Table 13.3.10 Distance Table of Salalah to East-West Trunk and Feeder Ports

(in nautical miles)

	BOM	COC	CLM	DAM	JEB	JED	KHI	KUW	MUS	PKL	SAL*	SZC
BOM		585	889	1406	1122	2353	501	1537	853	2238	1096	2959
COC	585		307	1882	1598	2544	1039	2013	1301	1656	1368	3150
CLM	889	307		2168	1884	2788	1341	2299	1596	1307	1634	3394
DAM	1406	1882	2168		290	2472	976	252	582	3517	1234	3100
JEB	1122	1598	1884	290		2198	692	465	302	3233	972	2804
JED	2353	2544	2788	2472	2198		2166	2613	1899	4124	1303	636
KHI	501	1039	1341	976	692	2166		1107	467	2690	892	2772
KUW	1537	2013	2299	252	465	2613	1107		717	3648	1391	3219
MUS	853	1301	1596	582	302	1899	467	717		2945	643	2505
PKL	2238	1656	1370	3517	3233	4124	2690	3648	2945		2985	4730
SAL*	1096	1368	1634	1234	972	1303	892	1391	643	2985		1903
SZC	2959	3150	3394	3100	2804	636	2772	3219	2505	4730	1903	

Remarks: BOM-Bombay, COC-Cochin, CLM-Colombo, DAM-Dammam, JEB-Jebel Ali, JED-Jeddah, KHI-Karachi, KUW-Kuwait, MUS-Muscat, PKL-Port Klang, SAL*-Salalah, SZC-Suez

Source: SPS, JICA Study Team

The groups of ports classified by nautical miles from Salalah are as follows:

Less than 1000 nautical miles

Muscat (643)----about 1.3 days by 20 knotter, about 1.5 days by 18 knotter (steaming time only)
Kuwait (892)---- 1.9 2.1
Jebel Ali (972)-- 2.0 2.3

1,000 to 1,500 nautical miles

Bombay (1,096)—about 2.3 days by 20 knotter, about 2.5 days by 18 knotter
Dammam (1,234)-- 2.6 2.9
Jeddah (1,303)----- 2.7 3.0
Cochin (1,368)----- 2.9 3.2
Kuwait (1,391)---- 2.9 3.2

Over 1,500 nautical miles

Colombo (1,634)---about 3.4 days by 20 knotter, about 3.8 days by 18 knotter
Suez (1,903)-------- 4.0 4.4
Port Klang (2,985)- 6.2 6.9

To/from Salalah on the East/South African route is different from the West-East Trunk and Feeder Line route. It is a North-South route and an average voyage covering ports of call is longer.

Table 13.3.11 Distance Table of Salalah to East/South Africa, Indian Ocean Feeder Ports

(in nautical miles)

	SAL	MBS	ZAN	DES	NCL	BIR	MPT	DUB	LDN	CTN	RUN	PLW	TMS
SAL		1359	1539	1580	2092	2655	3219	3593	4242	5276	2425	2250	2233
MBS	1359		115	162	720	1142	1860	2234	2883	3917	1639	1600	1381
ZAN	1539	115		47	700	1122	1745	2110	2768	3802	1524	1485	1266
DES	1580	162	47		546	1078	1698	2072	2721	3755	1477	1138	1219
NCL	2092	720	700	546		563	1183	1526	2179	3209	1311	1321	1054
BIR	2655	1142	1122	1078	563		620	961	1612	2646	2040	1684	1428
MPT	3219	1860	1745	1698	1183	620		341	651	2026	1533	1805	1533
DUB	3593	2234	2110	2072	1526	961	341		310	1375	1644	2146	1634
LDN	4242	2883	2768	2721	2179	1612	651	310		1065	1821	1920	1811
CTN	5276	3917	3802	3755	3209	2646	2026	1375	1065		2886	2987	2876
RUN	2425	1639	1524	1477	1311	2040	1533	1644	1821	2886		175	524
PLW	2250	1600	1485	1138	1321	1684	1805	2146	1920	2987	175		403
TMS	2233	1381	1266	1219	1054	1428	1533	1634	1811	2876	524	403	

Remarks: SAL-Salalah, MBS-Mombasa, ZAN-Zanzibar, DES-Dar es Salaam, NCL-Nacala, BIR-Beira, MPT-Maputo, DUB-Durban, LDN-East London, CTN-Cape Town, RUN-Port Reunion, PLW-Port Louis, TMS-Toamasina

Source: JICA Study Team based on Lloyd's Maritime Atlas

Feeder services to East/South African and Indian Ocean ports from Salalah are currently limited to one weekly service to East Africa and one alternate weekly service to Indian Ocean combined with South African ports. Because both the African Continent and Indian Ocean are big, sailing time is apt to be prolonged, which is different from feeder services connecting ports in South and South East Asia. Consequently, it is generally difficult to secure profit from a long voyage with thin cargo and because of this fundamental weak point, shipping business of the region is still in an inactive stage compared with that of other regions. However, for this very reason, it is safe to say that any transshipment hub for North-South trade has future room to expand.

(2) Port Development Plan

The port development plan of Salalah is a main objective of this report and is elaborated in a separate chapter. Therefore it is studied here whether the Port of Salalah's surrounding circumstance in terms of container port competition will become harder or not in the future. Table 13.3.12 shows a container port development outlook for the Middle East and the Indian

Subcontinent.

Table 13.3.12 Middle East/Indian Subcontinent:Container Handling Capacity

(1000TEU/year)

Region/Year	2000	2001	2002	2003	2004	2005
Red Sea	3600	4100	4700	5200	5200	6200
(Yemen)	(600)	(1100)	(1100)	(1100)	(1100)	(1600)
Arabian Gulf	10800	12530	12530	13530	13530	14530
(Oman)	(1550)	(2550)	(2550)	(3550)	(3550)	(4550)
Indian S. C'nent	6860	7340	8250	8800	9750	12500
Total	**21260**	**23970**	**25480**	**27530**	**28480**	**33230**
Share(%)						
Red Sea	16.9	17.1	18.5	18.9	18.3	18.7
Arabian Gulf	50.8	52.3	49.2	49.2	47.5	43.7
Indian S. C'nent	32.3	30.6	32.4	32.0	34.2	37.6
Total	**100.0**	**100.0**	**100.0**	**100.0**	**100.0**	**100.0**

Source: Ocean Shipping Consultants, the Study Team

Table 13.3.12 shows that the ports in the Arabian Gulf is expected to lose its share in the region due to more ambitious expansion projects in the other two areas. Two giants of Jebel Ali and Salalah will share the future capacity in the region.

In the Red Sea, Jeddah and Aden will account for the major portion of the additional capacity. Jeddah will gain additional 1.0mTEU of capacity by 2005.

(3) Transshipment Cost Comparison

The Study Team carried out a basic cost comparison study to clarify how competitive Salalah can be. Four cases are set for cost comparison of transshipment operation as follows:

Case 1 Salalah / Dubai (Gulf Transshipment)
Case 2 Salalah / Aden (Gulf Transshipment)
Case 3 Salalah / Dubai (East Africa Transshipment)
Case 4 Salalah / Dubai (Indian Sub-Continent Transshipment)

The following conditions are assumed in carrying out a cost estimate:

Main line vessel: 6,500 TEU
Feeder vessel: 1,400 TEU
Charter cost: Main line vessel $US 60,000/day, Feeder vessel $US 9,000/day
Transshipment cost: $US 35/TEU
Cargo volume: 1,000 TEU each way
Feeder port: Gulf / Abu Dhabi, Mina Sulman, Damman, Kuwait
East Africa / Mombassa, Dar es Salaam
Indian Subcontinent / Karachi, Mumbai

Table 13.3.13 Transportation Cost Comparison

($US/TEU)

Transportation cost / Case	Via Salalah	Via Dubai	Via Aden
Case 1	144	160	-
Case 2	139	-	125
Case 3	140	236	-
Case 4	129	195	-

Note: Figures are marginal cost incurred by transshipment and feeder transportation

The following process was taken to compare the transportation cost in case 1. First, five major Gulf ports are selected, namely Dubai, Abu Dhabi, Mina Sulman Damman and Kuwait. Feeder round voyage distance is 3,185 nautical miles for Salalah/Salalah (8 port calls) and 1,085 nm for Dubai/Dubai (6 port calls). It is assumed that mainline is served by 6,500 TEU vessel and its feeder line is served by 1,400 TEU ships from both Salalah, and from Dubai. It is also assumed that the total Gulf cargo is 1,000 TEU each way, totaling 2000 TEU for both ways (import and export). Twenty five per cent of the cargo is assumed to be destined to Dubai , and the remainder for elsewhere in the Gulf. This assumption is slightly high-side judging from the data available which shows about 10-15 % of the total Gulf cargo is to/from Dubai.

Transshipment moves are calculated by multiplying the basic figure of 1,000 TEU by four because there are two ports (transshipment port and final destination port) and two operation (loading and discharging) at each port. What favors Dubai is the fact that an estimated 25 % of Gulf cargo is destined to Dubai itself, meaning that the Dubai transshipment costs are 25 % less than those of Salalah, where all of the Gulf cargo requires transshipment operation since there is virtually no local market at present. Transshipment moves are, therefore, 4,000 TEU for Salalah and 3,000 TEU for Dubai.

Deviation time of mainline vessel is calculated by dividing the deviation distance from the main-route by her speed (22.5 knots). It is 0.6 day for Salalah, and 2.4 days for Dubai. Transshipment operation charge is assumed as US$35 per TEU per move at all ports, regardless of whether it is a hub port or feeder port. Because the transshipment cost is a major component of the comparison, the assumption of US$35 needs careful screening. The feeder round voyage time is calculated by dividing round voyage distance by each feeder vessel's speed. Feeder boat from Salalah needs 7.4 days to cover eight port calls including double calls at both Dubai and Salalah, while 2.8 days are needed for feeder ship from Dubai to cover six port calls including double call at Dubai.

The total marginal transportation costs are US$288,840 for transshipment at Salalah, and US$319,320 for transshipment at Dubai. Marginal cost per TEU (i.e. when divided by 2,000TEU) is US$144 and US$160 respectively. There is an approximately US$16 per TEU

difference in favor of Salalah. This is not a significant difference but it is nevertheless symbolic and will increase as the size of vessels gets larger. At the same time, it should be reminded that the limit of the simple model cost comparison in which many factors such as evolutionary change in managerial philosophy and sudden development of marine technology is inevitable.

13.3.3Previous Study

KPMG's demand projection was made available to the Study Team. This forecast takes the following four steps:

Step 1: Grasp the size of world container trade and regional container trade.
Step 2: Estimate the current regional transshipment market.
Step 3 Estimate the current Salalah transshipment market.
Step 4 Forecast the future figure of Salalah transshipment containers.

In Step 1, the data of Cargo Systems News Services are used to grasp the size of the world container market, which is said to be 160 million TEUs (and more than fifty per cent of the total is handled by the 20 largest port in the world).The inbound and outbound trade to the Arabian Gulf and Indian Sub-continent is estimated as being in the region of 5% of worldwide trade. A table showing 1998 figures classified by each Gulf and ISC port is presented.

In Step 2, UAE ports (Dubai, Fujairah, Khorfakkan and Mina Zayed), Colombo and Salalah are selected as transshipment data ports. Total transshipment volume of these ports was 3,806,000 TEU in 1998 and the total traffic of the same region was 9,202,000 TEU, thus it was calculated that about 41% of the total containerized trade is transshipment.

In Step 3, the proportion of the regional transshipment market in which Salalah would not be at a disadvantage relative to other ports in the region was estimated. As of 1998, the Salalah transshipment market is equal to 3,806,000 TEU at the time of 1998, or 100% of the regional transshipment market.

In Step 4, the expected rate of growth is treated. KPMG predicts that the container trade market will expand at greater rate of growth than the world-wide trade on account of the fact that general cargo is being increasingly containerized. The report points out that the compound annual growth rate for world container throughput during 1986-1997 was 9.6%; over the recent five years it increased slightly to 10%.

Projected market size for Salalah is finally calculated based on the current market estimates made in Steps 1 through 3, and a growth rate of 8%.

