unit (passenger car). Unlike the tanker business, carrier types are classified according to capacity of loadable numbers of passenger cars. For example, 6,000 CEU (Car Equivalent Unit) type means 6,000 passenger car loadable type ship.

103. Car carrier market is rather closed and freight rate level is not always available, but according to some major Japanese and European car carrier operators, the market has been bullish for 1999 and 2000. For these two years the main line runs have been full, which at US$750 per car on a full 6,000 CEU vessel equates to very substantial revenue of US$4.5m for a one-way voyage.

(iv) Ocean Freight of Bulk Carriers

104. The three major cargoes of bulk carrier are “iron ore”, “coal” and “grain”. The ocean freight for bulk carrier is decided according to the kind of cargo, size of ship, service route (including numbers of loading/discharging ports) and market level, but generally grain is highest of the three, coal next and iron ore is the lowest.

(v) Surcharges

105. Shipping lines quote various kinds of surcharges at their discretion subject to an agreement with shippers.

Table 4 Surcharges imposed by Shipping Lines

Bunker surcharge	As bunker prices rise, many conferences and independent carriers introduce a surcharge.
Container handling surcharge (CHS)	At the beginning of containerization, it was a common understanding between shipping lines and shippers that container handling charges were included in ocean freight, but a CHS has now been introduced.
Currency surcharge	When any country’s currency becomes greatly unstable, this surcharge is introduced.
Out-port surcharge	Many shipping conferences classify ports as “Main Ports and Out-ports” and this surcharge is levied for containers destined to an Out-port.
Congestion surcharge	When any port is heavily congested and ships are forced to wait for berthing for many days, this surcharge is introduced.

(vi) Disbursements (shipping cost)

106. Shipping costs are traditionally called "disbursements" in the shipping industry. They are basically comprised of the following items regardless of the type of ship; namely "Managing cost" ("Indirect cost" such as depreciation and interest and "Direct cost" such as manning cost) and "Operation cost" (bunker charge, dues at ports/canals). The disbursements of container vessel are the most complicated of all.

(a) Managing cost

107. Managing cost has two components: Indirect managing cost and Direct managing cost.

- Indirect managing cost
  - Capital cost for Container Ships: Annual capital cost can be assessed by calculating the sum of interest and depreciation costs as fixed life-long expenses based on an economic lifetime and an interest rate of planned percentage.
  - Capital cost for Containers (only containership): In container transportation system accounting, each container itself is treated as a small ship. Capital cost for each container is calculated in "US$ per day" when each container is registered with container number into container fleet immediately after the purchase. It varies according to the purchase price, kind of containers and sizes. The cost for a 20' standard box is usually about US$ 2.00 to 2.50 per day and is to be recovered from the shippers/consignees.
- Direct managing cost
  - Manning: to be budgeted according to Company Contract or Private
    Contract with crew and other charges such as pension plan payment, welfare fund
  - Repair & maintenance: to be budgeted by a fixed percentage
  - Insurance: to be budgeted according to insurance contract
  - Lubrication oils: to be budgeted according to lubrication oil kind
  - Overhead: to be budgeted according to in-house rates

(b) Operation Cost

108. Operation cost is the cost borne while vessels are in operation and consists of the following;

- General items, regardless of leg of a voyage: Any ship's voyage consists of an outward and inward (or homeward) legs and most costs are classified by each

leg. However it is convenient to have a group of general items which apply to the whole voyage.

- Port Charges including Canal toll
  Tonnage, Port/light dues, Wharfage, Pilotage, Towage, Handling lines, Tolls, Others
- General cargo expenses
  Dunnage materials, Hold cleaning, Tax on freight, Others
- Petties
  Communication, charge, Others

➢ Leg-wise charges (within Operation cost)

- Total bunker cost
- Agency fee
- Other cost (only containership)
  CY charges, Charges for LB (Land Bridge), CFS charges, Container maintenance charge, Equipment control charge, Feeder charge

(vii) Earnings vs Disbursements

109. There are various ways of calculating a voyage account based on the above earnings and disbursement items. The most popular method of voyage accounting of the current Japanese shipping lines is called "N/P, C/B and H/B system". Internationally, slight differences in voyage accounting methods are found in Britain, North Europe, and America.

(a) Net Proceeds (N/P)

110. Total earnings minus cargo expenses including container expenses is called "cargo profit/loss" or N/P in shipping terminology. However, N/P can also be used as "vessel operation profit/loss" which total earnings minus total operation cost of a particular vessel's voyage covering port charges, bunker charge and operation NOE.

(b) Charter Base (C/B)

111. Unit Value of "vessel operation profit/loss" is called C/B.

(c) Hire Base (H/B)

112. Vessel cost, regardless of whether it is owned or long-term chartered, covering capital cost, crew manning cost, insurance, M&R is called H/B.

113. C/B and H/B are usually shown in US$/DWT/Day or US$/Day (sometimes per month of 30 days). It is easy to calculate whether a vessel's

voyage is making a profit or running at a loss. N/P minus vessel's operation cost is C/B and C/B minus H/B is the vessels P/L. (Further a vessel's P/L minus general overhead is sometimes called business P/L)

(d) Per box freight earnings (container)

114. International ocean-going container freight is quickly being integrated in a box rate except for consolidated containers which contain variable cargo of different rates.
Traditionally, each freight conference or agreement used to have an independent tariff containing item-wise rates. However as containerization develops, cargo item-wise tariffs have started to disappear and are being replaced by a small number of box rates.

(e) Per box P/L (container)

115. In traditional shipping business accounting, vessel-wise P/L was the most important factor. In the container business, however, a container is treated as a small ship and in every day business earnings/disbursement together with P/L of a container are critical. In other words, vessel-wise P/L has less meaning in container transportation.

(viii) Earnings vs Disbursements of Tankers

116. For reference, the actual figures for each size of tankers are as follows:

- VLCC (from Jebel Dhanna/Ras Tanura to Yosu, Korea, total 40.3 Days)
  - N/P US$ 1,414,306
    Gross Freight US$ 1,885,725
    Operation Cost US$ 471,419
    Estimated Tonnage 341,325 DWT
  - C/B US$ 4.14/Day/DWT
  - H/B US$ 3.85/Day/DWT
  - P/L US$ 0.29/Day/DWT, US$ 3,989,065
- SUEZMAX (from Abidjan to Palanca, then to Philadelphia, total 30.17 Days)
  - N/P US$ 1,067,440
    Gross Freight US$ 1,404,000
    Operation Cost US$ 336,559
    Estimated Tonnage 146,602 DWT

- C/B US$ 0.24/Day/DWT
- H/B not available
- P/L not available

➢ AFRAMAX (from Coryton to Fredericia and Leixoes)

- N/P US$ 491,818

  Gross Freight US$ 666,521

  Operation Cost US$ 174,703

  Estimated Tonnage 43,894 DWT
- C/B US$ 0.80/Day/DWT
- H/B not available
- P/L not available

(ix) Earnings vs Disbursements of Bulk Carriers

117. The following example is of an iron ore carrier of a major Japanese shipping line transporting about 139,000 MT of ore from East Australia to North Europe via Suez.

Table 5 Example of Iron Ore Carrier

Ocean Freight	US$ 1,096,000
Bunkerage	336,000
Port Charges	123,000
Suez Tollage	127,000
DEM/DES	-68,000
Other Expenses	2,700
N/P	575,000
Daily C/B	11,000
Daily H/B	14,000
P/L	-177,000

VESSEL FLEET

(i) Tanker (except LPG/LNG tanker) in the world

118. The world tanker vessel fleet-mix distribution (excluding LPG/LNG tankers) shows that about 57 percent of vessels are below 200,000 DWT in 2000. This is commensurate with the global distribution of supply and demand for crude oil that is on routes that are potentially through the Suez Canal. The Suez Canal restriction doesn't allow for larger ships to pass through the Canal. The existence of the SUMED Pipeline provides alternative routes for supplying Europe from the Arabian Gulf.

119. Larger vessels such as ULCC have been decreasing and this trend will continue in the future. The reason of this decrease is to avoid risks of accidents. Once an accident occurs, the operator of the tanker must pay a large amount of compensation. Small size tankers are used for local transport. The production of this size will be stable.

120. It is estimated that the distribution of tankers larger than 300,000 DWT will become 0% in 2020, and the distribution of the other tanker size range will be calculated based on the recent and planned delivery (1997-2001) of tankers.

Table 6 Fleet-mix of Tankers

DWT Year	10-24,999	25-49,999	50-74,999	75-99,999	100-124,999	125-149,999	150-199,999	200-249,999	250-299,999	300,000 +	Total
1980	4.4%	9.5%	6.1%	8.8%	4.2%	5.6%	3.4%	1.3%	28.7%	28.0%	100%
1985	5.1%	11.9%	6.5%	10.2%	4.8%	6.3%	3.8%	1.1%	24.0%	26.2%	100%
1990	5.6%	13.5%	6.7%	12.3%	5.5%	6.7%	4.1%	1.0%	21.8%	23.0%	100%
1995	4.9%	12.9%	6.0%	13.3%	5.9%	7.1%	4.4%	1.0%	22.3%	22.2%	100%
2000	5.0%	13.8%	6.2%	14.7%	6.2%	6.9%	4.2%	1.0%	21.7%	20.3%	100%
2020	5.1%	14.6%	5.2%	20.8%	9.7%	11.7%	7.2%	1.5%	24.2%	0.0%	100%

Source) 1980-2000 : Clarkson Tanker Register
2020: JICA Study Team estimation

(ii) LPG/LNG Tanker in the world

121. The world LPG/LNG tanker fleet-mix distribution has been stable for recent 20 years.

122. Table 7 and Table 8 are the deliveries of LPG/LNG tankers (Note: they are not fleet-mixes but deliveries). The delivery distribution has remained unchanged. Therefore the future fleet-mix will be the same as was given by the recent fleet-mix distribution.

Table 7 LPG Tanker Delivery

Year of Delivery	Up to 5,000		5-20,000		20-60,000		60,000+		Total	
	No.	Cu.m	No.	Cu.m	No.	Cu.m	No.	Cu.m	No.	Cu.m
1980	32	51,832	3	17,924	4	175,330	5	381,896	44	626,982
1985	15	23,734	5	43,445	2	55,200	3	239,780	25	362,159
1990	31	75,444	6	77,257	3	97,328	6	457,883	46	707,912
1995	25	67,853	11	76,798	1	37,450	2	156,941	39	339,042
1997-99		12.8%		26.0%		22.6%		38.7%		100.0%
2020		12.8%		26.0%		22.6%		38.7%		100.0%

Source) 1980-1999 : Clarkson Liquid Gas Carrier Register
2020 : JICA Study Team estimation

Table 8 LNG Tanker Delivery

Year of Delivery	Up to 2,000		20-60,000		60-100,000		100,000+		Total	
	No.	Cu.m	No.	Cu.m	No.	Cu.m	No.	Cu.m	No.	Cu.m
1980							5	639,190	5	639,190
1985							1	125,000	1	125,000
1990							2	264,147	2	264,147
1995							5	673,059	5	673,059
1997-99		1.9%		0.0%		3.2%		94.9%		100.0%
2020		1.9%		0.0%		3.2%		94.9%		100.0%

Source)1980-1999: Clarkson Liquid Gas Carrier Register
2020 : JICA Study Team estimation

(iii) Bulk Carrier in the world

123. The two major commodities that move on large bulk carriers are coal and iron ore, primarily sourced in Australia, South Africa and Brazil. All three countries benefit from deep-water access channels and ports. Most of the other countries that serve as marginal suppliers of these products do not have deep-water access and are themselves restricted to loading smaller “Panamax” vessels (approximately 60,000-70,000 DWT). In order to analyze potential world bulk vessel routings, such as between South America and South Asia, vessel size has to be considered. For most of the routes, only the Suez Canal and the Cape route, and not the Panama Canal, can be considered viable alternatives for these vessels.

124. The ratio of over-150,000DWT has been increasing and this trend will continue in the future. The bulk carrier pursues economies of scale. The vessels of large size are used in a long-haul voyage of major bulk commodity. The future fleet-mix was calculated based on the recent and planned delivery

(1997-2001) of bulk carriers.

Table 9 Fleet-mix of Bulk Carriers

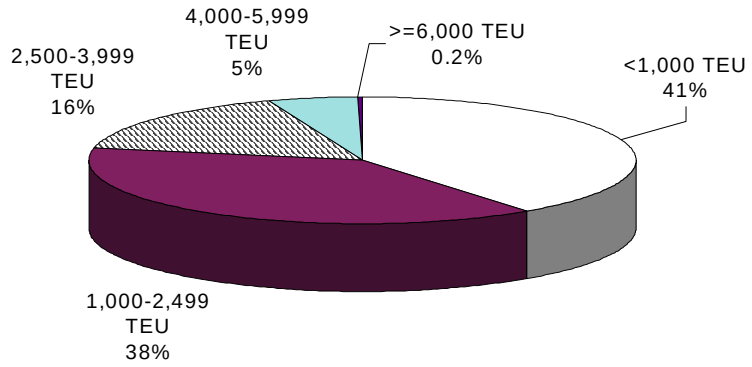
DWT / Year	10-24,999	25-49,999	50-74,999	75-99,999	100-124,999	125-149,999	150-199,999	200-249,999	250,000 +	Total
1980	23.3%	49.3%	14.8%	2.4%	1.8%	7.9%	0.6%	0.0%	0%	100%
1985	17.1%	45.9%	19.2%	2.9%	2.2%	9.8%	2.8%	0.1%	0%	100%
1990	13.3%	43.0%	20.0%	2.7%	2.3%	10.1%	8.4%	0.2%	0%	100%
1995	11.3%	40.0%	21.6%	2.8%	2.7%	12.0%	9.4%	0.2%	0%	100%
2000	9.1%	36.0%	24.4%	2.7%	2.3%	10.2%	14.8%	0.3%	0%	100%
2020	2.0%	25.3%	32.3%	3.8%	2.1%	9.5%	24.5%	0.5%	0.0%	100%

Source) 1980-2000 : Clarkson Bulk Carrier Register
2020 :JICA Study Team estimation

(iv) Containership in the world

125. The world container vessel fleet is predominantly below 50,000 DWT. It has been only in recent years that the vessel sizes have moved beyond the 50,000 DWT size markers.

126. The trend toward increasing vessel sizes continues apace as international trade volumes grow in an environment of globalization and liberalization while ship operators want to achieve better economies of scale and improved financial results.



Source: Clarkls on Liner Register

Figure 3 Number of Container Vessels

127. Today, only slightly more than five percent of the container fleet is above 4,000 TEU(that is approximately 57,000DWT) capacity. The very large vessel sizes are active only on those routes (Europe-Asia and Asia-North America) that provide sufficiently large volumes of cargo over a fairly narrow

range of ports. Part of the size configuration is also driven by the nature of the goods moving, with predominantly light, volumetric (high TEU requirement) cargo originating in Asia.

128. The ratio of Post Panamax has been increasing rapidly and this trend will continue in the future. These large containerships are used in Asia-Europe route, and directly influence the transits through the Suez Canal. The future Fleet-mix was calculated based on the recent and planned delivery (1997-2001) of containerships.

Table 10 Fleet-mix of Containerships

DWT / Year	10-24,999	25-49,999	50-74,999	75-99,999	100-124,999	125,000+	Total
1980	48.9%	49.9%	1.1%	0.0%	0.0%	0.0%	100%
1985	41.9%	55.7%	2.4%	0.0%	0.0%	0.0%	100%
1990	33.2%	59.0%	7.6%	0.2%	0.1%	0.0%	100%
1995	30.2%	57.9%	11.3%	0.4%	0.2%	0.0%	100%
2000	24.7%	51.7%	21.0%	1.9%	0.8%	0.0%	100%
2020	16.4%	40.4%	36.2%	5.0%	2.0%	0.0%	100%

Source: 1980-2000: Clarkson Liner Register
2020 : JICA Study Team estimation

(v) General Carrier in the world

129. The world general carrier fleet has been comprised of vessels less than 25,000 DWT for the past 20 years. Table 11 is the general carrier fleet delivery by year (Note: it is not fleet-mix but delivery). This table shows that there has been no general carrier larger than 25,000 DWT, and this trend will continue in the future. Therefore the future fleet-mix will be the same as the present fleet-mix distribution.

Table 11 General Carrier Delivery

DWT / Year	-24,999	25,000+	Total
1980	720,302	0	720,302
1985	378,319	0	378,319
1990	106,424	0	106,424
1995	189,337	0	189,337
2000	58,300	0	58,300
1997-00	100.0%	0.0%	100.0%
2020	100.0%	0.0%	100.0%

Source: 1980-2000: Clarkson Liner Register
2020 : JICA Study Team estimation

(vi) Car Carrier in the world

130. The world car carrier fleet is predominantly less than 25,000 DWT. Table 12 is the trend of the world pure car carrier fleet delivery by year (Note: it is not fleet-mix but delivery). This Table indicates that the trend of the fleet-mix shows no tendency to scale up or down. Therefore the future fleet-mix was calculated based on the recent and planned delivery (1997-2001) on pure car carriers.

Table 12 Pure Car Carrier Fleet of Delivery

DWT / Year	-24,999	25,000+	Total
1980	100.0%	0.0%	100.0%
1985	78.2%	21.8%	100.0%
1990	100.0%	0.0%	100.0%
1995	100.0%	0.0%	100.0%
2000	90.3%	9.7%	100.0%
2020	91.1%	8.9%	100.0%

Source: 1980-2000: Clarkson Liner Register
2020: JICA Study Team estimation

(vii) Fleet-mix in the Suez Canal

Table 13 Average Vessel Size in SCNT

(1000SCNT)

	(a)1980	(b)1999	(b)/(a)
Tankers	30.4	34.2	1.13
Bulk Carriers	15.5	26.2	1.69
Combined Carriers	40.6	53.8	1.33
General Carriers	6.9	8.8	1.28
Containerships	19.8	38.5	1.94
Lash	29.1	28.2	0.97
Ro/Ro	14.4	17.8	1.24
Car Carriers	30.8	46.5	1.51
Passenger Ships	12.3	15.0	1.22
War Ships	6.2	9.1	1.47
Others	2.7	4.0	1.48

Source: JICA Study Team from SCA Yearly Reports

131. Average vessel size through the Suez Canal has constantly increased from 1980 to 1999. The size increase was especially prominent for Containerships, Bulk Carriers, and Car Carriers.

