THE FINAL REPORT
ON
THE PRE-FEASIBILITY FOR THE CONSTRUCTION OF NEW SHIP REPAIR FACILITIES IN ETHIOPIA

January, 1974

OVERSEAS TECHNICAL
COOPERATION AGENCY

PREFACE

Complying with the request of the Imperial Ethiopian Government for a technical survey for its port and harbour development project, the Government of Japan entrusted the implementation of the prefeasibility survey for construction of new ship-repair facilities to the Overseas Technical Cooperation Agency.

In consideration of the fact that this project has an important significance as a foothold to promote the future industry of Ethiopia, the Overseas Technical Cooperation Agency sent a survey mission to Ethiopia on two occasions, in August 1972 and September 1973.

The survey team, after exchanging views and opinions with the officials concerned of the Ethiopian Government, and making various investigations and studies from the technical and economical viewpoints, has finally come to present the report to the Ethiopian Government, with recommendation that the construction of 6,000 G/T facilities in the Port of Massawa as a new ship-repair facility in Ethiopia is the best from the aspect of its feasibility.

I shall be most pleased if this report will contribute to the promotion of friendly relations as well as to the development of economic exchange between the both nations of Ethiopia and Japan.

Finally, I would like to take this opportunity to express my profound appreciation and thanks to the staff of the Ethiopian Government and the Japanese Embassy in Addis Ababa for their kind cooperation in executing the survey at the site, and to the Ministry of Foreign Affairs, Ministry of Transport and the Cooperative Association of Japan Shipbuilders for their assistance in sending the survey mission.

January 1974

Keiichi Tatsuke
Director General
OVERSEAS TECHNICAL COOPERATION AGENCY

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I. Conclusion and Recommendations

1. When constructing the ship repair facilities in Ethiopia, the following location and scale are considered the greatest possible from the viewpoint of feasibility:

a)	Location	Port of Massawa
b)	Scale	6,000 G. T.
c)	Investment amount	ET$ 14,560 thousand

2. It is recommended that the Government shall recognize the following matters and establish a certain policy to realize this project.

   a) To grasp the necessity of ship repair industry from the viewpoint of national economy.

   b) To establish some aid policy until the basis on which the ship repair industry can stand as an enterprise, is formed.

   c) To ask for the guidance of advanced shipbuilding nations to bring up the technology necessary for ship repair industry, and to bring up the native engineers.

   d) Establishment of an integrated administrative policy for shipping and shipbuilding.

II. Introduction

1. Object of survey

   The object of the present survey is to study the pre-feasibility of establishing the ship repair facilities in Ethiopia. For this purport, we first investigate the existing ship repair facilities in Ethiopia, and then, if new ship repair facilities be needed by Ethiopia in the future, study the capacity and location of suitable facilities, as well as the social economic effect of its establishment.

2. Organization of the survey team

This survey was conducted as a series of "Drawing up the development plan for the Port of Assab and the Port of Massawa," which was carried out by the "Japanese Survey Team" sent from Japan at the request of the Ethiopian Government. The pre-feasibility study of ship repair facilities was performed by the following three members:

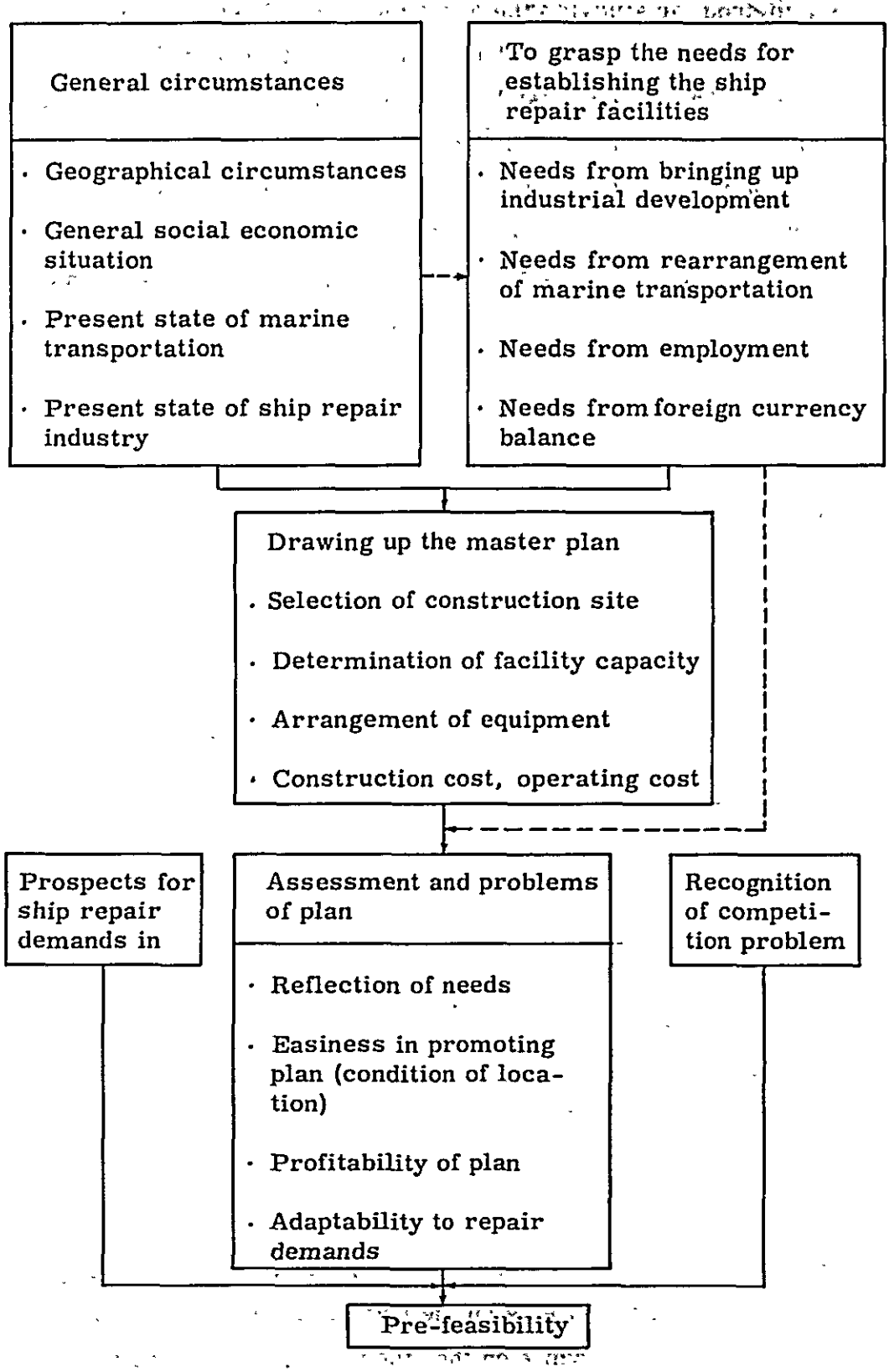
Nobutaka NANBU	*Section Chief, Shipbuilding* Division, Ship Bureau, Ministry of Transport
Ryuichiro TANINO	Section Chief, Shipbuilding Division, Ship Bureau, Ministry of Transport
Takashi OKUYAMA	General Manager, Technical Department, The Cooperative Association of Japan Shipbuilders

In executing the study and investigation, the survey team received a great deal of assistance from the Royal Ethiopian Embassy in Japan and the Marine Department of the Ethiopian Government.

3. Scope of survey

The scope of this survey is, in every respect, the feasibility study for the establishment of ship repair facilities, and the scheme of the study is as follows:

Study Scheme



4. Method for survey

As a method for studying the pre-feasibility of establishing the ship repair facilities, we adopt a kind of cost-benefit analysis method. The original cost-benefit analysis is an analysis method employed for determining the adoption or priority order among a project and its alternatives planned for achieving a certain object. In this case, the cost is the resources spent to accomplish the project (capital, labour, raw materials, etc.), and the benefit in the evaluated effect to be produced by executing the project.

In this study, the cases to be set up differ from each other only in location and capacity, and it is the aim to select the best one among them. Therefore, we adopt a rather simplified method than this, and evaluate the principal factors to be conceivable by means of the point system (factors of less cost or much benefit are assigned as higher points).

The greatest merit of this method is that this method makes it easy to select a project which reflects the needs more strongly, by introducing the conclusion through evaluation of the various factors even if the same evaluation factor, the relative weights very with the strength of needs for the project in the country.

Furthermore, as in the case of the pre-feasibility study of the construction project for ship repair facilities in Ethiopia, in case we intend to make a plan in a country where sufficient actual results or data are not available, this method is considered to be reasonable to avoid reaching an one-sided and distorted conclusion resulted from the insufficiency of actual records, shortage of data, etc.

Ship repair industry is originally a comprehensive industry having great economical effects on the related industries, labour intensification, etc., while on the other hand, it requires an

investment of rather long conception period and a considerably large amount for its equipments. Therefore, the priority of the plan should be thoroughly discussed from every viewpoint. When this method is adopted in the present study method, the former will substantially become as follows:

First, assigning the Port of Assawa and the Port of Massawa for the site, we draw up a few alternative feasibility plans of typical capacity, and then work out the arrangement of equipments for each facility capacity.

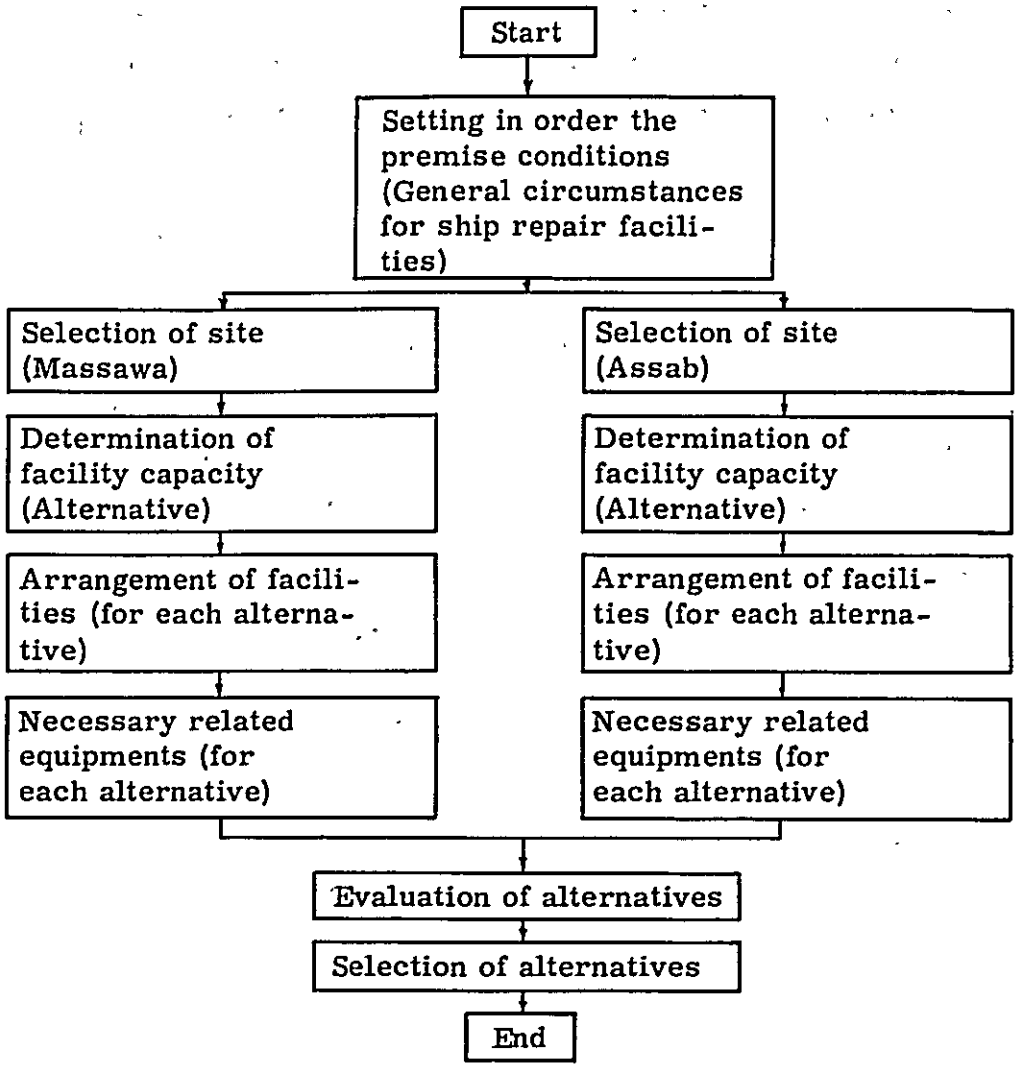
Secondly, we select the plan most advantageous for Ethiopia from the comprehensive viewpoint, by evaluating these alternatives for such factors as the quality of the site conditions, labour supply, repair demand, investment amount, profitability, etc. (most of these evaluation factors are social needs for the construction of ship repair facilities).

The survey team evaluates various alternative plans and recommends the best case, however the ultimate priority decision for each plan depends fundamentally upon the policy of the Ethiopian Government on this matter.

(1) The flow of the study method

The schematic chart of the flow of the study method will be shown as follows:

The Flow of the Study Method



(2) Evaluation table for alternative plans

The evaluation table for alternative plans is as shown below:

Evaluation Table for Alternative Plans

Evaluation \ Alternative			Alternative for site				
			Alternative for capacity				
		a	b	a x b	. .	. .	. . . . .
Individual evaluation	Factor 1						
	Factor 2						
	.						
	.						
	.						
	.						
	.						
	.						
Overall evaluation			$\sum$	a x b	.	.	.
Priority order							

Notes a: Weights among evaluation factors (determined according to the needs for ship repair facilities).

b: Evaluation grade for the factor in each case (evaluation will become higher for less cost and more utility).

(3) Evaluation factors

The following evaluation factors are adopted. We select the case of the highest evaluation by taking all the factors comprehensively into consideration.

A. Economic effect

- A-1 Impact on the related industries
- A-2 Benefit to the employment
  (The plan of high labour intensive capability is considered as giving more benefit)
- A-3 Impact on the foreign currency balance
- A-4 Impact on the reformation of marine transportation

B. Location conditions

- B-1 Climate (temperature, humidity, wind, etc.)
- B-2 Capability of water supply
- B-3 Capability of electric power supply
- B-4 Foundation for the ship repair industry
  (existing facilities and related industries, supply capability of shipbuilding and thereto related engineers)
- B-5 Hinterland
  (scale of the hinterland, and condition of the access formation)
- B-6 Competition problem

C. Demand for ship repairs
(adaptability of the facility capacity to the demand)

D. Amount of investments and operating funds

E. Profitability

5. Period of survey

The period of time for the survey and the places of visit were as stated below:

(1) The primary study on ship repair facilities (study of the existing condition)

22 - 29 August, 1972	Addis Ababa
29 - 31 August, 1972	Assab
31 August - 2 September, 1972	Massawa
2 - 3 September, 1972	Asmara
3 - 8 September, 1972	Addis Ababa
8 - 10 September, 1972	Djibouti
10 - 16 September, 1972	Addis Ababa

(2) The final study on ship repair facilities (complementary study of the existing condition, and pre-feasibility study)

25 September - 3 October, 1973	Addis Ababa
3 - 5 October, 1973	Asmara, Massawa
5 - 7 October, 1973	Assab
7 - 8 October, 1973	Djibouti
8 - 20 October, 1973	Addis Ababa

III. General Circumstances for Ship Repair Facilities

1. Circumstances

(1) Outline

Date of independence	: about 1,000 B. C.
Sovereign	: Emperor Haile Selassie I
Population	: about 25 million
Territorial area	: about 1.22 million sq. km
Capital	: Addis Ababa

(2) Climate and topography

Ethiopia is the only mountainous highland country in the plateau continent of Africa. The mountain ranges lying in the north-western and southeastern parts of the country are of 4,000-meter class. A huge valley divides the country into eastern and western parts, developing the northeastern lowland known as the world's hottest area on the Red Sea coast.

The air temperature on the highland where the majority of people live is about 16° - 26°C. Thus, the climate of the area is said to be mild notwithstanding its position in the tropical zone.

In the area spreading along the Red Sea coast where Massawa and Assab stand, it is extremely hot as the temperature rises to 35° - 40°C. The temperature variation during a year is little everywhere in the country.

The rainfalls on the country is little in general. There are a rainy season (mid-June to end-September) and a dry season (the rest of the year), with 80 per cent of annual precipitation in the former.

The altitude, precipitation and temperature of principal towns and cities are as given in Appendix 1.

(3) Population

Ethiopia has an estimated population of approximately 25.9 million as of 1972, of which about 13.5 million are male and about 12.4 million are female. The annual increase rate of population is estimated at 2.5 per cent. The population of the people of 30 years old and under accounts for some 70 per cent of the total. It is remarkable that the population of younger generation is greater.

The population in the cities and towns (of more than 2 thousand

population) is approximately 2.3 million, corresponding to some 9 per cent of the total, about 800 thousand people living in the capital city, Addis Ababa.

The population density is 20 per sq. km for the whole country and 3,980 per sq. km for Addis Ababa.

2. General economic state

(1) Outline

The G.D.P. (Gross Domestic Product) of Ethiopia as of 1972 was US$ 1,949 million, ranking 9th among all of the independent nations in Africa and boasting of the first place among East African nations. The economic growth rate for the recent three years are increasing steadily, with 7.3 per cent for '69 - '70, 2.1 per cent for '70 - '71 and 4.0 per cent for '71 - '72.

However, as the population is so many - the first in Africa is Nigeria of 57.98 million, the second is Egypt of 34.84 million and the third is Ethiopia of 25.89 million, as of 1972 - that the G.D.P. per head is as low as US$ 75.3, standing at the fifth from the bottom in all Africa and the last in East Africa. The future economic advancement utilizing the wide territory and plenty of labour is greatly expected.

(2) Industry

At present, agriculture is the key industry of Ethiopia, and approximately 90 per cent of the total population is engaged in agriculture, including the cattle breeding. However, it shows very low productivity, being mostly of self-sufficient nature. However, Ethiopia, having a climatic environment suitable for agriculture, owns the potential of becoming in the future a large granary of the Middle and Near East regions if properly developed. The main marketable agricultural product is coffee beans, representing a very important agri-

cultural product for Ethiopian economy.

The history of industrialization of this country is very short. She is still at a preliminary development stage, though the recent industrial production shows an average annual growth rate of 16 per cent. It is notable that her heavy chemical industry is carried out on a small scale. The ratio of industry in the whole economic activities is not great, however the industrial progress is promising in the future.

The present activities of mining, forestry and fishery are negligible, and the development of mining is needed with expectation.

Furthermore, it is a feature of Ethiopian economy that the share of service industries (Government and public services, commerce, etc.) is large.

(3) Foreign trade

The foreign trade of Ethiopia shows a characteristic typical of the developing countries. Export goods are all agricultural products, of which coffee beans representing 60 per cent. As the price of coffee beans is liable to be affected by the international market condition, the Ethiopian export trade is inevitably very unstable.