The following are preliminary comments on this projection:

1) The definition of the region should include East African ports, since containers to/from the ports are not negligible even today and will grow significantly in the future.
2) The transshipment container ratio of 41% needs further consideration, as this ratio is one of the keys of the forecast.
3) It is reasonable to assume that the entire regional market is Salalah's potential market. However, what portion of the pie can Salalah take? The share among the competing ports needs to be analyzed.
4) Transshipment operation needs a minimum of two moves per each container, thus counting of throughput is doubled and must be carefully interpreted when using throughput data.
5) A flat growth rate of 8% is applied to the entire catchment area.
6) Comparison of the result with JICA Study Team's forecast regarding regional transshipment market is as follows:

Table 13.3.14 Comparison of Transshipment Volume Forecast for the Market

(TEUs)

Year	KPMG Forecast	JICA Forecast	Remarks
2005	6,512,532	(High) 12,820,000	JICA figure including East African ports
		(Low) 9,934,000	
2020	20,658,854	(High) 30,917,000	------ do ------
		(Low) 16,933,000	

13.3.4 Demand Forecast

(1) Methodology

Demand forecast of transshipment containers is conducted based on the development scenario set up in the Chapter 10 of the progress report " Preliminary Development Scenario " which assumes GDP Growth in the surrounding regions (Middle East and Norht Africa, Indian Sub-Continent and Sub-Saharan Africa) for the period of 2000-2020 as is shown in Table 10.1.1 in the report. Two cases, the high case and low case are assumed up to 2020 by the projection of socio-economic indices of GDP.

As a first step, the historical data of container throughput (regardless whether it is transshipment or not) by region are analyzed in terms of co-relation between GDP and container throughput growth. Then, using the co-relation index, the future demand up to 2020 is ascertained. Then transshipment container throughput will be forecasted for three different scenarios regarding Salalah's strategic position in the future, making the number of forecasts six, i.e. three scenarios for both the high case and low case.

(2) Co-relation between GDP and Container Growth

It has been observed that there is a strong co-relation between growth of GDP and that of container throughput. Thus, it is possible to ascertain future throughput of a region utilizing GDP.

1) Middle East Region

To identify the future trend of containerization in the Middle Eastern region, the first task is to gather container throughput of the region. The countries as per Table 13.3.15 are selected taking the grouping systems of World Bank, OECD and Japanese Government. Some remarks are necessary regarding the countries included in the Table.

Iran and Iraq are omitted from the Table because the major portion of cargo to/from Iran has been and will be for direct service or transshipped within the Gulf while reliable container shipping data to/from Iraq is negligible and also unavailable.

Instead, Israel and Egypt are added. It is difficult to define the group of Middle East countries in terms of container shipping business and whether Egypt fits in with the group or not is even more difficult. However, the development of Port Said East Port will make it necessary to include Egypt in the Table, because the new East Port will bridge cargo from inland and Mediterranean ports to Middle East and Asia as another new transshipment hub. On the other hand, Israel is the largest Mediterranean Mid-East country and Zim Line may be one of the prospective users of Salalah.

Table 13.3.15 Container Throughput of Middle East Countries

(1000 TEU)

	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996
UAE	712	926	958	1,043	1,367	1,563	2,073	2,506	2,935	3,203	3,512	3,750
S. Arabia	947	824	830	823	759	789	1,071	1,154	1,219	1,183	1,222	1,148
Israel	308	345	376	392	514	462	540	512	649	687	891	990
Kuwait	236	201	200	220	229	126	71	187	202	221	224	235
Egypt	176	170	179	186	195	350	576	737	990	1,172	1,063	911
Oman	114	113	140	148	166	168	156	116	90	88	96	101
Total	2,493	2,579	2,683	2,812	3,230	3,457	4,487	5,310	6,805	6,554	7,008	7,135
Inc. %	-5.6	3.4	4.0	4.8	14.9	7.0	29.8	18.3	14.6	-4.7	6.9	1.8

Source: JICA Study Team

The growth of GDP of the same region, in the same period is shown in Table 13.3.16.

Table 13.3.16 GDP Growth in the Middle East

(%)

1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997
1.8	-0.8	3.3	0.4	2.7	5.3	3.5	6.2	4.2	0.5	3.6	3.9	4.0

Source: IMF " World Economic Outlook ", JICA Study Team

Figure 13.3.1 shows co-relation between Middle East Region GDP Index (1985 = 100) and Container Throughput in the same region. The correlation coefficient is 0.9599 and correlation formula is as follows:

$Y = 134.14 X - 10530$

Where Y: Middle East Region Container Throughput per Year (1000 TEU)

X: Middle East Region GDP Index (1985 = 100)

Using the formula, demand forecast of container for the future is conducted for two cases, the high growth case (GDP Growth; 4%) and low growth case (GDP Growth; 2%).

High Economic Growth Case

Year	1998	2000	2005	2010	2020
GDP Growth Ratio %	4	4	4	4	4
GDP Index (1985)	145.6	157.5	191.7	233.2	345.2
Containers(1000TEU)	9,001	10,597	15,185	20,751	35,775
Container Growth %		28.4	43.3	36.7	72.4

Low Economic Growth Case

Year	1998	2000	2005	2010	2020
GDP Growth Ratio %	4	2	2	2	2
GDP Index (1985)	140.0	148.6	164.1	181.2	220.8
Containers(1000TEU)	9,001	9,403	11,482	13,776	19,088
Container Growth %		14.0	22.1	20.0	38.6

2) Indian Subcontinent

Three countries are selected to represent the subcontinent, i.e. India, Sri Lanka and Pakistan. The container throughput of these countries is shown in Table 13.3.17.

Figure 13.3.1 Middle East: GDP/Container Throughput Co-relation

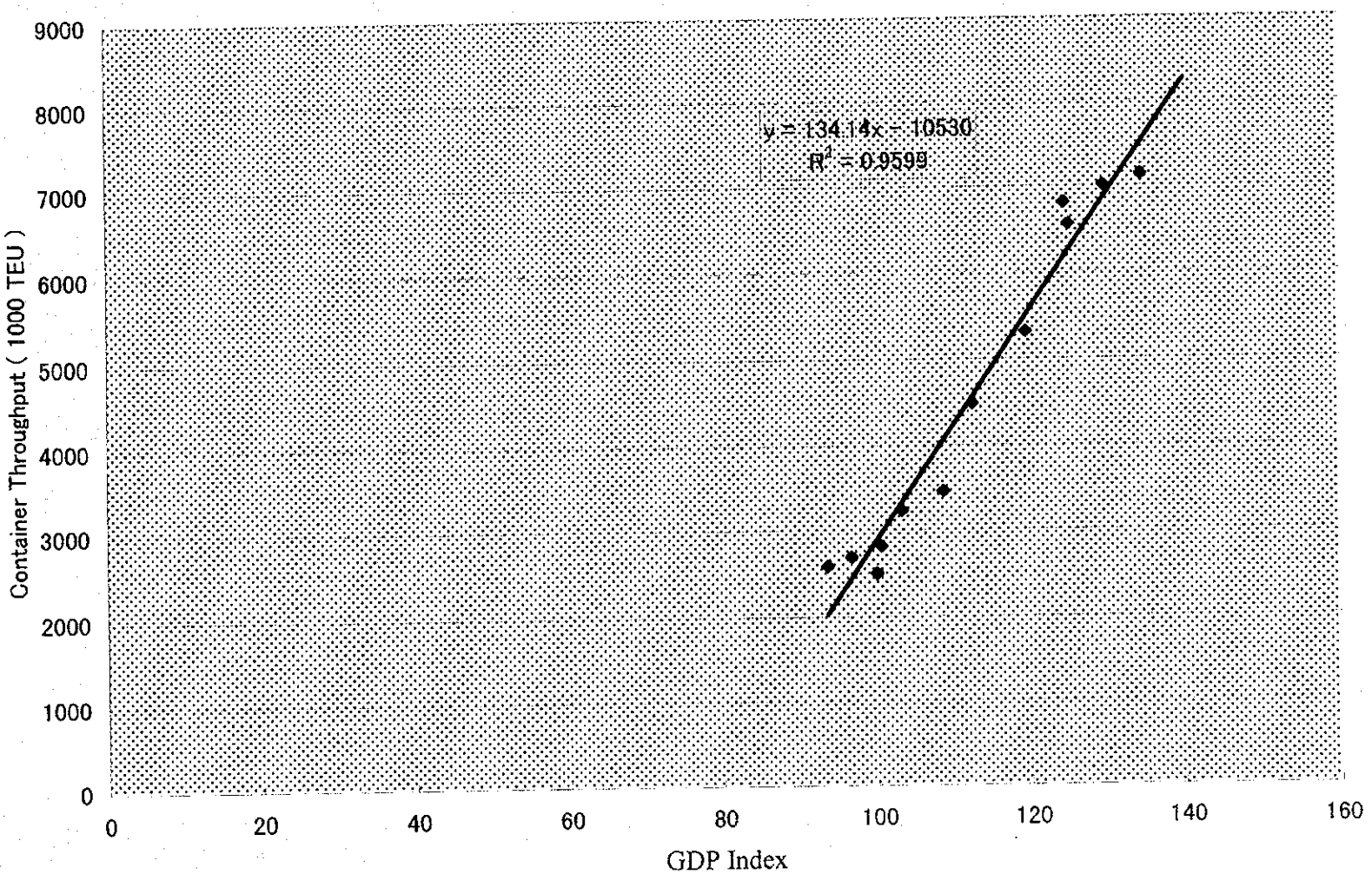


Table 13.3.17 Lifting of Containers: Three Countries of the India Sub-continent

(1000 TEU)

Year	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997
India	486	516	550	632	687	699	793	1017	1257	1360	1506	1803
S.Lanka	341	429	621	544	584	669	676	858	973	1029	1356	1687
Pakistan	292	281	340	343	390	470	510	510	513	551	555	505
Total	1119	1226	1511	1519	1661	1838	1979	2385	2743	2940	3417	3995
Inc.%	36.0	9.6	23.2	0.5	9.3	10.7	7.7	20.5	15.0	7.2	16.2	16.9

Source: Containerization International Yearbook, JICA Study Team

As historical data on GDP growth of this same region is not available , that of all Asia is given in Table 13.3.18.

Table 13.3.18 GDP Growth in Asia

(%)

1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997
6.9	6.9	8.1	9.1	6.2	5.9	6.9	8.8	8.7	9.1	8.6	7.0	5.9

Source: IMF " World Economic Outlook ", JICA Study Team

Figure 13.3.2 shows the co-relation between Indian Subcontinent Region GDP Index (1986 = 100) and Container Throughput in the same region. The correlation coefficient is 0.88 and correlation formula is as follows:

$Y = 5.5783 X + 198.88$

Where Y: Indian Subcontinent Region Container Throughput per Year (1000 TEU)

X: Indian Subcontinent Region GDP Index (1986 = 100)

As same with Middle East case, demand forecast for the future is conducted for two cases.

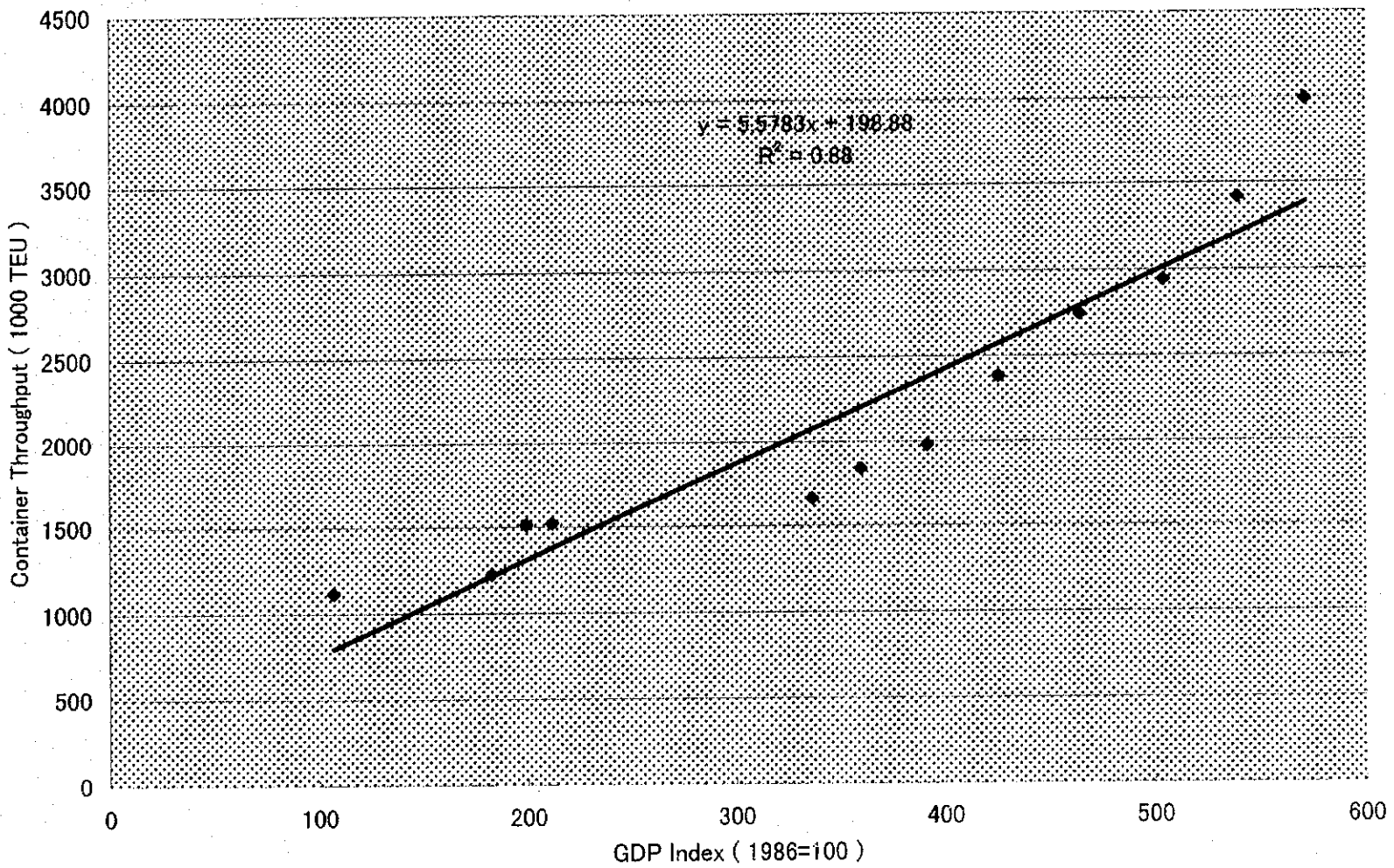
High Economic Growth Case

Year	1998	2000	2005	2010	2020
GDP Growth Ratio %	5.9	6	6	6	6
GDP Index (1986)	571.2	680.3	910.3	1218.3	2181.7
Container (1000TEU)	3,995	3,994	5,277	6,995	12,369
Container Growth %		0.0	32.1	32.6	76.8