132. The speed of enlargement has slowed down except for Bulk Carriers, Containership, and Car Carrier. (Table 14)

Table 14 Historical Data of Vessel Size

(1000SCNT)

	1975	1976	1977	1978	1979	1980	1981	1982	1983	1984	1985	1986
Tanker	36.2	30.3	28.8	29.7	32.0	30.4	39.3	37.7	37.9	36.7	36.4	37.9
Bulk Carrier	14.5	14.5	14.4	14.6	15.2	15.5	15.8	16.4	16.8	18.0	18.4	19.0
Combined Carrier	21.3	43.3	38.9	38.3	39.8	40.6	41.0	45.9	45.1	44.9	48.1	56.4
General Carrier	6.8	6.1	6.1	6.4	6.6	6.9	7.0	7.1	7.1	7.2	7.1	7.3
Containership	12.8	10.9	19.1	19.9	20.3	19.8	20.3	20.5	21.1	21.3	21.2	22.7
Lash	32.3	32.9	31.0	30.7	29.0	29.1	29.4	28.5	28.8	27.1	27.5	29.3
Ro/Ro	8.3	6.7	7.6	8.3	12.6	14.4	15.3	14.6	16.0	16.8	16.1	16.5
Car Carrier		21.0	23.8	26.3	27.7	30.8	32.9	34.0	34.4	33.8	35.7	36.9
Passenger Ship	9.6	12.9	12.7	11.3	12.1	12.3	12.7	11.5	11.9	13.4	11.7	11.8
Warship		3.7	6.0	3.3	3.4	6.2	5.5	6.1	5.9	5.4	5.5	5.4
Others	4.1	2.2	2.9	3.2	3.1	2.7	3.3	3.5	3.1	3.1	3.6	3.9
Total	9.6	11.2	11.2	11.7	13.1	13.5	15.9	16.1	17.0	17.4	17.8	19.9

1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	
37.1	36.9	39.4	43.1	44.2	37.5	43.2	39.3	39.2	35.0	34.6	42.1	34.2	Tanker
19.6	19.6	20.4	20.3	20.0	19.8	19.7	20.9	22.9	23.1	24.4	25.6	26.2	Bulk Carrier
53.5	48.9	46.8	51.0	50.3	52.0	49.0	51.1	51.1	52.3	54.6	52.3	53.8	Combined Carrier
7.5	7.6	7.7	7.9	7.8	7.5	7.2	6.7	7.6	7.7	7.9	8.4	8.8	General Carrier
23.1	24.3	25.7	26.6	27.6	26.8	27.6	29.1	30.9	31.9	34.6	38.1	38.5	Containership
29.3	26.9	29.9	31.3	32.4	32.8	32.2	30.5	31.1	29.5	29.7	29.1	28.2	Lash
16.2	15.7	17.6	17.9	19.1	20.8	20.7	23.3	22.3	23.0	23.4	17.9	17.8	Ro/Ro
38.3	39.3	40.8	41.6	42.2	42.0	41.6	43.1	43.9	44.7	44.3	44.7	46.5	Car Carrier
12.3	11.7	10.4	10.2	11.3	11.5	12.1	11.8	11.3	12.7	13.1	13.8	15.0	Passenger Ship
4.0	4.6	4.7	15.9	14.4	8.9	10.9	8.9	6.4	8.1	7.0	10.8	9.1	Warship
4.2	3.2	3.3	3.3	3.5	3.9	3.9	3.9	3.6	3.7	4.0	3.8	4.0	Others
19.8	19.6	21.2	23.2	23.3	22.2	22.9	22.3	23.9	24.1	25.6	28.7	28.5	Total

Source) JICA Study Team from SCA Yearly Reports

PORT DEVELOPMENT

(i) El Sokhna Port Development

133. The port is designed to accommodate ships with dimensions up to 350m length, 50m beam and 15m draught (actual draught is 17m). The Government has started the extension of ENR railway network from Adabya down south to the port. This rail siding will be at the terminal around June 2001. SSA is going to order two super Panamax gantry (possibly 22 across) cranes by the end of 2000, and if ordered they will be installed within 18 months.

134. Main container handling equipment in the yard will be two tire-mounted-yard-cranes and some reach-stackers for the first phase with the projected yearly throughput of 150,000TEU and yard stacking capacity of 45,000 TEU. All those boxes are domestic containers or for export.

135. Without any doubt the new port, together with one container terminal and two bulk terminals, is Egypt's most advanced port and will contribute to the economic development of the Gulf of Suez and Egypt as a whole.

(ii) Port Said East Port

136. According to SCCT (Suez Canal Terminal S.A.E.), the first phase of the project will be only for container terminal although some comments regarding the industrial zone are found in the brochure of the project, which will be realized in a long-term plan. Also according to the explanation by SCCT, the dredging operation at the site is, by and large, going on schedule to the turning basin (dredging beyond that point is SCA's responsibility).

137. SCCT is aiming at the grand opening of the new terminal on January 1st 2002 and anxious about substantial delays in quay construction which is one year behind the original schedule.

138. It is observed that if SCCT succeeds in inducing some major lines to use the new terminal as their hub for feeder service dedicated to Mediterranean feeder, the expected numbers of containers will be substantial and the number of container ships through Suez will surely increase. However the marketing efforts have just started and further because SCCT is not MSL itself, (although MSL holds 30 percent of the capital,) their marketing is not so direct as some other container terminal owned and operated directly by shipping lines.

139. The throughput capacity of the new terminal will easily become

around one million TEU judging from the performance of Salalah in Oman. In case half of the total handling containers are transshipped via Suez connecting Mediterranean and Red Sea, the number of container ships calling East Port Said will be around 250 x 1000 TEU ships (500,000 TEU divided by 2 because of transshipment operation).

140. In conclusion, SCCT in East Port Said will affect on The Suez Canal subject to a careful charging policy to encourage the feeder activities of the prospective user lines.

POSSIBILITY OF ALTERNATIVE ROUTES

(i) Panama Canal

141. The Panama Canal is an alternative route to some of the east-west international sea trade that transits the Suez Canal. Because there is a portion of the potential cargo handled by the Suez Canal that can also be routed across the American continent, via the Panama Canal, the potential future development of this route is important to analyze. This route can be considered to be both a direct or indirect competitor to the Suez Canal, depending on whether exporters are making route choices or importers are considering shifting supply source countries due to lower delivered transportation prices or higher quality transportation services.

142. It is important to note that manufacturing and assembly operations in Far East Asia have, over the last 20 years, shifted toward Southeast Asia, representing a move from Japan, Hong Kong and South Korea to the West and South, including Southern China. From these locations, some containers shipped to the U.S. East Coast are now moving via the Suez Canal, thereby bypassing both the Panama Canal and the U.S. land bridge. The reason for this is that there are significant timesavings by shipping from, Singapore, for example, to the U.S. East Coast ports in comparison with the Panama Canal route.

143. The Panama Canal serves primarily east-west sea-trade routes with the largest Panama Canal trade volume being agricultural exports from the United States to Asia. There is also some north-south trade activity between North and South America that uses the Canal, but it is less of a potential for affecting the Suez Canal. The most significant characteristic of the Panama Canal is the restriction on ship size due to the dimensions of the Panama Canal locks. There are studies underway by the Panamanians that are considering

the construction of new locks that could potentially alter the affect of the traditional dimension restriction on Panama Canal shipping.

144. The current capacity of the Panama Canal is approximately 15,000 transits, including those made by non-commercial ocean-going vessels. This equates to approximately 42-45 maximum sustainable canal transits per day. The quality of service provided by the Panama Canal is directly related to the capacity for meeting transit demand. As such, the ideal number of transits at the moment is closer to 38-39 transits per day. As the number goes above this level, operational problems begin to surface, including an increase in Canal Waters Time (CWT) which is measured as the period a ship is at the waterway and ready for transit until the transit is complete. The Panama Canal Authority has stated that they have an operating policy objective to have maximum CWT of 24 hours, yet in 1999 the average CWT rose to over 32 hours per transit.

145. The Panama Canal Authority has taken significant steps in recent years to provide increased transit capacity. This has included the widening of the Gaillard Cut, the augmentation of the tugboat fleet, design and procurement of additional locomotives for the locks, modernization of the vessel traffic management system, hydraulic conversion of miter gates and rising stem valves moving machinery and automation of locks machinery controls. This program is taking several years and will cost approximately $US 1 billion to complete. They intend to complete all of these steps by the end of 2002. The result of this major capital program will be an increase in the throughput capacity of the Panama Canal to a maximum sustainable level of about 48-50 transits per day. In order to have an average CWT of about 24 hours, the operating capacity will be approximately 43-44 transits per day, which translates to an annual level of about 17,000 Canal transits.

146. Additional capacity increases for the Panama Canal beyond this level would require the huge capital expenditures associated with the construction of new locks, with costs in the billions of dollars. This would be an enormous step for the Panama Canal, especially as it is now owned and operated solely by the Panamanian government. There are both considerable financial and environmental obstacles to the construction of new Panama Canal locks, which calls into question the real potential for further capacity increases.

(ii) The Arctic Ocean

147. INSROP (International Northern Sea Route Program) was started in

1993 as a joint international project with Fridtjof Nansen Institute of Norway, the Central Marine Research and Design Institute of Russia, and the Ship and Ocean Foundation of Japan. The project spanned a period of six years, with some 390 researchers from 14 countries working to overcome the numerous technological difficulties. Data obtained from the research were analyzed and integrated into a navigation simulation for specific routes. The purpose of the data analysis is to identify problems that need to be addressed including economic efficiency and to propose the feasible solutions.

148. INSROP is now at the phase of data evaluation and will proceed to the next phase of making some feasible service plans through the Arctic Ocean. The Russian Government is expected to play a main role in the next stage and exact time schedule has not been fixed. This project could be a reality within a long time. If it is realized, the transit distance between Europe and Far East will be shortened by about 40%. It is hoped that SCA staff will carefully watch the development of this project.

149. However, even in the future, the Arctic Ocean route will be in limited use. It will be hard to overcome the freezing in winter season and the severe circumstances throughout the year.

IV. TRANSIT FORECAST MODEL

A. STRUCTURE OF THE FORECAST MODEL

PURPOSE OF THE FORECAST MODEL

150. The forecast model is made to assist the decision-making of the Suez Canal Authority.

151. The future volume through the Suez Canal is quite important for the for reasons:

- To determine the future revenue of SCA
- To make a strategic toll system for the Suez Canal
- To determine the necessity of the enlargement of the Suez Canal

152. The main output of the forecast model is the number of vessels that will pass thorough the Canal in the future. The revenue can be calculated after the number of vessels is forecast.

153. A strategic toll system can be considered after type and size of vessels are analyzed. The toll should give reasonable benefits both to SCA and to ship operators.

154. The future number of vessels is directly related to the necessity of the enlargement of the Canal. If the number exceeds the capacity of the Canal, the Canal will have to be enlarged.

FRAMEWORK OF THE MODEL

155. Target year of the forecast is set at the year 2020.

156. This forecast model is a so-called long-term forecast model. Basically the forecast is the work of the analyses of trends and scenarios. The basic structure of the demand is followed after the past and the present trends, but it may change in the long run. Therefore, the factors that possibly may change in 20 years were analyzed. This procedure is totally different from a simple regression model that is often used in a short-term forecast model.

OUTPUT OF THE MODEL

157. The output of the forecast model is the number of vessels that will

pass through the Suez Canal (referred to as “Transit” hereafter in this study).

158. Transit should be classified by vessel type, vessel size, load status (laden / in-ballast), and direction (northbound / southbound) according to the purpose of the model. The characteristics of Transit are directly related to the strategy of the management of the Suez Canal.

159. The cargo volume and the commodity types are important but are less important than Transit. The reason is that the cargo volume and the commodity types have no direct relations to the operation of the canal. Therefore, the best efforts were paid to forecasting Transit. But the cargo volume and the commodity types are also the output of the model and have reasonable reliability.

Table 15 Classification of Transit

Category	Class
Vessel type	Crude Oil Tanker Other Tanker Bulk Carrier Containership General Cargo Carrier Car Carrier Other vessel *1
Vessel size	0 — 25,000DWT 25,000 — 50,000DWT 50,000 — 75,000DWT 75,000 — 100,000DWT 100,000 — 125,000DWT 125,000 — 150,000DWT 150,000 — 200,000DWT 200,000 — 250,000DWT 250,000 — 300,000DWT 300,000 + DWT
Load status	Laden In-ballast
Direction	Northbound Southbound
Commodity type	Crude Oil Oil Products LPG/LNG Chemicals Grain Fabricated Metal Coal & Coke Ores Fertilizer Automobile Containerized Cargo Others

Note: *1), other vessel type is separated in detail in later process

BASIC CONCEPT

160. Figure 4 is the flowchart of forecasting procedure. Boxes marked as P1 to P5 in this figure represent steps in the forecast. Boxes marked as F1 to F7 are relevant factors.

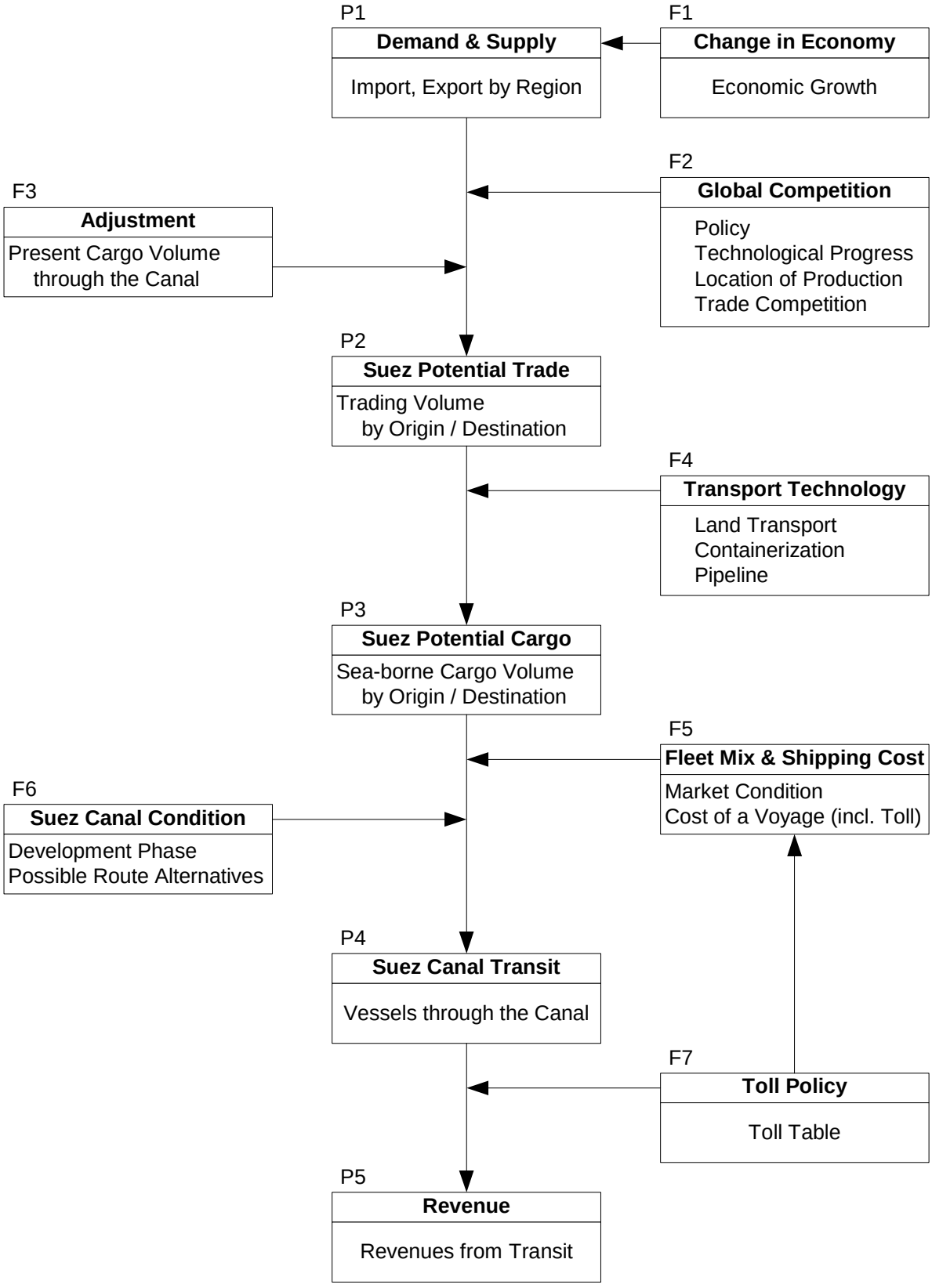


Figure 4 Flowchart for the Forecast

161. In P1 the future cargo demand and supply to/from regions are set. Various factors such as production capacity and consumption will affect imports and exports. In this model the GDP was selected as a representative variable of factors.

162. Future trade is set in P2. Trade is the result of the balancing of production and consumption in and between regions. There are many factors that affect the trade structure. The market is extending globally in accordance with developments in information technology and transport technology. These advanced technologies may change industrial structures or consumers' behaviors. Tough trade competition between regions is introduced after the activities of economic sectors. This competition will also affect the productivity and prices of goods. Political behavior, such as the formation of the EU, will ease the barriers to trading and extend the power of trading. It is not easy to establish this complex trade structure in numerical equations. Therefore, the output of a large-scale world trade forecast model was used in this model. The output of the model was modified to fit the forecast of the Suez Canal Transits.
The output of this process is called "Suez Potential Trade" in this study report. At first, Suez Potential Trade was estimated based on the world statistics. And then this estimation was adjusted to the actual cargo volume through the Canal.

163. In P3 Sea-borne trade is forecasted. Sea-born trade is picked up from the world trade. Transport technology will change the balance between maritime transport and other modes. Containerization is considered in this process. The volume of containerized cargo is estimated.
The output of this process is called "Suez Potential Cargo" in this study report. Suez Potential Cargo is the cargo that will use the Canal when there are no restrictions on maximum size and no toll on vessels.

164. The estimation of Canal Transit, P4, is the final output of the demand forecast model. Maritime factors related to the shipping business, and the physical restrictions and toll of the Canal are the relevant factors.

165. P5 is an additional function of the forecast model. The revenue from the Canal is calculated from the toll table and Transit.

CONSTRAINTS OF THE FORECAST MODEL

166. This model was constructed for long-term forecasting. It is not suitable in short-term forecasting or making short-term toll policy. Transit and

cargo volume fluctuates in the short-term. This fluctuation occurs owe to short-term fluctuations of economy and fleet market. Individual shippers' strategy or development of individual ports will affect transits and cargo movement in the short-term, too. The forecast model doesn't support these kind of short-term factors.

167. It should be recognized that forecasting constraints come from the structure of this forecast model. This model follows a 4-step estimation approach that is widely used in transportation demand forecasting. The structure is reasonable and easy to understand, but a drawback of this model is the difficulty in forecasting induced demand.

168. If the toll of the Canal becomes quite expensive, a destination country of the cargo may stop importing. Factories in an origin country of cargo may move to another country and the trade across the Canal may decrease. However, the model in this study doesn't consider such a scenario. This presumption may sound improper, but actually the toll will not be set at a high level, and the change of toll within a reasonable range will be absorbed in world trade in the long run.

169. It will be necessary to construct a dynamic model or general equilibrium model in order to forecast the induced demand. This kind of model is not necessary operational due to the present modeling technology.

170. According to above consideration, the model structure is selected as described in this study report.

171. The model developed in this study is a trend model in the sense that the parameters for forecasting are determined from the past and the present demand structure, although it is not a simple time-series trend model. The parameter should be revised and it may even necessary to revise the model structure if drastic changes in the economy or trade occur.