Most of import goods are centering on the heavy chemical industrial products along with the development of domestic industrialization.

Whereas a gradual increase in imports, exports depending heavily on coffee beans are levelling off, resulting in the great red figures of the trade balance, namely, the export (F.O.B.) as of 1972 is US$ 168.4 million while the import (C.I.F.) of the same year is US$ 189.4 million, showing the excess of imports by US$ 21.0 million.

Ethiopia is now at a developing stage or at the stage of initial investments preparing for the future industrialization, or in other words, in the conception period of investments. This is considered to be the greatest cause of the adverse balance of foreign currency, represented by a great deal of imports of machinery, industrial raw materials, etc. Henceforth, the country should exert their efforts for the improvement of foreign currency balance by adjusting the partiality of export industries, as well as by bringing up new export industries.

Appendices 2, 3 and 4 are given as the indices for the current economic situation of Ethiopia, particularly, indicating the position in Africa.

3. Economic position of the Port of Assab and the Port of Massawa

The present entrance ports for Ethiopia in terms of foreign trade are Assab, Djibouti and Massawa, which, as for 1964 (E.C.), share 34.4 per cent, 31.6 per cent and 34.0 per cent, respectively, or roughly equal parts.

As regards Assab and Djibouti, it is to be noticeable that the both ports commonly have Addis Ababa, the capital of Ethiopia, as the hinterland. As an access to Addis Ababa, Assab has a highway (about 877 km nearly completed) and Djibouti has a railway (about 1,000 km).

It is a problem that the ports have a distant hinterland, however when we consider that the potential of Addis Ababa being the capital and the city having the population largest in Ethiopia, the ports have sufficient possibility of developing as the bases for transit of goods, depending on the condition of formation of access in the future.

The city of Diredawa situated nearly in the midway between Addis Ababa and Assab will probably become one of the important

hinterland, if grown in the future keeping pace with the economic power rise of Ethiopia. However, as the Port of Djibouti is in French Somaliland, the weight on it is considered to be shifted on the Port of Assab.

The position of the Port of Assab, if expressed in a word, is a port having more or less the feature of a foreign trade port because of its scale, facilities, main sea routes, calling vessels (about 5,000 G. T. on the average), etc.

The Port of Massawa has Asmara, the second large city of Ethiopia, as its hinterland. The city is situated in a very ideal place about 120 km away from the port. The access is provided with one expressway and one railway which are considered to be sufficient for the present volume of cargoes.

The present state of the Port of Massawa, when judged from the port scale, condition of facilities, relation to principal sailing routes, size of vessels calling at (2,000 - 3,000 G. T. class), etc., is of a character as a domestic shipping port on the Red Sea coast.

4. Present state of marine transportation

The marine transportation system of Ethiopia can be divided roughly into two parts. One is the network of E. S. L. (Ethiopia Shipping Line), the only Government-operated shipping firm having foreign service ships (and one domestic service ship) and bears a part of Ethiopian external trade, and the other is the domestic shipping which sails chiefly along the Red Sea coast and performs feeder services for the foreign trade.

The substance of the E. S. L. is as follows:

Ethiopia Shipping Line

Owned vessels:	General cargo ship	"Lion of Juddah"
	"	"Queen of Sheeba"
	Tanker	"Ziwoy Haiq"
	"	"Lalibella"
Chartered vessels:	General cargo ship	"Gay Faith"
	"	"Gay Fortune"

Note: See Appendix 5 for details

The four owned ships, all registered in the Port of Assab, and the two chartered ships, making six vessels in total, constitute the foundation of Ethiopian shipping.

Among the six vessels, the "Ziwoy Haiq" is serving the Assab - Massawa route as a domestic tanker operation.

Of the remaining five vessels, the "Lalibella" is operated as a tanker, and other four vessels are mainly engaged in the European lines.

The cargoes shipped and the income gained by the five vessels other than the "Ziwoy Haiq" are shown in Appendix 6.

The actual showings of the cargoes shipped in 1972 was 96,515 tons tons or US$ 5.317 million (ET$ 10.9 million at the rate of US$ 1 = ET$ 2.05), of which the portion shipped by the Ethiopia's own transport system was 68,830 tons (71 per cent) or US$ 4.09 million (77 per cent). As the Ethiopia's own external trade for the same year was ET$ 633.49 million, the above results mean that the shipping share for E. S. L. was below 1.5 per cent. We consider, therefore, it will hereafter be necessary to raise the shipping share for domestic vessels by the formation of domestic fleet.

In fact, the E. S. L. is now carrying on an extremely high efficient shipping activity, e. g. the result of liners sailing on the European route shows an average turnround rate of 3. 3 turns/ship-year and the loading efficiency of nearly 100 per cent for the outward voyage and 70 per cent for the inward.

The E. S. L. has now a development plan for building tankers, bulk carriers and general cargo ships, one or two respectively. This plan is understood to be very appropriate if accompanied by a proper business activity, because the annual increase of shipping volume by the E. S. L. is 2 per cent against the fact that the future increase of external trade is about 10 per cent.

There are no accurate data available about the number of domestic service ships operated along the Red Sea coast. However, it is predicted that the needs for increasing their number and enlarging their size will be strengthened keeping pace with the rise of commodity transport activities, provided that in the future the Ethiopian economic power rises and the formation of the Port of Assab and the Port of Massawa is carried out.

5. Present state of ship repair industry

The ship repair facilities now existing in Ethiopia are merely the E. E. D. (Ethiopia Engineering Development) at the Port of Massawa and several kinds of workshops in Asmara which play the complementary role of the former.

The existing facilities related to the ship repair industry are described in the following:

(A) Ethiopian Engineering Development Ltd.

The Company established in 1947 has primitive shipyard and ancillary repair facilities, and is rendering ship-repairing services ususally to the local owner ships which are operating local sea transportation along the coast of the Red Sea area.

and Africa in the vicinity of Ethiopia and the ships calling at Massawa in transit. Particularly in emergent cases, the Company is also extending their limited and tentative repairing services to a large size ship like an ocean going vessel under technical help in welding, forgeing and metalling from Italian machine shops in Asmara.

The Works are mainly for repair of wooden and steel hull ships for its propulsion and engine and ancillary equipment and machinery, as well as for a primitive maintenance works.

Main Facilities:		Capacity
Slipways	3	500 - 1,200 t.d.w.
"	3	Wooden small boats

* Remarks: The above number of slipways and the capacity seems to be determined by the capacity of the winch (big 1 - 10 tons and small 2 - 5 tons) while the slip for take-up and take-down is only one.

* Ancillary Facilities:

Lathe machine	(small)	2
Compressor		1
Electric welder		6
Roller		1
Shaper		1
Others		

* Employees:

Qualified and skilled workers;

Engineer	1
Welder	14
Carpenter	4
Mechanic	8 (electric 3)

Take-up and take-down	9 (diver 6)
Others	8
Total	44 persons
Temporary workers	40 - 100 persons

* Steel consumed per year:

50 - 100 tons

* Number of ships repaired:

Year	Ships repaired on slipways		Ships repaired alongside quays	
	No. of ships	t.d.w.	No. of ships	t.d.w.
1967	32	5,570	-	-
1968	32	6,420	-	-
1969	22	5,120	2	930
1970	31	7,520	4	5,800
1971	25	7,320	4	2,530

* Number of ships repaired by flag

Year	Total No. of ships repaired	No. of foreign flag ships repaired	Percentage of foreign flag ships
1967	32	6	19
1968	32	9	28
1969	24	9	37
1970	35	10	29
1971	29	10	34

* Scope of repair

* Normal maintenance

* Hull repair (cutting, welding, painting, etc.)

* Engine repair (minor repair or major repair at Asmara)

* New ship building (once in the past)
* As a routine works in the Company, Limited works of renewing steel plates, hull-cleaning and painting, etc. are possible, however complicated repair works for engines appear to be done in workshops in Asmara.
* Turnover in 1969 ET$ 500,000

(B) Workshops in Asmara

1) DAL RE

Spares of the main engine can be worked and the repairing services of engines can be applied to at maximum 60 cm diameter cylinder. Therefore, we assume that a 5,000 - 6,000 G. T. ship's engine can be repaired, besides engines, main crankshafts and piston rods can also be reparied.

2) RAINIERI (workshop related to steel)
3) LORVSSO (workshop related to electricity)
4) SIGNORINI (workshop related to welding)
capable of welding aluminum, steel, stainless steel, etc.
5) COSTA RINCENSO
(workshop related to carpenter's work)

6. Necessity of construction of ship repair facilities

In newly planning the construction of ship repair facilities, it is necessary firstly to grasp what part the plan will play for the country and then to decide as to whether or not the plan should be executed. In other words, we are required to grasp correctly how and what sort of effects the construction of ship repair facilities would have on the country.

We hereunder describe about the main points of the necessity

and effects of the construction plan for ship repair facilities in Ethiopia. It is very difficult to evaluate the plan, since the plan is the first project for Ethiopia. Therefore, we will explain the plan referring to the examples of Japan and other countries.

(1) Effects on related industries

As the ship repair industry is a comprehensive industry, it requires a considerable power of the related industries for its existence. This can be said from the opposite direction as that the establishment of ship repair industry would give a strong impact on the related industries, thereby leading to bringing up the related industries.

A ship is composed of three main parts - hull, machinery and electricity/communication.

The hull part is built of steel, aluminium, every kind of pipes and other fittings. The machinery part contains propulsion engines and other auxiliaries, such as boilers, pumps, air-conditioners, etc. The electricity/communication part is composed of various nautical instruments and wireless equipments of U.H.F., V.H.F., etc. Hence, it can be understood that the ship is fabricated with various kinds of industrial products.

It is very difficult to evaluate and grasp how the ship repair industry can now contribute to Ethiopia in developing her industries. We describe hereunder about the Japanese case as an example to show the relations of the ship repair industry to other various industries.

(Reference) Propagating effect of shipbuilding industry on other industries (example)

The Japanese shipbuilding industry has grown to such an extent

as now building some 50 per cent of the world total shipbuilding. The position of the industry among other industries, or its relation to various industries is indicated as in Appendix 7 according to the data for 1965.

Though the economic structure (industrial structure) of Ethiopia is not necessarily the same as that of Japan, the both nations are very similar to each other in respect of scarce natural resources against abundant population. Therefore, both countries have to establish a policy for development of national economy on the ground of developing the processing trade type industries (imports of raw materials, exports of industrial products). From such viewpoint, it can be said that the Ethiopian industrial structure resembles greatly to the Japanese structure. For this reason, it is important to grasp the position of shipbuilding industry (same with ship repair industry) among other industries in the course of economic growth of Ethiopia in the future.

(2) Impact on shipping industry

The Ethiopian external trade has shown a steady growth of about 10 per cent every year, and its volume and scale will be expanded along with the rising of the Ethiopian economic power. Most of those commodities are fundamental to the economic activities of Ethiopia in the future, and their transportation will have to rely heavily on the shipping industry. Accordingly, those commodities should be supplied at a lower cost and with stability.

Whereas, in the external trade, the shipping share by ships under Ethiopian flag is as low as 1.5 per cent, so that the effect of fluctuation of the world transport cost on the Ethiopian economy is considered to be a serious problem. For this reason, it is extremely important for Ethiopia to under-

take the formation of her own shipping to carry out the transportation of cargoes necessary for the country. It is necessary at the same time to study the importance of development of her own shipbuilding industry to supply superior and low-cost ships to her own shipping industry.

Though the ship repair facilities now under our study in the present report is of a very small scale when viewed from the foregoing points, it is significant in terms of establishment of a new industry which has scarcely been existed in Ethiopia. The industry, therefore, should not be treated by short-term consideration, but it should be developed from a long-term viewpoint.

We would like to describe hereunder about the system of the "planned shipbuilding" as an example of success achieved in undertaking the simultaneous build-up of shipping and shipbuilding industries.

(Reference 1) Planned shipbuilding system (Japan)

The Japanese shipping industry which had suffered a decisive blow as a result World War II has undertaken its rehabilitation by systematic build-up of the domestic fleet. Considering its relation to the national economic growth, the Government firstly determined the annual building volume for shipping industry (building volume of domestic ships) and then let the Japanese shipyards build it. In this case, the Government financed an amount equivalent to some 60 - 70 per cent of the ship price, with a low interest rate, to the intended owners of ships to be built (in Japan, every shipowner is a private enterprise). Thus, the ships built by this planned shipbuilding system has totalled as much as 995 in number or 25.73 million G.T. up to the end of 1972. The Japanese shipbuilding industry has smoothly grown up because sufficient and stable orders

have been placed by the assistance of this system at the time when its foundation was yet poor. In other words, the cause of development of our shipbuilding industry now accounting for some 50 per cent of the world total shipbuilding is that our shipping and shipbuilding policies have always been planned as one body.

(Reference 2) Examples of assistance measures of various countries for the development of shipbuilding and shipping industries are shown in Appendix 8.

(3) Effect on employment

As Ethiopia has a population of the third in Africa, the G. D. P. per head is very low in spite of the high total G. D. P. This represents that the industrial structure is of very low additional value and of not labour intensive type, and it also shows that Ethiopia will be required to upgrade the industrial structure and, at the same time to manage to bring up the industriees by utilizing its abundant labour power.

Fortunately, the labour intensifying power of ship repair industry is so high that it can be said that whether this industry will succeed or not rests greatly with the labour cost. This can be substantiated by the recent brisk activities of shipbuilding industry in developing countries, such as in Southeast Asia, etc.

From the foregoing, the effect on employment under our contemplation in the present plan can be set in order as follows:

1) Effect of training skilled engineers

At the time of starting the operation of this industry, it is necessary that their staff are given guidance from skilled engineers invited from abroad. However, because of the necessity of its stabilized operation towards the future and the expensive cost

of foreign engineers, the industry is required to train the native engineers within two or three years and carry on the operation relying mostly on the trained native engineers. And, in the case where an expansion of the facilities is carried out after the operation has made steady headway to a certain extent, it is necessary that the level of native engineers is continuously elevated in such a way as the first trained engineers train the next generation.

2) Effect of employing general labourers.

The ship repair industry requires more general labourers in comparison with less high-class engineers. The labour cost is very low now in Ethiopia. When considered merely from this point, it is not necessarily preferable to carry out modernization and rationalization of the shipyard, but it is necessary to construct a ship repair yard suitable for the scale, the kind of demand at the site, the supply condition of labourers, etc.

It is, of course, imperative to take measures for the promotion of modernization and rationalization after securing the foundation, especially a moderate size of markets, and improving technical power for the ship repair yard.

(Reference) As an example showing the employing capacity of shipbuilding industry (including ship repair industry), the number of employees for individual shipyards is given in Appendix 9. As stated previously, the number of employees varies greatly with the extent of modernization and rationalization of the shipyard concerned.

(4) Effect on earning foreign currency:

The foreign currency balance of Ethiopia has been constantly

in the red every year. Ethiopia is now in the course of development, and it is natural that the weight of imports is much higher than exports. However, the country is necessary to exert their efforts for the improvement of the balance of foreign currency by bringing up the export industries. As to the ship repair industry, the country is depending entirely upon foreign countries in repairing even the ships of the E. S. L., and paying a huge amount of repairing expenses every year (ET$ 1.625 million in 1972).

To construct a new ship repair yard at home means a considerable expenditure if looked from the short-term viewpoint, however in the long term it will bring considerable earnings of foreign currency by repairing domestic ships, as well as by conducting sales activities for foreign ships.

7. Problem of competition with ship repair facilities in neighbouring countries

When planning a new project which has not been in existence in a country as in the case of construction of a ship repair yard in Ethiopia, we must consider the competition with neighbouring countries as an important factor for the construction feasibility study. Particularly as for the ship repair industry, the two points, namely the repair capacity (scale of facilities) and the technical capability, are vital factors for judging whether it can govern the market or not. However, if we are too nervous about the problem of competition, the feasibility of construction will necessarily be determined by foreign conditions.

Therefore, we wish to emphasize that in consideration of the fact that the construction plan for Ethiopian ship repair facilities reflects various impacts, such as bringing up the ability of repairing the domestic ships, making the foundation for developing the

industries, establishing the industry to plan the labour intensification from the viewpoint of employment effects, etc., it is more important and urgent to strengthen the constructed facilities themselves.

(1) Characteristics of ship repair industry from the viewpoint of competition

In the ship repair industry, the investment cost for the facilities is great and the repair cost per ship is high. Therefore, the industry is operated on the principle of production to order rather than ready production, whereby necessitating to grasp the demand by observing the market. In other words, the balance of demand and supply greatly affects the feasibility of the industry's existence as an enterprise.

(2) Present state of ship repair industry of neighbouring countries

The present state and the future plan of the ship repair industry of neighbouring countries are given in Appendix 10.

Our survey team were unable to carry out the direct investigations of neighbouring countries, and as a consequence, the data especially for the future plan are liable to be indefinite, since the present survey was at the feasibility study stage and the time allotted to the survey was rather short. However, it is considered sufficient if we try to grasp the data more accurately at a further advanced stage of our study.

(3) Target for efforts in securing the competitive power

In order that the ship repair industry of Ethiopia can acquire the adequate competitive power outwardly, the country is required to make their efforts on the following phases:

1) A certain extent of assistance measures by the Government aiming at bringing up the industry;
2) Bringing up the related industries;

3) Brisk business activities,

4) Improvement of technical capacity,

8. Subject ships for repairs and the scope of repairs

(1) Subject ships for repairs

The following are considered as the subject ships for repairs in Ethiopia:

(a) Coasters (smallwooden boats, small crafts)

(b) Fishing boats

(c) Ocean going vessels

(d) Vessels of the Royal Ethiopian Navy

(e) Others

The scope of the subject ships to be repaired is initially determined from the viewpoint of efficient operation of the yard taking into consideration the scale of facilities and the condition of equipments. However, it being the first facilities for Ethiopia, the objective scope should be enlarged as far as possible despite of some inefficiency be susceptible.

(2) Kind of repairs

The ship repairs can be roughly classified into periodical and temporary demands.

1) Periodical repairs

The periodical repair demand results from the regular survey executed once every four years and the intermediate survey executed once a year. In the regular survey, the ship undergoes a minute survey, every part of hull and machinery being overhauled, and her safety equipments, mooring and steering equipments, cargo gears and all others are also subjected to the inspection. Then, the ship undergoes repairing and maintenance necessary for the safety navigation for the ensuring four years.

While, in the annual intermediate survey, the ship is dry-docked and subjected to general inspection of her bottom shell, rudder, propeller and the rest of hull and machinery, and then undergoes reparis and maintenance.

The time required for repairing under the regular survey is about 10 days on the average, though it varies with the kind of ship, the extent of damage, etc.

2) Temporary repairs

The temporary repairs are required when the ship is suffered from disorder, for instance, due to casualties such as collision, grounding, etc., troubles during navigation, reconstruction and reformation of hull, etc.