Low Economic Growth Case

Year	1998	2000	2005	2010	2020
GDP Growth Ratio %	5.9	4	4	4	4
GDP Index (1986)	571.2	642.5	781.7	951.0	1353.6
Container (1000TEU)	3,995	3,783	4,559	5,504	7,750
Container Growth %		-5.3	20.5	20.7	40.8

Figure 13.3.2 Indian Subcontinent GDP/Container Throughput Co-relation



3) East and South Africa

The container throughput of South and East African ports is shown in Table 13.3.19. Due to the low level of containerization and lack of statistics in many African nations, East Africa is treated as one sub-region in terms of container throughput

Table 13.3.19 Container Throughput in South and East Africa

(1000 TEU)

Year	1986	1990	1991	1992	1993	1994	1995	1996	1997	1998
South Africa	629	808	897	925	1027	1187	1464	1688	1684	1684
East Africa	242	374	383	430	486	507	551	603	643	667
Total	871	1182	1280	1355	1513	1694	2015	2291	2327	2351

Source: World Container Markets to 2012 by Ocean Shipping Consultants, JICA Study Team

The growth of GDP of Sub-African Region is shown in Table 13.3.20. Although the periods of the two sets of data are slightly different, it is, however, still valid to identify the co-relation of GDP and throughput.

Table 13.3.20 GDP Growth of Sub-African Region

1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997
4.0	2.1	0.3	4.1	3.4	1.8	1.8	0.8	0.9	2.9	3.0	3.0	2.0

Source: IMF " World Economic Outlook ", JICA Study Team

Figure 13.3.3 shows the co-relation between East and South African Region GDP Index (1984 = 100) and Container Throughput in the same region. The correlation coefficient is 0.9518 and correlation formula is as follows:

$Y = 56.747 X - 5435$

Where Y: East and South Africa Region Container Throughput per Year (1000 TEU)

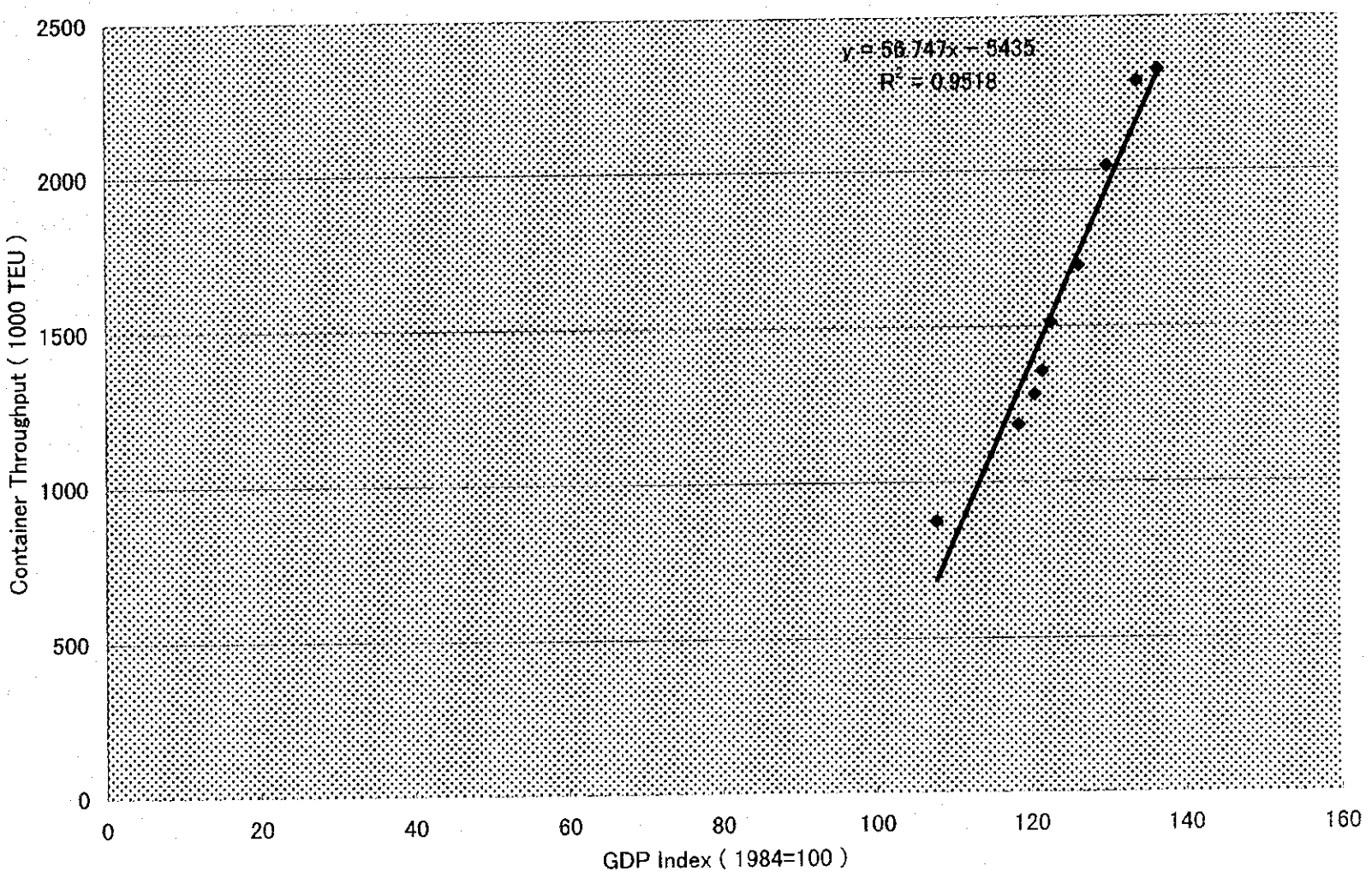
X: East and South Africa Region GDP Index (1984 = 100)

The high growth case (GDP Growth ; 4%) and the low growth case (GDP Growth; 2%) are as follows:

High Economic Growth Case

Year	1998	2000	2005	2010	2020
GDP Growth Ratio %	4	4	4	4	4
GDP Index (1984)	142.1	153.7	187.0	227.6	337.0
Container (1000 TEU)	2,351	3,287	5,177	7,481	13,689
Container Growth %		39.8	57.5	44.5	83.0

Figure 13.3.3 East& South Africa GDP/Container Throughput Co-ralation



Low Economic Growth Case

Year	1998	2000	2005	2010	2020
GDP Growth Ratio %	2	2	2	2	2
GDP Index (1984)	142.1	147.8	163.2	180.2	219.6
Container (1000 TEU)	2,351	2,952	3,826	4,791	7,027
Container Growth %		25.6	29.6	25.2	46.7

4) Summary

High Economic Growth Case and Low Economic Growth Case for the three Regions are summarized in Table 13.3.21 and 22.

Table 13.3.21 Container Throughput Outlook for High/Low Cases of the Three Regions

(Short Term: 2005, 1000 TEU)

Region	High Growth	Low Growth
Middle East	15,185 (59.2%)	11,482 (57.8%)
Indian Subcontinent	5,277 (20.6%)	4,559 (22.9%)
East/South Africa	5,177 (20.2%)	3,826 (19.3%)
Total	25,639 (100.0%)	19,867 (100.0%)

Table 13.3.22 Container Throughput Outlook for High/Low Cases of the Three Regions

(Long Term: 2020, 1000 TEU)

Region	High Growth	Low Growth
Middle East	35,775 (57.9%)	19,088 (56.4%)
Indian Subcontinent	12,369 (20.0%)	7,750 (22.9%)
East/South Africa	13,689 (22.1%)	7,027 (20.7%)
Total	61,833 (100.0%)	33,865 (100.0%)

Forecasted throughput for 2005 and 2020 are further summarized as follows:

Short Term: 2005 **High Growth Case ——25,639 thousand TEU**
Low Growth Case——19,867 thousand TEU

Long Term:2020 **High Growth Case——61,833 thousand TEU**
Low Growth Case——33,865 thousand TEU

(3) Assumptions of Demand Forecasting

The following assumptions are set for the transshipment container throughput at Salalah.

1. Panama Canal will not be widened and remains as it is at the time of 2020.

2. As a result, major East/West shipping routes are : Asia/North America, Asia/Europe and Europe/North America.

3. Imbalance of containers in the above major routes still exists.

4. The largest ship size is 8,000 TEU, with a length of 390m, a beam of 58m (22 boxes across), and a maximum loaded draft of 16m.

5. The overall transshipment containers' ratio in the three region market is assumed as a maximum of 25 %, thus the gross container throughput is increased by maximum of 50 % based on the following transshipment formula:

$$C = (C + 2T) \times 2 = (C + 2CR) \times 2 = 2C (1 + 2R)$$

Where : Total Container Throughput = C

Transshipment Container Throughput = $T = (C \times R) \times 2$

Transshipment Ratio = R (%)

Transshipment Throughput in Middle East ports is estimated in Table 13.3.23. It is to be noticed that the Mid-East transshipment incidence is much higher than that of the World average.

Table 13.3.23 Estimated Transshipment Incidence % of Mid-East, 1980-98

	1980	1985	1990	1995	1996	1997	1998
Dubai*	33.0	38.0	43.0	48.0	48.0	50.0	50.0
Fujairah	0.0	60.0	90.0	80.0	75.0	75.0	75.0
K. Fakkan	5.0	65.0	60.0	80.0	80.0	80.0	80.0
Abu Dhabi	0.0	0.0	10.0	50.0	60.0	60.0	60.0
Salalah	0.0	0.0	0.0	0.0	0.0	0.0	95.0
Jeddah	0.0	0.0	0.0	2.0	17.0	20.0	20.0
Other **	1.0	2.0	3.0	4.0	4.0	4.0	4.0
Total Gulf**	6.5	17.0	31.6	39.8	41.5	42.2	41.9
Other Mid-East	2.4	2.9	5.2	9.0	10.0	11.3	12.6
Total Mid-East	5.6	14.2	26.1	33.3	34.7	35.4	35.6
World	11.2	13.9	18.4	22.2	22.5	22.9	23.4

Remarks:* Port Rashid and Jebel Ali

** including Saudi Arabian Red Sea ports

Source: Drewry Shipping Consultants Ltd.

Transshipment Container Throughput for Each Case:

Short Term: 2005 — **High Growth Case —— 12,820 thousand TEU**
Low Growth Case ——–9,934 thousand TEU

Long Term:2020 — **High Growth Case——30,917 thousand TEU**
Low Growth Case———16,933 thousand TEU

(4) Salalah's Strategic Position

Based on the assumptions mentioned in (3), it is studied in this sub-chapter whether the strategic position of the port of Salalah is strengthened, remains unchanged or is weakened from 2000 to 2020. As elaborated in Section 3.2, there are three evolving trends in the field of international shipping: Alliances,Vessel size, and Imbalance of containers.

The socioeconomic framework of countries which have ports that could compete with Salalah is an important element in forecasting the future position of Salalah. In particular, changes in political stability, warfare, revolutionary movements or uprisings etc., need to be considered. Changes are separately forecasted by region.

Regional competition directly affects the position of Salalah. Outlook for the development of each competing port is one of the keys. For instance, if the civil strife of Sri-Lanka can be overcome and the security of Colombo considerably improved, the port will emerge as a strong competitor to Salalah. The same can be said of Aden. Thus, taking all the concerned factors into consideration, three scenarios for Salalah's strategic position, in future are set as is shown in Table 13.3.24.