172. In spite of our best efforts, the forecast, of course, will contain errors due to the nature of modeling. There are two (2) causes for these errors.

173. The 1st reason is due to the simplification of the model. Commodities, for example are classified into only 12 categories though the actual cargo consists of a lot more commodity types. Another example is zoning. Regions are grouped into zones. Some trades between two zones use ports in the other zone. This kind of trade results in a mismatch in the forecast and the actual transit.

174. The 2nd reason is that the factors considered in the forecast process are simplified. Actual Transit is the result of behaviors of shipping operators. There are a lot of trends and factors that may influence Transit. But some of them are very difficult to express numerically, and some are very difficult to give future values. Accordingly, parameters used in the model are limited.

B. FORECAST OF SUEZ POTENTIAL TRADE

SUEZ POTENTIAL ROUTE AND SUEZ POTENTIAL TRADE

175. Many commodities are moving across the Suez Canal. Suez Potential Routes are defined as the possible routes from the origins or the destinations of these commodities.

176. Suez Potential Trades are trades along Suez Potential Routes. The trade from East Asia to Oceania, for example, does not clearly pass through the Suez Canal. The trades of this kind are not Suez Potential Trade.

177. Suez Potential Trade includes trades by land-transport and air-transport. These trades do not use the Suez Canal at present, but may pass through the Canal if innovations in transportation technology occur in future.

178. In this study, the final output of Suez Potential Trade is expressed in tons, not monetary terms because cargo movement rather than trade is the more important factor here.

Table 16 Zoning for the study

Direction	Zone
North of the Canal	01.CS.America 02.N.Amrica 03.NW.Europe 04.W.Med 05.N.Africa 06.E.Med
South of the Canal	07.E.Africa 08.A.Gulf 09.S.Asia 10.SE.Asia 11.E.Asia 12.Oceania*

Note: *) Oceania is divided into 4 zones for dry bulk cargo in the later chapters

179. Suez Potential Trade is a portion of the world trades. Figure 5 shows Suez Potential Route. These routes are determined by comparing the voyage distance via the Canal to the distance via the Cape. The distance via the Panama Canal was also considered to define Suez Potential Route. A representative port was selected in each zone to determine the distances between zones.

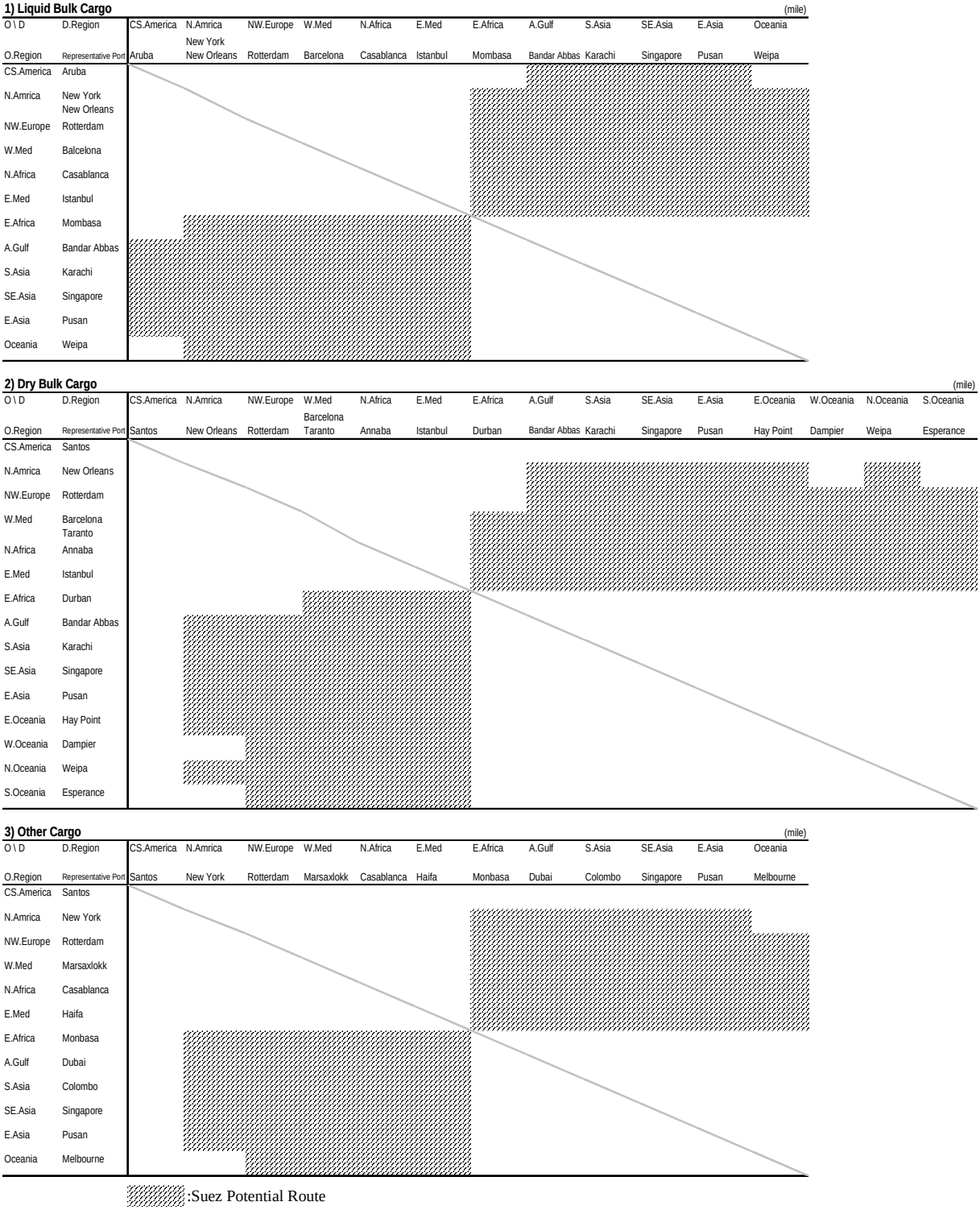


Figure 5 Suez Potential Route

METHODLOGY OF FORECAST

180. For the estimation of the Suez Potential Trade, a two-phase, multi-step forecasting approach was used.

181. The first phase was the forecast based on world statistics. First, the entire world trade by commodity and trade route was forecast. The world trade forecast in the study covers trade in all goods (sea-borne, land and air cargo) for the entire world as the foundation for the Suez Canal trade analysis. Then, Suez Canal specific potential trade by commodity and trade route in tons was calculated.

182. The second phase was the revision of the output of the first phase. After trade was forecast from world statistics, the sea-borne trade was calculated. The result of the forecast of sea-borne trade has some inconsistency with the actual transit. Therefore, the trade in the first phase was adjusted to the actual movement.

183. The models used to forecast international trade took into account a number separate economics factors to best reflect the impacts of future economic activity on trade demand. In the trade models for this project, a bottom-up approach was implemented for the forecasts that were then made subject to a set of imposed controls. This bottom-up approach assumes that the demand for each commodity represents a universe of individual economic decisions by companies and consumers. In this approach, differential price and production factors were taken into account as a result of a scaling process where the market shares were determined by the relative competitiveness of each exporting country for each commodity category.

184. In the model system, each commodity model of world trade model stands alone, defining the interrelationship between exporters and importers trading in a single commodity category. The main factor affecting future patterns of trade is the observed past pattern of traded goods in the world. The pooled cross-sectional economic model uses as a foundation the past patterns of trade as reported by official government agencies. The historical trade statistics have detail by commodity and trade partner country, covering trade by 160 countries worldwide.

185. Import demand equations in the model are estimated based on macroeconomic data, industry data, price data, exchange rate, and exporter performance measures – relative wages and relative rates of productivity growth. The models also take into account market size and wealth per person

in each trading country. These last two factors are important because shifts in future trade may be related to market size since larger markets tend to demand more of some products. Larger markets also tend to be more competitive as foreign sellers find it less expensive to penetrate larger markets (the market potential is greater and thus the cost of entry per probable unit of sales is less). The wealth effect on trade is usually positive since wealthier markets attract more foreign suppliers. The model also captures the influence of technology investments and globalization of production.

186. The Suez Canal Routes and Commodity categories were mapped to the world trade forecast dimensions using detailed historical trade statistics. The Suez Potential Zones have been defined using groupings of individual countries. The Suez Canal commodity categories have been defined using underlying historic patterns of trade, collected and reported using the four-digit Standard International Trade Classification of commodities.

187. A presumption of the forecast is the future economic growth. Table 17 shows the future regional economic growth rates used for forecasting.

Table 17 Economic Growth in future (-2020)

Zone	%/Year
01 CS. America	3.79
02 N. America	2.77
03 NW. Europe	2.39
04 W. Mediterranean	4.25
05 E. Mediterranean	2.47
06 CIS/E. Europe	4.34
07 E. Africa	4.84
08 A. Gulf	4.00
09 S. Asia	6.86
10 SE. Asia	5.57
11 Mid Asia	6.84
12 E. Asia	2.58
13 Oceania	3.60

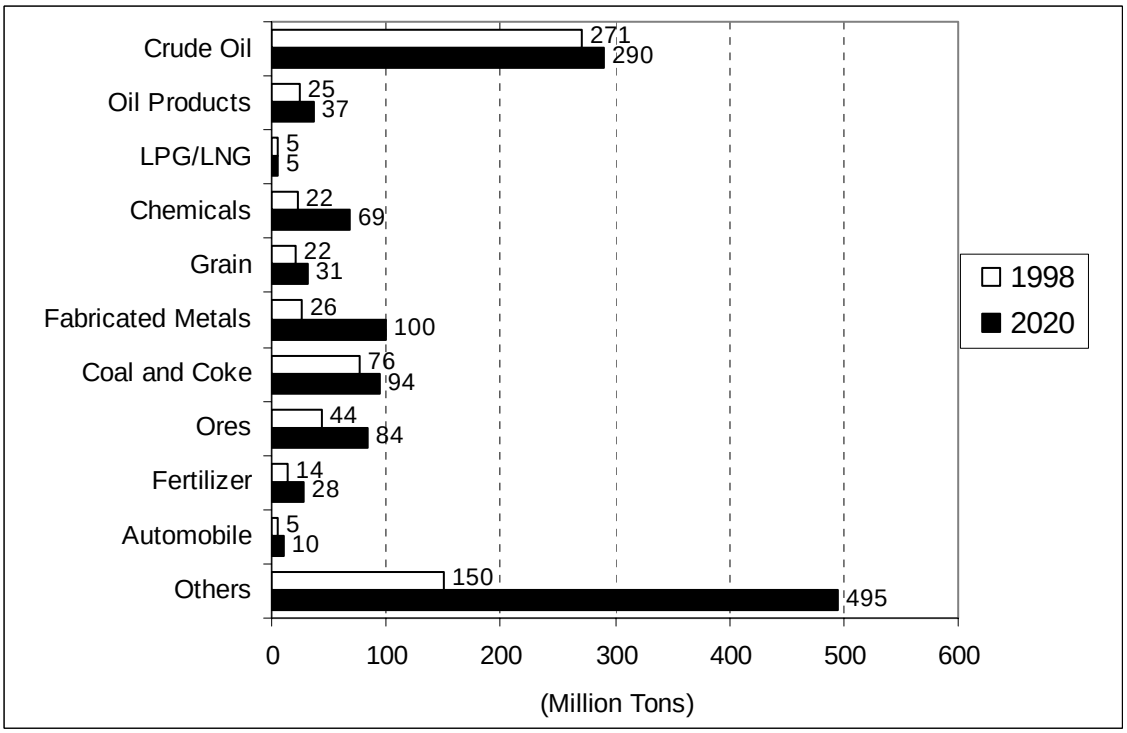
188. A change in the trade pattern is an important factors. Successful negotiations for significant expansion of the WTO will lead to increased levels of overall world trade, as countries further specialize production to those areas where they have the greatest comparative advantage and can buy and sell more commodities internationally.

189. The common characteristics of trading country blocks are a decrease in tariffs and an increase in trade between the countries in the trade block or agreement.

190. There is also a potential factor where global environmental concerns reduce the potential for trade by constraining the growth of industrial development and activity.

RESULT OF FORECAST

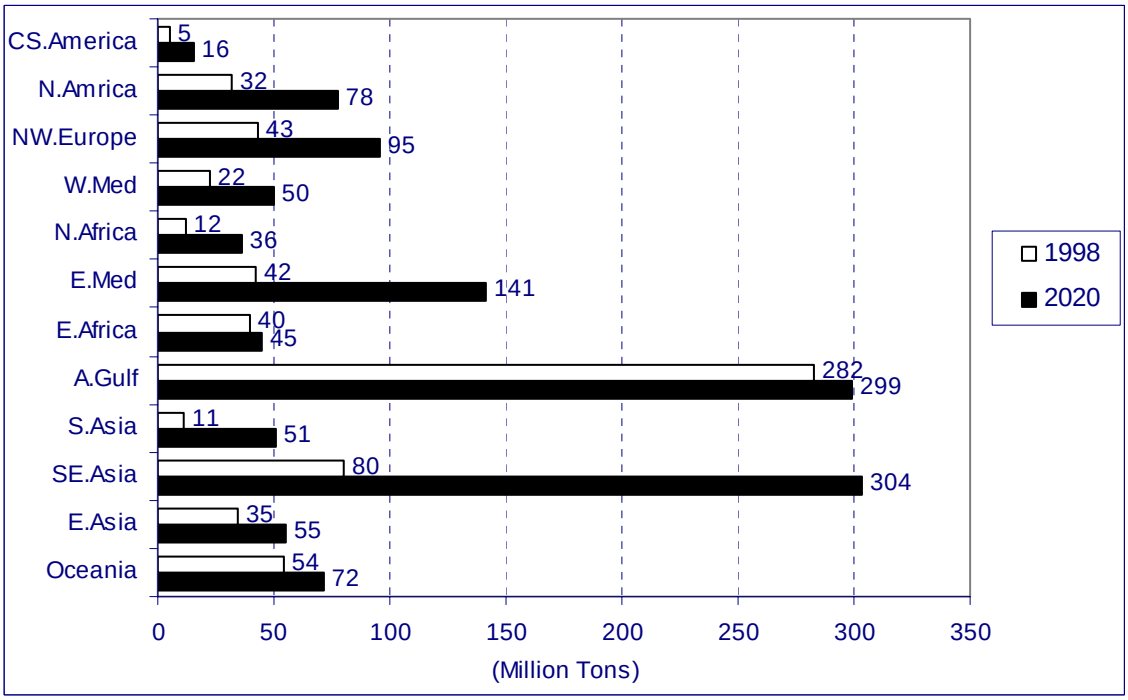
191. The total potential tonnage of trade will increase over 88 percent between 1998 and the year 2020, rising from 660 million tons to over 1,243 million tons. Among the potential commodity trade, "Others" (including General Cargo) is forecast to grow at a fast pace.



Source: JICA Study Team

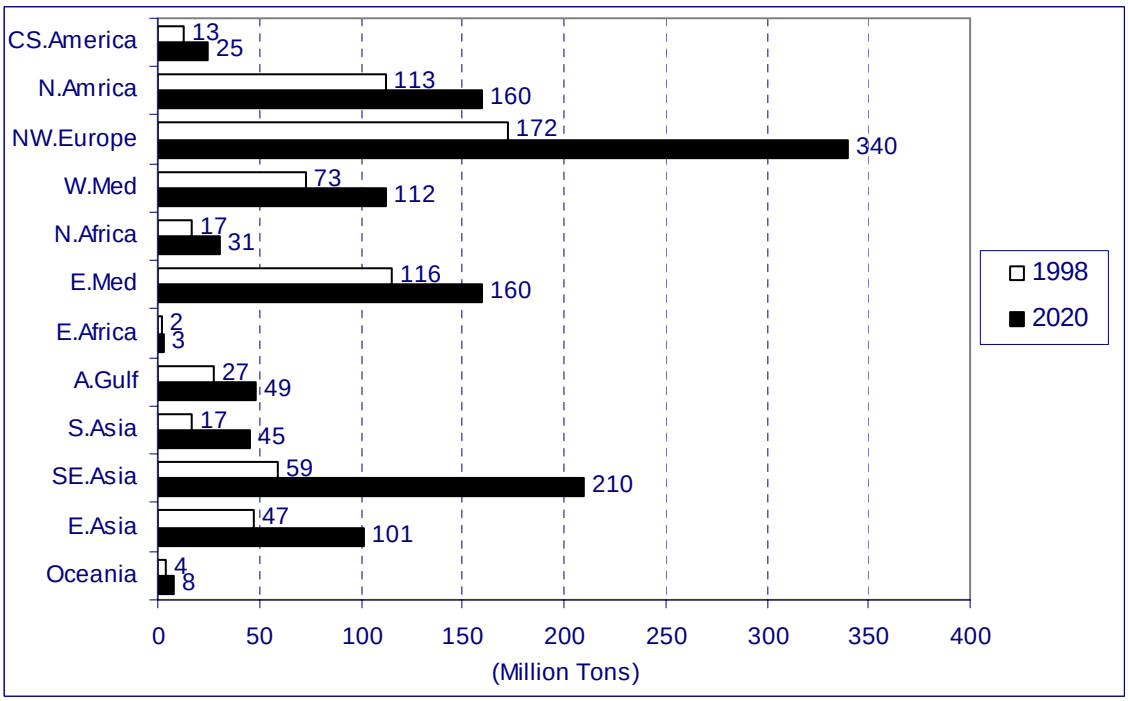
Figure 6 Suez Potential Trade Tonnage Forecast by Commodity

192. From a geographic perspective, the world trade region that is the largest source of Suez Potential Trade tonnage today is the Arabian Gulf region. By 2020, however, SE.Asia will be the largest origin of Suez Potential Trade, with Arabian Gulf falling to second.



Source: JICA Study Team

Figure 7 Suez Potential Trade Tonnage Forecast by Export Region



Source) JICA Study Team

Figure 8 Suez Potential Trade Tonnage Forecast by Import Region

C. FORECAST OF SUEZ POTENTIAL CARGO

SUEZ POTENTIAL CARGO

193. Suez Potential Cargo is the sea-borne trade portion of Suez Potential Trade. Some of Suez Potential Trade use land transportation such as trains. Some use airplanes. Crude oil uses pipelines. These cargos are not Suez Potential Cargo.

194. Some of Suez Potential Trade includes the cargo that will not use the Suez Canal even if that trade is sea-borne trade. One reason is the statistics. The zone for forecast is country–basis because the world trade is measured for each country in statistics. In this study, sea-borne trade to/from US East Coast is picked up from US total trade. US total trade to/from Suez Potential Zone is included in Suez Potential Trade, but trade between US West Coast and Suez Potential Trade is not included in Suez Potential Cargo.

195. In this stage of forecasting, the volume of containerized cargo is estimated. Containerized cargo is not a commodity type but a cargo type. But containerized cargo is treated as a commodity type in this report.