The repair demand from foreign ships as expected in Ethiopia at first, occurs in such a case where the ship which called at the Port of Assab, the Port of Massawa, or other ports in neighbouring countries, is required to undergo urgent repairs.

The repairing time for the temporary repairs is about 5 days on the average, though it varies with the kind of ship, the extent of damage, etc.

9. Prospects for ship repair demand

(1) General

The ability of the ship repair facilities to secure repairing work depends on the level of repairing techniques of the yard, the time for repairs in the yard, the level of repair charge, etc.

Nevertheless, a considerable potential demand is expected for the reason that the number of ships which call at the Ethiopian ports is about 1,400 per annum, and that no noticeable ship

repair yard exists in neighbouring countries.

It can hardly be said that the Ethiopian ship repair facilities fulfil the above-mentioned conditions, therefore especially at the early stage, it will be necessary to obligate the domestic ships to carry out repairs at home in every case, as well as to undertake brisk sales activities.

We hereunder study, though quite roughly, the demand estimation for the ship repair industry of Ethiopia.

(2) Estimate of repair demand

1) Domestic ships

(A) Foreign trade ships

The foreign trade ships presently under Ethiopian flag are only the five vessels (totalling 43,493 G. T.) owned by the E. S. L., and the shipping share in external trade is 1.5 per cent. Assuming that the home fleet will be built up in line with the increase of external trade meeting with the development of Ethiopian economy, we can estimate the future volume of foreign trade ships of domestic ownership, as follows:

(Appendix 11 - Method for estimating foreign trade ships of domestic ownership)

Year	Number of vessels
1975	7
1976	8
1977	9
1978	11
1979	12
1980	14
1981	15
1982	17
1983	18
1984	20

Notes: Shipping share assumed to be raised by 0.35 per cent annually and up to 5 per cent finally.

(B) Domestic transport ships

As of 1972, the ships registered in the Port of Assab were 35 and those in the Port of Massawa were 30, excluding the wooden "Dhow" which cannot be the object of ship repairing when considered on the basis of profitability, and foreign trade ships owned by the E. S. L.

Their average size is estimated at about 200 G. T. according to the ship-size survey carried out in the Port of Massawa. As the past data for domestic transport ships were unavailable, we intended to estimate their increase by assuming that they will grow keeping pace with the future development of economy.

Estimate of the number of domestic transport ships:

Year	Number of ships
1975	65
1976	76
1977	79
1978	82
1979	85
1980	88
1981	91
1982	95
1983	99
1984	103

(C) Royal Ethiopian Navy

The Royal Ethiopian Navy has 15 vessels at present, having a possibility of contributing greatly to the profitability of ship repair industry as a regular domestic customer depending on the condition of the future development plan.

However, we excluded the demand from the R. E. N. when calculating the profitability for the reason that we were unable to ascertain their development plan

which is a national secret, and that we could not grasp the past results of their repair expenses. It is said that in the past one frigate was repaired in Madagascar or Bombay, one mine-sweeper at the E. E. D. and the remaining 13 at the Naval Base in Massawa.

2) Foreign ships

As the foreign ships having a possibility of utilizing the Ethiopian ship repair facilities, we think firstly of the ships calling at Ethiopian ports and the ships owned by neighbouring countries. And, whether the latter would become a customer or not, as mentioned previously, is dependent mainly upon the technical level, the time spent for repairing and the condition of repair facilities in other countries. Therefore, we excluded the latter from studying the profitability since it is too optimistic to expect the latter from the beginning as a definite demand source.

The volume by kind of ships under flags of African countries is given in Appendix 12 for reference.

Accordingly, as the ship which could be the source of repair demand to the Ethiopian ship repair facilities, we considered only the ships calling at Ethiopian ports.

The number of ships and its distribution by size of the ships calling at the ports of Assab and Massawa are given in Appendix 13 - " Method for estimating foreign custom ships for repairs."

It can hardly be considered that all of those ships would be the customer for repairs. This is because that the ships to undergo repairs are required to be completely or nearly emptied, excepting the case where the repairing is very simple. From such point of view, we must

as certain the number of ships calling at the ports of loading or discharging cargoes relating to Ethiopia. However, only a small part of the ships which are completely or nearly emptied are actually repaired.

Furthermore, for the purpose of executing efficient operation, the repair yard should make selection of ships for repairs meeting with the scale of the repair facilities.

From the foregoing, if we estimate the number of foreign ships to be repaired, it would be as follows:

Estimate of the number of foreign ships to be repaired at the Ethiopian repair facilities:

Subject / Year	3,000 G. T.	6,000 G. T.	10,000 G. T.
1975	11	12	7
76	11	12	7
77	11	13	7
78	12	13	7
79	12	14	8
80	12	14	8
81	13	15	8
82	13	15	8
83	14	16	9
84	14	16	9

3) Total demand

The total number of ships being expected to utilize the ship repair facilities in Ethiopia is as given in the Table below.

This is very rough and merely an estimation with many

uncertain factors so that it should be revised more precisely by further studies in the future. Further, the number of ships has a character being varied with the scale of the ship repair facilities.

Year	Domestic ships		Foreign ships			Total number		
	Domestic transport ships	Foreign trade ships	3,000 G. T.	6,000 G. T.	10,000 G. T.	3,000 G. T.	6,000 G. T.	10,000 G. T.
1975	65	7	11	12	7	24	23	16
76	76	8	11	12	7	26	24	17
77	79	9	11	13	7	27	26	18
78	82	11	12	13	7	29	29	21
79	85	12	12	14	8	29	31	23
80	88	14	12	14	8	30	33	25
81	91	15	13	15	8	32	36	26
82	95	17	13	15	8	32	37	28
83	99	18	14	16	9	34	39	30
84	103	20	14	16	9	35	42	32

Note: The total number indicates the number of ships corresponding to the respective yard scale.

Domestic ships: Domestic transport ships are estimated assuming the average size at 200 G. T. Foreign trade ships are all assumed at 3,000 G. T. and over.

IV. Master Plan

1. Layout of ship repair facilities (classified by alternative plans)

(1) General

We have set up the following alternatives to be available in Ethiopia as ship repair facilities and prepared respective layout.

However, we have eliminated the layout of the Ethiopian Engineering Development Ltd. (EED) because of its inadequacy for the future Ethiopian project due to the maximum capacity being limited to 2,000 G. T. by the shallow depth of the front sea area of the present site.

Alternative of facility site	Facilities scale	
Massawa	2,000 G. T.	(EED expanding plan)
	3,000 G. T.	
	6,000 G. T.	
	10,000 G. T.	
Assab	3,000 G. T.	
	6,000 G. T.	
	10,000 G. T.	

Out way of thinking in preparing the layout and our concept of operation of the facilities are given in the following:

(2) Planning of layout

The new construction of facilities requires a huge amount of investments, necessitating a considerable time of period before the investment effects appear. In addition, it being the first ship repair facilities for Ethiopia, we have shown

an example of layout of minimum necessity for 3,000 G. T., 6,000 G. T. and 10,000 G. T.

It is not possible to determine the position of the site without fully carrying out the test standard penetration of the strength of basement, the position of existing rocks under the basement, etc. by experts, since the facilities require extensive civil engineering works. Accordingly, we worked out the layout for 3,000 G. T. and 6,000 G. T. assuming the reclaimed land with shorelines of two sides be obtainable. Furthermore, in the case of 10,000 G. T., we have planned assuming only one side of shoreline be obtainable.

As for the site for construction, it is necessary to make a final determination by taking into full consideration the climate, weather, tidal currents, water depth, entering and leaving ports of ships, etc.

The area of the site for facilities has an ample space taking the possibility of expansion into consideration so as to meet with the enlarged size of ships to be repaired. It is desirable for the actual construction of facilities to make the width of a dock as wider as possible. Because, the lengthwise expansion can be done within a short period of time of suspension of the work in the dock, while the widthwise expansion is difficult unless the work in the dock is stopped during the work period.

(3) Summary of layout

It is preferable to carry out building and repairing to be compatible with each other for the efficient operation of the shipyard.

In consideration of the necessity of building small craft of up to 500 G. T. to comply with the request of the Ethiopian

Government and as a result of the survey, we have planned the building facilities together with the repair facilities. However, in the case of the 10,000 G. T. layout, the building of small craft in a larger dock than the above class will be uneconomical due to the adaptability of its equipments, so that we have planned the facilities capable of building 3,000 G. T. class as newbuilding facilities.

a) Scale of 3,000 G. T. repair facilities
(Refer to the 3,000 G. T. General Arrangement)
The objective vessels for the facilities are the coasters to be operated around the Red Sea coast.

Area of the site	55,000 m^2
Dimensions of 3,000 G. T. repair dock	(L) (W) (D) 110m x 20m x 6.5m
Standard objective ship, 3,000 G. T.	(Lpp) (B) (D) 93m x 15m x 8m
Maximum ship for docking abt. 4,800 G. T.	(Lpp) (B) (D) 105m x 18m x 9m
Dimensions of 500 G. T. building berth	(L) (W) 60m x 14m
Standard objective ship, 500 G. T.	(Lpp) (B) (D) 50m x 88m x 44m
Maximum ship for slipway 700 G. T.	(Lpp) (B) (D) 56m x 10m x 5m

Note: The building berth can be used as a repair berth.

Mooring quays, 240m & 100m (maintaining more than 6m depth at low tide)

b) Scale of 6,000 G. T. repair facilities

(Refer to the 6,000 G. T. General Arrangement)

The objective vessels for the facilities are the foreign trade ships owned by the E. S. L., and the foreign ships of representative size in the range of 4,000 G. T. to 8,000 G. T. calling at the ports of Ethiopia.

In addition, it is possible to repair two 1,000 G. T. - class ships, or four 500 G. T. - class ships simultaneously, with the use of the middle gate.

As for the building of a 500 G. T. - class ship, we adopted the building dock system which is, of course, fully effective for use as a repair dock.

Furthermore, as for newbuilding of ships, the building dock system has much more merits because it facilities construction in a horizontal level and is easy in assembling hull blocks.

In this layout, we provided a slip-berth for building or repairing of small steel or wooden craft by taking into consideration such a case when no shipbuilding facilities are available in the vicinity.

Area of the site	78,000 m^2
Dimensions of 6,000 G. T. repair dock	(L) (W) (D) 140^m x 23^m x 9^m
Standard objective ship, 6,000 G. T.	(Lpp) (B) (D) 125^m x 18.5^m x 10.5^m
Maximum ship for docking abt. 8,000 G. T.	(Lpp) (B) (D) 132^m x 19^m x 11.3^m
Dimensions of 500 G. T. building dock	(L) (W) (D) 60^m x 14^m x 6^m

Standard objective ship, 500 G. T.	(Lpp) (B) (C) 50^m x 8.8^m x 4.4^m
Maximum ship for docking, 700 G. T.	(Lpp) (B) (C) 56^m x 10^m x 5^m
Dimensions of slipway	(L) (W) 50^m x 20^m

Objective ship, 100 G. T. - 300 G. T. small craft

Mooring quays, 165^m & 220^m (maintaining more than 8^m depth at low tide)

c) Scale of 10,000 G. T. repair facilities
(Refer to the 10,000 G. T. General Arrangement)
The scale of the facilities was determined assuming that the cargo ships calling at the ports of Ethiopia will be of larger size in the future.

In addition, it is possible to repair two 2,000 G. T. - class ships, or four 1,000 G. T. - class ships simultaneously, with the use of the middle gate.

As for the building of a 3,000 G. T. class ship, two plans are shown of a building dock and a slip berth. As the layout of such class may not be profitable at the present condition, we displayed a form of perfect facilities for ship building and repairing as may be expected in the future.

It will be insufficient to have only one dock for effective utilization of repair facilities, and its shortcoming will be covered by utilizing the building dock for repair work and thereby providing completely ideal repair facilities.

Furthermore, if the building dock and slip-berth are put in full operation, it would be possible to build about ten vessels for greater coasting service per year, enabling

to fulfil the demand for merchant fleet rapidly at the time of necessary.

Area of the site	133,000 m^2
Dimensions of 10,000 G. T. repair dock	(L) (W) (D) 160m x 28m x 10.5m
Standard objective ship, 10,000 G. T.	(Lpp) (B) (D) 140m x 23m x 12m
Maximum ship for docking, abt. 13,000 G. T.	(Lpp) (B) (D) 148m x 23.5m x 13.5m
Dimensions of 3,000 G. T. building dock	(L) (W) (D) 110m x 20m x 6.5m
Standard objective ship, 3,000 G. T.	(Lpp) (B) (D) 93m x 15m x 8m
Maximum ship for docking 4,800 G. T.	(Lpp) (B) (D) 105m x 18m x 9m
Dimensions of 3,000 G. T. slip-berth	(L) (W) 120m x 35m
Objective ship for building, 3,000 G. T. 10,000 G. T.	(Lpp) (B) (D) 93m x 15m x 8m 65m x 11m x 5.6m

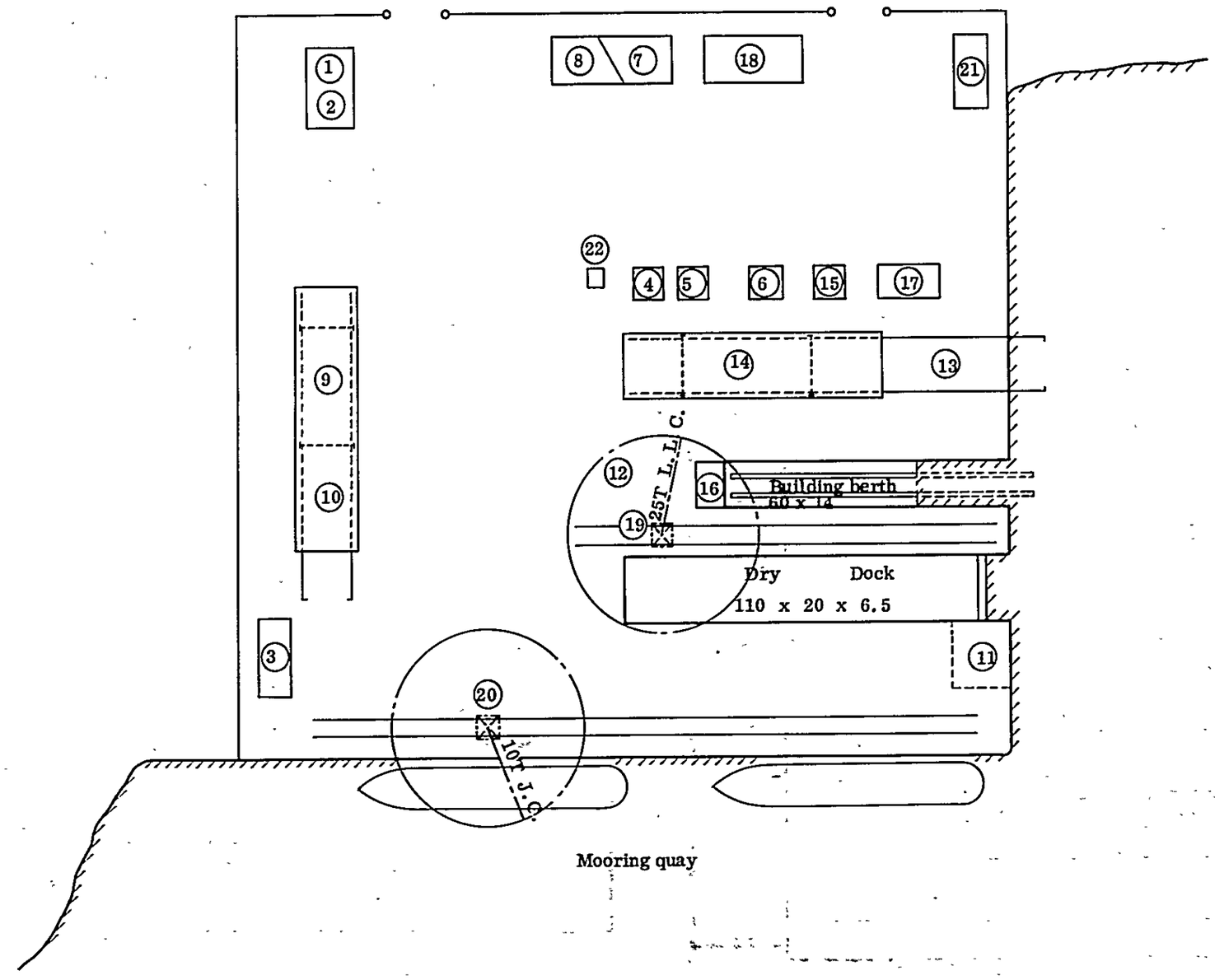
Mooring quays, 100m, 180m, 200m (maintaining more than 9.5m depth at low tide)

Layout of typical repair ship facilities (3,000 G.T.)

Factory area : 55,000 m^2

① ~ ⑳ Refer to appendix

Scale : 1/1,500



Necessary Auxiliary Facilities (3,000 G.T.)