Table 13.3.24 Salalah's Strategic Position (Three Scenarios)

Assumptions:	**Strengthened**	**No change**	**Weakened**
Alliances/Major Lines	More mergers take place fewer groups	Status quo.	Alliances collapse
Vessel Size	Getting bigger	Status quo.	Main stream of vessels becomes 3/4000 TEU
Imbalance of Boxes	No decrease	Status quo	Decrease remarkably
Socio-Economic (Economic Growth)	All three regions show high growth	No big change in OECD's forecast	All three regions show low growth
Socio-Economic (Social Stability)	All three regions stable	No big change from current condition	New warfare in one or two regions

Competing Port (Aden)	Yemen' political state not improved	Status quo	Yemen's political state stabilized
Competing Port (Singapore)	Number of feeder services increase	Status quo	Number of feeder services decrease
Competing Port (Dubai)	Minor improvement	No improvement	Big improvement
Competing Port (Colombo)	Sri-Lanka becomes more unstable	Status quo	Sri-Lanka grows stable

Source: JICA Study Team

The shares of the major international alliances and independent shipping lines in terms of TEU Space onboard container vessels(hardware) are shown in Table 13.3.25.

Table 13.3.25 TEU Space Shares of Major Alliances and Independent Lines

	World-wide		Euro-Asia (E/B)		Euro-Asia (W/B)		Euro-Asia (TTL)	
	TEU	**%**	**TEU**	**%**	**TEU**	**%**	**TEU**	**%**
Grand	2.5m	17.4	0.9m	28.1	1.1m	28.2	2.0m	28.2
New World	2.8m	19.4	0.5m	15.8	0.7m	17.9	1.2m	16.9
United	2.5m	17.4	0.5m	15.6	0.6m	15.4	1.1m	15.5
Maersk-SL	2.6m	18.0	0.5m	15.6	0.6m	15.4	1.1m	15.5
COSCO/YM/K	1.8m	12.5	0.5m	15.6	0.6m	15.4	1.1m	15.5
Evergreen	2.3m	15.7	0.3m	9.3	0.3m	7.7	0.6m	8.4
Total	14.5m	100.0	3.2m	100.0	3.9m	100.0	7.1m	100.0

Source: JICA Study Team

It is to be noticed that while TEU share of Maersk-Sealand is 18.0 percent of the world total, its share in the Europe-Asia trade is only 15.5 percent, substantially less than that of the largest player, Grand Alliance. Assuming that the TEU share eventually converges the container market share, it would be rational to use the TEU share to forecast the share of terminals in the container transshipment market. According to a reliable source in the shipping business, New World Alliance and Maersk-Sealand are discussing the possibility of cooperating in the area of container marketing and terminal using.

If this becomes a reality, the share point of the new group will become 37.4 % of the world total and 32.4 % in the Europe-Asia trade. On the other hand, if Maersk-Sealand remains as an only user of Salalah, the share will also remain as it is, namely about 15 percent. The implications of such a development for Port Salalah are that one of two small users, in addition to Maersk-Sealand, would begin to use its facilities. This means that Port Salalah would be able to maintain its existing share in the market of 20%. On the other hand, if Maersk-Sealand remains as an only user of Salalah, the share will also remain as it is, namely about 15 %.

For visual reference, Figure 13.3.4 shows the locations of three major transshipment hubs

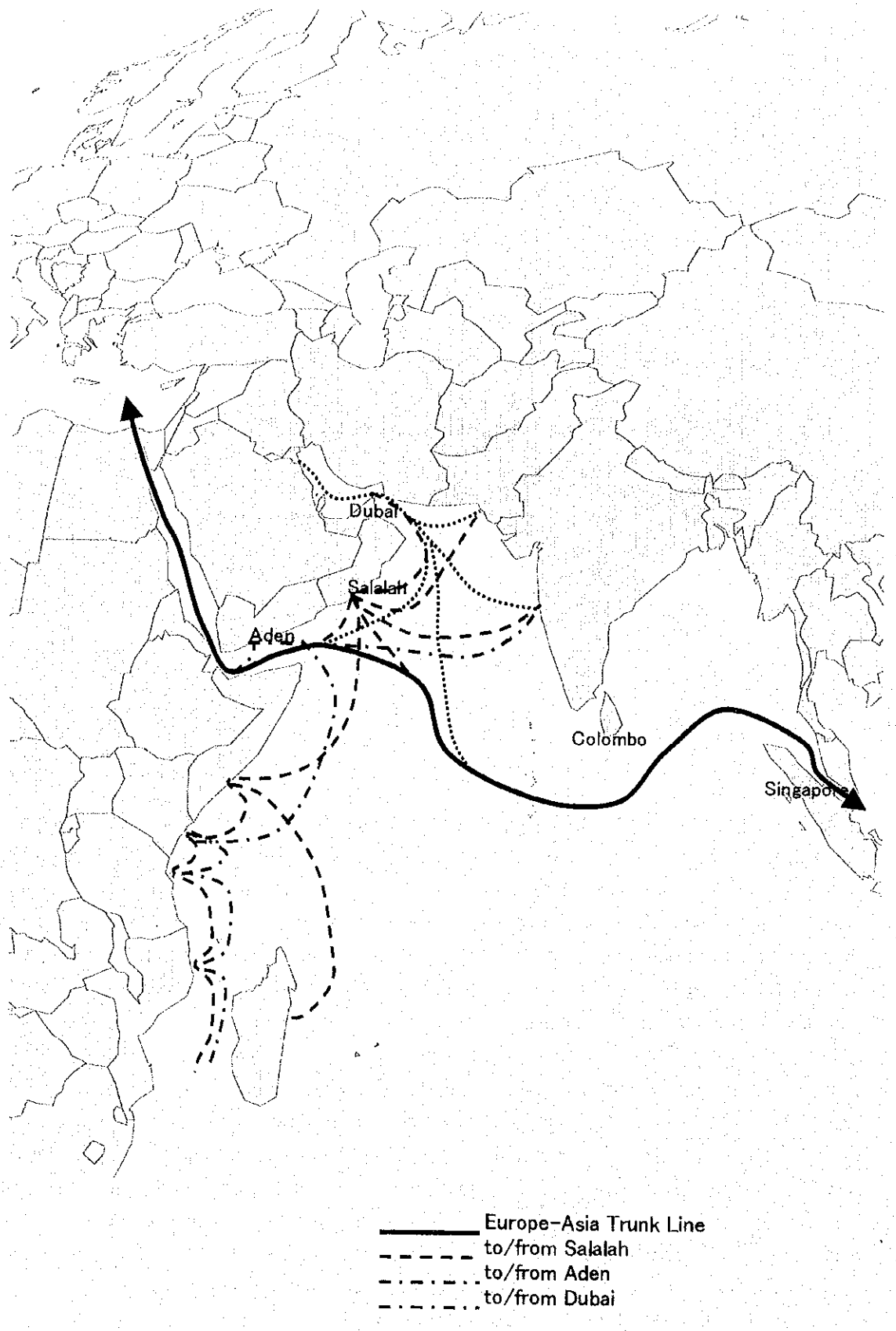


Figure 13.3.4 Middle East transshipment Hubs and Feeder Areas

(Salalah, Aden and Dubai) and their feeder network routes. Each of the three has its own strong points and weak points as already elaborated in 13.3.1. If it is fair to conclude that there is little to choose among the three ports, the transshipment market share for each port would rightly be 33.33 percent. Table 13.3.26 illustrates the differences and similarities of the three for comparison.

Table 13.3.26 Comparison of Salalah, Aden and Dubai

	Salalah	Aden	Dubai
Deviation (n.m.)*	320	7	1,300
Estimated Capacity (TEU) p.a.	2,000,000**	500,000***	3,250,000
Estimated Local Market**	-	15,000	1,000,000
Container Berths	4	2	10
Total Quay Length	1,236m	700m	2,885m
Depth alongside	16m	16m	13-14m
Gantry Cranes:			
Panamax	1	-	15
Post Panamax	6+5*****	4+2******	8
Ownership	60% private	100% private	100% government

Remarks:* Approximate deviation from Europe-Far East route
** Phase 1 *** Phase 1 ****Estimated loaded TEU non-transship traffic available to each port, 1998. ***** +5 are Extra-Super Post Panamax which cover 22 rows of containers, to be introduced within 2000 ****** +2 are Post Panamax, to be introduced within 2000

Source: JICA Study Team , Drewry Shipping Consultants Ltd

Based on the above TEU and market share assumptions and shipping trade circumstances, and further assuming that Salalah port's share of transshipment container throughput in the whole region in 2000 as being 20 percent, the change of the port share according to the above scenarios are set as follows:

Strengthened : **Share increases to 30 percent**

Status quo: **Share remains at 20 percent**

Weakened **Share decreases to 15 percent**

The above shares are combined with the previous figures of High and Low cases in Table 13.3.27. SPS is expecting to handle about 1.5 m TEU in 2000. Using the table it is easy to see this projected figure is within reach by the year of 2005. For example, the High Case-20 percent share case (Strategic Position: Status quo) yields 2,563,900 TEU.

Table 13.3.27 Demand Forecast of Transshipment Containers at Salalah

Term	Economic Growth	Transshipment Market in the Region (thousand TEU)	Salalah's Strategic Position	Salalah's Share in the Market	Throughput of Salalaah (thousand TEU)
Short Term (2005)	High	12,820	Strengthened	30 %	3,846
		12,820	Status quo	20 %	2,564
		12,820	Weakened	15 %	1,923
	Low	9,934	Strengthened	30 %	2,980
		9,934	Status quo	20 %	1,987
		9,934	Weakened	15 %	1,490
Long Term (2020)	High	30,917	Strengthened	30 %	9,275
		30,917	Status quo	20 %	6,183
		30,917	Weakened	15%	4,638
	Low	16,933	Strengthened	30 %	5,080
		16,933	Status quo	20 %	3,387
		16,933	Weakened	15 %	2,540

Source: JICA Study Team

Several comments can be made concerning the above table:

1) The cases in which the existing facilities can handle the forecasted throughput are;

Short Term (2005)	Low Growth-15 % Share Case	1,490 thousand TEU
Long Term (2020)		None

2) The cases in which a minimal addition of facilities such as additional two berths are required for Short Term are:

Short Term (2005)	High Growth-20 % Share Case	2,564 thousand TEU
	Low Growth-30% Share Case	2,980 thousand TEU

3) For the long term development, the required scale of development differs depending on the scenario. The extreme case is Long Term High Growth- 30 % Case, in which it is necessary to build 15 new berths in addition to the existing four berths, on the assumption that each terminal is to handle 500,000 TEU per year.

4) The most likely zone of the forecast is Long Term (2020) High Growth-20 % Case and Low Growth-30% Case, in which 6-8 additional berths are needed. Short Term (2005) High Growth-20 % is also likely in which two additional berths are needed.

13.4 Demand Forecast of Domestic Cargo

13.4.1 Methodology

There are two different methods of forecasting demand for port traffic in general. One is the so-called macro forecast method on the basis of socioeconomic frameworks in the catchment area of the port, and the other is the so-called micro forecast method on the basis of the characteristics of cargo flow by each commodity group of cargo.

The former method forecasts the total cargo volume as a whole by statistical correlation between the cargo volume and socioeconomic indices such as GDP of the catchment area of the port and/or population, and past time trend. The latter one is a cumulative method forecasting the cargo volume based on analyses of the patterns of major commodities individually (related indices, the forecast demand, supply situation and so on).

13.4.2 Socioeconomic Indicators

The economic indicators used for the cargo demand forecast in this study are GDP in Oman and GRDP in the Governorate of Dhofar at constant prices in 1989. The future scenario for high, middle and low cases of GDP and GRDP are given in Chapter 9.

13.4.3 Catchment Area for Domestic Cargo

(1) General

Many factors are considered in determining the catchment area of domestic cargo handled in a port. The catchment area depends on such factors as geographical condition around the port, the level of commercial activities in the related area, transportation networks, total transport cost and the level of service in other ports located around the port. Theoretically, the catchment area of a port varies according to the kind of cargo and sometimes may shift in the course of regional development. The catchment areas of adjacent ports, especially at their outskirts, sometimes overlap each other.

In this study, the geographical profile, transportation network, the level of commercial activities in the related area and land transport cost are reviewed and then the catchment area of Salalah port is evaluated considering total transport cost.

(2) Geographical Profile

Salalah port is located at the southeast coast of the Arabian Peninsula, facing the Arabian Sea. Aden port, situated in the republic of Yemen, is the only competitive port in this area.

The distance between Salalah port and Aden port is about 1,100 km on map but these ports are not directly connected by road. The other neighboring ports are Sultan Qaboos port in Oman, Fujairah port and Khor Fakkan port in Fujairah, and Rashid port and Jebel Ali port in Dubai. The former ports face the Gulf of Oman while the latter ports are located inside of Hormuz Strait. The distance by road from Salalah port to Sultan Qaboos port, which is the nearest of these five ports, is more than 1,000 km.