METHODOLOGY OF FORECAST

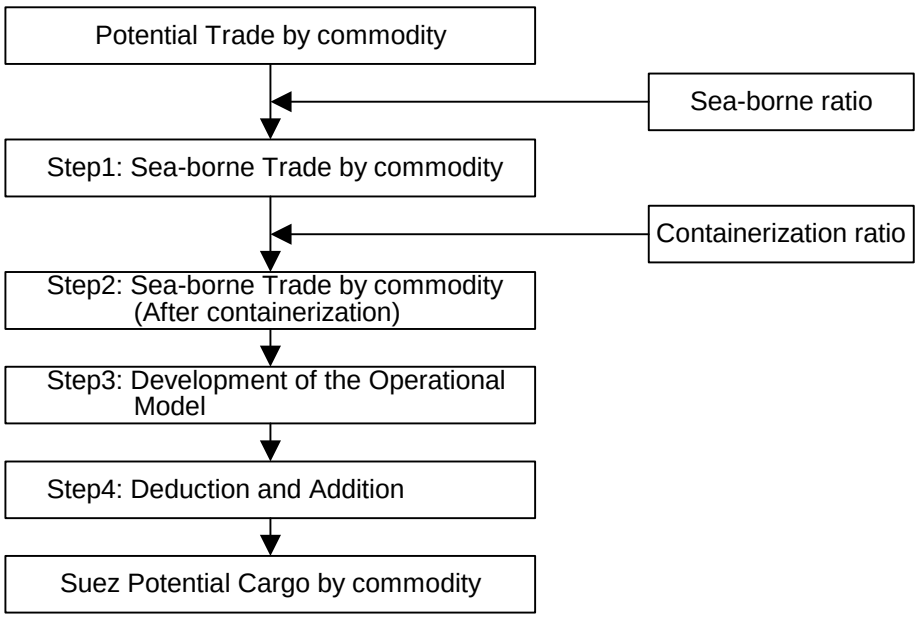


Figure 9 Flowchart of Forecasting Suez Potential Cargo

196. Step1 of the procedure is the calculation of sea-borne trade. It is

calculated by the multiplication of the Potential Trade and sea-borne ratio by commodity and O-D pairs.

197. Step2 is containerization. The volume of containerized cargo is the sum of all containerized cargo of each commodity type. The sea-borne tonnage portion of world trade includes containerized cargo. It does not have underlying detail on what goods are in the containers. In order to forecast the future potential containerized tonnage for the Suez Canal on a comparable basis, commodity group disaggregated sea-borne tonnage into containerized and non-containerized tonnage. Therefore, sea-borne containerized potential trade tonnage for The Suez Canal was estimated for each commodity category, for each trade route. The remainder of The Suez Canal sea-borne trade tonnage is measured in non-containerized tons. Finally, the containerized tons were aggregated with non-containerized tons to yield total sea-borne Suez Canal tons.

198. Step3 is the development of the forecasting model. The first step of forecasting Transit was the forecast of Suez Potential Trade, which involved two problems.

The first one was the difficulty of the operation of the model. Suez Potential Trade was forecast from a large-scale model. This model is too complex to use for easy forecasting. The second problem was the inconsistency of the actual Suez Transits. A large-scale model was developed based on world statistics. But the estimation of the present cargo volume under the large-scale model was not equal to the actual Suez cargo volume.

Therefore, a model called “the Operational Forecasting Model” was developed to forecast Suez Potential Cargo.

199. Step4 is the deduction and the addition of some cargo volume from/to the output of the forecast model. These cargoes are pipeline crude and containerized cargo.

The example is the containerized cargo between US East coast and East Asia. Most of this cargo doesn’t use the Suez Canal because few container routes are established. This cargo is, in a sense, potential cargo of the Suez Canal because the Panama Canal has a physical constraint. This cargo was considered here as an input of the next process, a route choice model.

Crude oil by pipelines was excluded in this step. Crude oil by pipeline was treated as sea-born trade at first because major transportation mode was ship. However, this cargo was not sea-borne trade for the Suez Canal.

FACTORS

(i) Pipelines

200. Competitive Crude Oil pipelines in operation are only SUMED line and Iraq-Turkey line. But pipelines are strong competitors to the Suez Canal. The possibility for the use of the pipelines will be determined by political decision.

201. Cost of pipeline transport is very competitive to Tanker. Therefore, it is expected that pipelines will be maximally used. This means that the volume of the crude oil equal to the capacity of the pipeline will be subtracted from the potential trade of the Suez Canal.

202. The future prospects for the operation of pipelines are unclear because it is a political matter. In this study it is presumed that pipelines other than SUMED and Iraq-Turkey pipelines will not be operated because these pipelines have been closed for many years. Iraq-Turkey line may increase its transmitting volume if the UN sanctions against Iraq ends. But the future of this line will be almost the same because no future plan has been developed to increase its transmitting volume.

203. In conclusion, it is presumed in forecasting that 120 mil tons will use the SUMED line and 30mil tons will use the Iraq-Turkey line in the future. The uses of other lines are not included in the forecast.

(ii) Possible routes

204. Container trades between East Coast and SE. & E. Asia are potential trades of the Suez Canal as long as the possible routes are limited to the Suez route and the Cape route. But if the Panama Canal is considered, the route between East Coast and E. Asia will be the potential route of the Panama Canal.

205. Most actual trades between East Coast and Asia use the land-bridges, and some are sea-borne trades. Actually most of the sea-borne container routes are crossing through the Panama Canal in spite of the fact that the Panama Canal has a physical constraint. Containership has to call on many ports during its voyage. It unloads and loads containers at each port. In general, enough local demand at each calling port is necessary for routing.
Singapore is in a profitable position for the Suez Canal, but container demand is located east of Singapore. Therefore the cargo between US East Coast and Singapore prefers to move across the Pacific and the Panama Canal at

present.

206. However, routes from Asia to East Coast across the Atlantic are becoming popular, and in the future these routes may grow. It is still uncertain that this route becomes the major route.

207. Therefore in this study, half of the future container trades between East Coast and E./SE. Asia were presumed to use the Suez Canal.

Table 18 Distance via Suez and via Panama for Containership

(miles)

Route	via Suez	via Panama
E.Asia (Pusan) – N.America (New York)	12,719	10,085
SE.Asia (Singapore) – N.America (New York)	10,216	11,368

208. The distances between Asia and America/Europe are in Table 19. As seen in this table, the Panama Canal is favorable to a voyage between East Asia and America.

Bulk cargo is carried on large bulk carriers over Panamax size. Therefore, bulk cargo along this route was not treated as Panama Potential Cargo. Other cargos are, in general, carried on smaller vessels. They can pass through the Panama Canal. Accordingly, other cargos were assumed to be Panama Potential Cargo.

Table 19 Distance via Suez and via Panama

(miles)

Route	via Suez	via Panama
E.Asia (Pusan) – N.America (New Orleans)	14,000	9,516
E.Asia (Pusan) – CS.America (Santos)	13,807	12,546
E.Asia (Pusan) – NW. Europe (Rotterdam)	10,791	12,914
SE.Asia (Singapore) – N.America (New Orleans)	11,467	11,937
SE.Asia (Singapore) – CS.America (Santos)	11,304	11,967
SE.Asia (Singapore) – NW. Europe (Rotterdam)	8,288	15,335

FORECAST MODEL OF SUEZ POTENTIAL CARGO

(i) Purpose of the operational forecast model

209. Trade is the result of imbalances between demands and supplies of commodities to/from regions. There are many factors that will determine supplies from a region. The availability of labor, machinery, resources, and technology are examples. Demand also has many factors such as the necessity of commodities that are used for production and consumption in a region. Price of commodity is an important factor of trade, but the actual price in the market is the result of the balance of trading.

210. The trade forecast model has many variables prices, population, growth rate for each country. These variables produce thousands of equations. This large-scale model is preferred to forecast detail changes in the socio-economic conditions of each country. However, the handling of the large-scale model is very difficult. Continuous data collection and model correction are necessary to maintain the model.

211. The operational forecast model was developed for easy operation. Users can estimate future demand by inputting values of socio-economic parameter in the model when the socio-economic condition changes.

(ii) Structure of the model

212. This model consists of the following 4 steps;

- 1st step is the forecast of the total import of Suez Potential Cargo (=total export).
- 2nd step is the forecast of the import of Suez Potential Cargo to each zone.
- 3rd step is the forecast of the export of Suez Potential Cargo from each zone.
- 4th step is the forecast of Suez Potential Cargo between zones.

213. The 1st step uses the elasticity of the growth of demand (import) against the economic growth rate. The 2nd step uses the present patterns of import export to each zone and the economic growth of each zone. The 3rd step uses the present pattern of export from each zone. In both the 2nd and 3rd steps, scenarios of the future movement of cargo are considered and are reflected in the parameters. The Frator Method, which is commonly used in transport demand forecasting, is employed in the 4th step.

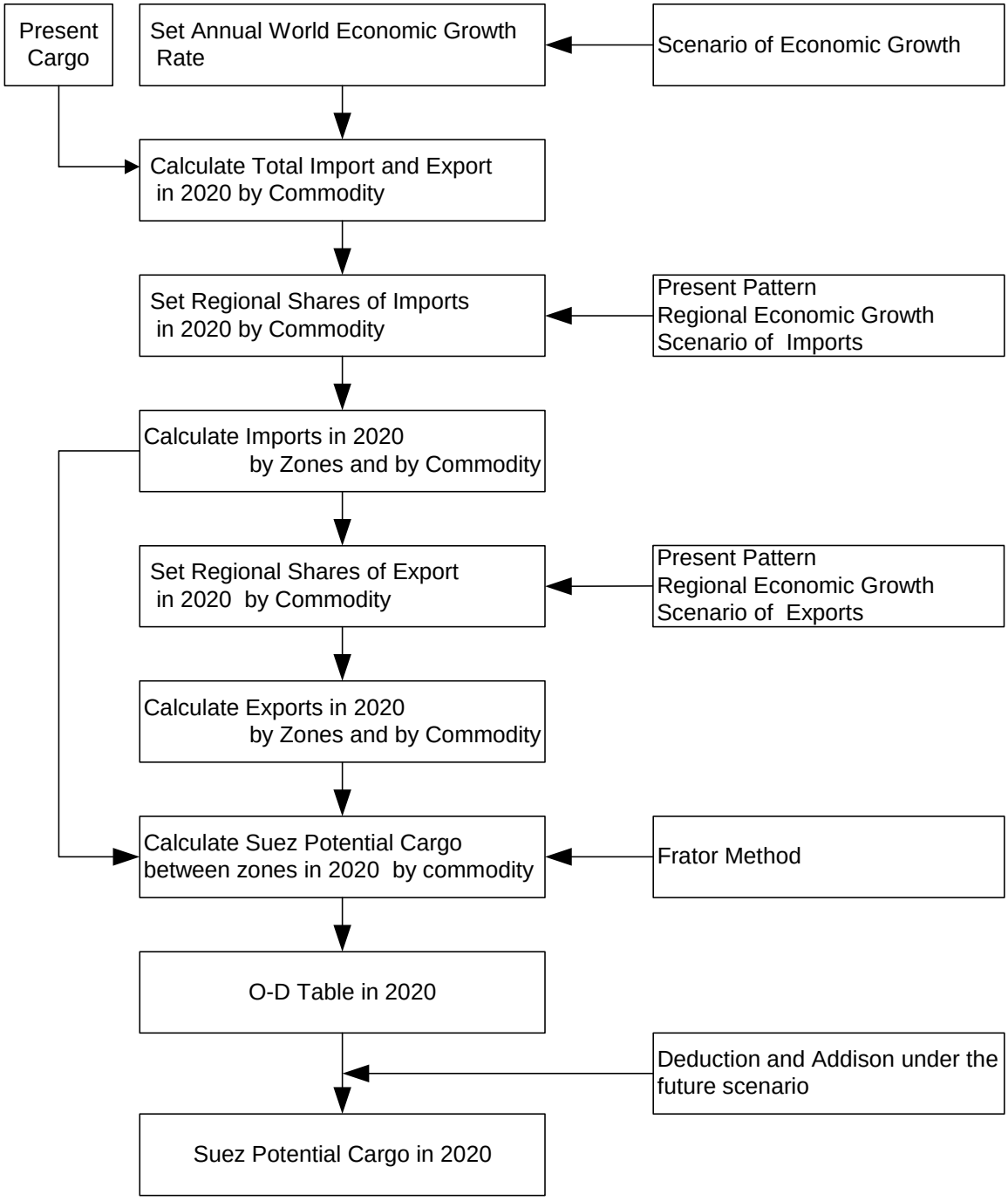


Figure 10 Flowchart of Cargo Forecasting Model

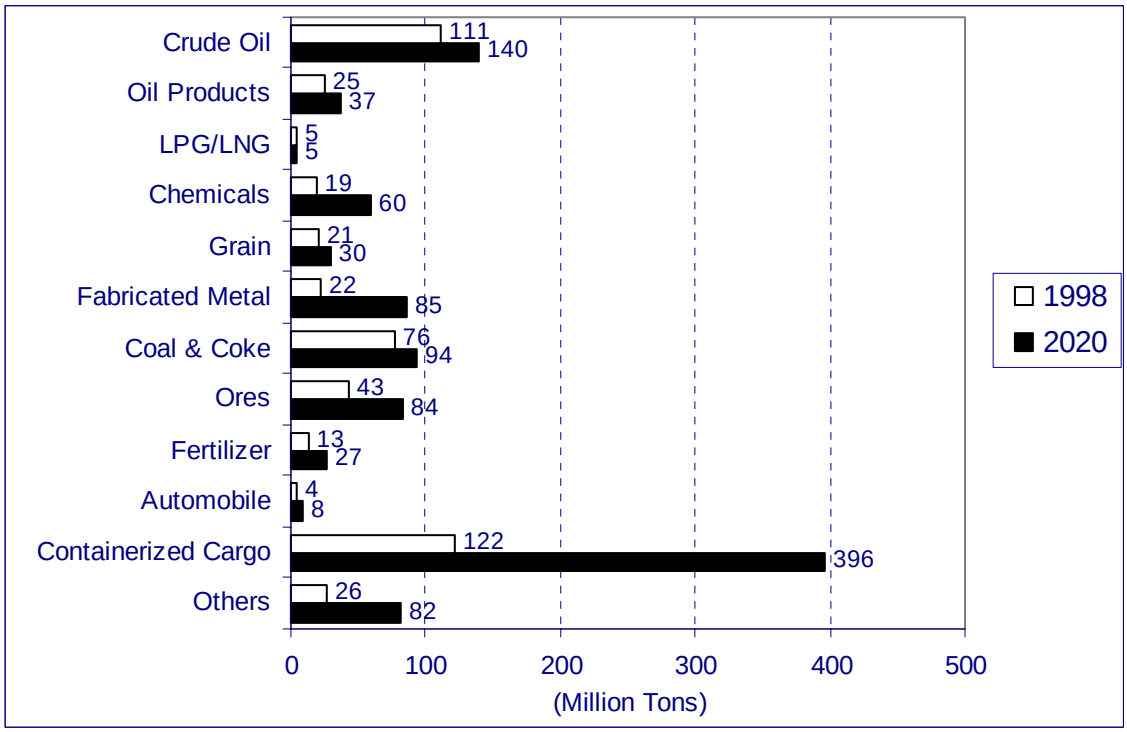
214. Suez Potential Cargo is the possible sea-borne cargo of the Suez Canal. The pipeline Crude Oil and a portion of Containerized Cargo between Asia and N.America were excluded from Suez Potential Cargo.

215. However, in the operational forecast model, the potential cargo includes these cargoes such as pipeline oil. However these cargoes should be

subtracted after the total cargo volume is forecast.

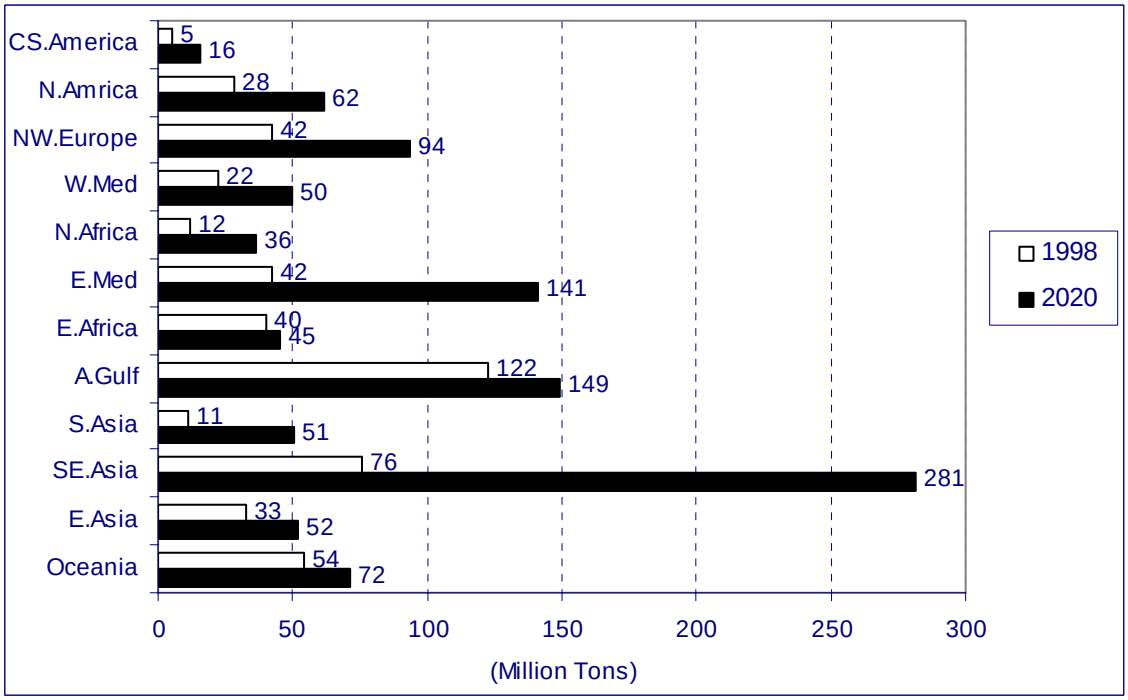
RESULTS OF FORECAST

216. Containerized Cargo will rapidly increase in the next 20 years. The major source of increase will be the trade from SE.Asia.
Industrialization in SE.Asia will have a big impact on Suez Potential Cargo.
The volume of Crude Oil and LPG/LNG will stay at their the present levels, and they will have much smaller shares in the total volume.