No.	Facilities	Description	Area	Remarks
1	Head Office	Management Section	360m^2	
2	and Dock	General Section		
	House	Labour Section		
		Business Section		
		Materials Section		
		Designing and Drawing Section		
		Mess Room, Shower Room,		
		Locker Room, and Repair Ship		
		Seamen's Rest Room		
3	Worker's		240m^2	
	Rest House			
4	O_2 Room	Manifold System or Liquid		
		Oxygen Tank		
5	C_2H_2 and	Acetylene Gas Cylinder and		
	LPG Room	LPG Tank		
6	Compressor	Air Compressor and		150ps
	Room	Storage Tank		
7	Second Office	The Field Oversees Room	570m^2	
		Worker's Rest Room, Locker		
		Room, Tool, Shop		
8	Mold Loft	Floor of Ceder Planking	570m^2	Located upstairs
		13m x 35m		For better
				ventilation
				and sun-shine
9	Machine	Lathe Machine	1,600m^2	
		16' x 1, 10' x 1, 6' x 1		

No.	Facilities	Description	Area	Remarks
10	Fitting and Repair Shop	Universal Milling Machine x 1 Radial Drilling Machine x 1 Horizontal Boring Machine 12' Floor Grinder Shearing Machine x 2 Surface Plate x 1 Overhead Travelling Crane 5T x 2 Oil Pressure Press 5T x 1 Carpenter Shop, Joiner Shop, Sheet Metal Shop, Rigger Shop, Pipe Shop Pipe Bender 7.5kW x 1 Beehive Surface Cutting Surface Welding Surface 12" Circular Saw x 1 30" Band Saw x 1 Surface Planing Machine x 1 Bending Roller Electric Welding Equipment Gas Cutting Equipment Overhead Travelling Crane 5T x 2	1,200m2 50m2 50m2 100m2	Surface is Grating Structure
11	Pump Room (Underground)	Dock Drainage Pump 100ps x 2 Dock Drainage Sub Pump 50ps x 1	120m2	(1) This Pump Room is utilized both for Drydock and Building Dock (2) Underground System is for better operation of Pump Suction Head

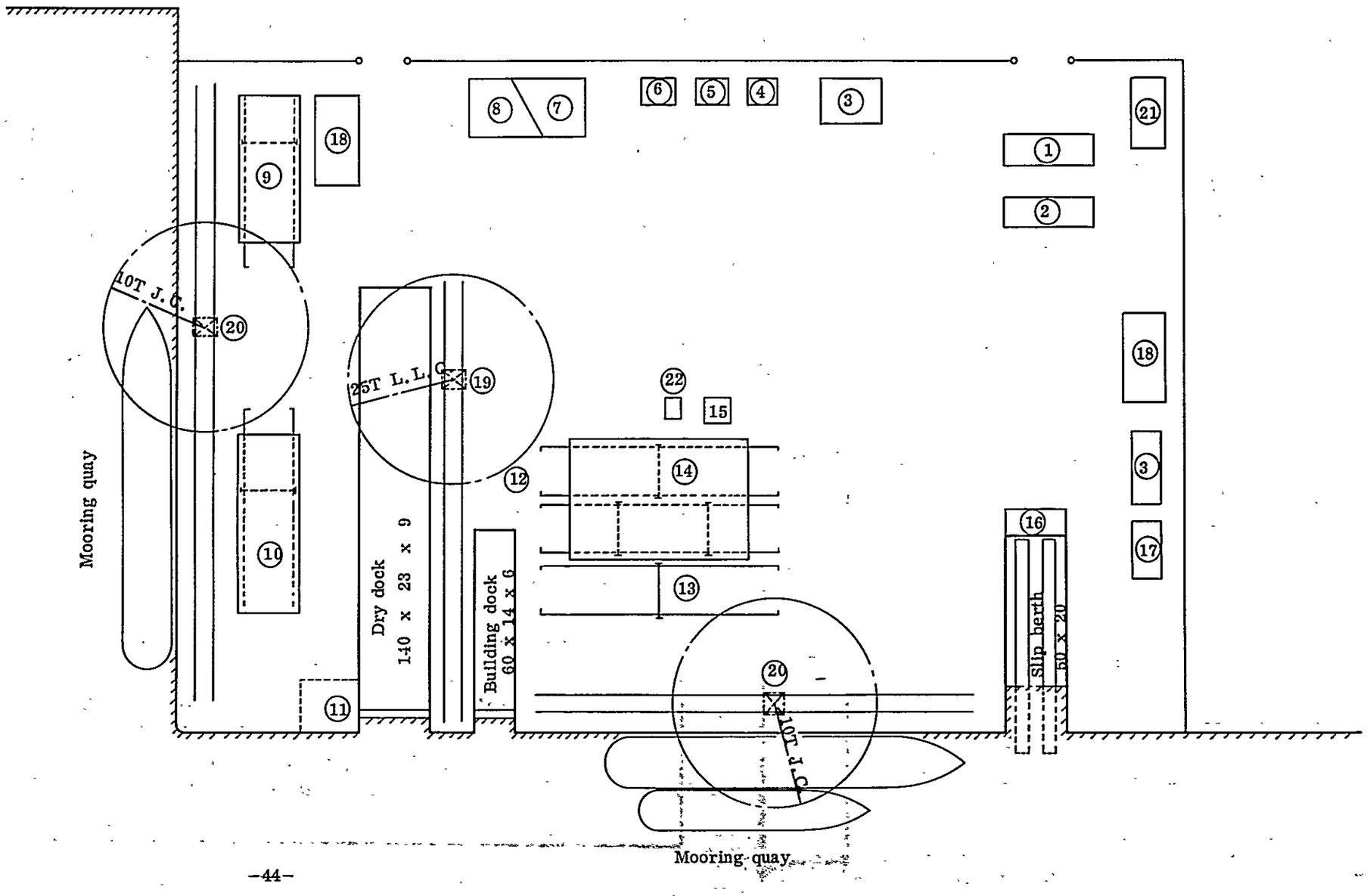
No.	Facilities	Description	Area	Remarks
12	Assembly Yard and Block Stock Yard	Assembly Surface Electric Welding Equipment Gas Cutting Equipment	2,800m^2	Surface is Grating Structure
13	Material Storage Yard	Marking Shop, Fabrication Shop, Bending Shop, Sub	1,200m^2 1,600m^2	
14	Assembly Shop	Assembly Shop, Assembly Shop, Worker's Rest Room, Electric Welding Equipment Gas Cutting Equipment 200 Ton Press x 1 Plate Mangling Roller		
		Beehive Surface	50m^2	
		Marking Surface	150m^2	Surface is Grating Structure
		Assembly Surface (Cutting and Welding)	300m^2	
		Overhead Travelling Crane 5^T x 2		
15	Paint Store		80m^2	
16	Winch Room	25 Ton Winch for Pulling Steel and Wooden Ship	30m^2	
17	Galvanizing Shop	For Zincing of Pipe	250m^2	
18	Store		450m^2	
19	25^T L. L. C.	Level Luffing Crane (25^T x 22^m - 75^T x 35m) x 1		
20	10^T J. C.	Jib Crane (10^T x 25^m x 5^T x 40^m) x 1		
21	Electric Sub Station		240m^2	
22	Lavatory			

Layout of typical repair ship facilities (6,000 G.T.)

Factory area : 78,000 m^2

① ~ ⑳ Refer to appendix

Scale : 1/1,500



Necessary Auxiliary Facilities (6,000 G/T)

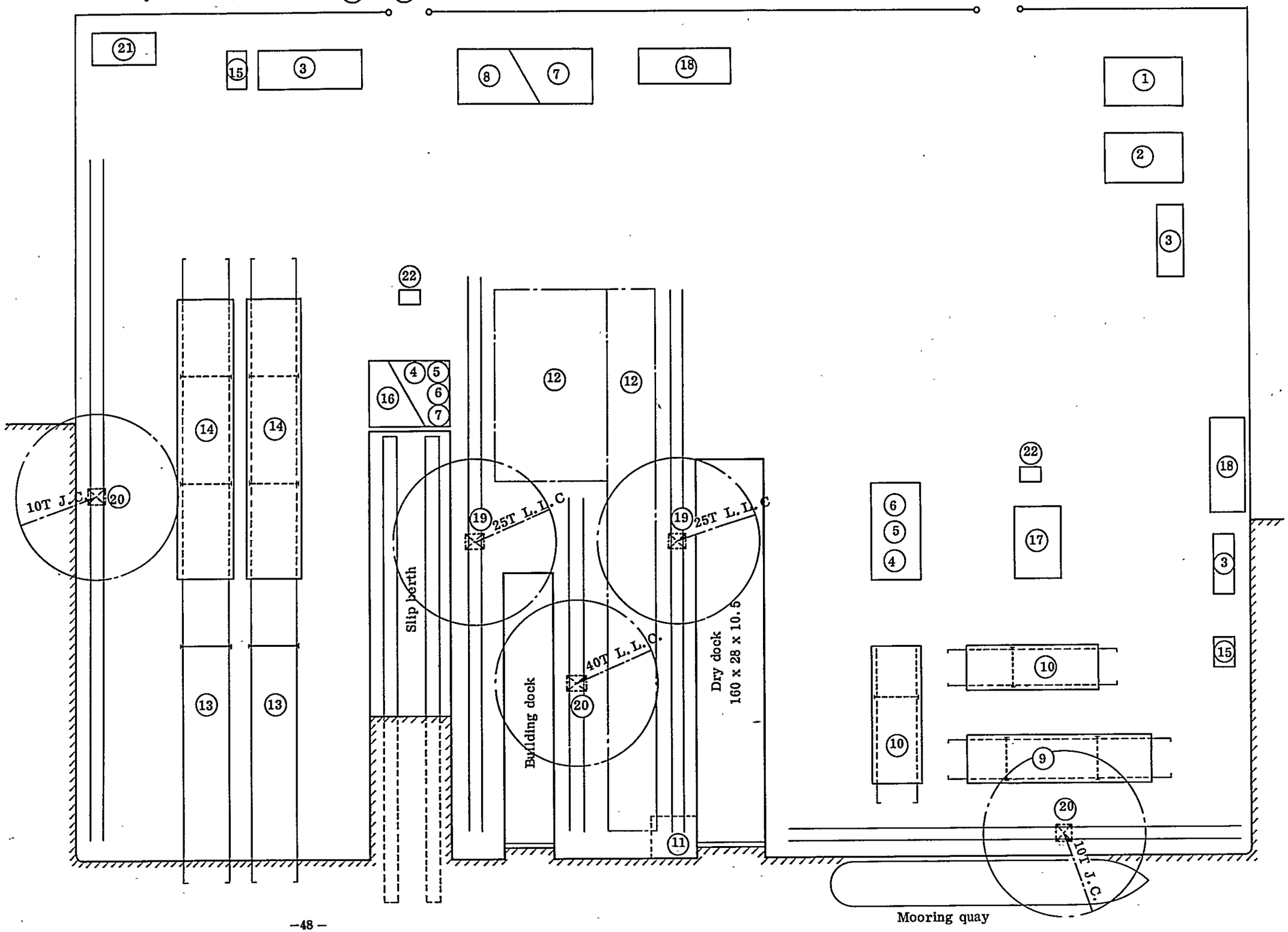
No.	Facilities	Description	Area	Remarks
1	Head Office	Management Section	300m^2	
		General Section		
		Labour Section		
		Business Section		
		Materials Section		
		Designing and Drawing Section	300m^2	
2	Dock House	Mess Room, Shower Room, Locker Room, and Repair Ship Seamen's Rest Room		
3	Worker's Rest House		230m^2	
			300m^2	
4	O_2 Room	Manifold System or Liquid Oxygen Tank		
5	C_2H_2 And LPG Room	Acetylene Gas Cylinder and LPG Tank		
6	Compressor Room	Air Compressor and Storage Tank		200ps
7	Second Office	The Field Oversees Room Worker's Rest Room, Locker Room, Tool, Shop	800m^2	
8	Mold Loft	Floor or Ceder Planking 13m x 35m	800m^2	Located upstairs For better Ventilation and Sunshine
9	Machine Shop	Lathe Machine 24 x 1' 16' x 1, 10' x 1. 8' x 1, 61 x 1 Universal Milling Machine x 1 Radial Drilling Machine x 1	1,000m^2	

No.	Facilities	Description	Area	Remarks
		Horizontal Boring Machine		
		12" Floor Grinder		
		Shaping Machine x 2		
		Surface Plate x 1		
		Overhead Travelling Crane 5T x 2		
		Oil Pressure Press 5T x 1		
10	Fitting and Riper Shop	Carpenter Shop, Joiner Shop, Sheet Metal Shop, Rigger Shop, Pipe Shop	1,200m^2	
		Pipe Bender 7.5kW x 1		
		Beehive Surface	50m^2	
		Cutting Surface	120m^2	Surface is Grating Structure
		Welding Surface	200m^2	
		12" Circular Saw		
		30" Band Saw x 1		
		Surface Planing Machine x 1		
		Bending Roller		
		Electric Welding Equipment		
		Gas Cutting Equipment		
		Overhead Travelling Crane 5T x 1		
11	Pump Room (Underground)	Dock Drainage Pump 150ps x 2	150m^2	(1) This Pump Room is utilized both for Drydock and Building Dock (2) Underground System is for better Operation of Pump Suction Head
		Dock Drainage Sub Pump 70psx1		

No.	Facilities	Description	Area	Remarks
12	Assembly Yard and Block Stock Yard	Assembly Surface Electric Welding Equipment Gas Cutting Equipment	3,000m^2	Surface is Grating Structure
13	Material Storage Yard	Semi Portal Crane 5^T x 1 Marking Shop, Fabrication	1,600m^2	
14	Assembly Shop	Shop, Bending Shop, Sub Assembly Shop, Assembly Shop, Worker's Rest Room, Electric Welding Equipment Gas Cutting Equipment 300 Ton Press x 1 Plate Mangling Roller	2,400m^2	
		Beehive Surface	50m^2	
		Marking Surface Assembly Surface (Cutting and Welding) Overhead Travelling Crane 5^T x 3	180m^2	Surface is Grating Structure
15	Paint Store		100m^2	
16	Winch Room	20 Ton Winch for Pulling Small Wooden Ship	25m^2	
17	Galvanizing Shop	For Zincing of Pipe	250m^2	
18	Store		900m^2	
19	25^T L. L. C.	Level Luffing Crane (25^T x 22^m-7.5^T x 35m) x 1 unit	200m^2	
20	10T J. C.	Jib Crane (10^T x 25^m - 5^T x 40m) x 2 unit		
21	Electric Substation		270m^2	
22	Lavatory			

Layout of typical repair ship facilities (10,000 G.T.)

Factory area : 133,000 m^2 ① ~ ⑳ Refer to appendix Scale : 1/1,500



Necessary Auxiliary Facilities (10,000 G.T.)

No.	Facilities	Description	Area	Remarks
1	Head Office	Management Section General Section Labour Section Business Section Materials Section Designing and Drawing Section	700m^2	
2	Dock House	Mess Room, Shower Room, Locker Room, and Repair Ship Seamen's Rest Room	700m^2	
3	Worker's Rest House		220m^2	
4	O_2 Room	Manifold System or Liquid Oxygen Tank		
5	C_2H_2 and LPG Room	Acetylene Gas Cylinder and LPG Tank		
6	Compressor Room	Air Compressor and *Storage Tank*		300ps
7	Second Office	The Field Oversees Room Worker's Rest Room, Locker Room, Tool, Shop	1,300m^2	
8	Mold Loft	Floor of Ceder Planking 20m x 55m	1,300m^2	Located upstairs For better Ventilation and Sun-shine
9	Machine Shop	Lathe Machine 24 x 1 16' x 1, 10' x 2, 8' x 4, 6' x 2 Universal Milling Machine x 1 Radial Drilling Machine x 1	1,600m^2	

No.	Facilities	Description	Area	Remarks
		Horizontal Boring Machine		
		12" Floor Grinder		
		Shaping Machine x 1		
		Surface Plate x 3		
		Overhead Travelling Crane 5T x 2		
		Oil Pressure Press 5T x 2		
10	Fitting and	Carpenter Shop, Joiner Shop,	1,200m2	
	Repair Shop	Sheet Metal Shop, Rigger	900m2	
		Shop, Pipe Shop		
		Pipe Bender 7.5kW x 1		
		Beehive Surface	200m2	
		Cutting Surface	200m2	Surface is Grat-
		Welding Surface	400m2	ing Structure
		12" Circular Saw x 2		
		30" Band Saw x 1		
		Surface Planing Machine x 1		
		Bending Roller		
		Electric Welding Equipment		
		Gas Cutting Equipment		
		Overhead Travelling Crane 5T x 2		
11	Pump Room (Underground)	Dock Drainage Pump 200ps x 2	230m2	(1) This Pump Room is utilized both for Drydock and Building Dock (2) Underground System is for better Operation of Pump Suction Head
		Dock Drainage Sub Pump 50ps x 2		

No.	Facilities	Description	Area	Remarks
12	Assembly Yard and Block Stock Yard	Assembly Surface Electric Welding Equipment Gas-Cutting Equipment	9,000m	Surface is Grating Structure
13	Material Storage Yard	Semi-Portal Crane 6^T x 1 Marking Shop, Fabrication	8,000m^2	
14	Assembly Shop	Shop, Bending Shop, Sub-Assembly Shop, Assembly Shop, Worker's Rest Room Electric Welding Equipment Gas-Cutting Equipment 400 Ton Press x 1 Plate Mangling Roller	2,000m^2	
		Beehive Surface	200m^2	
		Marking Surface 300m^2	300m^2	Surface is Grating Structure
		Assembly Surface Overhead Travelling Crane 5^T x 4	1,400m^2	
15	Paint Store		120m^2	
16	Winch Room	40 Ton Winch for Pulling Small Wooden Ship	40m^2	
17	Galvanizing Shop	For Zincing of Pipe	250m^2	
18	Store		600m^2	
19	40^T L. L. C. 25^T L. L. C.	Level Luffing Crane (40^T x 17m-22^T x 30m)x1unit (25 x 20 -7.5 x 35)x1		
20	10^T J. C	Jib Crane (10^T x 25m-5^T x 40m)x2unit		
21	Electric Substation		360m^2	
22	Lavatory			

2. Investment amount

a) The unit price of the investment is based upon the present price level, and the exchange rate of currency was calculated at ET$ 1 = ¥ 130.

b) The investment amount is limited to the facilities, excluding the road to the shipyard, reclamation of the vicinity land, construction of the water and electricity supplied.

Expenses for construction Unit: 1,000 yen, Inside of ( ) means 1,000 ET$

Item \ Facilities	3,000 G.T.	6,000 G.T.	10,000 G.T.
Expense for geological research	10,000 (77)	13,500 (104)	21,000 (162)
Civil work for quay, reclamation, pavement, and expense to secure the land	506,000 (3,892)	626,400 (4,818)	843,280 (6,487)
Dry dock: Floating gate, pump, keel blocks and accessories	242,500 (1,866)	438,200 (3,371)	675,700 (5,198)
(Note: Including middle gate for 6,000 G.T., 10,000 G.T.) Building dock:		91,630	219,500
Floating gate, keel blocks and accessories pump common use for dry docks	701	(705)	1,866
Slipway and berth including accessories (Note: Slipway of 6,000 G.T. is for repairing only)	34,000 (262)	28,100 (216)	86,000 (662)
Crane, LLC, JC, OHC	161,520 (1,242)	236,280 (1,818)	381,600 (2,935)
Electric facilities, wiring and emergency power sources	19,400 (149)	25,658 (197)	35,120 (270)
Air, gas, oxygen, water, sea water and piping	19,400 (149)	25,658 (197)	35,120 (270)
Machines, instruments, tools and surface table	40,160 (309)	53,490 (412)	83,492 (642)
Buildings	180,000 (1,385)	249,000 (1,915)	690,000 (5,308)
Transport facilities	7,200 (55)	9,800 (75)	13,200 (102)
Total	1,293,480 (9,950)	1,892,858 (14,560)	3,262,892 (25,100)

(Note) Exchange rate: ETS1 = Yen 130

3. Construction and Operation of the Facilities

(1) Construction of the facilities

a) Mooring quay

It is necessary to provide a mooring quay of 1.5 - 2.5 times longer than objective repairing ship's length and we selected 2 times longer one for this layout.

The depth of water was determined to have more than 0.5 m clearance between the bottom of repairing ship and sea bottom and designed to keep the depth by dredging in the case of insufficient. If necessary, ships are to be moored to dolphins or pontoons provided near the coast line. Bollards, fairleads, fenders, are provided on the side of mooring quay and also provided supply equipments of electricity, water, air, town gas and oxygen.

b) Dock

Generally, the depth of building dock is shallower compared with that of the repairing dock, but in these layouts we planned the depth of dock as adaptable for repairing also. We have selected the most effective depth of dock because the increasing the depth means the increasing of the construction cost. The width of dock of all layouts were planned as wide as possible to be able to accomodate larger ships in future. The discharge water pump has a capacity to discharge the water in dock within 2 - 3 hours as appropriate for use as busy repairing dock. Pump room is installed near the inlet of water of the dock so as to utilize the water head. Two pumps of the same type are installed for the purpose of facilitating interchangeability of parts. Piping or lines of water, sea water, air, oxygen and electricity are installed along the upper parts of dock wall.

c) Crane

We planned to provide a rather large size dock side crane so

as to hang up the main engine of the ship under repair, provided it is somewhat dismantled.