(3) Transport Network

Road transportation is the only means for domestic cargo transport in Oman. Domestic sea transportation is used mainly for the transport of fuel from Al Fahal Oil Terminal although a few coastal services with small vessel are operated in isolated areas along the eastern coast.

The road network in Oman and the eastern side of UEA including major ports is shown in Fig.13.4.1. Dual carriage highways connect Muscat, the Capital of Oman, Abu Dhabi, the Capital of UAE, and Dubai, the largest commercial center of this region. An artery road connects Salalah and the northern part of Oman. The distances between major cities are shown in Table 13.4.1. Muscat, Sohar, Fujayrah, Dubai and Abu Dhabi Cities are within 500 km of each other, meaning any destination could be reached within half-day by vehicle. Sohar City is situated almost in the center of these cities, by contrast, Salalah City is located more than 1,000 km from these cities.

Table 13.4.1 Distance Table between Major Cities

(Unit Km)

	Salalah	Muscat	Sohar	Fujairah	Dubai	Abu Dhabi
Salalah	-	1,020	1,120	1,220	1,200	1,210
Muscat	1,020	-	230	340	450	480
Sohar	1,120	230	-	110	220	260
Fujayrah	1,220	340	110	-	120	270
Dubai	1,200	450	220	120	-	150
Abu Dhabi	1,210	480	260	270	150	-

Note : All figures represent the approximate road length between two cities.

Source : DG of Road and Others

(4) Level of Commercial Activities in Related Areas

The level of commercial activities mainly depends on the size of the market in related areas. The population density by Wilayat in Oman and UAE is shown in Fig. 13.4.2. Densely populated areas (more than 50 persons/km^2) are only located in the northern part of Oman,

the northeast part of UAE and Salalah. The former two areas are connected by dual carriage highway, and more than 25% of import by value to Oman came from UAE and more than 40% of export by value from Oman went to UAE in 1998. It is understood that these two areas have deep economic relations and basically form one market. The total population of these areas is more than 2 million and Dubai is the one of the major commercial centers in the Middle East. The population in Salalah area is about 150,000, which is less than one tenth of the former area. The major economic activities around Salalah are fishery and agriculture; daily consumption goods are supplied through Dubai at present.

(5) Land Transport Cost

Based on interviews with trucking companies, the road haulage tariffs from each entry port are shown in Table 14.4.2.

Table 13.4.2 Road Haulage Tariffs from Each Entry Port

(Unite R.O.)

Entry Ports / Destination	Sultan Qaboos	Dubai	Salalah
Muscat	50	120-150	250-325
Sohar	80-100	80-100	320-400
Nizwa	80-100	180-225	200-250
Hayma	180-225	300-360	160-200
Thamarat	200-300	320-400	60-80
Salalah	230-325	350-450	50

Source : various

Note : Cargo weight is up to 30ton including container box.

According to statistics on vehicle registration in Oman, about 70% of commercial vehicles are registered in the northern part of Oman. Most of the trucking companies are established in the northern part of Oman, as land transport service is the dominant means of transport in this area. The cargo volume from Muscat to Salalah is larger than from Salalah to Muscat at present and therefore road haulage tariff of the former direction is higher than the latter.

(6) Total Transport Cost

The total transport cost is evaluated by weighing monetary costs and time costs as well as the level of service. Here, the monetary cost is the total freight cost from door to door, including charges for land and sea transport, and fees for loading, unloading, storage, handling and so on. Time costs are estimated by converting total travel time of cargo from

origin to destination including idling time and time lost due to congestion, into money units based on value of time for the cargo. The level of service is a combination of quantitative and qualitative features. The quantitative characteristics for a higher level of service involve minimizing congestion and idling while the qualitative characteristics for a higher level of service involve safety, reliability, timely delivery, etc. Every shipper, in general, will select the transportation route which minimizes the total transport cost.

In order to determine the catchment area of Salalah port, the following factors could be assumed.

a) For bulk cargo, shipper will select one of the nearest berthing facilities to optimize total transport cost, in case development of new dedicated berthing facility could be an alternative, because the volume of cargo is very large, the time cost of the cargo is not so high, the maritime service of bulk cargo is tramper and the maritime transport cost is not significantly affected by the location of port. It is, therefore, obvious that the catchment area of bulk cargo is very limited.

b) For break bulk cargo, the sea transport cost is mainly decided by the size of vessel in service and the volume of one lot handled at a time. The volume of break bulk cargo handled in Salalah port is very small at present and will not become so large compared with the competitive ports in the foreseeable future because the size of the market around Salalah is small. It is, therefore, obvious that the catchment area of break bulk cargo is very limited.

c) For container cargo, the major trade partners of Sultan Qaboos port are Europe, Southeast and Fareast Asia, and the Indian Subcontinent at present, and therefore it is estimated that the money cost advantage of Salalah to the other competing ports is around R.O.100 including port charges. After the hub-feeder transport system is well organized, the time cost for most of the cargo due to feeder service could be ignored because the feeder ports will receive reliable and punctual feeder services and the difference of travel time from Salalah to Muscat between by land and by sea will be less than three days. The catchment area of container cargo could be estimated by the money cost of land transport.

(7) Catchment Area

Based on the before-mentioned factors, the catchment area of Salalah port for bulk and break bulk cargo is assumed to be the Governorate of Dhofar, mainly the Wilayat of Salalah. The catchment area for container cargo is assumed to be the Governorate of Dhofar and Al Wusta Region.

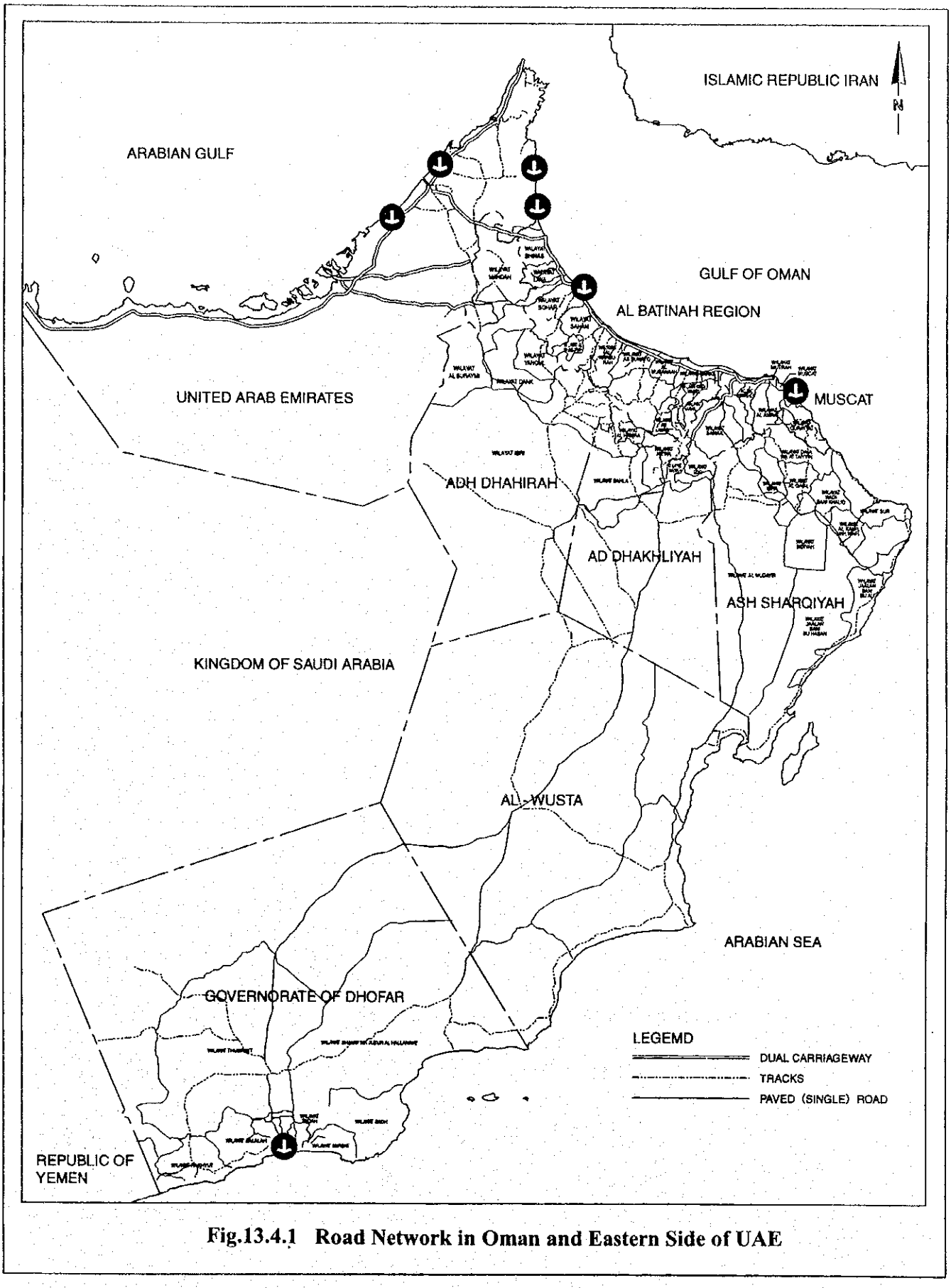


Fig.13.4.1 Road Network in Oman and Eastern Side of UAE

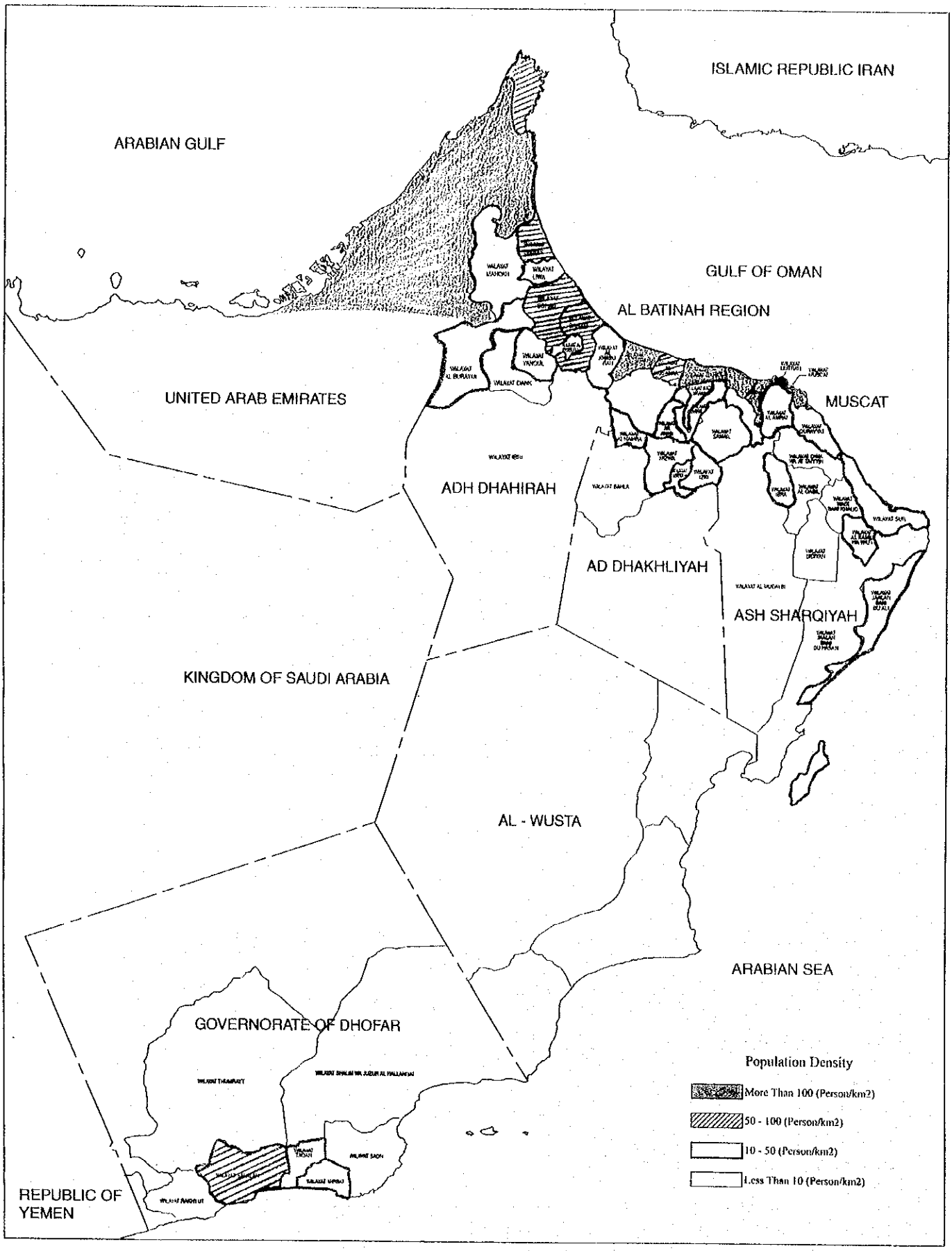


Fig.13.4.2 Population Density in Oman and Eastern Side of UAE

13.4.4 Traffic Demand Forecast

(1) Macro Forecast

1) Procedure

There are several methods of conducting a macro forecast; the most popular one is to use a statistical correlation between the cargo volume handled in the port and socioeconomic indices of the catchment area. The import cargo volume excluding fuel handled in Salalah port from 1989 to 1999 fluctuated between 110,000 tons and 180,000 tons, and the percentage of foreign trade import volume of Oman fell continuously (from around 8 % to less than 5 %). On the other hand, export cargo volume handled in Salalah has dramatically increased from 64,000 tons in 1997 to 247,000 tons in 1998 and 530,000 ton in 1999. According to the foreign trade statistics of Oman, the share of import and export volume by sea has been around 50% for the past several years. Cement is the largest export commodity in Salalah port; the volume handled in the port was 50,000 tons in 1997, 85,000 tons in 1998 and 430,000 tons in 1999. By contrast, the volume of cargo excluding cement was only 14,000 tons in 1997, 162,300 tons in 1998 and 100,000 tons in 1999. Therefore, attempting to conduct the macro forecast based on a statistical correlation between the cargo volume and socioeconomic indices of the catchment area would not be appropriate.