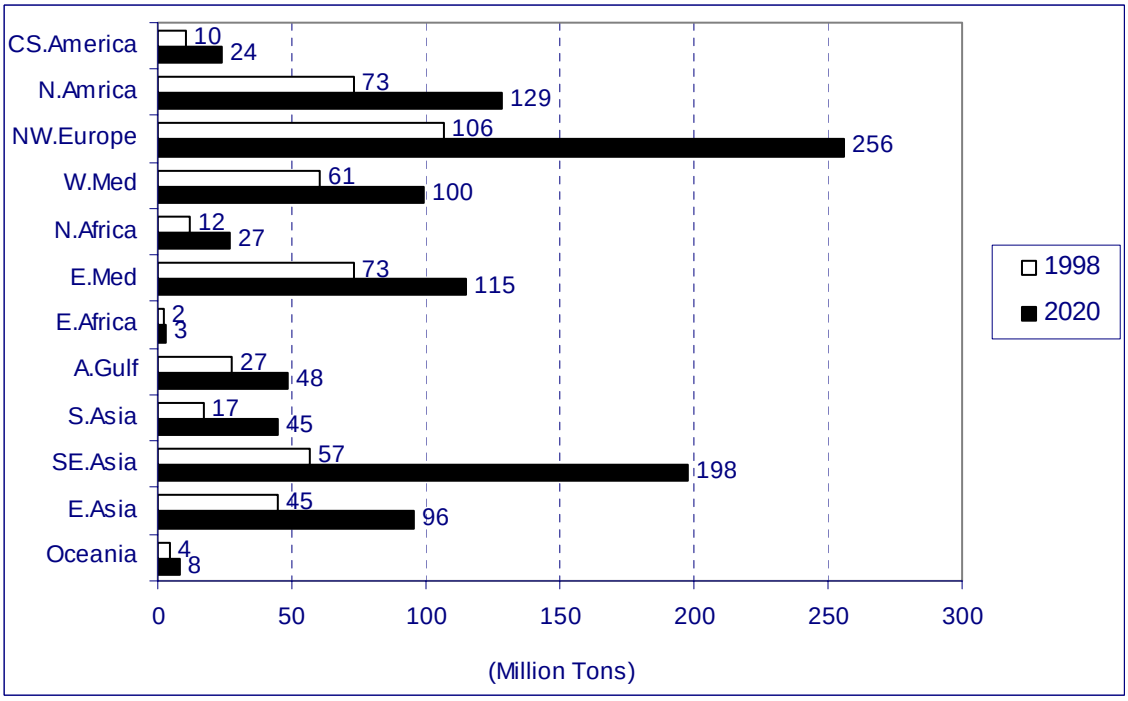
Source: Estimated by JICA Study Team

Figure 11 Suez Potential Cargo Forecast by Commodity



Source: Estimated by JICA Study Team

Figure 12 Suez Potential Cargo Forecast by Export Zone



Source: Estimated by JICA Study Team

Figure 13 Suez Potential Cargo Forecast by Import Zone

D. FORECAST OF THE SUEZ TRANSIT

FACTORS OF ROUTE CHOICE

217. The allocation of vessels is determined so that the ship operator gets the maximum profit. The profit is the difference of freight and cost. Freight is determined by the demand and the supply of fleets. And cost the operator would care of is voyage cost in a depression market or shipping cost in a healthy market. It means that the market is an important factor in route choice. However it is almost impossible to forecast the future fleet market.

218. Therefore the forecasting model in this study concentrates on route choice in a healthy market. The operators choose a route whose shipping cost is the minimum.

219. Each ship operator has his shipping cost. Even one operator has a variety of shipping costs depending on the voyages. However in the forecast model, typical costs are calculated and are used for the route choice.

220. Even if the cost structures of operators are the same, the size of vessels should be considered. The shipping costs are not the same if cargo is carried in vessels of different sizes. In general, the larger vessel carries one unit of cargo (one ton of cargo) at a lower cost. In this respect, vessel size is one of the factors that affect the route choice.

221. In conclusion, the key factor in route choice is the shipping cost of cargo. Shipping cost is influenced by ship size, vessel contract price, cost of crews, toll, bunker oil prices, and many other elements as will be described in this chapter.

222. Other factors are the development of ports and the strategy of ship operators.

223. Deep water ports are necessary for calling of large vessels such as VLCC and over-Panamax containership. Port developments should be considered individually, but this survey is not suitable to this macroscopic forecast model. Consequently, present pattern and trend is presumed in the forecast. The trend includes that container terminals will be developed according to the increase of containerized cargo.

224. The strategy of ship operator becomes more important especially in containership routing. Alliances and calling ports strategy are the keys for ship operators to survive. Hub-operation will affect the shipping cost and

containerization of regions. It is also difficult to include individual strategy in the model. This factor is included as the trend of maritime transportation.

PROCEDURE OF TRANSIT FORECAST

(i) General Procedure

225. As seen in Figure 14, six steps are used to forecast Suez transits of the major vessel types (Tanker, Bulk Carrier, Containership, General Cargo Carrier, and Pure Car Carrier) while the present pattern and scenario setting is used for other vessel types. The numbers of other vessel types are relatively small, and the route choice model is not easy to build up. This is the reason that Figure 14 has two flows.

226. The Steps for the major vessel types were:

- Step1: Estimate type of vessels on which cargo is carried.
  - A vessel type matrix was used for this purpose. (refer to Sec4.5.2)
  - Cargo volume on each vessel type was the output of this step.
- Step2: Estimate sizes of vessels on which cargo is carried.
  - Fleet mix distribution was used for this purpose. (refer to Sec.4.5.3)
  - Cargo volume of each O-D was allocated to vessels of each size according to this fleet mix distribution.
- Step3: Estimate shipping costs of all alternative routes
  - Shipping cost equation was established (refer to Sec.4.3.2) and cost of alternative routes was calculated by using this cost equation.
- Step4: Sum up the cargo volumes that choose the Suez Canal
  - Each cargo was assumed to choose the route of minimum shipping cost. The volumes of cargo were summed up by commodity type, vessel type and vessel size.
- Step5: Estimate number of laden vessels.
  - The number of laden vessels was calculated by dividing the cargo volume by the average volume on a vessel.
- Step6: Estimate number of total vessels
  - The number of in-ballast vessels was calculated by using laden/ in-ballast ratio. Then laden and in-ballast vessels were summed up.
  - The output of this procedure was the number of total vessels passing through the Canal by type, size, and laden/in-ballast. This is the output of the Demand Forecasting Model.

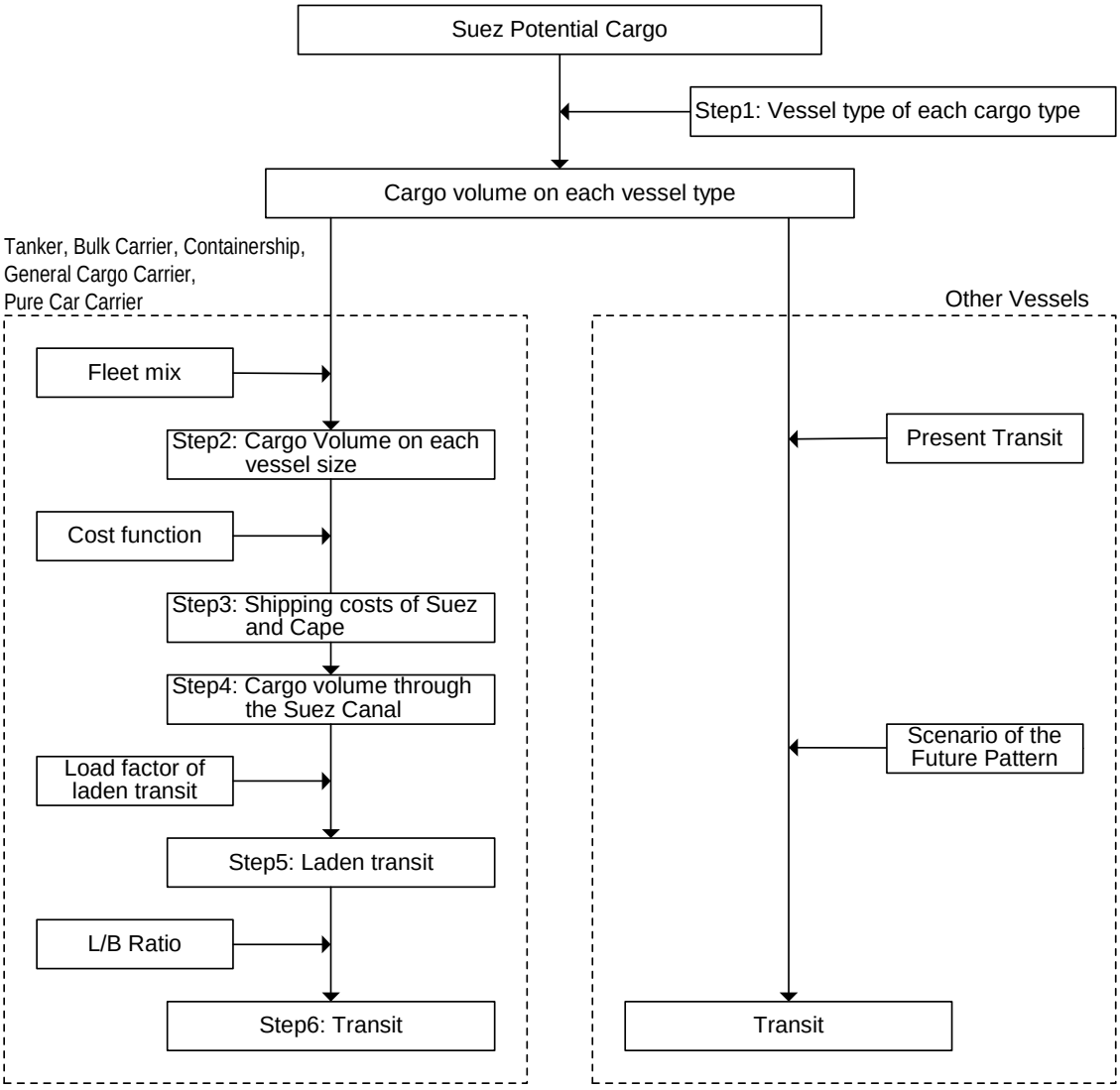


Figure 14 Procedure of forecasting the Suez Transits

(ii) Procedure for each vessel type

227. The special process that was dependent on vessel type is described below.

(a) Crude Oil Tanker

228. The route choice of Crude Oil Tanker is different from that of other tanker and other vessels in some points.

229. Crude Oil Tanker is restricted to pass through the Canal due to the size of the Canal. In the forecast, it was presumed that 300,000DWT or larger laden tankers could not use the Canal. Some VLCCs transport Crude Oil in half-laden condition. But the number of such transits is not large, and was not

included in the forecast.

230. Another difference was that the route is forecast based on a round voyage (two-directions). The alternative routes were S/S, C/S, and C/C. In-ballast Tankers were directly forecast in the route choice process.

231. Crude Oil Tanker is so large that some ports cannot be used as calling ports. Therefore, the following restrictions are added to the route choice.

232. N.America East Coast was divided into two sub-zones. One was the East Coast and another was the Mexican Gulf. Ports on the East Coast don't have deep-water berths, and cannot accommodate tankers over about 150,000DWT. The Mexican Gulf can accommodate ULCCs. Therefore, the crude oil demand from the Arabian Gulf was divided into demand to each zone based on the present ratio of the Suez transit cargo. And then different fleet-mixes were applied.

(b) Other Tanker

233. The route choices of Other Tankers (Tanker other than Crude Oil Tanker) were forecast for laden vessels (one-direction). Laden/in-ballast ratio was used to estimate in-ballast vessels.

(c) Bulk Carrier

234. The large volumes of bulk cargo on Bulk Carrier move from Oceania to Europe. Because Oceania stands in a sensitive location for the route choice, Oceania was divided into four regions (north/south/east/west). West Mediterranean was also divided into two.

(d) Containership

235. In general, containerized cargo is time-sensitive. Ship operators or shippers select the fastest and shortest route. In order to reflect this behavior in the forecast process, inventory cost saving of the cargo was considered. The cost for route choice was the sum of basic shipping cost and additional shipping costs.

236. There are two types of additional costs:

- Inventory cost of containerized cargo
  - The average value of time sensitive containerized cargo was estimated, and then, inventory cost per container was calculated. This value was multiplied by the number of expensive

containers.

- Capital cost of container box
  - Container box also has values. This value was multiplied by the number of containers on a Containership.

These costs were treated as parts of shipping cost in the forecast model.

(e) General Cargo Carrier

237. There is a lack of available data on the movement of General Cargo Carrier and General Cargo. Therefore, no modification was performed for General Cargo Carrier. The forecast was processed according to the basic procedure in the flowchart.

(f) Pure Car Carrier

238. A Pure Car Carrier (PCC) carries high-valued commodities. Therefore, commodity inventory cost should be included in the shipping cost. The value of automobile was estimated, and then inventory cost per cargo ton was calculated. This value was multiplied by the volume of automobile on a PCC. This cost was treated as a part of shipping cost in the forecast model.

239. The critical O-D for the choice of the Suez Canal is E.Asia -NW.Europe. At present no PCC on this route chooses the Cape route while the shipping cost via the Cape is highly competitive. Demand of PCCs is strong, and PCCs calls on many ports in the Mediterranean. Therefore most of the voyages between Asia-NW.Europe are not direct ones. Therefore, voyage distance between Asia and E.Med was used for the shipping between Asia and NW.Europe.

(g) Other Vessels

240. The sizes of Other Vessels are relatively small. This vessel type was directly forecast from the present pattern and the future scenario each vessel type. Other Vessels were classified into Combined Carrier, LASH, Ro/Ro, Passenger Ship, War Ship, and Others.

(iii) Shipping Cost Estimation

241. Shipping cost is structured as in Table 20.

Table 20 Component of Shipping Cost

Managing Cost	Indirect Cost	Capital
	Direct Cost	Manning, Insurance, Administration, Others
Voyage Cost		Fuel, Port Charge, Toll, Other charges

242. Managing cost is the cost that is born even if a vessel is not in voyage. Indirect Managing Cost is sometimes called Capital Cost. This cost includes the cost of construction of vessels, fitting out expense, the interest of the capital for construction. A part of this cost is charged to a voyage according to days of the voyage. Direct Managing Cost is the expense that the shipping company has to pay for operation even if a vessel does not voyage.

243. Voyage cost is the cost that is expensed during a voyage. Most of this cost is fuel cost. Others are port charge, toll and other charges such as cost for pilots.

244. Even if there are two voyages whose vessel types, commodity types, and volumes of loaded cargo are the same, the actual shipping costs depend on each voyage. However, shipping cost should be simplified to use in the model. For this purpose, a shipping cost is modeled. A shipping cost model is expressed as a function of trip distance of a voyage.

245. The shipping cost is calculated by the following equation;

C= B x D + A + Esc

, where C: shipping cost of cargo of a trip (USD/ton)

A,B : coefficient(constant)

D : distance of one trip (from an origin to a destination)

Esc : additional cost of the Suez route (USD/ton)

B is the coefficient for voyage distance. Esc is the additional cost that is added only when a vessel selects the Suez Canal. The values of these parameters are listed in Table 21, Table 22 and Table 23.

Table 21 Coefficient B of a Shipping Cost Function

Shipping Cost 'B' (dependent on the distance) (US$/ton-1000mile)

	V-Size (1000DWT)									
V-Type	0-25	25-50	50-75	75-100	100-125	125-150	150-200	200-250	250-300	300+
Crude Oil Tankers	3.774	1.448	0.928	0.722	0.611	0.561	0.534	0.444	0.415	0.408
Tankers (Products)	4.486	1.372	0.970	0.807	0.711	0.629	0.616	-	-	-
Tankers (LNG)	10.884	4.809	3.597	-	-	-	-	-	-	-
Tankers (LPG)	4.513	2.080	1.796	-	-	-	-	-	-	-
Tankers (Chemicals)	3.287	1.798	1.334	1.083	1.027	-	-	-	-	-
Tankers (Others)	5.404	1.758	1.176	0.895	-	-	-	-	-	-
Bulk Carriers	1.845	1.122	0.748	0.668	0.537	0.492	0.459	0.421	-	-
General Cargo Ships	3.558	2.073	1.842	-	-	-	-	-	-	-
Containerships	4.246	2.690	2.259	1.992	1.832	-	-	-	-	-

Table 22 Coefficient Esc of a Shipping Cost Function for a Laden Vessel

Shipping Cost 'EscL' (additional cost of the Suez route) (US$/ton)

	V-Size (1000DWT)									
V-Type	0-25	25-50	50-75	75-100	100-125	125-150	150-200	200-250	250-300	300+
Crude Oil Tankers	5.781	3.652	2.671	2.190	1.932	1.814	1.799	1.568	1.471	1.448
Tankers (Products)	7.436	4.256	3.284	2.888	2.651	2.523	2.488	-	-	-
Tankers (LNG)	15.060	10.135	8.978	-	-	-	-	-	-	-
Tankers (LPG)	9.096	6.095	5.426	-	-	-	-	-	-	-
Tankers (Chemicals)	6.525	4.819	3.932	3.391	3.270	-	-	-	-	-
Tankers (Others)	8.640	5.110	4.160	3.627	-	-	-	-	-	-
Bulk Carriers	5.302	4.012	2.735	2.437	1.937	1.837	1.701	1.592	-	-
General Cargo Ships	9.649	6.625	5.769	-	-	-	-	-	-	-
Containerships	9.393	7.436	6.869	6.838	6.736	-	-	-	-	-

Table 23 Coefficient Esc of a Shipping Cost Function for a In-ballast Vessel

Shipping Cost 'EscB' (additional cost of the Suez route) (US$/ton)

	V-Size (1000DWT)									
					100-12	125-15	150-20	200-25		
V-Type	0-25	25-50	50-75	75-100	5	0	0	0	250-300	300+
Crude Oil Tankers	5.004	3.145	2.298	1.884	1.662	1.561	1.496	1.281	1.243	1.225

246. Two kinds of Escs are listed in the tables. EscL in Table 22 is the additional cost for laden vessels. EscB in Table 23 is the additional cost for in-ballast vessels. The former Esc is easy to understand, but the latter Esc needs explanation because Esc is the additional cost for unit cargo volume.

247. In-ballast vessels, of course, don't carry any cargo. Therefore, "cost

for unit cargo volume" seems meaningless. But even if a vessel is in-ballast, some cost should be burdened to the vessel. EscB is used as this cost. The route choices of in-ballast vessels were done only for Crude Oil Tanker. Additional Cost of a round voyage is (EscL+EscB) x (Cargo volume) for S/S or (EscL) x (Cargo volume) for S/C. The values in these tables are calculated under the present Toll Table of SCA.

248. Here DS is denoted as the distance via Suez, and DC is denoted as the distance via Cape. If B x DC + A > B x DS + A + Esc, then Suez is selected. If B x DC + A < B x DS + A + Esc, then Cape is selected. In an other form, If B x (DC – DS) > Esc, then Suez is selected. Otherwise, Cape is selected.

249. The difference of distance DD that is calculated from the equation B x DD = Esc is the break-even distance. If DC – DS > DD, then Suez is selected. If DC – DS < DD, then Cape is selected.

(iv) Distances of trips

250. Distance of a trip from one zone to another zone is assumed to be the distance between representative ports of both zones. The distance is measured along a voyage route both in the Suez route and the Cape route.