All of the travelling crane of each shop were planned to the same type for the purpose of their easy maintenance.

d) Plan for transport

The efficiency of each shop depends on the transport of parts or materials. It is preferable to pave the road exposed to heavy cargo traffic, so it was planned to pave 10 per cent of all roads.

As the means of transport, we selected trailer, truck and small size tractor without using any conveyer system.

e) Power facility

1. Electrical power facility

The necessary power for the layout is 15 - 20% of the total of required electric power for each equipment, and estimated emergency electric power is 40 - 50% of required electricity for each equipment.

The theoretical equation of the necessary electric power for welding machine among those various kinds of requirement for electricity is as follows:

$$P = \alpha p \sqrt{n\beta + n(n-1)\beta^2}$$

αp = Mean capacity of actually operating n sets of welding machine which has nominal capacity P.

β = Operational rate of welding machine.

It will be difficult to calculate accurately, so that we assumed as 10KVA for 400/500A and as 8KVA for 300A.

Facilities	Electric power per hour	Number of welding machine	Emergency dynamo
3,000 G. T.	800KW - 1,000KW	300A 25 sets 400A 15 "	400KVA
6,000 G. T.	1,200KW - 1,500KW	300A 38 " 400/500A 22 "	600KVA
10,000 G. T.	2,000KW - 2,500KW	300A 45 " 400/500A 45 "	1,000KVA

Wiring should be divided by the service, i.e. power, welding machine and lighting, and it is preferable to lead the main power cable under the ground.

2. Supplying capacity of air, gas and water

Necessary amount of acetylene gas per month = 4 kg x Number of direct workers = A.

Necessary amount of oxygen per month = m^3/0.23 kg x A.

Compressed air was assumed as 5 ps per one air hose.

Facilities	Air	Acetylene gas	Oxygen	Water
3,000 G. T.	150ps	720kg/month	3,000m^3/month	1,500T/month
6,000 G. T.	200ps	1,080kg/month	4,700m^3/month	3,000T/month
10,000 G. T.	350ps	1,920kg/month	8,300m^3/month	5,000T/month

f) Building

Machine shop, fitting and repairing shop, assembly shop, store and each power house are to be constructed of steel frames or concrete blocks. Head office, mess. room, dock house and workers rest house are to be simplified buildings.

g) Tug boat

It is necessary to have two or three.800 - 1,500 ps tug boats for docking repair ships, but we did not include them in the plan, because due to their low operation rate, it was thought enough to utilize harbour tugs as necessary.

(2) Plan to get and train persons necessary to operate the facility

a) General

Education of manager, engineer, mechanic and worker is essentially important for effective operation of the facility and its future development, so that it should be carried out intentionally. It is also necessary to foster middle class staff for gard work who has comprehensive judgement because repairing work is quite intricate and is not of the nature repeating the same procedure like in ship building work.

b) Necessary personnel for staff

It is preferable to select staffs of personnel, administration, management, design and production and to educate from early opportunity by joining the planning of the facilities for investigation.

c) Engineer

Education and training of engineers of basic planning, hull, equipment, calculation, engine, electrical instrument and dock should be carried out and positioned in the design department and yard.

d) Mechanic

It is necessary to execute education and training of yard staffs of pattern shop, machine shop, welding shop, piping, plating shop, hull construction, inspection, wood shop, equipment, metal equipment, painting shop and dock to meet the operation

of the repairing facilities.

e) Worker

It is necessary to maintain the necessary personnel by planned promotion of employment by providing the training facility in which carried out education of welders, fitters, machine workers, plate workers and ironworkers or by considering diversion from other fields.

f) Necessary personnel

3,000 G. T. facilities

	Until 4th year since erection	Until 4-8th year since erection	After 8th year since erection
Direct worker	180	240	300
Indirect worker	24	30	40
Staff	20	25	30

6,000 G. T. facilities

	Until 4th year since erection	Until 4-8th year since erection	After 8th year since erection
Direct worker	270	360	450
Indirect worker	36	48	60
Staff	30	40	45

10,000 G. T. facilities

	Until 4th year since erection	Until 4-8th year since erection	After 8th year since erection
Direct worker	480	640	800
Indirect worker	54	72	90
Staff	40	50	60

It is preferable to begin the operation with 50 per cent of required personnel and intensify gradually, in any of the cases.

g) Plan for education

1. The repletion of necessary staff personnel should be made by carrying out education and training for six months to one year for management staff and for one to two years for engineer at shipyard or university.

2. It is necessary to provide the facility of education and training in each shop to carry out at least six months education to secure the necessary personnel, especially it is necessary to continue the training of welders for the purpose of developing the welding technique and improving the quality of products.

3. It should be planned to secure the base of improving by education or leadership of the staff of engineers, administraters and mechanics who have been dispatched from advanced nation of shipbuilding. The number of these staffs will be around 3 per cent - 5 per cent of total number of the personnel of facilities.

(3) Maintenance of facilities

It is necessary to have preventive maintenance for all facilities to keep the production.

a) The cause of trouble

1. Troubles due to failure in design, machining and erection or miss-handling are apt to occur at the begining of operation.

2. Troubles due to deterioration of equipment, wear of parts or electrical contacts are apt to occur after long operating time, so it is necessary to change the parts or renew the equipment for these troubles.

3. Troubles suddenly occur due to accidental cause can be prevented by continuous inspection or improvement of operating condition.

b) Preventive maintenance

The occurrence of accidents in machinery can be prevented by preventive maintenance. For instance, it can be done by steadily keeping the record of the results of inspection of machinery on the prescribed form, wherein the inspections are to be regularly executed once a year, once a month and every day before operation. At the same time, it is preferable to keep records in regard to operating rate, number or frequency of accidents of machinery and to designate the responsible persons for crane, dock gate and switch board which may incur big damage in consequence of accident, and also to prepare such spare parts as being difficult to obtain instantly.

4. Profitability

Profitability is the most important element for the planning of new project which controls whether the project can come into existence or not.

In this report we present six alternatives including the enlargement of E. E. D. As for profitability, we made only rough estimation and the final purpose is to decide which project will be the most suitable for the project of Ethiopia from the stand point of adaptability of scale of project against the demand under careful comparison of all layouts.

A. Investigation of profitability was carried out under the following assumptions:

(1) Depreciation for the facilities is constant rate for twenty year term and remaining value is 30 per cent of the original.

(2) Total amount of the necessary fund is dependent upon loan which is of 6 per cent interest, unredeemable for fine years and equal annual repayment for fifteen years.

(3) Wages and salaries are assumed at 20 per cent of sales and the cost of materials at 30 per cent.

(4) 10 per cent of the total sales is reserved for tax and other margine.

(5) Operation of facilities is to begin from 1975, and the upper limit of operation rate is 80 per cent.

B. Total amount of investment in the facility

The amount for each case is as follows:

3,000 G. T.	ET$ 9,950	thousand
6,000 G. T.	ET$14,560	"
10,000 G. T.	ET$25,100	"

C. Sales

The sales of repairing was calculated by the estimated demand corresponding to each layout. We assume that domestic ships are given the obligation of the regular inspection of once every four years, the intermediate inspection of energy year, that 10 per cent (of total number of domestic ships) undergo temporary repairing, and that all repairings are temporary for foreign ships. The mean expense for temporary repairing is assumed as equivalent to supplementary docking expense because the sales of temporary repairing differ according to its grade.

(For reference) Calculation method of sales is as follows:

Number of domestic ships ..... A

Number of foreign ships ..... B

Expense for regular inspection ..... a

Expense for intermediate inspection ..... b

Expense for supplementary docking c

A) Total sales of repairing

$$= \frac{1}{4} \times A \times a + \frac{3}{4} \times A \times b + \frac{1}{10} \times A \times C + B \times C$$

B) The formlae for the calculation of expenses classified by ship type and kind of repairing are as follows: (this figure is the mean value of 60 repairing enterprises in Japan)

a = 0.0369 G.T. + 26

b = 0.0215 G.T. + 22

c = 0.0092 G.T. + 9

(Note, unit: thousand ET$)

By using above formulae, the sales classified by kind of repairing for facilities of 3,000 G.T., 6,000 G.T. and 10,000 G.T. scale are obtained as follows:

Kind of repair	3,000 G.T.	6,000 G.T.	10,000 G.T.
Regular inspection	136.7 thousand ET$	247.4 thousand ET$	395.0 thousand ET$
Intermediate inspection	86.5	151.0	237.0
Supplementary docking	36.6	64.2	101.0

(4) Calculation of profitability

1. 3,000 G.T.

Year	Expenditure						Total	Income	Profit
	Investment part			Operation part				Sales	
	Repayment	Interest	Depreciation	Wages	Materials	Others			
1975	0	597	348	348	521	174	1,988	1,738	△250
76	0	〃	〃	389	583	194	2,111	1,943	△168
77	0	〃	〃	409	614	205	2,173	2,046	△127
78	0	〃	〃	437	656	219	2,257	2,185	△ 72
79	0	〃	〃	437	656	219	2,257	2,185	△ 72
80	663	〃	〃	458	686	229	2,981	2,288	△693
81	〃	557	〃	485	728	243	3,024	2,427	△597
82	〃	517	〃	485	728	243	2,984	2,427	△557
83	〃	478	〃	513	770	257	3,029	2,567	△462
84	〃	438	〃	533	799	266	3,047	2,664	△383
85	〃	398	〃	〃	〃	〃	3,007	〃	△343
86	〃	358	〃	〃	〃	〃	2,967	〃	△303
87	〃	319	〃	〃	〃	〃	2,948	〃	△284
88	〃	279	〃	〃	〃	〃	2,908	〃	△244
89	〃	239	〃	〃	〃	〃	2,868	〃	△204
90	664	199	〃	〃	〃	〃	2,829	〃	△165
91	〃	159	〃	〃	〃	〃	2,789	〃	△125
92	〃	120	〃	〃	〃	〃	2,750	〃	△ 86
93	〃	80	〃	〃	〃	〃	2,710	〃	△ 46
94	664	40	348	〃	〃	〃	2,670	〃	△ 6

2. 6,000 G.T.

Year	Expenditure							Incomes	Profit
	Investment part			Operation part			Total	Sales	
	Repayment	Interest	Depreciation	Wages	Materials	Others			
1975	0	874	510	553	830	277	3,044	2,767	△277
76	0	〃	〃	590	885	295	3,154	2,949	△205
77	0	〃	〃	639	959	320	3,302	3,195	△107
78	0	〃	〃	748	1,122	374	3,628	3,739	△111
79	0	〃	〃	797	1,196	399	3,776	3,985	△209
80	970	874	〃	870	1,304	435	4,963	4,348	△615
81	〃	815	〃	955	1,433	478	5,161	4,775	△386
82	〃	757	〃	991	1,487	496	5,211	4,956	△255
83	〃	699	〃	〃	〃	〃	5,153	〃	△197
84	970	641	〃	〃	〃	〃	5,095	〃	△139
85	971	583	〃	〃	〃	〃	5,038	〃	△ 82
86	〃	524	〃	〃	〃	〃	4,979	〃	△ 23
87	〃	466	〃	〃	〃	〃	4,921	〃	35
88	〃	407	〃	・	・	・	・	・	・
89	〃	349	〃	・	・	・	・	・	・
90	〃	297	〃	・	・	・	・	・	・
91	〃	233	〃	・	・	・	・	・	・
92	〃	174	〃	・	・	・	・	・	・
93	〃	116	〃	・	・	・	・	・	・
94	971	58	510	・	・	・	・	・	・

3. 10,000 G.T.

Year	Expenditure							Income	
	Investment part			Operation part			Total	Sales	
	Repayment	Interest	Depreciation	Wages	Materials	Others			
1975	0	1,506	878	657	986	329	4,356	3,286	△1,070
76	0	〃	〃	657	986	329	4,356		△1,070
77	0	〃	〃	772	1,158	386	4,700	3,860	△ 840
78	0	〃	〃	944	1,416	472	5,216	4,719	△ 497
79	0	〃	〃	1,021	1,532	511	5,448	5,107	△ 341
80	1,673	1,506	〃	1,136	1,704	568	7,465	5,680	△1,785
81	〃	1,406	〃	1,193	1,790	597	7,537	5,967	△1,570
82	〃	1,305	〃	1,308	1,962	654	7,780	6,540	△1,240
83	〃	1,205	〃	1,386	2,078	693	7,913	6,928	△ 985
84	〃	1,104	〃	1,500	2,250	750	8,155	7,501	△ 654
85	〃	1,004	〃	〃	〃	〃	8,055	〃	△ 554
86	〃	903	〃	〃	〃	〃	7,954	〃	△ 453
87	〃	803	〃	〃	〃	〃	7,854	〃	△ 353
88	〃	702	〃	〃	〃	〃	7,753	〃	△ 252
89	1,673	602	〃	〃	〃	〃	7,653	〃	△ 152
90	1,674	502	〃	〃	〃	〃	7,553	〃	△ 52
91	〃	402	〃	〃	〃	〃	7,453	〃	48
92	〃	301	〃	・	・	・	・	・	・
93	〃	201	〃	・	・	・	・	・	・
94	〃	100	878	・	・	・	・	・	・

D. Conclusion on profitability

(1) 3,000 G. T.

The time when the annual balance income and expenditure goes into the block figure will be the 21st year from the erection, however, the facilities will be unsuitable as the new project from the viewpoint of profitability, because the accumulation of red figure will become enormous. The principal reason is that this project does not meet the demand.

(2) 6,000 G. T.

The time when the annual balance goes into the block figure will be the 13th year from the erection. And the accumulation of red figure will be around ET$ 2,000 thousand, so that this will be a profitable project irrespective of the burden of interest, provided the starting cost of ET$3,000 thousand is allowed. Main reason is that this project meet the demand.

(3) 10,000 G. T.

The time when the annual balance goes to block figure will be the 17th year from erection. However, the accumulated red figure will be bigger than that for 3,000 G. T., and this means that the project is rather unreasonable at the present stage. The reason is isolation from the demand just like in the case of 3,000 G. T.

5. *Evaluation of alternatives*

For the purpose of relative evaluation of seven alternatives (including the expansion plan of E. E. D.), we adopted the "Evaluation list" and "Element of evaluation" of method for investigation described in 4 of § 1.

(1) Importance degree of elements of evaluation.

The importance degree of elements of evaluation should be determined by the needs for ship repairing facilities in Ethiopia. Our survey team as an attempt has divided elements into five, as A. Economical effect, B. Conditions of location, C. Demand for repairing (adaptability of scale of repairing facilities for demand) D. Investment and operating capital and E. Profitability. The degree of importance was graded in five stages and we gave 1 point to 1, 2 and 3 of B, 2 points to A, C, D and 4, 5, 6 of B and gave 5 points to profitability due to its high importance. (Refer to the method of investigation "Elements of evaluation II - 4)

(2) Evaluation of each case with regard to each evaluation element.

It is necessary to make the relative ranking of each case, so that we graded each element in three stages and gave 3 points, 2 points and 1 point from higher level of evaluation. There may be many other elements of evaluation other than mentioned above and the ways to break down the element in more details, and it will be also important to make absolute evaluation not relative comparison (especially for profitability etc.). But survey of this time is feasibility investigation at the utmost, so that it will be plenty enough by summarized evaluation to determine whether to proceed to further detailed investigation or not.

Evaluation Table of Alternatives

Alternatives			Port of Massawa								Port of Assab						Reference for Evaluation
			2,000 G/T (Enlargement of EED)		3,000 G/T		6,000 G/T		10,000 G/T		3,000 G/T		6,000 G/T		10,000 G/T		
Evaluation		Weight between Evaluation Elements (a)	Evalup-tion (b)	Points (a x b)	b	a x b	b	a x b	b	a x b	b	a x b	b	a x b	b	a x b	
Economical effect	*Impact on related Industry*	2	1	2	1	2	3	6	3	6	1	2	3	6	3	6	It is estimated that larger the scale of facility, bigger the economical effect. The value of "Impact against income and expenditure of foreign currency" assumed the same for 6,000 G/T and 10,000 G/T because mean tonnages of ship calling at port of Massawa and Assab was up to 5,000 G/T.
	Benefit for employment	2	1	2	1	2	2	4	3	6	1	2	2	4	3	6	
	Impact against income and expenditure of foreign currency	2	1	2	1	2	3	6	3	6	1	2	3	6	3	6	
	Impact against consideration of Marine transportation	2	1	2	1	2	2	4	3	6	1	2	2	4	3	6	
Terms of location	Weather (temperature, Humidity, wind and etc.)	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	Weather is not moderate from the view-point of temperature
	Water supply	1	2	2	2	2	2	2	2	2	1	1	1	1	1	1	Supply of water and electricity are *rather worse but it is possible to have* up to 6,000 G/T in Massawa Port.
	Electricity supply	1	2	2	2	2	2	2	2	2	1	1	1	1	1	1	
	Base as shipbuilding *industry*	2	3	6	3	6	2	4	1	2	1	2	1	2	1	2	*Present practical result of E.E.D. It.* work shop in Asmara
	Hinterland	2	2	4	2	4	2	4	2	4	1	2	1	2	1	2	*There is no facilities beyond 6,000G/T* in neighboring nations now.
	Competitor	2	1	2	1	2	3	6	3	6	1	2	3	6	3	6	There is no facilities beyond 6,000G/T in neighboring nations now.
Demand for ship repair		2	2	4	2	4	3	6	1	2	2	4	3	6	1	2	6,000G/T will be most appropriate facilities both from suitability for demand and adaptability for future use.
Amount of investment and o operating funds		2	3	6	3	6	2	4	1	2	3	6	2	4	1	2	
Profitability		5	3	15	2	10	3	15	1	5	2	10	3	15	1	5	
Overall evaluation (Σ a x b)			50		45		64		50		37		58		46		
Priority of alternatives			3		6		1		3		7		2		5		

V. Points of Problem of the Project

The survey team concludes as points of problem of the present survey and construction of ship repairing facilities in Ethiopia as follows:

1. The position of the present survey and the advancement in future.

   This is the final investigation of the pre-feasibility of construction and operation of ship repairing facility in Ethiopia. As the first step, we should make investigation regarding the necessity, feasibility and possibility study (to determine the priority to other projects) of this project from the standpoint of broad outlook and as the second stage we should carry out the practical construction feasibility study (detailed layout, careful investment plan and profitability) at the scheduled site which has been decided by the first step, in other words the completion the final budget. The final step is the establishment of the attitude of co-operation in both fund and management sides and execution of procedure of project (tangible economical co-operation). Consequently, the profitability estimated from anticipated demand and amount of investment was the result of the daring assumption. So it is necessary to make modification hereafter while proceeding on careful study.