Alternatively, the macro forecast can be conducted by utilizing the foreign trade cargo volume of all Oman, to estimate the cargo volume in the port, identifying the role and function of the port in future, and considering future prosperity of the catchment area until the target year. This method applied in this forecast work. In addition, the following assumptions are made in conducting the macro forecast.

a) Diversifying the economic activities and reducing the disparity between the northern and southern areas is the one of the crucial policies of Oman, and therefore the southern area will catch up by the year 2020.
b) Most of the cargo from/to the catchment area will pass the port in the near future, provided the port provides rational service with reliable facilities and operation.

2) Import and Export Cargo of All Oman

The correlation between GDP and import and export cargo volume from 1989 to 1998 was calculated using a regression analysis, but a reliable correlation could not obtained. In calculation, trade data was elaborated in detail and the following considerations were adopted.

a) The annual import volume of cement fluctuated between 31,000 tons and 558,000 tons in this period. Two cement companies, namely Oman Cement Co. and Raysut Cement Co.,

are producing cement using domestic materials and most of the domestic cement consumption except special types of cement will be supplied by domestic production in the foreseeable future. The imported volume of cement is, therefore, not included in this regression analysis.

b) The import volume of fuels and related materials in 1993 doubled compared to other years and therefore Dummy 1 is adopted as the import volume in 1993. The import volume of Irons and steels in 1996 and 1997 also doubled compared to other years and therefore Dummy 2 is adopted as the import volume in 1996 and 1997.

c) Volume of re-export tripled from 1997 to 1998 and therefore Dummy 1 is adopted as the export volume in 1998.

The correlation between import cargo (excluding cement) and export cargo and GDP is given in the following equation.

- Import Cargo Excluding Cement of All Oman

$$Y = 0.69458 \times X - 783.673$$

(R^2=0.981, Dummy1 on in 1993 and Dummy2 on in 1996&1997)

Where, Y : Import volume of all Oman (1,000 ton)
X : GDP of Oman (Million R.O)

- Export Cargo of All Oman

$$Y = 0.33086 \times X - 839.063$$ (R^2=0.981, Dummy1 on in 1998)

Where, Y : Import volume of all Oman (1,000 ton)
X : GDP of Oman (Million R.O)

Fig.13.4.3 shows the result of the macro forecast for import cargo volume excluding cement and export cargo volume of all Oman.

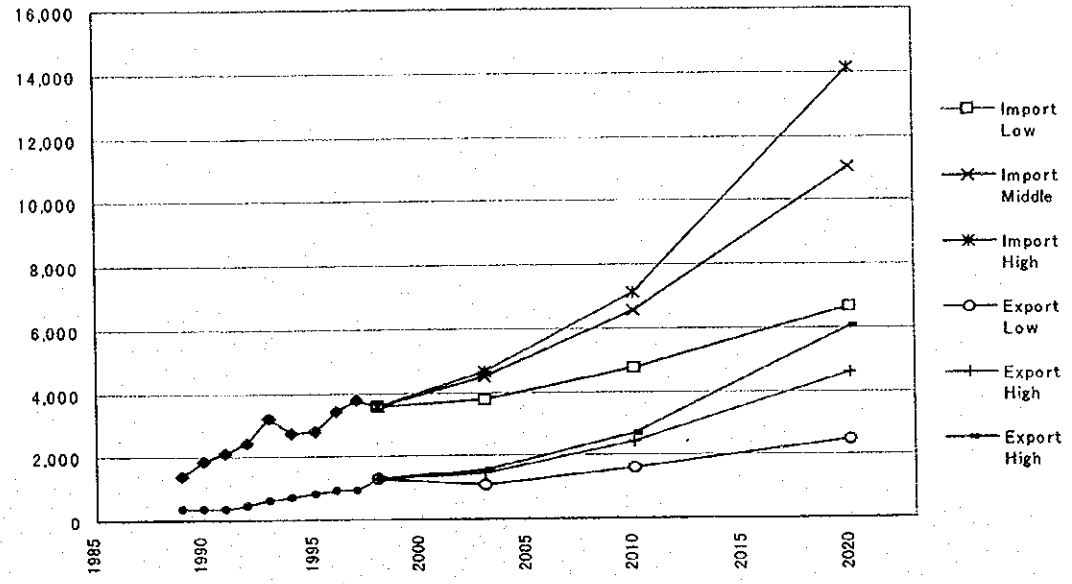
3) Import and Export Cargo Volume in Salalah Port

Import and export cargo volume handled in Salalah port is simply estimated based on the following assumption.

a) All cargo to/from the Governorate of Dhofar utilizes the port of Salalah
b) The share of cargo volume from the Governorate of Dhofar is the same as that of GDP to all Oman

Table 13.4.3 shows the result of macro forecast for import cargo volume (excluding cement) and export cargo volume handled in Salalah.

Fig. 13.4.3 Import Excluding Cement and Export Cargo Volume of Oman (Macro Forecast)



(Unit : 1,000 ton)

Year	Import (Excluding Cement)			Export		
	Low Case	Middle Case	High Case	Low Case	Middle Case	High Case
2003	3,745	4,499	4,666	1,094	1,454	1,533
2010	4,757	6,545	7,127	1,576	2,428	2,705
2020	6,655	11,063	14,163	2,481	4,580	6,057

Table 13.4.3 Summary of Import and Export Cargo Volume of Salalah (Macro Forecast)

(Unit : 1,000 ton)

Year	Import (Excluding cement)			Export		
	Low Case	Middle Case	High Case	Low Case	Middle Case	High Case
2003	307	369	383	90	119	126
2010	374	515	560	124	191	213
2020	491	815	1,044	183	338	446

(2) Micro Forecast

1) Premise

In Chapter 12, future industrial activities in the hinterland are evaluated by HS (Harmonized System) Code, and recommended production volumes and the level of realization are given individually. According to this evaluation, the following industries would generate a large volume of sea cargo.

a) Cement	b) Cereals	c) Animal Feed
d) Vegetable Oil	e) Fish Processing	f) Calcined Gypsum
g) High Purity Lime Stone	h) Textile and its Articles	i) Re-export

Table 13.4.4 shows the cargo volume handled in Salalah port in 1999 including imported/ exported cargo to/from the factories of a)cement, b)wheat and flour, c)animal feed, and d)vegetable oil. The share of these cargoes was more than 80 % of total import/export cargo (607,000ton/741,000ton). The cargo from/to these eight industries and re-export are, therefore, forecasted individually and the other cargo volume is forecasted as other general cargo, in total, including the cargo to/from the recommended industrial activities in the hinterland which is not shown in above a)-i) industries.

Table 13.4.4 Cargo Volume Handled in Salalah Port in1999 with Origin/Destination

(Unit : 1,000 ton)

Origin/Destination	Export		Import	
Dhofar Cattle Feed	Cattle Feed(Break)	1	Cattle Feed(Bulk) Cattle Feed(Break)	16 19
Raysut Cement	Cement(Bulk) Cement(Break)	344 86	Bozalani	7
Salalah Mills	Flour(Break) Wheat(Bulk)	36 3	Wheat(Bulk)	85
Vegetable Oil			Palm Oil	10
Oman Drilling			Fly Ash / Bentonite	8
Dhofar Marble & Granite	Build Material	42		
PDO and Others	Pipe	2	Pipe	18
Other General Cargo		17		21
Sub Total		**531**		**184**
Container (TEU)		706		1,927
Container (1,000 ton)*		7		19
Total		**538**		**203**
Domestic Cargo	Loading		Unloading	
Fuel		Nil		398
Grand Total		**538**		**601**

Note : The weight of container per TEU is approx. 10ton based on the statistical data of container handled in Sultan Qaboos port.

Source : SPS (Salalah Port Service)

2) Forecast Cases

According to the industrial development scenarios in the hinterland given in Chapter 12, the cargo volume is forecasted and summarized for the following three cases.

Case 1 : Without case,
Case 2 : Scenario(1), and
Case 3 : Scenario(2)

3) Cement

The recommended production volume of cement given in Chapter 12 is as follows.

Table 13.4.5 Recommended Production Volume of Cement

(Unit : 1,000 ton)

Year	2003	2010	2020
Local Market (Case1,2,3)	370	450	600
Export (Case1,2,3)	370	450	600

Domestic limestone is used as a main raw material for production of the existing factory, and iron ore and bozalani for special type cement such as oil well cement are imported from India and other countries. Seventy percent of export cargo was shipped by bulk cargo and the balance was in jumbo and small bag by general cargo in 1999.

In this forecast, it is assumed that

a) All products for local market will be transported by truck.
b) 70% of export will be shipped by bulk and the balance will be in bag by general cargo.
c) 1% of all raw materials will be imported by bulk cargo

Table 13.4.6 Export and Import Volume of Cement and its Materials by Cargo Style

(Unit : 1,000 ton)

Year		2003	2010	2020
Export (Case 1,2,3)	General	74	90	120
	Container	-	-	-
	Bulk	296	360	480
Import (Case 1,2,3)	General	-	-	-
	Container	-	-	-
	Bulk	7	9	12

4) Cereals

The recommended production volume of cereals given in Chapter 12 is as follows.

Table 13.4.7 Recommended Production Volume of Cereals

(Unit : 1,000 ton)

Year	2003	2010	2020
Local Market (Case 1,2,3)	35	43	58
Export (Case 1,2,3)	40	49	66
Additional Export (Case 2,3)	0	244	274

Raw materials for production of the existing factory were imported from Australia, Argentina and other countries by bulk cargo and 100% of exports was shipped by bagged cargo through the conventional terminal in 1999. The ratio of products to raw materials was 80% and a certain part of by-products was used for animal feed production.

In this forecast, the following conditions are assumed.

a) All products for local market will be transported by truck.
b) For export, containerized ratio is assumed to be 20% in 2003, 40% in 2010 and 60% in 2020, and the balance will be shipped by bagged cargo.
c) For additional export, all products will be shipped by bulk cargo.
d) For raw materials, 125% of production volume will be imported by bulk cargo.

Table 13.4.8 Export and Import Volume of Cereals and its Materials by Cargo Style

(Unit : 1,000 ton)

Year		2003	2010	2020
Export (Case 1)	General	32	29	26
	Container	8	20	40
	Bulk	-	-	-
Import (Case 1)	General	-	-	-
	Container	-	-	-
	Bulk	94	115	155
Export (Case 2,3)	General	32	29	26
	Container	8	20	40
	Bulk	-	244	274
Import (Case 2,3)	General	-	-	-
	Container	-	-	-
	Bulk	94	420	498

5) Animal Feed

The recommended production volume of animal feed given in Chapter 12 is as follows.

Table 13.4.9 Recommended Production Volume of Animal Feeds

(Unit : 1,000 ton)

Year	2003	2010	2020
Local Market (Case 1,2,3)	58	71	96
Export (Case 1,2,3)	12	51	68
Additional Export (Case 2,3)	0	168	226

Actual sales volume of existing cattle feed factory was about 60,000 tons in 1999. Raw materials for production were imported by bulk, palletized bag and container, and certain volume of bran from the flour mill factory was used. The ratio of products to materials was 100%.