251. The voyage distance of a return trip (north via Suez and south via Suez) is twice the distance in this table. The voyage distance of a round trip (north via Suez and south via the Cape) is the sum of both distances in this table.

252. The representative ports of zones are very important factors for route choice model. In this study, one port is selected for each of Tanker, Bulk Carrier, and other vessels. Some additional work will be necessary for more detailed study. For example, the representative port of CS.America is Santos in Brazil because this port is a big exporting port of dry bulk cargo. If another port is selected, the Suez Route may become advantageous.

253. It is recommended in future work that ports should be studied based on the ability of ports facilities and the handling volume of each commodity.

PRESUMPTIONS

(i) Alternative routes of the Suez Canal Route

254. Theoretical alternative sea-borne routes to the Suez Canal Route

are as follows.

- The Cape of Good Hope
- Panama Canal
- Arctic Ocean

255. The Panama route can be competitive to the Suez route but it is quite uncertain. Trades that may use the Panama Canal are limited because of the physical restrictions of the Panama Canal and the trade structure of commodities.

256. The Arctic route will not be popular in 2020 even if some commodities may use this route.

257. In conclusion, the Cape of Good Hope route is chosen as the alternative route for the Suez route in the route choice model.

(ii) A vessel type matrix

258. A vessel type matrix is used to set the type of vessel on which each unit cargo (one ton of cargo) is carried. Crude Oil is carried on Tankers. But containerized cargo is carried on General Cargo Carriers as well as Containerships. A Containership carries only containerized cargo if the vessel is a full-containership.

259. In order to set a vessel type matrix for forecasting, the actual vessel matrix of the Suez Canal is referred. The actual vessel matrix is derived from SCA Transit database in 1997-1999.

260. After reviewing the present matrix, the following scenario was introduced:

- Basically, vessels will shifts to the following four major vessel types.
  - Tanker
  - Bulk Carrier
  - Containership
  - Car Carrier
- For minor routes, General Cargo Carrier will remain, but will shift to mainly Containership and Bulk Carrier for major routes.
- Ro/Ro Ships will remain in the future. Transit and the cargo volume were set to be equal to the present ones. Therefore, Ro/Ro ship was not listed in these tables, but added later.
- LASH and Combined Carrier will be negligible.

- Passenger Ships and War Ships don't carry cargo.

261. Then, Table 24 and Table 25 were used in the route choice model. Vessel Type Matrix (0) was applied to the major routes. Vessel Type Matrix (1) was applied to the minor routes. The major routes and the minor routes are listed Table 26.

Table 24 Vessel Type Matrix for forecasting (0)

Southbound (%,2020)

Vessel Type	Crude Oil	Oil Products	LNG/LPG	Chemicals	Grain	Fabricated Metal	Coal & Coke	Ore	Fertilizers	Automobile	Containers	Others
Tankers	100.0%	100.0%	100.0%	100.0%								
Bulk Carriers					100.0%	100.0%	100.0%	100.0%	100.0%			100.0%
Combined Carriers												
General Cargo Carriers												
Containerships											100.0%	
LASH Ships												
Ro/Ro Ships												
Car Carriers										100.0%		
Passenger Ships												
War Ships												
Others												
Total	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%

Northbound (%,2020)

Vessel Type	Crude Oil	Oil Products	LNG/LPG	Chemicals	Grain	Fabricated Metal	Coal & Coke	Ore	Fertilizers	Automobile	Containers	Others
Tankers	100.0%	100.0%	100.0%	100.0%								
Bulk Carriers					100.0%	100.0%	100.0%	100.0%	100.0%			100.0%
Combined Carriers												
General Cargo Carriers												
Containerships											100.0%	
LASH Ships												
Ro/Ro Ships												
Car Carriers										100.0%		
Passenger Ships												
War Ships												
Others												
Total	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%

Table 25 Vessel Type Matrix for forecasting (1)

Southbound (%,2020)

Vessel Type	Crude Oil	Oil Products	LNG/LPG	Chemicals	Grain	Fabricated Metal	Coal & Coke	Ore	Fertilizers	Automobile	Containers	Others
Tankers	100.0%	100.0%	100.0%	100.0%								
Bulk Carriers					100.0%	100.0%	100.0%	100.0%	100.0%			40.6%
Combined Carriers												
General Cargo Carriers										2.5%		59.4%
Containerships											100.0%	
LASH Ships												
Ro/Ro Ships												
Car Carriers										97.5%		
Passenger Ships												
War Ships												
Others												
Total	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%

Northbound (%,2020)

Vessel Type	Crude Oil	Oil Products	LNG/LPG	Chemicals	Grain	Fabricated Metal	Coal & Coke	Ore	Fertilizers	Automobile	Containers	Others
Tankers	100.0%	100.0%	100.0%	100.0%								
Bulk Carriers					100.0%	100.0%	100.0%	100.0%	100.0%			59.3%
Combined Carriers												
General Cargo Carriers										0.3%		40.7%
Containerships											100.0%	
LASH Ships												
Ro/Ro Ships												
Car Carriers										99.7%		
Passenger Ships												
War Ships												
Others												
Total	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%

Table 26 Route Setting for Vessel Type Matrixes

origin \ destination		North the Canal						South the Canal					
		1	2	3	4	5	6	7	8	9	10	11	12
		CS.America	N.America	NW.Europe	W.Med	N.Africa	E.Med	E.Africa	A.Gulf	S.Asia	SE.Asia	E.Asia	Oceania
North the Canal	1 CS.America												
	2 N.America												
	3 NW.Europe												
	4 W.Med												
	5 N.Africa												
	6 E.Med												
South the Canal	7 E.Africa												
	8 A.Gulf												
	9 S.Asia												
	10 SE.Asia												
	11 E.Asia												
	12 Oceania												

: major routes

: minor routes

(iii) Fleet-mix

262. Fleet-mix is the distribution of the capacity of vessels. Two parameters were used to set the future fleet-mix of the Suez potential transits:

the present potential fleet mix and the future world fleet-mix.

263. The potential fleet-mix except Crude Oil Tanker will be almost equal to the fleet mix through the Canal. Therefore, the present potential fleet mix was estimated from the actual Suez transits. However the potential fleet-mix of Crude Oil Tanker is not clearly equal to the fleet mix through the Canal because laden VLSSs use the Cape route. Therefore, the present potential fleet-mix was derived from another data source. (Database from JAMRI)

264. The future world fleet-mix was set from the trend of new buildings of vessels.

265. Accordingly, the calculation of the future fleet-mix had 3 steps.

- Step1: Calculate the present fleet-mix from database
  For Crude Oil Tanker, JAMRI database that contains all voyages via Suez and via Cape was analyzed. The data year was 1999.
  For other vessels, SCA data was analyzed. The average fleet-mix from 1997 to 1999 was used.
- Step2: Calculate the growth rate of the fleet-mix by vessel size
  For Crude Oil Tanker, Product Tanker, Chemical Tanker, Bulk Carrier and Containership, the future fleet-mixes were estimated from Clerkson's data.
  For Other vessels, the present fleet-mixes were used for the future fleet-mix.
- Step3: Multiply the present fleet-mix by the ratio between the future share and the present share. Then future fleet-mixes were obtained. These fleet-mixes were adjusted such that the total percentage became 100%.

266. After the present potential fleet-mix and the future world fleet-mix were set, the future potential fleet-mix was calculated. In this stage, the voyage distance was considered because vessel sizes were not equal in different routes. All routes were divided into three categories. The distance is classified into three ranges.

- Short range : shorter than 6116 miles (distance between A.Gulf and NW.Europe)
- Middle range : shorter than 8228 miles (distance between SE.Asia and NW.Europe)

- Long range : longer than 8228 miles

267. After reviewing the present fleet-mix for each range, the scenario in Table 27 was applied.

Table 27 Scenario of Fleet-mix of Suez Transit vessels in 2020

Vessel Type	Scenario
Crude Oil Tanker	Fleet-mixes will differ in each route.
Products Tanker	Long and middle ranges have the same fleet-mixes. The trend of the world fleet-mix is applied to each of long & middle range and short ranges.
LPG/LNG Tanker	Present fleet-mix will continue in all ranges.
Chemical Tanker	All ranges have the same fleet-mix. The trend of the world fleet-mix is applied to all ranges.
Bulk Carrier	Each range (short, middle, and long) has its own fleet-mix. The trend of the world fleet-mix is applied to middle range and long range. Present fleet-mix will continue in short range
Containership	Long and middle ranges have the same fleet-mixes. The trend of the world fleet-mix is applied to long & middle range. Present fleet-mix will continue in short range.
General Cargo Carrier	Present fleet-mix will continue in all ranges.
Car Carrier	All ranges have the same fleet-mix. The trend of the world fleet-mix is applied to all ranges.

Table 28 Present Fleet-Mix

(1000DWT)

V-Type	Note	0-25	25-50	50-75	75-100	100-125	125-150	150-200	200-250	250-300	300+	Total
Crude Oil Tankers	NW.Europe				1%	1%	0%	0%		69%	29%	100%
	S.Europe & N Africa		0%		8%	9%	19%	11%		53%		100%
	US Gulf			0%	1%	0%	1%	1%	1%	29%	67%	100%
	Others	0%	0%		1%		1%		3%	43%	52%	100%
	Other Origins		0%	4%	15%	8%	8%	2%		45%	18%	100%
Tankers (Products)	long&middle	3%	30%	16%	41%	7%	1%	2%				100%
	short	9%	43%	17%	24%	6%		1%				100%
Tankers (LNG)	all	1%	38%	61%								100%
Tankers (LPG)	all	32%	41%	25%			1%	1%				100%
Tankers (Chemicals)	all	40%	58%	1%	1%	0%						100%
Tankers (Others)	all	27%	44%	14%	16%							100%
Bulk Carriers	long	3%	38%	36%	2%	1%	5%	14%	0%			100%
	middle	6%	32%	31%	4%	3%	13%	12%				100%
	short	9%	62%	13%	2%	1%	4%	9%	0%			100%
General Cargo Ships	all	93%	7%	0%								100%
Containerships	long&middle	1%	26%	63%	9%	1%						100%
	short	5%	63%	27%	2%	3%						100%
Car Carriers	all	92%	8%	0%								100%

Source: JAMRI database in 1999(Crude Oil Tanker)
SCA database ave.'97-'99 (except Crude Oil Tanker)

Table 29 Growth Ratio of Fleet-mix

(1000DWT)

V-Type	Note	0-25	25-50	50-75	75-100	100-125	125-150	150-200	200-250	250-300	300+	Total
Crude Oil Tankers	A.G / N.Amrica				1.41	1.56	1.70	1.71		1.12		1.00
	A.G / N. Europe & UK		1.06		1.41	1.56	1.70	1.71		1.12		1.00
	A.G / S. Europe $ N Africa			0.84	1.41	1.56	1.70	1.71	1.50	1.12		1.00
	A.G / US Gulf & Carrebian	1.02	1.06		1.41		1.70		1.50	1.12		1.00
	Others		1.06	0.84	1.41	1.56	1.70	1.71		1.12		1.00
Tankers (Products)	long&middle	1.02	1.06	0.84	1.41	1.56	1.70	1.71				1.00
	short	1.02	1.06	0.84	1.41	1.56		1.71				1.00
Tankers (LNG)	all	1.00	1.00	1.00								1.00
Tankers (LPG)	all	1.00	1.00	1.00			1.00	1.00				1.00
Tankers (Chemicals)	all	1.02	1.06	0.84	1.41	1.56						1.00
Tankers (Others)	all	1.02	1.06	0.84	1.41							1.00
Bulk Carriers	long	0.22	0.70	1.32	1.41	0.91	0.93	1.66	1.67			1.00
	middle	0.22	0.70	1.32	1.41	0.91	0.93	1.66				1.00
	short	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00			1.00
General Cargo Ships	all	1.00	1.00	1.00								1.00
Containerships	long&middle	0.66	0.78	1.72	2.63	2.50						1.00
	short	1.00	1.00	1.00	1.00	1.00						1.00
Car Carriers	all	1.01	0.92	1.00								1.00

Source: Estimated by JICA study team

Table 30 Future Fleet-Mix

(1000DWT)

V-Type	Note	0-25	25-50	50-75	75-100	100-125	125-150	150-200	200-250	250-300	300+	Total
Crude Oil Tankers	NW.Europe				1%	1%	1%	1%		96%		100%
	S.Europe & N Africa		0%		8%	10%	24%	14%		44%		100%
	US Gulf			0%	3%	0%	3%	5%	5%	83%		100%
	Others	0%	1%		1%		3%		8%	87%		100%
	Other Origins		0%	3%	20%	12%	13%	4%		48%		100%
Tankers (Products)	long&middle	3%	26%	11%	48%	9%	1%	3%				100%
	short	8%	40%	12%	30%	8%		2%				100%
Tankers (LNG)	all	1%	38%	61%								100%
Tankers (LPG)	all	32%	41%	25%			1%	1%				100%
Tankers (Chemicals)	all	39%	59%	0%	2%	0%						100%
Tankers (Others)	all	25%	43%	11%	21%							100%
Bulk Carriers	long	1%	25%	45%	3%	1%	4%	21%	1%			100%
	middle	1%	21%	39%	5%	3%	11%	19%				100%
	short	9%	62%	13%	2%	1%	4%	9%	0%			100%
General Cargo Ships	all	93%	7%	0%								100%
Containerships	long&middle	0%	13%	69%	15%	2%						100%
	short	5%	63%	27%	2%	3%						100%
Car Carriers	all	93%	7%	0%								100%

Source: Estimated by JICA study team

(iv) The Canal constraints

268. Due to the physical restriction of the Canal, laden tankers of more than 200,000DWT are have difficulty using the Canal at present. For the setting of the conditions in 2020, it is presumed that full-loaded tankers under 300,000DWT can use the Canal. This setting is a tentative setting for this study and not authorized by the Study Team. The maximum vessel size will be dependent on the future work of SCA.

269. Other conditions, such as toll system, operation system, are presumed to be the same as the present condition.

RESULTS OF FORECAST

(i) Cargo on Vessel

270. The cargo will be 851,178thousand ton in 2020, about 2.78 times the cargo volume in 1999. This growth will be mainly caused by the large increase of Containerships, Tanker and Bulk Carrier. The industrialization in Asia will largely contribute to this demand increase. Tanker will carry 110,373 thousand tons, 13% of total cargo volume and 50,305thousand tons out of that volume will be Crude Oil.

Table 31 Cargo Ton in 2020

(1000ton)

Vessel Type	(1)Forecast in 2020 S-bound	N-bound	Total	Comp. Ratio	(2)Actual in 1999 Total	Comp. Ratio	Growth (1)/(2)
Tankers	36,715	73,659	110,373	13.0%	37,736	12.3%	2.92
Crude Oil Tankers	2,798	47,508	50,305	5.9%	9,505	3.1%	5.29
Other Tankers	33,917	26,151	60,068	7.1%	28,232	9.2%	2.13
Bulk Carriers	119,317	204,316	323,633	38.0%	114,506	37.3%	2.83
Combined Carriers	-	-	-	0.0%	1,865	0.6%	0.00
General Cargo Ships	9,031	3,035	12,066	1.4%	18,192	5.9%	0.66
Containerships	175,266	219,363	394,629	46.4%	126,958	41.4%	3.11
LASH Ships	-	-	-	0.0%	953	0.3%	0.00
Ro/Ro Ships	1,242	710	1,952	0.2%	1,528	0.5%	1.28
Car Carriers	3,314	4,907	8,221	1.0%	3,781	1.2%	2.17
Passenger Ships	0	0	1	0.0%	0	0.0%	9.79
War Ships	22	38	60	0.0%	95	0.0%	0.63
Others	122	122	243	0.0%	1,055	0.3%	0.23
Total	345,029	506,149	851,178	100.0%	306,670	100.0%	2.78

Source: (1)JICA study team, (2)SCA transit database 1999

(ii) Transit

271. Total number of transits is expected to be 28,657 (78.5 transits per day in average) in 2020. This demand is about 2.11 times the transits in 1999. Most of cargo vessel types will increase their transits.

272. The Containership will have the largest increment to 11,639 transits, 2.66 times the transits in 1999. The share of Tanker will be almost same. General Cargo Carrier will decrease.

273. Note that Ro/Ro Ship, Passenger Ship and Naval Ship are not forecasted. The numbers in 2020 in the table are of the average transits from 1997 to 1999.

Table 32 Transit in 2020

(Number)

Vessel Type	(1)Forecast in 2020 V-Number	Comp. Ratio	(2)Actual in 1999 V-Number	Comp. Ratio	Growth (1)/(2)
Tankers	4,179	14.6%	1,991	14.6%	2.10
Crude Oil Tankers	725	2.5%	-	-	-
Other Tankers	3,455	12.1%	-	-	-
Bulk Carriers	8,037	28.0%	2,805	20.6%	2.87
Combined Carriers	-	0.0%	42	0.3%	-
General Cargo Ships	1,674	5.8%	2,157	15.8%	0.78
Containerships	11,639	40.6%	4,377	32.2%	2.66
LASH Ships	-	0.0%	41	0.3%	-
Ro/Ro Ships	259	0.9%	219	1.6%	1.18
Car Carriers	2,075	7.2%	929	6.8%	2.23
Passenger Ships	105	0.4%	120	0.9%	0.87
War Ships	215	0.7%	198	1.5%	1.08
Others	473	1.7%	734	5.4%	0.64
Total	28,657	100.0%	13,613	100.0%	2.11

Daily Transit	78.5	37.3

Source) (1)JICA study team, (2)SCA transit database 1999

274. Table 33 is the transits in 2020 by loading status and direction (northbound /southbound). Most transits (26,608transits, 93% of the total transits) will be laden transits.

275. Directions of transits are almost balanced similar to transits in 1999.

Table 33 Transit in 2020 by L/B and Direction

(Number,2020)

Vessel Type	Laden			In Ballast			Total		
	S-bound	N-bound	Total	S-bound	N-bound	Total	S-bound	N-bound	Total
Tankers	1,818	1,568	3,386	608	185	793	2,426	1,753	4,179
Crude Oil Tankers	24	268	292	406	27	433	430	295	725
Other Tankers	1,795	1,299	3,094	202	159	360	1,996	1,458	3,455
Bulk Carriers	3,172	4,549	7,721	141	174	316	3,313	4,724	8,037
Combined Carriers	-	-	-	-	-	-	-	-	-
General Cargo Ships	1,156	390	1,546	23	105	129	1,179	495	1,674
Containerships	5,187	6,339	11,526	82	31	114	5,269	6,370	11,639
LASH Ships	-	-	-	-	-	-	-	-	-
Ro/Ro Ships	120	105	225	16	19	34	135	124	259
Car Carriers	713	1,056	1,768	300	7	307	1,013	1,063	2,075
Passenger Ships	1	1	2	48	55	103	49	56	105
War Ships	11	8	19	103	92	195	114	100	215
Others	207	207	414	29	29	59	236	236	473
Total	12,385	14,223	26,608	1,351	698	2,049	13,736	14,921	28,657

Source: JICA Study Team estimation

276. Table 34 is the transit in 2020 by vessel size. Tanker, Bulk Carrier, Containership will be larger than the present sizes. As for Tanker, transits by 250-300,000DWT class will increase more than the average increase of Tanker. This is caused by the presumption that the maximum size of laden Tanker is set 300,000DWT.