2. Points of Problem

   (1) The first point of problem is the attitude of Government confronting this project. Generally the ship repairing enterprise is the excellent industry in which repayment of investment fund is very efficient (much sales against investment) at the site blessed with high demand. However, in such case as the establishment of a new project of ship repairing enterprise in Ethiopia where they have practically no experience or base, it is necessary to bring it up with long-term view for the

purpose of bleeding domestic industry, without making final conclusion from a nearsighted viewpoint.

(2) The second point of problem is that we excluded all the ships of the Royal Ethiopian navy from the subject of repairing ship because it was unable to catch the past actual results and future program of formation. Ships belonging to the Navy are of high accuracy and for their repairing is required fairly high technique. In other words, the repairing of navy ships will as a matter of course contribute to the development of the facilities by offering high grade fixed demand.

(3) The third point of problem is the Suez Canal.

The Suez Canal is being closed now and we can not anticipate its Opening, accordingly we estimated on closed condition, the influences caused by the opening of the Suez Canal will be as follows:

(A) The Suez Canal will become the principal route between Asia and Europe and will increase the possibility of ships to call at Ethiopian ports.

(B) At the moment, Ethiopia is in a favorable situation to have no remarkable shipbuilding industry in the neighbourhood, but if the Canal was re-opened Egypt would rise as a strong competitor.

There are merit (A) and demerit (B) as mentioned above, but we can expect more merit than demerit because there will be big influence upon Ethiopian shipping due to extreme shortening of sea route to Europe.

(4) Finally we recommended 6,000 G. T. project as the first genuine ship repairing facilities in Ethiopia, and drew up the layout of the project considering that it is the only one facility in

Ethiopia, and so that it may respond to the wide demand and be able to operate as effectively as possible.

VI. Acknowledgements

In completing our study,

We hereby express our sincere gratitude for kind assistance and help rendered by H. E. Ato Negash Garedew and other many peoples of Marine Department and other friends in Ethiopia.

Out study on possibility on establishment of ship-repair facilities in Ethiopia will terminate. We are afraid, however, if we have done enough study due to very short stay in Ethiopia. However, what impressed us most throughout of our study in this country was a wonderful nature and character of the people of Ethiopia. We sincerely hope that our study will contribute to furtherance of development of Empire of Ethiopian country where live the people with whom we have now been so faimilar as one of our best friends.

Believing that this project will no doubt be implemented and the first embarkation of now industry in Ethiopia, the establishment of ship-repair facilities will be launched soon.

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Appendix 1 Altitude, precipitation and temperature in principal cities

City	Altitude (m above sea level)	Precipitation per annum (mm)	Temperature (1969, °C)		
			February	June	October
Addis Ababa	2,408	1,138	21.6 / 10.4	21.4 / 19.8	22.8 / 9.4
Asmara	2,325	506	22.0 / 5.8	26.1 / 11.0	22.7 / 8.5
Assab	11	60	32.1 / 23.7	38.8 / 29.5	36.9 / 26.5
Bahar Dar	1,802	1,475	26.2 / 9.4	27.3 / 14.6	26.0 / 11.7
Debra Markos	2,509	1,384	22.5 / 9.3	21.8 / 9.9	22.4 / 9.1
Diredaua	1,160	652	26.7 / 15.0	34.9 / 21.9	32.2 / 18.5
Gorrahei	2,002	2,532	23.4 / 13.1	21.6 / 12.6	22.7 / 12.7
Jimma	1,740	1,430	26.2 / 12.3	25.5 / 13.1	18.8 / 10.4
Massawa	5	189	29.2 / 15.4	40.9 / 22.2	36.0 / 19.9

* Figure in upper line of "Temperature" is for the maximum, and that in the lower for the minimum

Appendix 2 Trend of G.D.P. per capita of African countries

Countries	Amount in million US$				Annual growth rate %		
	1969	1970	1971	1972a/	1969–70	1970–71	1971–72a/
NORTH AFRICA							
Algeria	4,109.6	4,343.9	4,281.4	4,795.2	5.7	–1.4	12.0a/
Egypt	7,094.8	7,295.3	7,504.1	7,804.3	2.8	2.9	4.0a/
Libyan Arab Rep.	3,565.0	3,722.5	3,420.6	3,359.0	4.4	–8.1	–1.8
Morocco	3,187.7	3,351.8	3,516.5	3,720.4	5.1	4.9	5.8
Sudan	1,794.3	1,831.1	1,936.6	1,994.7	2.1	5.8	3.0a/
Tunisia	1,227.4	1,387.0	1,508.7	1,787.8	13.0	8.8	18.5
	20,978.8	21.931.6	22.167.9	23.461.4	4.5	1.1	5.8
WEST AFRICA							
Dahomey	226.0	249.0	259.0	264.2	10.2	4.0	2.0a/
Gambia	40.9	46.1	49.1	50.6	12.7	6.6	3.0a/
Ghana	2,371.6	2,519.6	2,530.8	2,589.0	6.2	0.4	2.3
Guinea	292.9	320.0	283.1	297.3	9.3	–11.5	5.0a/
Ivory Coast	1,312.0	1,490.8	1,526.5	1,648.6	13.6	2.5	8.0a/
Liberia	399.7	417.5	449.1	468.0	4.5	7.6	4.2
Mali	251.4	267.4	277.2	278.6	6.4	3.7	0.5a/
Mauritania	180.8	191.6	200.4	208.4	6.0	4.6	4.0a/
Niger	355.8	363.3	345.3	367.4	2.1	–5.0	3.5a/
Nigeria	6,765.9	7,438.8	8,329.8	8,946.2	9.9	12.0	7.4
Senegal	767.7	796.7	736.8	766.3	3.8	–7.5	4.0a/
Sierra Leone	447.5	444.1	476.3	504.9	–0.8	7.2	6.0a/
Togo	252.3	269.5	270.2	281.0	6.8	0.3	4.0a/
Upper Volta	304.8	309.7	314.7	321.0	1.6	1.6	2.0a/
	13,969.3	15,124.1	16,048.3	16,981.5	8.3	6.1	5.8
CENTRAL AFRICA							
Burundi	193.7	211.1	212.9	212.9	9.0	0.9	0.0a/
Cameroon	977.3	1,011.9	1,017.5	1,058.2	4.6	–0.4	4.0a/
CAR	193.5	194.1	192.1	201.7	0.3	–1.0	5.0a/
Chad	284.3	288.1	294.2	303.0	1.3	2.1	3.0a/
Congo	240.0	235.5	237.2	249.1	–1.9	0.7	5.0a/
Equatorial Guinea	75.8	76.0	75.3	79.1	0.3	–0.9	5.0a/
Gabon	330.7	335.2	355.8	391.4	1.4	6.1	10.0a/
Rwanda	194.4	215.7	221.2	221.2	11.0	2.5	0.0a/
Zaire	1,869.6	2,050.8	2,161.7	2,265.5	9.7	5.4	4.8
	4,359.3	4,628.4	4,767.9	4,982.1	6.2	3.0	4.5
EAST AFRICA							
Botswana	78.5	83.0	97.7	109.8	5.7	17.7	12.4
Ethiopia	1,711.2	1,836.0	1,874.1	1,949.0	7.3	2.1	4.0
Konya	1,472.1	1,617.8	1,733.0	1,852.6	9.9	7.1	6.9
Lesotho	78.5	78.1	79.5	81.9	–0.5	1.8	3.0a/
Madagascar	823.4	891.8	918.1	875.9	8.3	3.0	–4.6

Countries	Amount in million US$				Annual growth rates %		
	1969	1970	1971	1972a/	1969–70	1970–71	1971–72a/
EAST AFRICA (Cont'd.)							
Malawi	318.5	325.1	354.4	381.7	2.1	9.0	7.7
Mauritius	189.3	188.6	205.6	226.2	–0.4	9.0	10.0
Somalia	231.7	245.0	252.6	265.2	5.7	3.1	5.0a/
Swaziland	95.3	96.2	104.9	115.4	0.9	9.0	10.0a/
Tanzania	1,201.2	1,281.0	1,339.6	1,428.0	6.6	4.6	66.6
Uganda	1,267.1	1,304.2	1,326.3	1,340.9	2.9	1.7	1.1
Zambia	1,790.0	1,604.5	1,686.4	1,770.7	–10.4	5.1	5.0a/
	9,256.8	9,551.3	9,972.2	10,397.3	3.2	4.4	4.3
Total 41 countries	48,564.2	51.235.4	52,956.3	55,822.3	5.5	3.4	5.4

Source: ECA secretariat.

a/ Preliminary estimates.

Appendix 3 Trend of G.D.P. per capita of African countries

	Population in millions				Annual increas of population, per cent			Per capita GDP at constant 1970 market prices (US$)				Growth rate in per capita GDP, per cent		
	1969	1970	1971	1972a/	1969–70	1970–71	1971–72a/	1969	1970	1971	1972a/	1969–70	1970–71	1971–72a/
NORTH AFRICA														
Algeria	13.91	14.33	14.77	15.27	3.0	3.1	3.4	295.4	303.1	289.9	314.0	2.6	−4.4	8.3
Egypt	32.50	33.33	34.08	34.84	2.6	2.4	2.2	218.3	218.9	219.9	224.0	0.3	0.5	1.7
Libyan Arab Rep.	1.87	1.94	2.01	2.08	3.7	3.6	3.6	1,906.4	1,918.8	1,701.8	1,614.9	0.7	−11.3	−5.1
Morocco	15.28	15.78	16.25	16.80	3.2	3.0	3.4	208.6	212.4	216.4	221.5	1.8	1.9	2.4
Sudan	15.31	15.70	16.09	16.49	2.5	2.5	2.4	113.8	116.3	120.4	121.0	2.2	3.5	0.5
Tunisia	5.03	5.14	5.25	5.35	2.2	2.2	2.2	244.0	269.8	287.4	334.2	10.6	6.5	16.3
	83.90	86.22	88.45	90.83	2.8	2.6	2.7	250.0	254.4	250.6	258.3	1.7	−1.5	3.1
WEST AFRICA														
Dahomey	2.62	2.69	2.76	2.83	2.7	2.6	2.6	86.2	92.6	93.8	93.4	7.4	1.3	−0.4
Gambia	0.35	0.36	0.37	0.38	2.8	2.8	2.8	116.9	128.1	132.7	133.2	9.6	−3.6	0.4
Ghana	8.43	8.64	8.86	9.09	2.5	2.5	2.6	281.3	291.6	285.6	284.8	3.7	−2.1	−0.3
Guinea	3.83	3.92	4.01	4.10	2.3	2.3	2.3	76.5	81.6	70.6	72.5	6.7	−13.5	2.7
Ivory Coast	4.21	4.31	4.42	4.53	2.4	2.6	2.6	311.6	345.9	345.4	363.9	11.0	−0.1	5.4
Liberia	1.15	1.17	1.19	1.21	1.7	1.7	1.7	347.6	356.8	377.4	386.8	2.6	5.8	2.5
Mali	4.93	5.05	5.14	5.26	2.4	1.8	2.4	51.5	53.3	53.9	53.0	3.5	1.1	−1.7
Mauritania	1.14	1.17	1.20	1.23	2.6	2.6	2.6	158.6	163.4	167.0	169.4	3.0	2.2	1.4
Niger	3.91	4.02	4.13	4.24	2.8	2.7	2.7	91.0	90.4	81.6	86.7	−0.7	−7.1	3.7
Nigeria	53.70	55.07	56.51	57.98	2.6	2.6	2.6	126.0	135.1	147.4	154.3	7.2	9.1	4.7
Senegal	3.78	3.93	4.02	4.11	4.0	2.3	2.3	203.1	202.7	183.3	186.4	−0.2	−9.6	1.7
Sierra Leone	2.58	2.64	2.70	2.77	2.3	2.4	2.6	173.4	168.2	176.4	182.3	−3.0	4.8	3.3
Togo	1.92	1.97	2.02	2.07	2.6	2.5	2.6	131.4	136.8	133.8	135.7	4.2	−2.2	1.4
Upper Volta	5.28	5.38	5.49	5.60	1.9	2.0	2.0	57.7	57.6	57.3	57.3	−0.2	−0.5	0.0
	97.83	100.32	102.82	105.40	2.6	2.5	2.5	142.8	150.8	156.1	161.1	5.6	3.5	3.2
CENTRAL AFRICA														
Burundi	3.47	3.54	3.62	3.70	2.0	2.2	2.3	55.8	59.6	58.8	57.5	6.8	−1.3	−2.2
Cameroon	5.74	5.84	5.97	6.11	1.7	2.2	2.3	170.3	174.9	170.4	173.2	2.7	−2.6	1.6
Central African Rep.	1.58	1.61	1.64	1.67	1.9	1.9	1.9	122.5	120.6	117.1	120.8	−1.6	−2.9	3.2
Chad	3.62	3.71	3.80	3.89	2.5	2.4	2.4	78.5	77.7	77.4	77.9	−1.1	−0.3	0.6
Congo	0.92	0.94	0.96	0.98	2.2	2.2	2.1	260.9	250.5	247.1	254.2	−4.0	−1.4	2.9
Equatorial Guinea	0.29	0.29	0.30	0.30	2.0	3.0	2.0	261.4	262.1	251.0	263.7	2.7	−4.0	3.0
Gabon	0.49	0.50	0.51	0.52	2.0	2.0	2.0	674.9	670.4	697.6	752.7	−0.7	4.0	7.9
Rwanda	3.49	3.59	3.69	3.80	2.9	3.0	3.0	55.7	60.1	59.9	58.2	7.9	−0.4	−2.8
Zaire	20.70	21.57	22.48	23.43	4.2	4.2	4.2	90.3	95.1	96.2	96.7	5.3	1.2	0.5
	40.30	41.59	42.97	44.40	3.2	3.3	3.3	108.2	11.3	110.9	112.2	2.9	−0.3	1.2
EAST AFRICA														
Botswana	0.63	0.65	0.67	0.69	3.2	3.1	3.1	124.6	127.7	145.8	159.1	2.5	14.2	9.2
Ethiopia	24.02	24.63	25.25	25.89	2.5	2.5	2.5	71.2	74.5	74.2	75.3	4.6	−0.4	1.5
Kenya	10.88	11.22	11.67	12.07	3.1	3.9	3.4	135.3	144.2	148.5	152.5	6.6	3.0	2.7
Lesotho	0.90	0.92	0.94	0.96	2.2	2.1	2.1	87.2	84.9	84.6	85.3	−2.6	−0.3	0.8
Madagascar	6.60	6.75	6.94	7.33	2.2	2.8	2.8	124.8	132.1	132.3	122.8	5.8	0.2	−7.2
Malawi	4.33	4.44	4.55	4.67	2.5	2.5	2.6	73.6	73.2	77.9	81.9	−0.5	6.4	5.1
Mauritius	0.80	0.81	0.82	0.83	1.2	1.2	1.2	236.6	232.8	250.7	269.3	−1.6	7.7	7.4
Somalia	2.73	2.79	2.86	2.94	2.2	2.5	2.8	84.9	87.8	88.3	90.5	3.4	0.5	2.5
Swaziland	0.40	0.41	0.42	0.43	2.5	2.4	2.4	238.3	234.6	249.8	268.4	−1.6	6.5	7.8
Tanzania	12.93	13.27	13.63	14.00	2.6	2.7	2.7	92.9	96.5	98.3	102.0	3.9	1.9	3.8
Uganda	9.55	9.81	10.13	10.46	2.7	3.3	3.3	132.7	132.9	130.9	128.2	0.2	−1.5	−2.1
Zambia	4.17	4.28	4.40	4.52	2.7	2.7	2.7	429.3	374.9	383.3	401.5	−12.7	2.2	4.7
	77.94	79.98	82.28	84.79	2.6	2.9	3.1	118.8	119.4	121.2	122.6	0.5	1.5	1.2
Total 41 countries	299.97	308.11	316.52	325.42	2.7	2.7	2.8	161.9	166.3	167.3	171.5	2.7	0.6	2.5

Sources: United Nations Monthly Bulletin of Statistics, January 1973 and ECA secretariat.

a/ Provisional estimates.

Appendix 4 External trade of African countries

Value in million US$ and % changes

	Total exports f.o.b.					Total Imports c.i.f.				
				% change					% change	
	1970	1971	1972	1970–1971	1971–1972	1970	1971	1972	1970–1971	1971–1972
NORTH AFRICA										
Algeria	1,008.9	852.5	1,429.4	–15.5	67.7	1,257.1	1,221.3	1,759.2	–2.8	44.0
Egypt	761.7	789.3	825.2	3.6	4.5	786.6	919.7	873.8	16.9	–5.0
Libyan Arab Rep.	2,365.6	2,695.0	2,310.4	13.9	–14.3	554.4	701.0	1,094.4	26.4	56.1
Morocco	488.3	500.5	639.1	2.5	27.7	684.3	697.9	771.5	2.0	10.5
Sudan	293.5	330.8	360.3	12.7	8.9	311.1	355.1	353.4	14.1	–0.5
Tunisia	182.5	215.8	310.5	18.2	43.9	304.6	341.9	458.5	12.2	34.1
Total	5,100.5	5,383.9	5,874.9	5.6	9.1	3,898.1	4,236.9	5,310.8	8.7	25.3
WEST AFRICA										
Dahomey	32.6	41.9	39.1	28.5	–6.7	63.6	76.3	86.3	20.0	13.1
Gambia	16.9	13.3	19.5	–21.3	46.6	18.0	26.1	25.8	45.0	–1.1
Ghana	438.8	322.4	442.0	–25.5	37.1	410.7	434.3	309.0	5.7	–28.9
Guinea	54.0	50.0	59.4	–7.4	18.8	70.0	80.0	96.8	14.3	21.0
Ivory Coast	468.8	455.7	545.5	–2.8	19.7	387.8	399.2	442.1	2.9	10.7
Liberia	212.6	221.1	245.0	4.0	10.8	149.6	157.4	180.0	5.2	14.4
Mali	32.8	35.3	26.2	7.6	–25.8	47.2	54.9	55.0	16.3	0.2
Mauritania	88.9	93.9	117.3	5.6	24.9	55.9	63.0	78.2	12.7	24.1
Niger	31.7	38.4	52.8	21.1	37.5	58.4	53.9	66.5	–7.7	23.4
Nigeria	1,239.6	1,810.6	2,143.8	46.1	18.4	1,059.0	1,510.5	1,505.9	42.6	–0.3
Senegal	151.9	125.0	213.0	–17.7	70.4	192.8	217.9	275.0	13.0	26.2
Sierra Leone	101.5	100.1	119.3	–1.4	19.2	116.3	113.2	124.3	–2.7	9.8
Togo	54.6	49.1	49.0	–10.1	–0.2	64.6	70.1	83.6	8.5	19.3
Upper Volta	18.2	15.9	20.1	–12.6	26.4	46.7	50.6	58.7	8.4	16.0
Total	2,936.9	3,372.7	4,092.0	14.8	21.3	2,740.6	3,307.4	3,387.2	20.7	2.4