In this forecast, the following conditions are assumed.

a) All products for local market will be transported by truck.
b) For export, containerized ratio is assumed to be 20% in 2003, 40% in 2010 and 60% in 2020, and the balance will be shipped by bagged cargo.
c) For additional export, all products will be shipped by bulk cargo.
d) For raw materials, 70% of production volume will be imported by bulk cargo, 20% will be imported by container cargo, and the balance will be supplied from the flour mill factory.

Table 13.4.10 Export and Import Volume of Animal Feeds and its Materials by Cargo Style

(Unit : 1,000 ton)

Year		2003	2010	2020
Export (Case 1)	General	10	31	27
	Container	2	20	41
	Bulk	-	-	-
Import (Case 1)	General	-	-	-
	Container	14	24	33
	Bulk	49	85	115
Export (Case 2,3)	General	10	31	27
	Container	2	20	41
	Bulk	-	168	226
Import (Case 2,3)	General	-	-	-
	Container	14	58	78
	Bulk	49	203	273

6) Vegetable Oil

The recommended production volume of vegetable oil given in Chapter 12 is as follows.

Table 13.4.11 Recommended Production Volume of Vegetable Oil

(Unit : 1,000 ton)

Year	2003	2010	2020
Local Market (Case 1,2,3)	7	7	7
Additional Local Market (Case 2,3)	-	1.6	4.6
Export (Case 1,2,3)	20	20	20
Additional Export (Case 2,3)		4	13

The existing factory started to operate in 1999. Seventy percent of Raw materials (Palm oil) for production were imported from Malaysia and 30% (Corn and Sunflower) from the US as bulk cargo in 1999. Small volume of packing materials, such as plastic materials (mainly HDPE) and carton rolls were imported by container cargo.

In this forecast, the following conditions are assumed.

a) All products for local market will be transported by truck.
b) For export, containerized ratio is assumed to be 100%.
c) For raw materials, 105% of production volume will be imported by bulk cargo.
d) Plastic materials and carton rolls will be imported by container but these volumes are assumed to be included in the Other Cargoes.

Table 13.4.12 Export and Import Volume of Vegetable Oil and its Materials by Cargo Style

(Unit : 1,000 ton)

Year		2003	2010	2020
Export (Case 1)	General	-	-	-
	Container	20	20	20
	Bulk	-	-	-
Import (Case 1)	General	-	-	-
	Container	-	-	-
	Bulk	28	28	28
Export (Case 2,3)	General	-	-	-
	Container	20	24	33
	Bulk	-	-	-
Import (Case 2,3)	General	-	-	-
	Container	-	-	-
	Bulk	28	34	47

7) Fish Processing

The recommended production volume of fish processing given in Chapter 12 is as follows.

Table 13.4.13 Recommended Production Volume of Fish Processing

(Unit : 1,000 ton)

Year	2003	2010	2020
Export (Case 1,2,3)	26	41	76
Additional Export (Case 2,3)		15	8

One fish-processing factory is under construction in Raysut Industrial Estate and will begin operating in the near future.

In this forecast, the following conditions are assumed.

a) All products will be exported by container including reefer container cargo.
b) Fish will come through the local fishery port and 25% of the production volume will be imported by container.

Table 13.4.14 Export and Import Volume of Fish Processing and its Materials

(Unit : 1,000 ton)

Year		2003	2010	2020
Export (Case 1)	General	-	-	-
	Container	26	41	76
	Bulk	-	-	-
Import (Case 1)	General	-	-	-
	Container	7	10	19
	Bulk	-	-	-
Export (Case 2,3)	General	-	-	-
	Container	26	56	84
	Bulk	-	-	-
Import (Case 2,3)	General	-	-	-
	Container	7	14	21
	Bulk	-	-	-

8) Calcined Gypsum and High Purity Limestone

The recommended production volume of calcined gypsum and high purity limestone given in Chapter 12 is as follows.

Table 13.4.15 Recommended Production Volume of Calcined Gypsum and High Purity Limestone

(Unit : 1,000 ton)

Year	2003	2010	2020
Gypsum Export (Case 1,2,3)	0	21	30
Limestone Export (Case 1,2,3)	0	21	30

In this forecast, the following conditions are assumed.

a) Thirty percent and seventy percent of products will be exported by general cargo and container cargo, respectively.

b) All material will be supplied from local production.

Table 13.4.16 Export Volume of Calcined Gypsum and High Purity Limestone

(Unit : 1,000 ton)

Year		2003	2010	2020
Gypsum Export (Case 1,2,3)	General	-	6	9
	Container	-	15	21
	Bulk	-	-	-
Lime Stone Export (Case 1,2,3)	General	-	6	9
	Container	-	15	21
	Bulk	-	-	-

9) Textile and its Articles

The recommended production volume of textile and its articles given in Chapter 12 is as follows.

Table 13.4.17 Recommended Production Volume of Textile and its Articles

(Unit : 1,000 ton)

Year	2003	2010	2020
Re-Export 1 (Case 1)	5	6	8
Re-Export 1 (Case 2,3)	5	4	3
Re-Export 2 (Case 2)	20	25	60
Re-Export 2 (Case 3)	41	51	93
Local products Export (Case 2,3)	0	10	20

In this forecast, the following conditions are assumed.

a) For re-export 1, all articles will be imported by container cargo and 50% of import articles will be exported by general cargo and the rest will be transported by truck.

b) For re-export 2, all articles will be imported and exported by container cargo.

c) For export of local products, 100% of materials will be imported by container and products will be exported by container.

Table 13.4.18 Export and Import Volume of Textile and its Articles by Cargo Style

(Unit : 1,000 ton)

Year		2003	2010	2020
Export (Case 1)	General	3	3	4
	Container	-	-	-
	Bulk	-	-	-
Import (Case 1)	General	-	-	-
	Container	5	6	8
	Bulk	-	-	-
Export (Case 2)	General	3	2	2
	Container	20	35	80
	Bulk	-	-	-
Import (Case 2)	General	-	-	-
	Container	25	39	83
	Bulk	-	-	-
Export (Case 3)	General	3	2	2
	Container	41	61	113
	Bulk	-	-	-
Import (Case 3)	General	-	-	-
	Container	46	65	116
	Bulk	-	-	-

10) Re-Export Goods

Re-export good volumes are recommended in Chapter 12 as the commodities handled at distribution facilities in the free zone. Certain parts of these goods already included in before-mentioned eight industries, for example textiles, are excluded from total recommended re-export volume.

Table 13.4.19 Recommended Volume of Re-Export Goods

(Unit : 1,000 ton)

Year	2003	2010	2020
Re-Export (Case 1)	11	14	19
Re-Export (Case 2)	525	632	727
Re-Export (Case 3)	1,036	1,261	1,639

In this forecast, the following conditions are assumed.

a) For re-export, all articles will be imported by container cargo and will be exported by container cargo.
b) Import and export cargo volumes are the same.

Table 13.4.20 Export and Import Volume of Re-Export Goods by Cargo Style

(Unit : 1,000 ton)

Year		2003	2010	2020
Export (Case 1)	Container	11	14	19
Import (Case 1)	Container	11	14	19
Export (Case 2)	Container	525	632	727
Import (Case 2)	Container	525	632	727
Export (Case 3)	Container	1,036	1,261	1,639
Import (Case 3)	Container	1,036	1,261	1,639

11) Other General Cargo

The import and export cargo handled in Salalah port in 1999 excluding cattle feed, cement, wheat and flour, and palm oil was about 57,000 tons and 68,000 tons, respectively, including import container of 1,927 TEUs and export container of 706 TEUs. The average annual growth rate (AAGR) for each case and containerized ratio are assumed considering development scenario of each case. (See Table 13.4.21)

Table 13.4.21 Average Annual Growth Rate and Containerized Ratio of Other General Cargo

	AAGR (%)	Containerized Ratio (%)		
		2003	2010	2020
Case 1	3.0	20	40	60
Case 2	5.0	20	40	60
Case 3	7.0	20	50	70

Table 13.4.22 Export and Import Volume of Other General Cargo by Cargo Style

(Unit : 1,000 ton)

Year		2003	2010	2020
Export (Case 1)	General	64	57	52
	Container	16	38	78
Import (Case 1)	General	52	48	44
	Container	13	32	66
Export (Case 2)	General	68	69	76
	Container	17	46	114
Import (Case 2)	General	56	60	64
	Container	14	40	96
Export (Case 3)	General	72	72	84
	Container	18	72	196
Import (Case 3)	General	60	60	72
	Container	15	60	168

12) Summary of Micro Forecast

The results of the micro forecast are summarized in Table 13.4.23.

Table 13.4.23 Summary of Micro Forecast Cargo Volume

(Unit : 1,000 ton)

Case	year / Style	2003		2010		2020	
		Import	Export	Import	Export	Import	Export
Case 1	Container	50	83	86	183	145	316
	General	52	183	48	222	44	247
	Bulk	178	296	237	360	310	480
	Total	**280**	**562**	**371**	**765**	**499**	**1,043**
Case 2	Container	585	618	783	863	1,005	1,161
	General	56	187	60	233	64	269
	Bulk	178	296	666	772	830	980
	Total	**819**	**1,101**	**1,509**	**1,868**	**1,899**	**2,410**
Case 3	Container	1,118	1,151	1,458	1,544	2,022	2,188
	General	60	191	60	236	72	277
	Bulk	178	296	666	772	830	980
	Total	**1,356**	**1,638**	**2,184**	**2,552**	**2,924**	**3,445**

(3) Cross Check of the Result

Fig. 13.4.4 shows the result of the macro and micro forecast for total import cargo volume while Fig. 13.4.5 shows that for total export cargo volume. For import cargo, there is only a slight difference between Case1 of the micro forecast and the Low Case of the macro forecast, but the cargo volumes of Case 2 and Case 3 in the micro forecast are quite larger than that of the High Case in the macro forecast. For export cargo, the difference between the micro forecast and macro forecast is quite large. The major reason for the difference between macro forecast and micro forecast Case1 is that the trade data used for the macro forecast included a very small volume of cement (14,000 tons for all Oman in 1998), although more than 400,000 tons of cement was handled in Salalah port in 1999.

The scenarios of industrial development in the hinterland given in Chapter 12 are including a kind of evolution of economy in the catchment area due to the new container pub port. In this case, the regression analysis method adopted in the macro forecast, in general, does not give appropriate result. The result of the micro forecast is, therefore, more reasonable for further study.

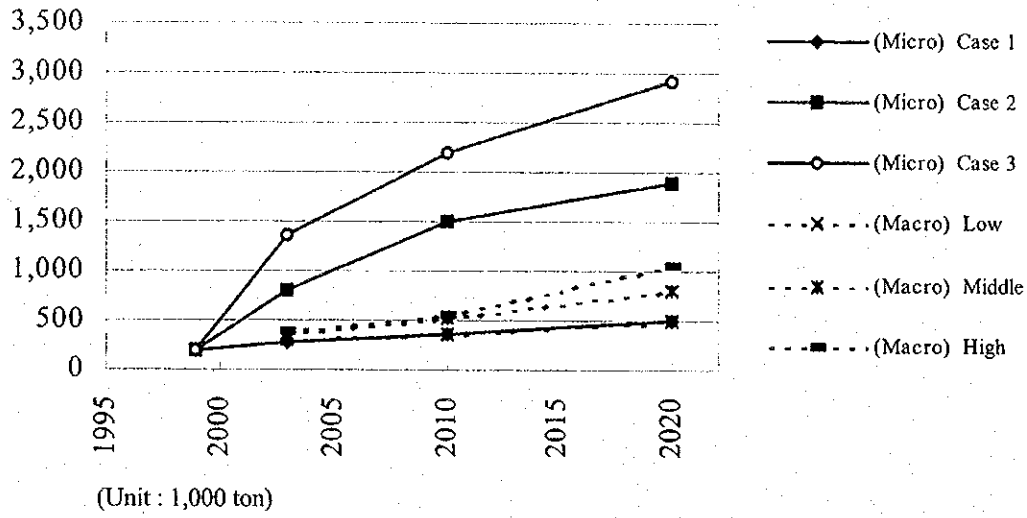


Fig. 13.4.4 Result of Total Import Volume by Micro and Macro Forecast

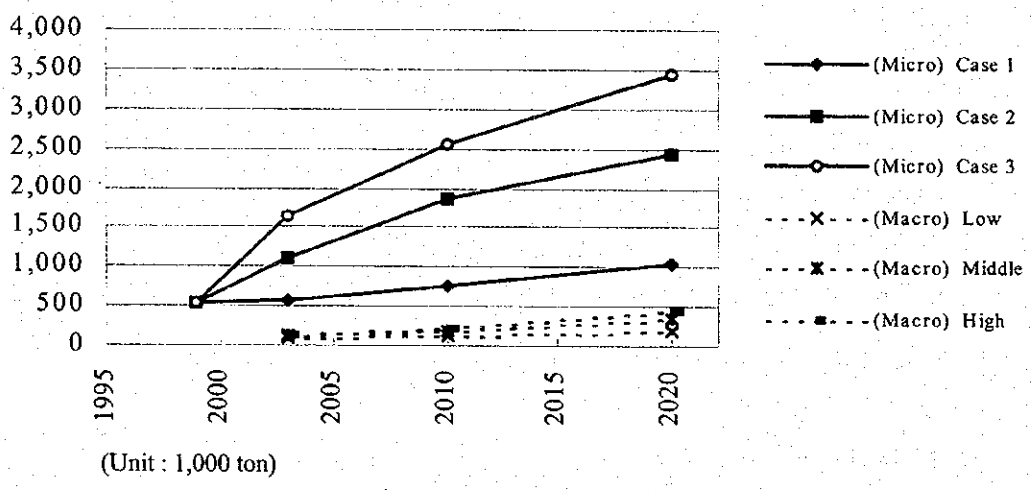


Fig. 13.4.5 Result of Total Export Volume by Micro and Macro Forecast

(4) Container Volume

1) Average Cargo Weight per TEU

The projected container cargo volumes are converted into loaded container volume in TEU based on average cargo weight per TEU at Sultan Qaboos port. The average cargo weight per TEU from 1995 to 1999 is 10.1 tons/TEU and it is assumed that this figure is the same for import and export container in Salalah port until target year.