Table 34 Transit by Size in 2020

(Number,2020)

Vessel Type	V-Size(1000DWT)										
	0-25	25-50	50-75	75-100	100-125	125-150	150-200	200-250	250-300	300+	Total
Tankers	2,110	1,214	82	161	72	115	59	15	350	-	4,179
Crude Oil Tankers	4	7	8	107	63	115	58	15	350	-	725
Other Tankers	2,107	1,208	74	55	9	0	1	-	-	-	3,455
Bulk Carriers	886	4,578	1,906	137	27	116	378	9	-	-	8,037
Combined Carriers	-	-	-	-	-	-	-	-	-	-	-
General Cargo Ships	1,635	39	1	-	-	-	-	-	-	-	1,674
Containerships	492	3,990	5,495	752	910	-	-	-	-	-	11,639
LASH Ships	-	-	-	-	-	-	-	-	-	-	-
Ro/Ro Ships	150	109	-	-	-	-	-	-	-	-	259
Car Carriers	1,992	82	1	-	-	-	-	-	-	-	2,075
Passenger Ships	104	-	1	-	-	-	-	-	-	-	105
War Ships	213	2	-	-	-	-	-	-	-	-	215
Others	473	-	-	-	-	-	-	-	-	-	473
Total	8,056	10,014	7,485	1,050	1,010	231	437	24	350	-	28,657

Source: JICA Study Team estimation

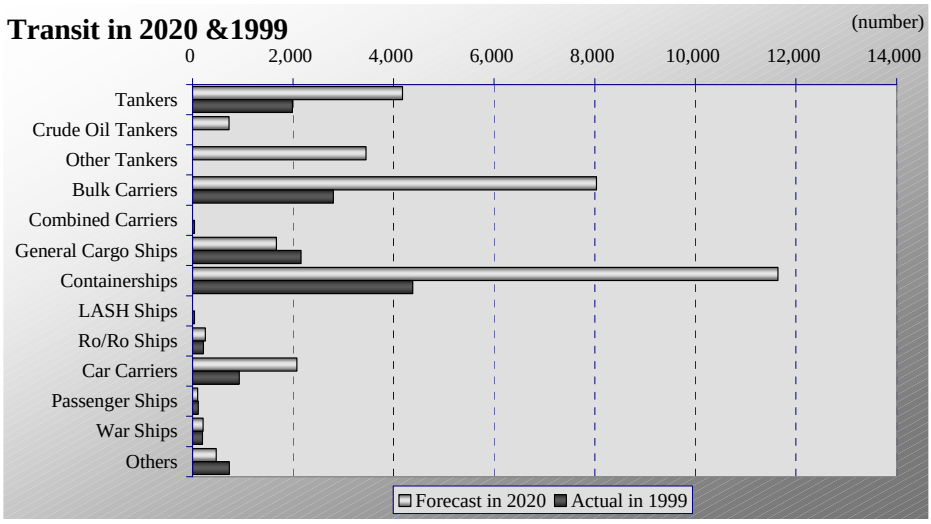


Figure 15 Transit in 2020 and 1999

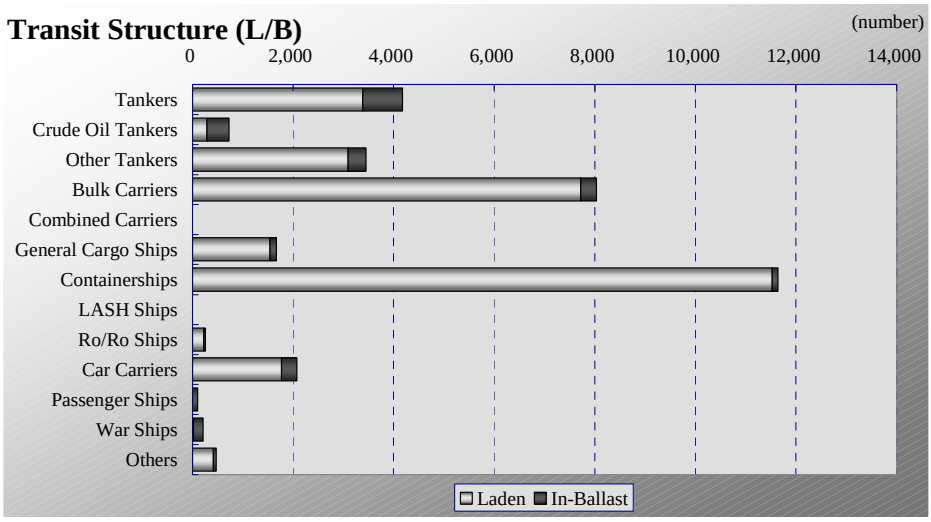


Figure 16 Transit Laden/in-Ballast in 2020

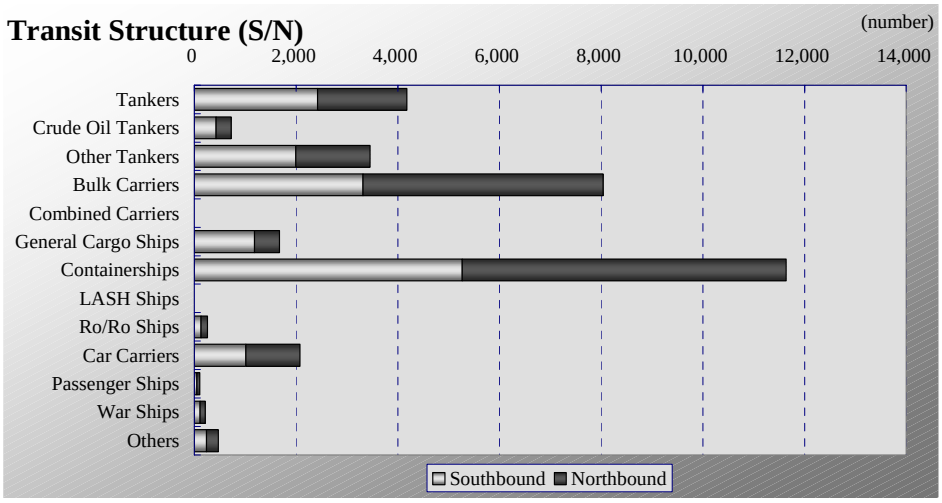


Figure 17 Transit Northbound/southbound in 2020

E. REVENUE FORECAST

PROCEDURE AND RESULT OF FORECAST

277. Forecast of revenue is quite simple. The result of the forecast of Transit was used. The representative SCNT of each vessel size class was determined by converting DWT to SCNT. Then, Toll was multiplied by SCNT.

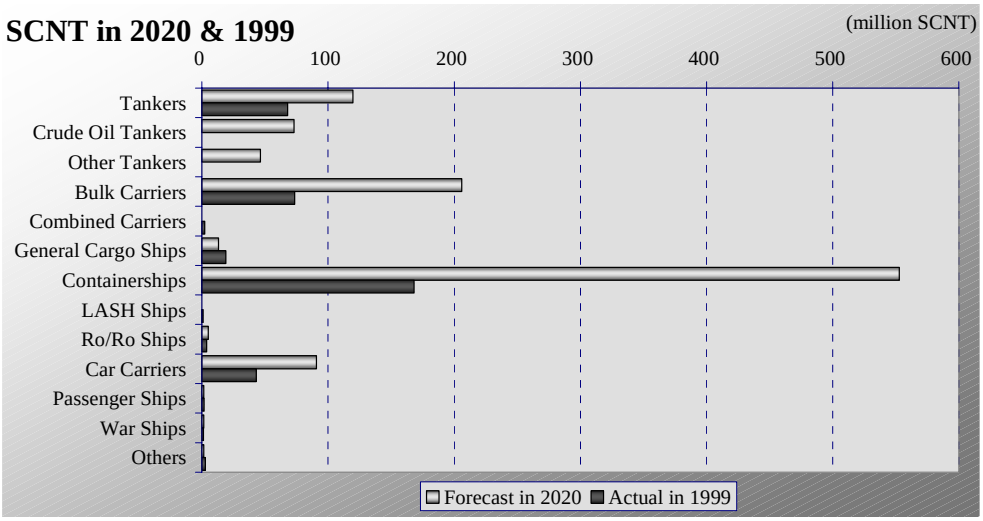
278. Table 35 is the future SCNT by vessel type. The trend of growth of SCNT is similar to that of Transit. Containership, Tanker and Bulk Carrier will contribute to the great increase in SCNT.

Table 35 Suez Canal Net Ton (2020)

(1000SCNT)

Vessel Type	(1)Forecast in 2020 SCNT	Comp. Ratio	(2)Actual in 1999 SCNT	Comp. Ratio	Growth (1)/(2)
Tankers	119,595	12.1%	67,862	17.6%	1.76
Crude Oil Tankers	73,076	7.4%	-	-	-
Other Tankers	46,519	4.7%	-	-	-
Bulk Carriers	206,084	20.8%	73,610	19.1%	2.80
Combined Carriers	-	0.0%	2,260	0.6%	-
General Cargo Ships	13,217	1.3%	18,880	4.9%	0.70
Containerships	552,734	55.7%	168,278	43.7%	3.28
LASH Ships	-	0.0%	1,159	0.3%	-
Ro/Ro Ships	5,144	0.5%	3,890	1.0%	1.32
Car Carriers	90,800	9.2%	43,262	11.2%	2.10
Passenger Ships	1,465	0.1%	1,797	0.5%	0.82
War Ships	1,434	0.1%	1,370	0.4%	1.05
Others	1,414	0.1%	2,758	0.7%	0.51
Total	991,888	100.0%	385,125	100.0%	2.58

Source) (1)JICA study team, (2)SCA transit database 1999



Source: JICA Study Team estimation

Figure 18 SCNT in 2020 and 1999

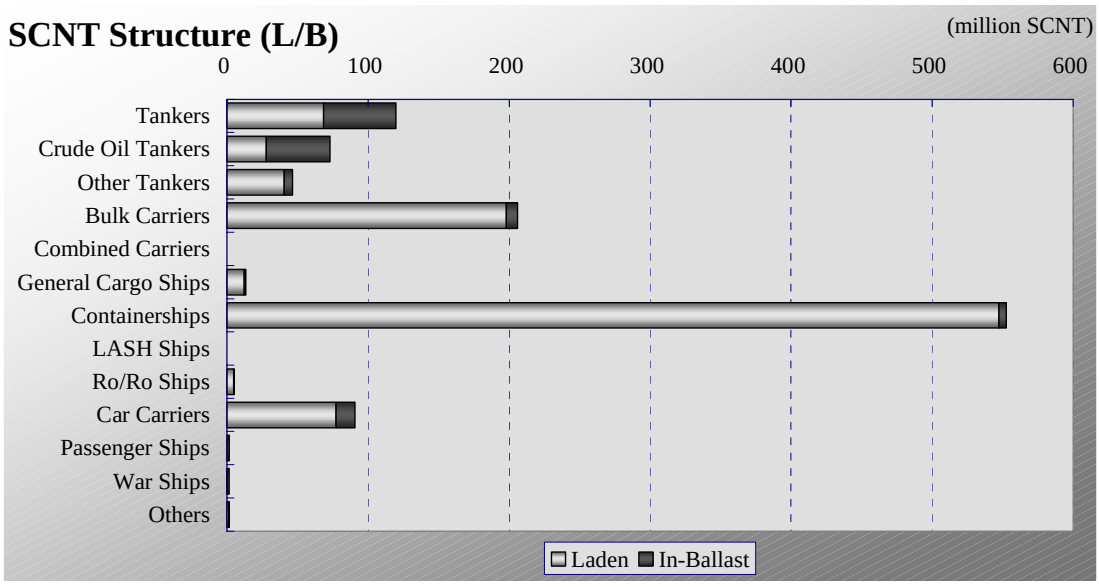
279. Crude oil tanker should be paid attention to. SCNT of in-ballast Crude Tanker is near that of laden Tanker. Even if the maximum size of the Suez transits becomes 300,000DWT, some tankers will use C/S route. In-Ballast VLCCs will pass the Canal bound for the south. As a result, Crude Oil Tanker will remain in the profitable position in SCNT while it will be only 2.5% in number of vessels.

Table 36 Suez Canal Net Ton by Direction and L/B (2020)

(1000SCNT,2020)

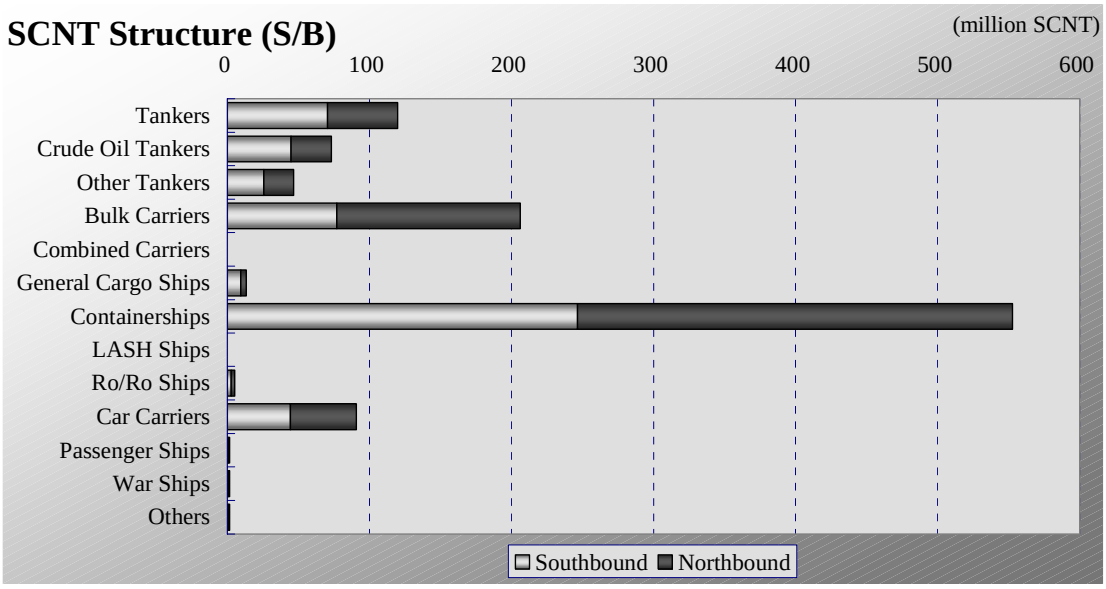
Vessel Type	Laden			In Ballast			Total		
	S-bound	N-bound	Total	S-bound	N-bound	Total	S-bound	N-bound	Total
Tankers	23,210	45,089	68,299	47,204	4,093	51,297	70,414	49,182	119,595
Crude Oil Tankers	1,547	26,271	27,818	43,269	1,990	45,259	44,816	28,260	73,076
Other Tankers	21,663	18,818	40,481	3,935	2,103	6,038	25,598	20,921	46,519
Bulk Carriers	73,068	125,119	198,187	3,879	4,019	7,897	76,946	129,138	206,084
Combined Carriers	-	-	-	-	-	-	-	-	-
General Cargo Ships	9,133	3,069	12,202	184	831	1,015	9,317	3,900	13,217
Containerships	242,398	304,918	547,316	3,964	1,454	5,418	246,362	306,372	552,734
LASH Ships	-	-	-	-	-	-	-	-	-
Ro/Ro Ships	2,515	2,320	4,834	138	171	309	2,653	2,491	5,144
Car Carriers	31,187	46,185	77,372	13,116	312	13,428	44,303	46,497	90,800
Passenger Ships	14	15	29	653	783	1,436	668	798	1,465
War Ships	111	115	226	646	562	1,208	757	677	1,434
Others	620	620	1,239	88	88	175	707	707	1,414
Total	382,255	527,449	909,703	69,872	12,313	82,185	452,127	539,761	991,888

Source: JICA Study Team estimation



Source: JICA Study Team estimation

Figure 19 SCNT Laden/In-ballast in 2020



Source: JICA Study Team estimation

Figure 20 SCNT Northbound/Southbound in 2020

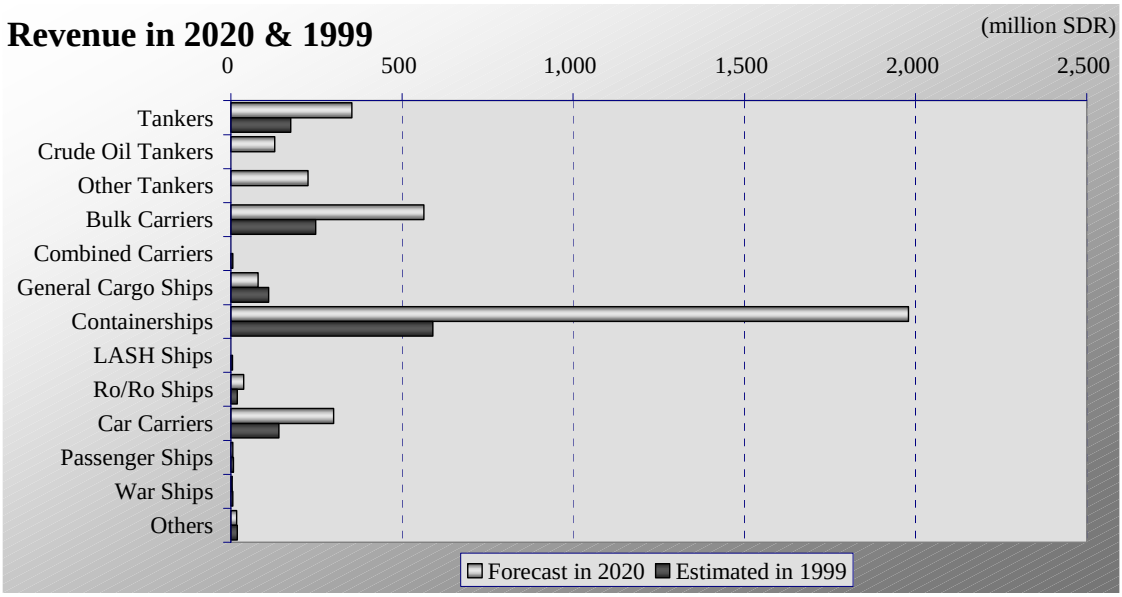
280. Table 37 is the revenue from Transit in 2020. The major source of the revenue will be Containership. Containership is the best revenue source for SCA at present, and the share of Containership will exceed 50%. The share of Car Carrier will be smaller because of less growth than Containership.