Value in million US$ and % changes

	Total exports f.o.b.					Total imports c.i.f.				
				% change					% change	
	1970	1971	1972	1970–1971	1971–1972	1970	1971	1972	1970–1971	1971–1972
CENTRAL AFRICA										
Burundi	23.6	18.5	26.3	–21.6	42.2	22.4	29.9	31.3	33.5	4.7
Cameroon	226.1	206.3	218.0	–8.8	5.7	242.1	249.7	299.0	3.1	19.7
C.A.R.	30.6	34.3	35.2	12.1	2.6	34.2	35.1	37.1	2.6	5.7
Chad	29.5	28.0	33.2	–5.1	18.8	61.4	61.6	60.6	0.3	–1.6
Congo P.R.	30.8	42.3	50.8	37.3	20.1	57.3	78.9	86.0	37.7	9.0
Gabon	121.0	186.5	196.5	54.1	5.4	79.7	96.5	136.8	21.1	41.8
Rwanda	24.6	22.3	19.1	–9.3	–14.4	29.1	33.0	35.0	13.4	6.1
Zaire	788.2	680.0	700.0	–13.7	2.9	616.9	726.9	600.0	17.8	–17.5
Total	1,274.4	1,218.2	1,279.1	–4.4	5.0	1,143.1	1,311.6	1,285.8	14.7	–2.0
EAST AFRICA										
Botswana	28.0	46.2	41.3	65.0	–10.6	62.7	84.0	90.3	34.0	7.5
Ethiopia	122.3	123.8	168.4	1.2	36.0	171.6	187.8	189.4	9.4	0.9
Kenya	305.0	314.3	359.1	3.0	14.3	442.2	560.2	534.6	26.7	–4.6
Lesotho	5.2	3.1	3.9	–40.4	25.8	32.1	39.2	38.7	22.1	–1.3
Madagascar	144.8	146.9	163.6	1.5	11.4	170.5	213.3	202.3	25.1	–5.2
Malawi	59.6	71.2	84.1	19.5	18.1	99.0	107.8	133.6	8.9	23.9
Mauritius	69.2	64.9	107.0	–6.2	64.9	75.6	114.1	120.0	50.9	5.2
Somalia	31.4	34.5	43.3	9.9	25.5	45.1	62.7	75.5	39.0	20.4
Swaziland	70.5	78.4	94.4	11.2	20.4	59.8	67.0	74.6	12.0	11.3
Tanzania	259.0	278.4	318.8	7.5	14.5	318.4	381.6	410.0	19.8	7.4
Uganda	279.1	260.0	282.5	–6.8	8.7	171.9	249.6	162.2	45.2	–35.0
Zambia	1,000.9	678.8	758.5	–32.2	11.7	544.0	630.0	645.0	15.8	2.4
Total	2,375.0	2,100.5	2,424.9	–11.6	15.4	2,192.9	2,697.3	2,676.2	23.0	–0.8
Total 40 countries	11,686.8	12,075.3	13,670.9	3.3	13.2	9,974.7	11,553.2	12,660.0	15.8	9.6

Source: ECA secretariat.

Appendix 5, Ethiopia Shipping Line

Name of Vessel	G/T	D/W	Principal Dimension $L_{OA} \times B_M \times D_M \times d$	H.P.	V (Service)	Year To be Build	Main Route
Lion of Judah	5.182 Ton	6,550 Ton	397'0" x 55' 6-1/8 x 31' 8-3/4 x 25' 11-1/4"	5,400 BHP	16.5 KT	1966	Europe
Queen of Sheeba	5,182 Ton	6,550 Ton	397'0" x 55' 6-1/8" x 31' 8-3/4" x 25' 11-1/4"	5,400 BHP	16.5 KT	1966	Europe
Lalibelia	21,886 Ton	34,075 Ton	671' 1/2" x 85' 3-5/8" x 47'4" x 35'0"	12,600 BHP	16.5 KT (Trial)	1966	Tramper
Ziway Haiq	2,051 Ton	2,980 Ton	260'0" x 45'0" x 20'6" x 16' 7-3/8"	1,600 BHP	10.0 KT	1964	Coaster
Gay Faith (Charter Ship)	5,700 Ton	9,285 Ton	486'0" x 61'0" x 39'2" x 27' 4-3/4	7,200 BHP	17.5 KT	—	Europe
Gay Fortune (Charter Ship)	5,543 Ton	7,590 Ton	393'0" x 55' 6-5/8" x 35'9" x 27' 6-5/8"	6,000 BHP	14.5 KT	1955	Europe

Appendix 6 Cargoes shipped by E.S.L.

INWARD									
Name of Port	Ethiopian Ports				Name of Port	Non Ethiopian Ports			
	1972		1st Half 1973			1972		1st Half 1973	
	W.Tons	Earnings	W.Tons	Earnings		W.Tons	Earnings	W.Tons	Earnings
		US$		US$			US$		US$
Assab	10,174	1,215,142	5,666	795,068	Jeddah	8,231	305,878	9,491	409,303
Djibouti	10,690	930,838	7,077	796,942	Port Sudan	5,471	485,773	–	–
Massawa	5,176	452,513	2,377	128,832	Mogeiscio	45	15,598	–	–
Total	26,040	2,598,493	15,120	1,720,842	Hodeidah	7,872	215,939	5,316	228,888
					Aden	2,540	50,800	–	–
					Total	24,159	1,073,988	14,807	638,191
OUTWARD									
		US$		US$			US$		US$
Assab	20,565	680,228	6,510	285,711	Port Sudan	1,961	93,624	365	15,426
Djibout	15,356	570,116	9,166	300,397	Aden	861	22,139	–	–
Massawa	6,869	241,704	5,479	187,870	Jeddah	704	36,978	392	17,538
Total	42,790	1,492,048	21,155	773,988	Total	3,526	152,741	757	32,964

Appendix 7 Relation of Shipbuilding industry to other industries

Industry		A		B	
		Value (ET $)	Proportion (per cent)	Value (ET $)	Proportion (per cent)
Domestic industry	Agriculture and forestry	–	–	–	5.6
	Fishery	–	–	14,377	–
	Mining	–	–	23	–
	Fiber product etc.	17,899	6.4	–	–
	Petroleum, coal, chemical product etc.	7,652	2.7	–	–
	Iron and steel	77,903	27.9	–	–
	Non-ferrous metal	22,852	8.2	–	–
	General machinery	100,092	36.6	–	–
	Vehicle	311	0.1	–	–
	Construction industry	2,068	0.7	–	–
	Electricity, gas, water service	4,223	1.5	–	–
	Commerce	32,538	11.7	–	–
	Transport business	8,223	2.9	21,872	8.5
	Shipbuilding industry	719	0.3	719	0.3
	Others	3,589	1.3	207	0.1
Import		975	1.3	–	–
Export		–	–	220,730	85.5
Total		279,044	100	257,928	100

Note: 1) A: The value shipbuilding industry purchased from other industries,
B: The value shipbuilding industry sold to other industries,
2) The value is converted into ET $,
3) The results of 1965.

Appendix 8 Assisting measures of various countries for shipbuilding and shipping industries

Name of country	Protection of domestic market	Direct construction subsidy	Tax system	Subsidy for reorganization of shipbuilders etc.	Export financing system	Others (Subsidy for research etc.)
West Germany			Exemption of import duty and sales tax for shipbuilding materials	Financing of ERP fund for the investment cost of business change or rationalization. (12 year term, 6% interest.) Possession of stock by the government (Deutsche Schiffswerft)	Financing from ERP fund. Subsidy for interest (equally applied to cash ship.)	Subsidy for individual project
Sweden			Exemption of import duty for shipbuilding materials. Exemption of added value tax.	Complete government possession (Uddevalla) non-interest financing and guarantee for loan by the government for reformation of enterprise (Gotaverken) Cooperation of enterprises led by the government (four big shipyards)	Governmental guarantee for export credit. Financing from the Export Credit Bank. Insurance by the Export Credit Guarantee Bureau.	Subsidy for the R and D project for strengthening competitive power of shipbuilding industry.
France	Import certification	Subsidy of 4.9% of ship price to shipyard (subject to reorganization).	Exemption of import duty for shipbuilding materials. Exemption of added value tax.	Subsidy for business change investment cost (20% of investment). Financing business change (10 - 20 year term, 6.75% interest, Economics and Development Fund), subject to the execution of reorganization. Direct subsidy for construction.	Financing from (Crédit Français) and Crédit National depending upon the credit guarantee and insurance by COFACE (French Trading Insurance Co.).	
U. K.	6% import duty on ships 80G.T. and under. (ships from Commonwealth of Nations and EFTA excluded) Tying of domestic ship financing to home shipyards. (the same financing condition as for export).	Conforming to Industry Law, 1972; 4% of contract price for 1973, 3% for 1974, abolishment scheduled for 1975 and after.	Exemption of import duty for shipbuilding materials. Reduction of 2% of ship price from indirect tax.	Subsidy (35%) and free depreciation for the investment in the developing region. The first year depreciation for the investment in other region. Poll subsidy and exemption of employment tax for the employment in the developing region. Government possession (Upper Clyde Shipbuilders Ltd., Cammell Laird and Co.) Governmental financing for salvation of hard operation (Harland and Wolff Ltd.).	Governmental guarantee for export credit (E.C.G.D. Export Credit Guarantee Department). Export credit insurance by the government	Operation of national research institute. Subsidy for the research carried out by the member of British Ship Research Association.

Name of country	Protection of domestic market	Direct construction subsidy	Tax system	Subsidy for reorganization of shipbuilders etc.	Export financing system	Others (Subsidy for research etc.)
U. S. A.	The subject ship of direct subsidy for building cost limited to home-built ships. (Tying) Prohibition of repair abroad to ships subsidized for construction or operation. Construction by the grant for replacement is limited to home shipyards. (Tying)	Subsidy of 45% of ship price to home ship built at home (the subsidiary rate is scheduled to be decreased by 2% annually and to the last 35%, starting on 1 July, 1972.) Grant for home-built ship replacing overage one.			Financing from Export and Import Bank of America. Governmental credit guarantee.	60% of whole production of shipbuilding industry is ordered by the government. R and D are all executed by the government (Navy and Maritime Administration).
Canada	25% import duty (no duty on ship built in C.N.). Import certification. The subject ship of direct subsidy for construction is limited to home-built ships (tying). Depreciation rate for the first year of Kanadian flag ship is discriminated (33-1/3% for home-built, 15% for foreign-built).	Subsidy of 21% of ship price to home shipyard for the construction of domestic ship (for commercial ship, 1972 and after) or 35% for fishing vessel. For the construction of export vessel, subsidy of 17% of construction cost (for 25,000 G.T. and under) or 14% (for ships over 25,000 G.T.). (scheduled to be abolished on and after 29 June, 1972.)	Reduction of import duty for certain shipbuilding materials (steel plates, big diesel engines etc.)		Financing and credit insurance by Canadian Public Corporation for the Promotion of Export.	National Research Board
Finland			Exemption of tax for 4% of export credit interest.		Financing from Finnish Export Credit Bank.	
Italy	Import certification (apply to governmental trading country and Japan).	Subsidy of 10% of construction cost to shipyard.	Exemption of import duty for shipbuilding materials. Exemption of sales tax.	Subsidy and favourable taxation for reorganization and business change. Subsidy of investment (5%) and favourable taxation for renewing equipments. Public possession of shipyard stock (Italcantieri).	General export financing system. Compulsory export credit insurance system.	Subsidy for research concerning shipbuilding.
Spain	14% import duty, import certification (import is virtually prohibitive). Home ship credit (deferred payment; 80% value, 8 year term, 6.75 - 7.25% interest) tyed to home shipyards (home ship credit is more favourable than export credit).		Exemption of import duty for shipbuilding materials. Partial rebate of import tax for domestic ship construction materials (7% of price of imported materials). Rebate of indirect tax for export ships (12% of the rest of ship price minus imported material price).	Governmental possession of shipyard stock. Favourable financing and taxation for the investment for amalgamation and reorganization.	Long term, low interest financing from city banks dependent upon the guarantee of intermediate and long term credit organization. Compulsory export credit insurance.	

Name of country	Protection of domestic market	Direct construction subsidy	Tax system	Subsidy for reorganization of shipbuilders etc.	Export financing system	Others (Subsidy for research etc.)
Norway			Rebate of import duty for shipbuilding materials. (6% of ship price) Exemption of sales tax.	Government-owned company (one).	Financing from mortgage bank. Credit insurance system by the export credit guarantee foundation. (public organization) (shipbuilders scarcely utilize the system).	Subsidy for private research organization.
Netherlands			Exemption of import duty for shipbuilding materials. Exemption of added value tax.	There was an instance of governmental guarantee for financing reorganization of shipyard.	Interest subsidy system. Governmental re-insurance system for private credit insurance company (C.I.C.).	Subsidy for private research organization.
Denmark			Rebate of tax for shipbuilding materials. (indiscriminate rebate of 3 - 4.75% of ship price as for import duty.) Exemption of added value tax.	There was an instance of governmental guarantee for the urgent financing from the Central Bank for solving operation crisis. (reparation and independence of machinery department.) (B & W)	Financing from Danish ship Credit Fund.	Subsidy for private research organization
Belgium		Subsidy of 6% of ship price to shipyard	Exemption of import tax for shipbuilding materials. Exemption of added value tax.		Interest subsidy Governmental credit insurance	Subsidy for Maritime Research Institute.

Appendix 9 Number of employees of some shipyards

Shipyard	Manager and senior engineer		Worker		Total
	Business department	Engineering department	Permanent	Temporary	
Jurong (Singapore) 1- 90,000 t.d.w. berth 1-300,000 t.d.w. berth · Repairing	186	216	1,500	500	2,400
Projected (Thailand) 1-12,000 G.T. berth · Repairing	33		330	47	410
Fukuoka Shipbuilding Co. (Japan) 1-7,000 G.T. berth · Shipbuilding	36	44	70	310	460

Appendix 10 Present state and future plan of ship reparing industry of neighbouring countries

Place	Existing yard (Principal equipment and its capacity)	Future plan etc.
Djibouti (French territory)	o Slipway: 1-390 ft. (cradle: 130 ft, capacity: 500 t. d. w.) o Auxiliary facilities: 1-80 t floating crane, 1-19 ft. lathe, 1- shaper, 3/4- compressors 3/4- welders	o They have a construction plan of a 3,000 G. T. floating dock. The building capital is to be supplied by the government. 40 engineers have already moved from Aden for this shipyard. (construction date is uncertain)
Aden	o Slipways 1-270 ft. (capacity: 1,500 t. d. w.) 1-300 t. d. w. 1-220 t. d. w. 1-120 t. d. w. o Floating docks No. 1: 500 t. d. w. capacity No. 2: 1,400 t. d. w. capacity	o Since the independence of Aden the port activity has suffered depression, and ship repairing activity is scarcely carried on. Engineers who were formerly there have moved to Djibouti.
Port Sudan	o Slipway 1-500/600 t. d. w. capacity	None

Place	Existing yard (Principal equipment and its capacity)	Future plan etc.
Mombasa (Kenya)	o Slipway 690 ft. length by 60 ft. width (capacity 2,000 G.T.) o Capable of repairing both hull and engine parts of ships up to 2,000 G.T.	o They have the construction plan for a 20,000 t.d.w. dry dock. The construction cost is expected to be supplied from U.K. The date of implementation is uncertain.

Note: The existence of Egypt as the biggest shipbuilding country among the neighbouring countries should be noted, though she has no influence at present because of the closure of Suez Canal. There are around Port-Side and Alexandria 8/10 dry docks (the maximum of their capacities: 50,000 t.d.w.), 20 slipways (the maximum of their capacities: 12,000 t.d.w.)

Appendix 11 Method for estimating foreign trade ships of domestic ownership

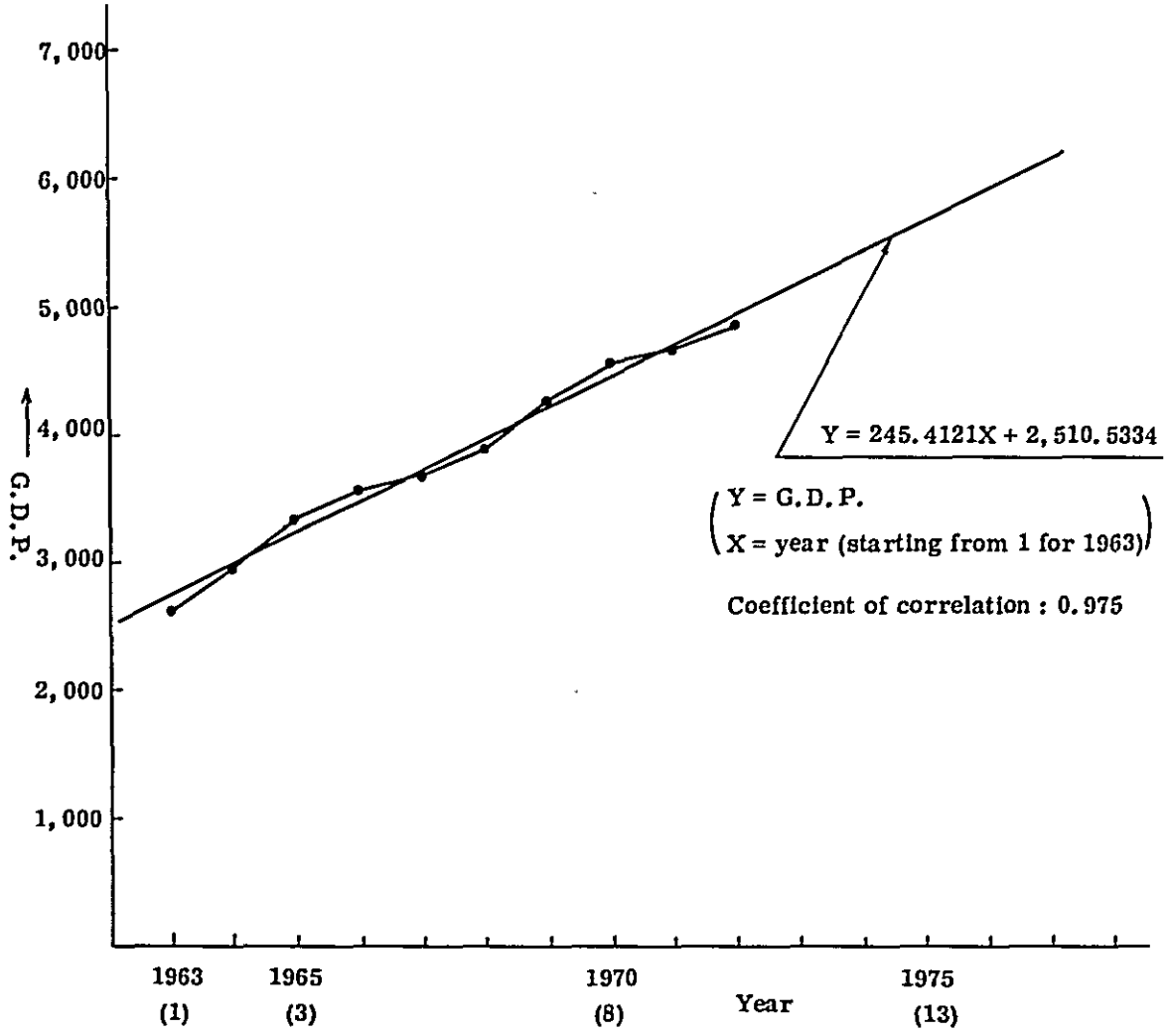
1. Estimation of future G. D. P.