Table 37 Revenue (2020)

(million SDR)

Vessel Type	(1)Forecast in 2020 Revenue	Comp. Ratio	(2)Estimated in 1999 Revenue	Comp. Ratio	Growth (1)/(2)
Tankers	353.2	10.6%	175.4	13.3%	2.01
Crude Oil Tankers	127.8	3.8%	-	-	-
Other Tankers	225.4	6.7%	-	-	-
Bulk Carriers	564.1	16.9%	248.2	18.8%	2.27
Combined Carriers	-	0.0%	5.2	0.4%	-
General Cargo Ships	79.2	2.4%	110.3	8.3%	0.72
Containerships	1,979.0	59.3%	589.7	44.6%	3.36
LASH Ships	-	0.0%	4.6	0.3%	-
Ro/Ro Ships	37.2	1.1%	18.6	1.4%	2.00
Car Carriers	300.0	9.0%	140.2	10.6%	2.14
Passenger Ships	5.9	0.2%	7.2	0.5%	0.83
War Ships	3.9	0.1%	5.3	0.4%	0.73
Others	16.9	0.5%	18.9	1.4%	0.89
Total	3,339.4	100.0%	1,323.6	100.0%	2.52

Source: JICA Study Team estimation



Source: JICA Study Team estimation

Figure 21 Revenue in 2020 and 1999

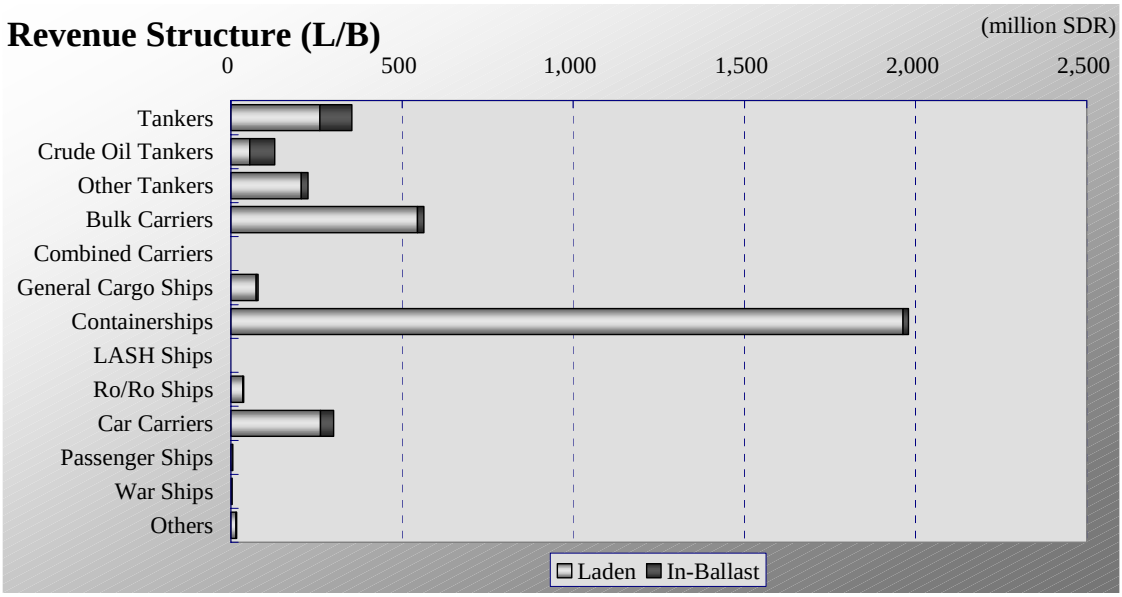
281. Table 38 shows the structure of revenue. It is almost the same as that of SCNT.

Table 38 Revenue by Direction and L/B (2020)

(million SDR, 2020)

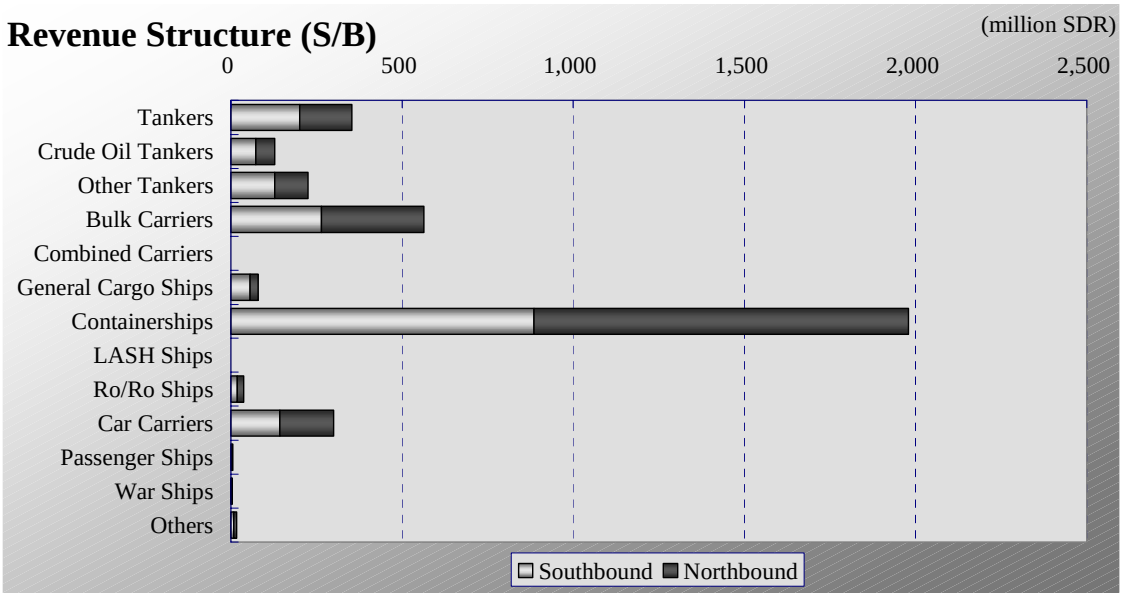
Vessel Type	Laden			In Ballast			Total		
	S-bound	N-bound	Total	S-bound	N-bound	Total	S-bound	N-bound	Total
Tankers	119.3	140.7	260.0	81.7	11.5	93.2	201.0	152.2	353.2
Crude Oil Tankers	3.5	51.5	55.0	69.2	3.6	72.8	72.7	55.1	127.8
Other Tankers	115.8	89.1	204.9	12.5	7.9	20.4	128.3	97.0	225.4
Bulk Carriers	256.8	287.9	544.6	7.5	12.0	19.5	264.3	299.8	564.1
Combined Carriers	-	-	-	-	-	-	-	-	-
General Cargo Ships	55.3	18.6	73.9	0.9	4.3	5.2	56.3	22.9	79.2
Containerships	873.0	1,089.6	1,962.6	12.0	4.4	16.4	885.0	1,094.0	1,979.0
LASH Ships	-	-	-	-	-	-	-	-	-
Ro/Ro Ships	18.1	16.2	34.3	1.3	1.6	2.9	19.3	17.8	37.2
Car Carriers	105.4	156.0	261.4	37.6	0.9	38.5	143.0	156.9	300.0
Passenger Ships	0.1	0.0	0.1	2.7	3.1	5.8	2.8	3.1	5.9
War Ships	0.4	0.3	0.7	1.7	1.5	3.2	2.1	1.8	3.9
Others	7.5	7.5	15.1	0.9	0.9	1.8	8.5	8.5	16.9
Total	1,435.8	1,716.9	3,152.8	146.5	40.1	186.6	1,582.3	1,757.1	3,339.4

Source: JICA Study Team estimation



Source: JICA Study Team estimation

Figure 22 Revenue Laden/In-ballast in 2020



Source: JICA Study Team estimation

Figure 23 Revenue Northbound/Southbound in 2020

F. SUMMARY AND ADDITIONAL SCENARIO

BASELINE SCENARIO

(i) Presumptions

282. Table 39 is the presumptions used for forecasting.

Table 39 Presumption of the Forecast

World Trade	GDP	: 3.1%
Potential Cargo	Sea-borne ratio	: the present ratio (1998)
	Containerization ratio	
	Liquid Cargo	: the present ratio (1998)
	Bulk Cargo	: the present ratio (1998)
	Other Cargo	: Increase to 80-90%
	Deduction to Crude Oil Pipelines	
	SUMED	: 120 million ton/year
	Iraq-Turkey	: 30 million ton/year
Transit	Route Choice	: A route with the minimum shipping cost is selected
	Canal Size Constraint	: Full-laden Tanker of 300,000DWT
	Toll	: the present toll table
	Discount	
	Crude Oil Tanker	: 45%(in-ballastVLCC from Mexican Gulf) 55%(in-ballast VLCC from CS. America)
	Bulk Carrier	: 80%(between NW. Europe and Oceania) 50%(between NW. Europe and SE./E. Asia) 50%(between E. Africa and W.E. Med)
	LNG Tanker	: 35% for every trip
	Surcharge	
	Containership	: 9.7% for every trip
	War Ship	: 25% for every trip
	Other Charges	: Tugboats, Agents, Pilots and Others Fee to Port Authority
	Shipping Cost	: a cost model was developed
	Commodity Inventory Cost is added for Containership (Applied to 30% of containerized cargo)	
	Container Box Capital Cost is added for Containership (Applied to 80% of nominal capacity of a Containership)	
	Commodity Inventory Cost is added for Car Carrier	
	Market Condition	: healthy market
SCA Revenue	Revenue from Toll and Tugboat	

(ii) Results

283. In 2020, the Suez Canal will get 28,657 vessels as a demand. If all demand passes through the Canal, 3,339mil SDR will be paid to SCA.

Table 40 Summary of Forecast (2020)

Vessel Type	Transit (Number)	SCNT (1000SCNT)	Revenue (million SDR)
Tankers	4,179	119,595	353
Crude Oil Tankers	725	73,076	128
Other Tankers	3,455	46,519	225
Bulk Carriers	8,037	206,084	564
Combined Carriers	-	-	-
General Cargo Ships	1,674	13,217	79
Containerships	11,639	552,734	1,979
LASH Ships	-	-	-
Ro/Ro Ships	259	5,144	37
Car Carriers	2,075	90,800	300
Passenger Ships	105	1,465	6
War Ships	215	1,434	4
Others	473	1,414	17
Total	28,657	991,888	3,339

Source: JICA Study Team estimation

Transit Structure (V-Type)

Total 28,657 transits

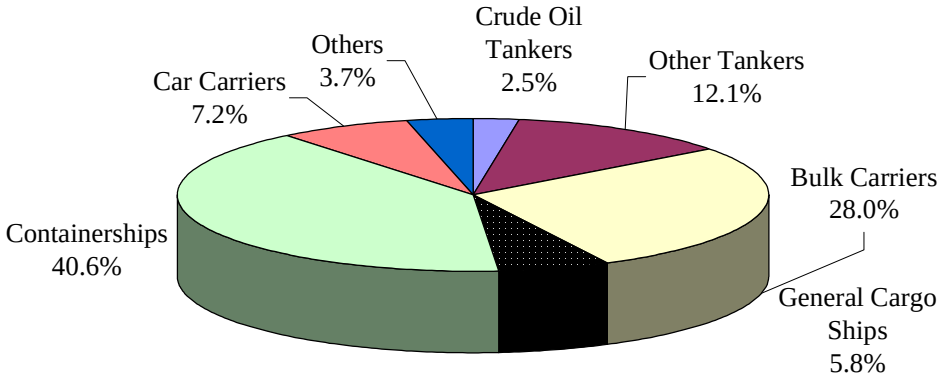


Figure 24 Transit in 2020

SCNT Structure (V-Type)

Total 991,888 thousand SCNT

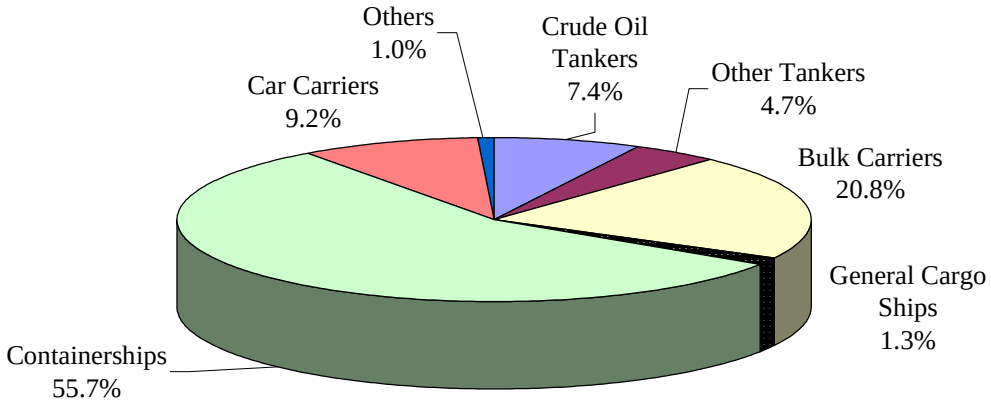


Figure 25 SCNT in 2020

Revenue Structure (V-Type)

Total 3,339 million SDR

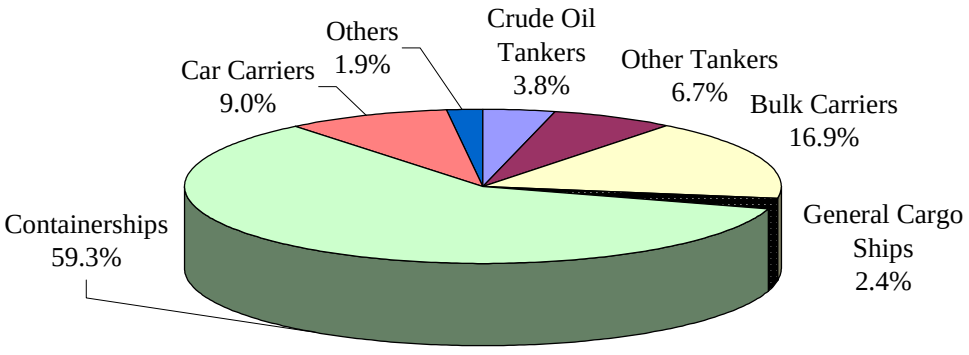


Figure 26 Revenue from Transit in 2020

ADDITIONAL CASE AND SCENARIO

284. This additional case is a negative condition of the Canal work. In baseline case, the maximum size of the canal transits was presumed to be 300,000DWT. But if the work of the Canal is delayed and the maximum size becomes 200,000DWT, the Canal will lose the chance to get Transit.

Table 41 Additional Case for the Canal Size

	Scenario
Case 0 (Baseline case)	300,000DWT or smaller laden vessels can use the Canal.
Case 1	200,000DWT or smaller laden vessel can use the Canal.

285. The number of laden Tanker will be 168 for case 1, while it will be 292 for case0. The Canal will lose 124 laden tankers. These tankers will use the Canal in ballast, but SCA will lose 31.4 mil SDR, about 24.6% of revenue from Crude Oil Tanker.

Table 42 Result of Forecast of Crude Oil Tanker

	Presumption		Result				
	V-Size Range (1000DWT)	SC transit Possibility	Transit (Number) Laden	In-Ballast	Total	SCNT (1000SCNT)	Revenue (millionSDR)
(1) Case 0	0-200	O	168	192	360	21,365	45.8
	200-300	O	124	241	365	51,711	82.0
	300+	X		0	0	0	0
	Total		292	433	725	73,076	127.8
(2) Case 1	0-200	O	168	192	360	21,365	45.8
	200-300	X		241	241	34,066	50.6
	300+	X		0	0	0	0
	Total		168	433	601	55,431	96.4
Difference [=(2)-(1)]	0-200				0		
	200-300		-124		-124	-17,645	-31.4
	300+				0		
	Total		-124	0	-124	-17,645	-31.4
Ratio [=(2)-(1)/(1)]			-42.5%		-17.1%	-24.1%	-24.6%

286. In baseline scenario, the shipping market is presumed to be healthy. But the actual market will not be necessarily healthy. Because it is almost impossible to forecast the future market, the forecast under other market conditions were studied.

Table 43 Additional Scenario for the Market Conditions

	Scenario
Scenario 0 (Baseline Scenario)	Market is healthy. Charter rate will cover the full capital cost.
Scenario 1	Market is not healthy. Charter rate will cover only 50% of the capital cost.
Scenario 2	Market is not healthy. Charter rate will not cover the capital cost.

287. If the market is not healthy and no capital cost is considered for the route choice, the transit will be 24,696 vessels per year. This value is 86% of Transit under a healthy market. The loss of revenue would be as much as 380.3 million SDR (= 3,339.4 - 2,959.1)

Table 44 Forecast under different market conditions
(case0: 300,000DWT Canal)

	Transit (Number)	SCNT (1000SCNT)	Revenue (millionSDR)
Scenario 0 (Healthy Market)	28,657 78.5/day	991,888	3,339.4
Scenario 1 (50% of the Capital cost)	27,239 74.6/day	943,629	3,207.8
Scenario 2 (0% of Capital cost)	24,696 67.7/day	840,042	2,959.1

288. If the Canal Work is delayed (200,000DWT Canal), the forecast under each scenario is given in Table 45.

Table 45 Forecast under different market conditions
(case1: 200,000DWT Canal)

	Transit (Number)	SCNT (1000SCNT)	Revenue (millionSDR)
Scenario 0 (Healthy Market)	28,533	974,242	3,307.9
	78.2/day		
Scenario 1 (50% of Capital cost)	27,190	936,608	3,195.3
	74.5/day		
Scenario 2 (0% of Capital cost)	24,677	837,322	2,954.3
	67.6/day		

289. In the baseline scenario, the future world fleet-mix was set based on the scenario that the recent delivery would be the future fleet-mix. Another additional scenario was considered based on the idea that the much larger Containerships and Car Carriers would be used in the future

Table 46 Additional scenario for the Future Fleet-Mix

(1000DWT)

V-Type	Voyage distance range	Scenario	0-25	25-50	50-75	75-100	100-125	125-150	Total
Containership	Long & middle	Baseline		13%	69%	15%	2%		100%
		Additional		5%	25%	40%	25%	5%	100%
	Short	Baseline	5%	63%	27%	2%	3%		100%
		Additional	5%	63%	27%	2%	3%		100%
Car Carrier	All	Baseline	93%	7%					100%
		Additional	75%	25%					100%

290. Table 47 shows the result of the forecast of the additional scenario. Due to the larger Container ships and Car Carriers, total number of transits will be smaller. But total SCNT will be larger.
Revenue will be slightly less than that of the baseline scenario because SCA tariff table is favorable to larger vessels.

Table 47 Summary of Forecast (2020)

(Larger Containerships and Car Carriers)

Vessel Type	Transit (Number)	SCNT (1000SCNT)	Revenue (million SDR)
Tankers	4,179	119,595	353
Crude Oil Tankers	725	73,076	128
Other Tankers	3,455	46,519	225
Bulk Carriers	8,037	206,084	564
Combined Carriers	-	-	-
General Cargo Ships	1,674	13,217	79
Containerships	9,997	575,584	1,965
LASH Ships	-	-	-
Ro/Ro Ships	259	5,144	37
Car Carriers	1,905	90,800	293
Passenger Ships	105	1,465	6
War Ships	215	1,434	4
Others	473	1,414	17
Total	26,843	1,014,738	3,319

Daily Transit	73.5

Source: JICA Study Team estimation