The past trend and estimation of G. D. P. are as given below.

Year	G. D. P. (million ET$)	Year	G. D. P. (million ET$)
1962	2,528	1973	5,201
63	2,634	74	5,446
64	2,961	75	5,692
65	3,385	76	5,937
66	3,596	77	6,183
67	3,699	78	6,428
68	3,902	79	6,674
69	4,278	80	6,919
70	4,590	81	7,164
71	4,685	82	7,410
72	4,873	83	7,655
		84	7,901

Note: The estimated value for the future was obtained by extending the past trend toward future by means of trend equation, as illustrated in the diagram below:

Equation for estimating G.D.P.



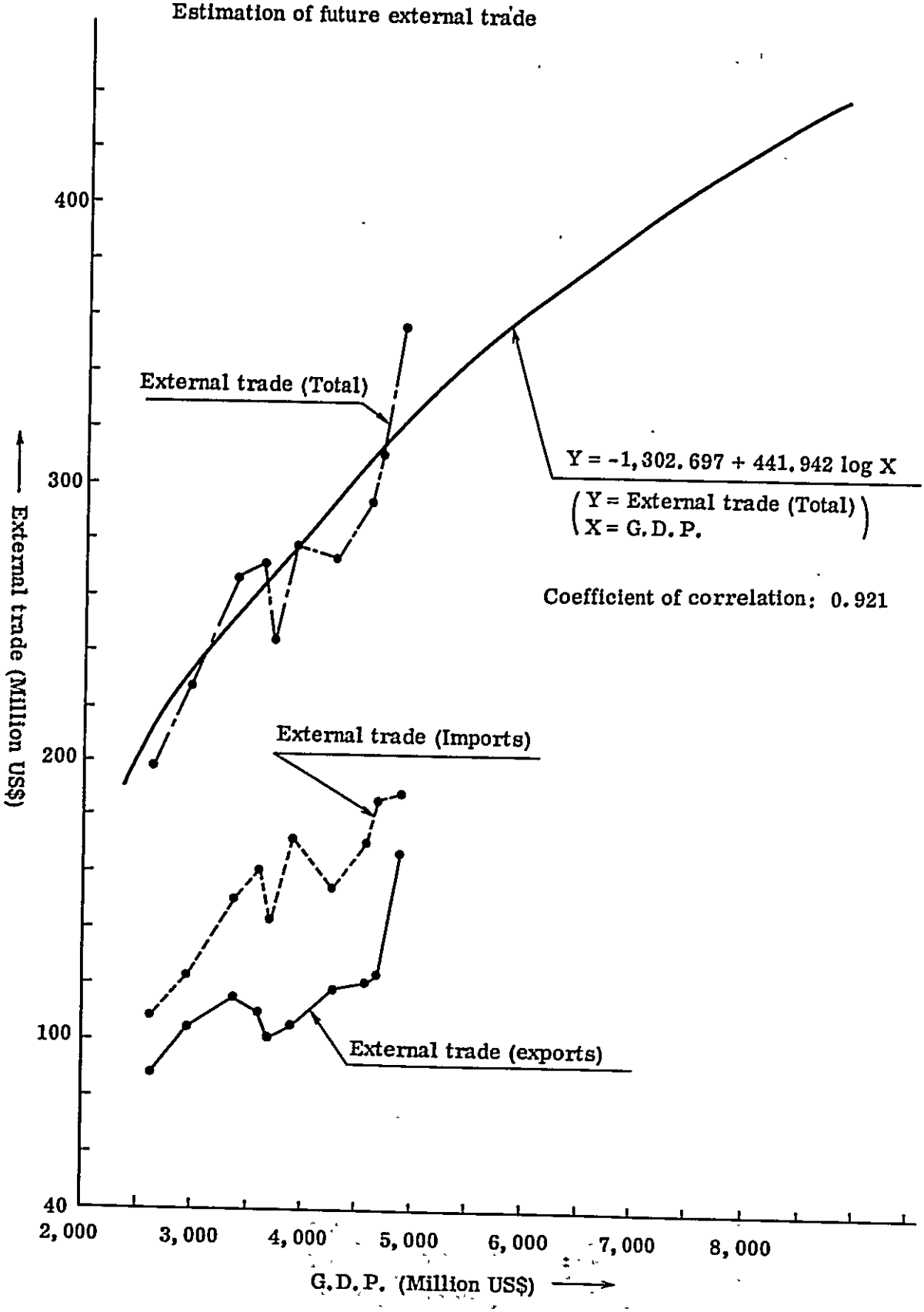
2. Estimation of future external trade

The past amount (monetary basis) and the future estimation of external trade are as given below:

Year	External trade (million US$)	Year	External trade (million US$)
1962	180.5	1974	344.6
63	199.1	75	353.4
64	228.1	76	361.7
65	266.2	77	369.8
66	272.6	78	377.5
67	244.2	79	384.9
68	279.4	80	392.1
69	274.7	81	399.0
70	293.9	82	405.7
71	311.6	83	412.2
72	357.8	84	418.4
73	335.5		

Note: The future estimation was obtained by the correlation of past trend to G.D.P.

Estimation of future external trade



3. Estimation of number of foreign trade ships of domestic ownership in future.

The estimation of number of foreign trade ships of domestic ownership is to be made based on the results for 1972.

Results for 1972	External trade	US$357.8 million
	Shipping share	1.5% (US$5.355 million)
	Necessary capacity	43,493 G.T.
	Necessary number of ships	5 (average G.T.: 8,698)

Assumption for estimation

1. Annual average sailing days are assumed to be the same as the present figure.
2. Number of ships is calculated with the assumption that average size of ships is the same as the present one.
3. Estimation is made for the other in which the share increases 0.35% annually and up to 5%.

Estimated value

Year	External trade (million US$)	Shipping share rises up to 5%		
		External trade	Converted into G.T.	Converted into ship number
1975	353.4	6,538	53,101	7
76	361.7	7,957	65,626	8
77	369.8	9,430	76,589	9
78	377.5	10,948	88,919	11
79	384.9	12,509	101,597	12
80	392.1	14,116	114,649	14
81	399.0	15,761	128,009	15
82	405.7	17,445	141,687	17
83	412.2	19,167	155,672	18
84	418.4	20,920	169,910	20

Appendix 12 Capacity of ships of African countries by kind of ship

Country	Oil tanker		Bulk carrier		Combination Ship		General cargo Ship		Passenger		Liquified gas carrier		Chemicals carrier		Others		Total	
	No.	G.T.	No.	G.T.	No.	G.T.	No.	G.T.	No.	G.T.	No.	G.T.	No.	G.T.	No.	G.T.	No.	G.T.
Algeria	2	31,915	2	23,494			9	33,725			2	36,557			25	7,065	40	132,756
Cameroon															13	2,334	13	2,334
Congo (Brazzaville)															4	1,070	4	1,070
Dahomey															2	206	2	206
Egypt	18	69,160					45	137,679							64	35,906	127	242,745
Gabon	1	347					1	425							4	747	6	1,519
Gambia															4	1,135	4	1,135
Ghana							16	115,152							58	51,031	74	166,183
Guinea			1	10,764			3	4,132							5	642	9	15,538
Cote d'Ivoire	1	166					11	76,558							24	5,592	36	82,316
Kenya	4	3,197					7	15,841							12	2,819	23	21,857
Liberia	790	25,500,907	593	9,872,261	102	4,577,255	653	4,040,491	6	101,748	20	207,087	2	14,368	68	129,565	2,234	44,443,652
Libya							8	4,694							5	1,238	13	5,932
Madagascal	7	29,955					18	17,588					1	1,599	22	3,020	48	52,162
Mauritanie															4	1,681	4	1,681
Mauritius							5	24,522							6	1,566	11	26,088
Morocco	2	937					16	37,993							21	7,977	39	46,907
Nigeria	4	2,109					22	87,342							30	9,775	56	99,226
Sénégal	4	3,876					7	6,045							28	6,359	39	16,280
Sierra Leone	1	165													7	1,630	8	1,795
Somalia	11	142,442	4				132	678,145							1	166	148	873,209
South Africa	1	646	3	52,456			61	313,214	2	57,725					188	107,062	255	511,190
Sudan				32,543			9	34,382							5	1,120	14	35,502
Tanzania	1	239					7	16,075							4	2,404	12	18,718
Tunisia	1	6,433					11	14,763					1	3,280	10	3,792	23	28,268
Uganda							1	5,510									1	5,510
Zaire							4	35,901							5	4,320	9	40,221
							1	5,513									1	5,513

Note: Lloyd's statistics (as of mid – 1972)

Appendix 13 Method for estimating foreign custom ships for repair

1. Estimation of number of ships emptied at Ethiopian ports

(1) Port of Assab, 1972

(Estimation formula)

$$\frac{\text{Shipping ratio, Port of Assab}}{\text{Shipping ratio, E.S.L.}} \times \text{G.T. of E.S.L.} \div \begin{matrix}\text{average G.T.}\\ \text{of ships calling}\\ \text{at Port of Assab}\end{matrix}$$

$$= \frac{0.344}{0.015} \times 43,493 \text{ G.T.} \div 4,677 \text{ G.T./ship} = 213 \text{ ships}$$

(2) Port of Massawa, 1972

$$\frac{0.340}{0.015} \times 43,493 \text{ G.T.} \div 3,319 \text{ G.T./ship} = 297 \text{ ships}$$

2. Estimation of number of ships in future

It is thought that, accompanying the growth of Ethiopian economics, her external trade and also the ships calling at the port will increase. However, the past results show that the number of ships has remained on the nearly same level over the last 10 years. Therefore, we determined at the moment to let the number of ships as of 1972 slide unchanged, standing on safer side from the profitability viewpoint. Although, the Ethiopian cargoes which are now going to and from Port of Djibouti, about 31.6 per cent, are naturally required to be shifted to the Port of Assab and the Port of Massawa with the progress of their formation. Assuming the shift is made on an arithmetical progression over 10 years, we added 196 ships corresponding to 31.6 per cent. (estimated with the same calculation method as for the Port of Assab and the Port of Massawa, provided the average size taken equal to that of the Port of Assab.)

The resultant figures are as follows:

Year	Port of Assab (number)	Port of Massawa (number)	To be shifted from Port of Djibouti (number)	Total (number)
1975	213 ship	297 ship	20 ship	530 ship
1976	"	"	40	550
1977	"	"	60	570
1978	"	"	80	590
1979	"	"	100	610
1980	"	"	120	630
1981	"	"	140	650
1982	"	"	160	670
1983	"	"	180	690
1984	"	"	196	706

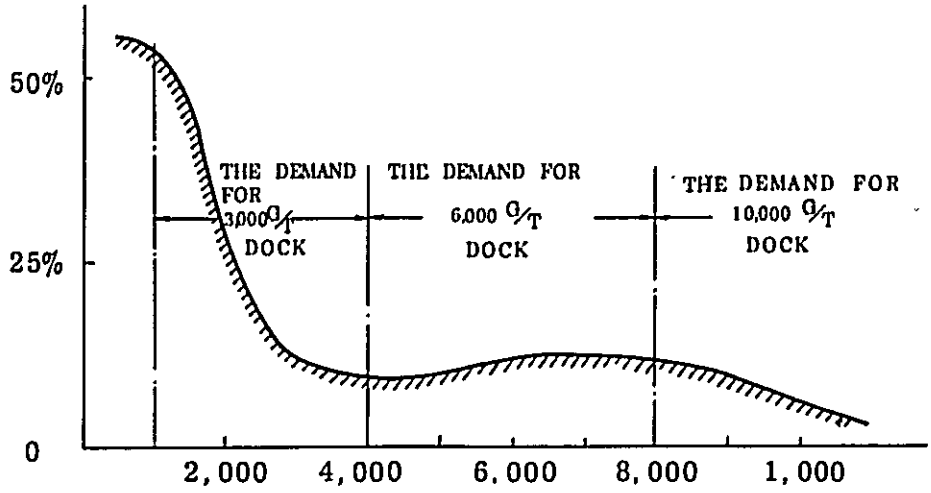
3. Expected custom ships for repair among the ships of completely or nearly empty condition.

   The ships which call at Ethiopian ports and become completely or nearly empty condition are not necessarily considered all of them undergo repair. Even if they intended repairs, those would be of a temporary nature, because they are foreigners. Referring to the examples with ship repairing facilities in Japan or South-east Asia, about 10 per cent of ships which call at a port and are completely or nearly unloaded appear to undergo more or less slight repair there.

4. Methods for estimating custom ships for repair divided by scale of repairing facilities.

   The methods for estimating the custom ships for repair divided by the scale of repairing facilities are as follows:

Distribution of number of custom ships for repair calling at Ethiopian ports divided by the scale of repairing facilities



To select the custom ships fitting the scale of repairing facilities is to efficiently operate the facilities. The distribution of the size of ships calling at Ethiopian ports is as illustrated above, referring to Port of Massawa for example. From this the ratios of custom ships by the scale of facilities are calculated as follows:

Scale of facilities	Adaptability	Ratio to total calling ships
3,000 G. T.	1,000 G. T. and over less than 4,000 G. T.	19. 2%
6,000 G. T.	4,000 G. T. and over less than 8,000 G. T.	22. 1%
10,000 G. T.	8,000 G. T. and over less than 10,000 G. T.	11. 8%

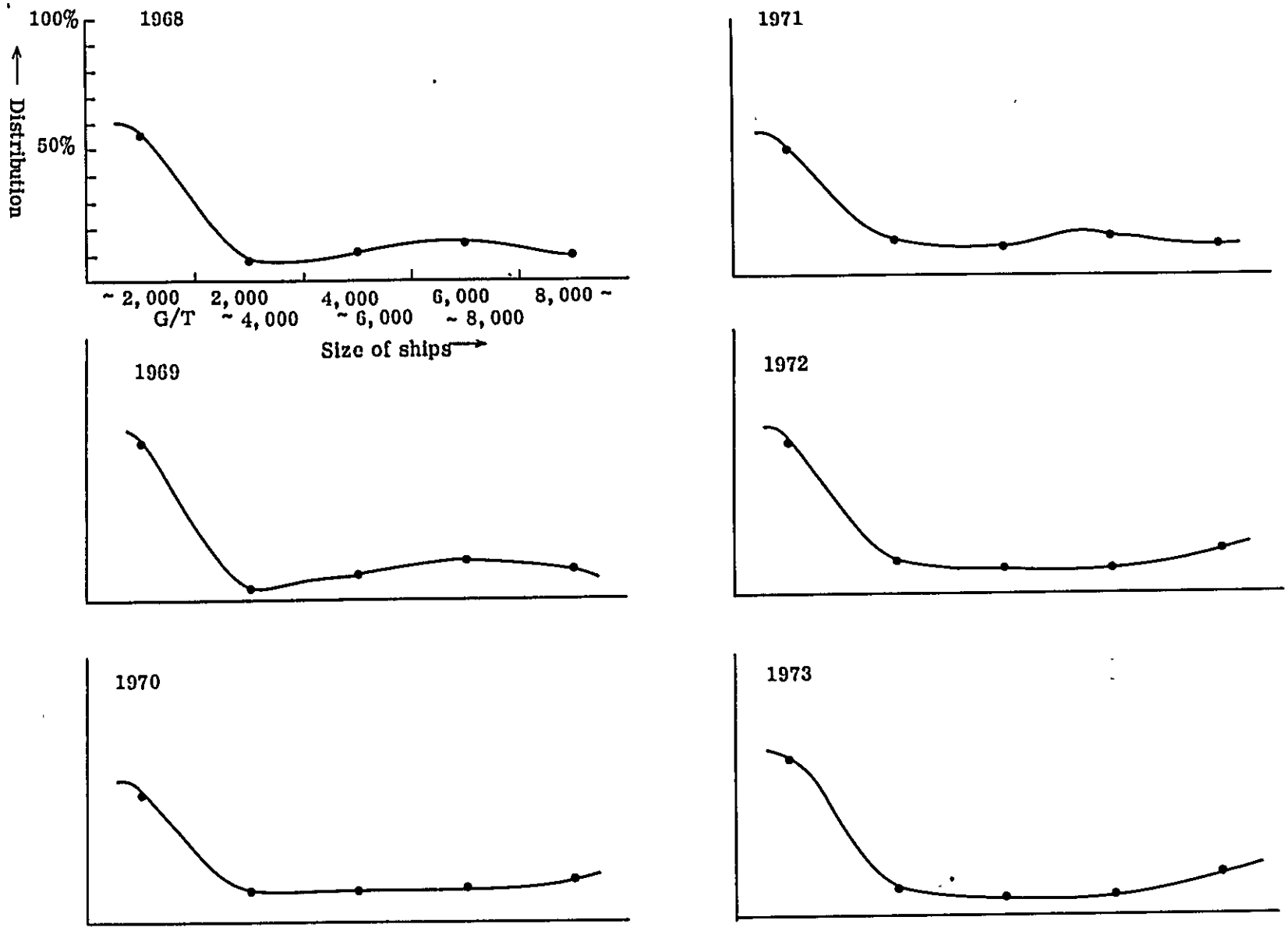
The number of ships for repairing facilities of different scales are obtained by multiplying the number of ships which call at Ethiopian ports, become completely or nearly empty and are considered to actually undergo repairs by the ratios above.

(Reference 1) Trends of volume of ships calling at the Port of Assab and the Port of Massawa

Year	Port of Assab			Port of Massawa		
	Number	Total G.T. (1,000 G.T.)	Average G.T.	Number	Total G.T. (1,000 G.T.)	Average G.T.
1964	–	–	–	767	3,318	4,326
1965	–	–	–	784	3,198	4,079
1966	748	3,473	4,643	821	3,451	4,203
1967	643	2,747	4,272	877	3,124	3,562
1968	598	2,881	4,818	766	2,322	3,044
1969	635	3,109	4,896	840	2,398	2,855
1970	591	3,075	5,203	811	2,544	3,137
1971	577	3,190	5,529	751	2,598	3,459
1972	660	3,087	4,677	733	2,433	3,319
1973	–	–	–	759	2,549	3,358

Note: About 150 ships (average for all years) of the above are domestic.

(Reference 2) Distribution of size of ships by the year referring to the Port of Massawa for example


100%
50%
Distribution
1968
~ 2,000
2,000 ~ 4,000
4,000 ~ 6,000
6,000 ~ 8,000
8,000 ~
G/T
Size of ships
1969
1970
1971
1972
1973