2) Empty Container Ratio

The container volume handled in Dubai port in 1997 is shown in Table 13.4.24. The empty container (empty/loaded) ratio of landed and shipped were 21.5% and 50.5% respectively,

and the total volume of landed and shipped was almost balanced. The forecasted exported container cargo volume is larger than imported in Salalah port and the empty container ratio of exported container volume is assumed to be 21.5%. It is also assumed that an equal numbers of import and export containers in TEUs will be handled at the port.

Table 13.4.24 Container Volume Handled in Dubai Port in 1997

(Unit : TEUs)

	Landed	Shipped
Loaded Container	1,070,872	863,001
Empty Container	230,383	435,829
Total	1,301,255	1,298,830
Empty/Loaded Ratio	21.5 %	50.5 %

Source : Containerisation International 2000

3) Container Volume

Container volumes handled in Salalah port are summarized in Table 13.4.25.

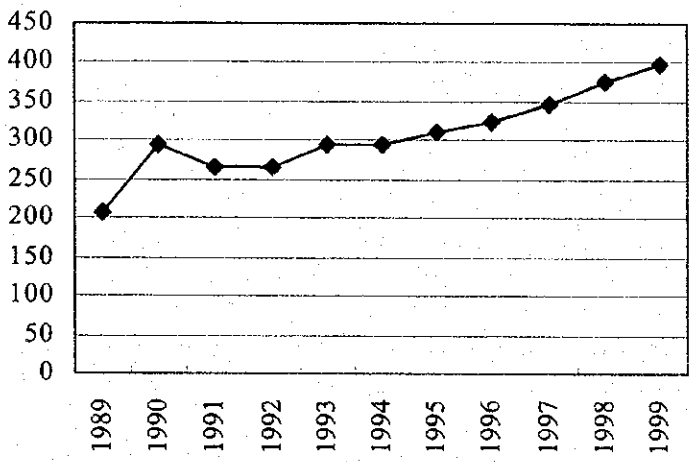
Table 13.4.25 Container Volumes Handled in Salalah Port

		2003		2010		2020	
		Import	Export	Import	Export	Import	Export
Case 1	Container Cargo Volume (1,000 ton)	50	83	86	183	145	316
	Loaded Container Volume (1,000 TEUs)	5	8	9	18	14	31
	Empty Container Volume (1,000 TEUs)	5	2	13	4	24	7
	Total (1,000 TEUs)	10	10	22	22	38	38
	Grand Total (1,000 TEUs)	20		44		76	
Case 2	Container Cargo Volume (1,000 ton)	585	618	783	863	1,005	1,161
	Loaded Container Volume (1,000 TEUs)	58	61	78	85	100	115
	Empty Container Volume (1,000 TEUs)	16	13	26	18	40	25
	Total (1,000 TEUs)	74	74	104	104	140	140
	Grand Total (1,000 TEUs)	149		208		279	
Case 3	Container Cargo Volume (1,000 ton)	1,118	1,151	1,458	1,544	2,022	2,188
	Loaded Container Volume (1,000 TEUs)	111	114	144	153	200	217
	Empty Container Volume (1,000 TEUs)	28	25	41	33	63	47
	Total (1,000 TEUs)	138	138	186	186	263	263
	Grand Total (1,000 TEUs)	277		371		526	

(5) Fuel

1) Domestic Consumption

The port handled about 400,000 tons in total in 1999, and the average annual growth rate for the past 7 years is about 6%. (See Fig.13.4.6) All fuels are shipped from the Muscat refinery for local consumption of aircraft, vehicle and electric power station in the Governorate of Dhofar. The average shares of Jet (A1), Gasoline, Gas Oil and Light Fuel are about 10%, 20%, 60%, 10%, respectively in 1999.



Note : Unit 1,000 ton

Source : Statistical Year Book & SPS (Salalah Port Service)

Fig. 13.4.6 Volume of Fuel Handled in Salalah Port

The major users of Gas Oil are electric power stations and private factories in Dhofar Region at present. Natural gas will be supplied by pipeline by the year 2003 and the Ministry of Electricity and Water already has a plan to build electric power stations fueled by natural gas. After natural gas is supplied by pipeline, all private factories in Salalah area, which are now using gas oil for operation, will also switch to natural gas.

It will be assumed that the recent growth rate of 6 % will continue for all products except Gas Oil. After the switch to natural gas, the need for Gas Oil will be eliminated and thereby the total consumption of fuel in Salalah area will be reduced by 40%.

2) Bunkering

The size of the global bunker market is not established with any degree of certainty. A key reason for this is that significant quantities of fuel oil, gas oil and others are traded and re-traded as cargoes and the distinctions between cargoes and bunkers gets extremely blurred. The share of bunker is perhaps 20 % of the heavy fuel oil sector. The total demand of world

maritime fuel is about 120 million MT, and the market share of Singapore and Rotterdam/Antwerp is around 10%, respectively. (Source : MOL)

The major bunker points in Europe and Asia and the bunker price are shown in Table. 13.4.26.

Table 13.4.26 Major Bunker Ports and Bunker Price

(Unit : US$/MT)

Name of Port	IFO380	IFO180	MDO
North Europe			
Rotterdam	119	124	204
Antwerp	119	124	204
Hamburg	123	129	212
Le Havre	125	134	230
South Europe			
Gibraltar	124	131	234
Genoa	126	135	239
Piraeus	118	126	220
Istanbul	136	141	237
Middle East/Africa			
Suez	142	146	265
Jeddah	-	134	236
Fujairah offshore	161	165	249
Kuwait	160	163	246
Durban	-	159	241
East Asia			
Singapore	158	162	216
Hong Kong	175	179	221
Tokyo	185	190	275
Korea	167	171	238
Melbourne	184	188	273

Source : Weekly Bunker Price Indicators (11 May - 17 May 2000) in Bunkerstem Market Report

Fujairah offshore was formerly one of the largest bunker points in the Middle East. Until 1997, Fujairah was known to be the cheapest bunker market in the world and the estimated bunker volume was 800,000 MT per month, but the volume has dropped to about half or 400,000 MT per month after only one year. That is because competition in the bunker market is fierce and most of the customers in Fujairah were crude tanker from/to the Gulf of which the number fell drastically due to the Asian economic crisis in 1998. In the Singapore/ Fujairah bunker price relationship, Singapore generally leads the way and Fujairah follows. But as Singapore was the head of the price trend dog, and Fujairah the tail, we do sometimes see that the dog chases its tail. (Source : The Bunker Bulletin from Bunkerworld)

Salalah port is located near the east-west trunk line and there is a large container transshipment terminal, and therefore there is some possibility to become a principal

bunkering port in the Middle East area. The cost competitiveness to Singapore and the size of demand, however, should be evaluated thoroughly.

The ratio of bunkering volume to total cargo throughput of Singapore, Rotterdam and Algeciras is as follows.

Singapore	0.038 MT / metric ton
Rotterdam	0.049 MT / metric ton
Algeciras	0.029 MT / metric ton

From these figures, it could be optimistically forecasted that the volume of bunkering would be between 3% - 5% of total cargo throughput.

The forecasted volume of general cargo and bulk cargo is about 1 million tons in Case1 and 2 million tons in Case3, and therefore the optimistic bunker demand for these ships could be around 50,000 tons. (See Table 13.4.23) This volume is negligible compared to the bunker demand of container ships.

3) Summary of Fuel Demand

The result of fuel demand forecast is summarized in Table 13.4.27.

Table 13.4.27 Summary of Fuel Demand Forecast Volume

(Unit : 1,000 ton)

Year	2003	2010	2020
Domestic Consumption	200	300	540
Bunker	0.3 – 0.5 × Volume of Container (TEUs) / 1,000		

(6) Cruise Ship

1) Route and Duration of Cruise Ships Calling Salalah at Present

The routes of cruise ships calling Salalah port can be grouped into three patterns, namely Around the World, between Mediterranean Sea and Southeast Asia, and between Red Sea and Persian Gulf. For example, Saga Rose called Salalah as part of an Around the World cruise lasting 113 days. Star Flyer called on the way from Safaga to Phuket route (27 day cruise), and Crystal Symphony called from Piraeus to Mumbai (16 day cruise). Song of Flour called on the way from Aqaba to Dubai (12 day cruise) and Silver Cloud called from Dubai to Safaga (9 day cruise). The duration of cruise on the Indian Ocean area is, in general, longer than 7 nights, whether Salalah port is called or not.
The best cruise season in the Indian Ocean area is, in general, from October to March. No cruise ship called Salalah port between the end of April and the end of October in 1999.

2) Popularity of Cruising

The total number of cruise passengers almost doubled from 1990 to 1998, and the average annual growth rate (AAGR) of total number of passenger is about 8.2%. The growth rates of UK and Asia are very large. (See Table 13.4.28) According to the UK market data, the share of cruises in the less than 7day category increased from 22% in 1992 to 58% in 1997. In addition, there was a substantial increase in the number of passenge in the less than 7 day category while the share of passenger in longer cruises decreased.

Table 13.4.28 Number of Cruise Passengers in 1990 and 1998

(Unit : Persons)

Nationality	1990	1998	AAGR
United State	3,500,000	5,500,000	0.058
Canada	150,000	250,000	0.066
United Kingdom	180,000	635,000	0.171
France	75,000	165,000	0.104
Germany	190,000	283,000	0.051
Rest of Europe	180,000	370,000	0.094
Asia	75,000	800,000	0.344
Japan	25,000	200,000	0.297
Australia	100,000	200,000	0.091
Total	4,475,000	8,403,000	0.082

Source : Complete Guide to Cruising & Cruise Ships 2000

Table 13.4.29 UK Market Trend in Cruise Duration

(Unit : %)

Year	less than 5	5-7 days	8-14 days	15-21 days	more than 22
1992	2	20	62	9	3
1993	5	22	60	9	2
1994	7	31	52	7	2
1995	4	47	41	5	1
1996	6	40	43	7	5
1997	13	45	34	6	2

Source : Travelstat(IRN) based on the International Passenger Survey(IPS)-PSA Annual Cruise Market Digest

3) Around the World Cruises

Around the World Cruises is one of the most important cruise routes calling Salalah port. Table 13.4.30 shows the list of Around the World Cruises in 1999/2000. Most of the ships in this Table sail the Indian Ocean during the best cruise season, but only several ships will call Salalah because the calling ports on the cruise route will be carefully selected considering the experienced travelers' interest.

Table 13.4.30 List of Around the World Cruises in 1999/2000

	Name of Ship	Days	Start Date	From	To
1	Olvia	92	1999/10/18	Tokyo	Tokyo
2	Albatros	100	1999/11/7	Genoa	Genoa
3	Europa	160	1999/11/8	Lisbon	Venice
4	Aegean I	114	1999/11/19	Athens	Athens
5	Ocean Explorler I	127	1999/11/19	Athens	Athens
6	Astor	111	1999/12/13	Nice	Venice
7	Delphin	176	1999/12/14	Genoa	Palma de Mallorca
8	Saga Rose	100	2000/1/4	Southampton	Southampton
9	Oriana	91	2000/1/5	Southampton	Southampton
10	Queen Elizabeth 2	100	2000/1/6	New York	New York
11	Rotterdam	96	2000/1/6	Ft. Lauderdale	Los Aneles
12	Maxim Gorkiy	120	2000/1/8	Genoa	Bremerhaven
13	Olvia	89	2000/1/16	Tokyo	Tokyo
14	Crystal Symphony	104	2000/1/20	Los Angeles	London
15	Victoria	83	2000/2/17	Southampton	Southampton
16	Nippon Maru	100	1999/3/16	Yokohama	Yokohama
17	Asuka	100	2000/3/25	Yokohama	Kobe
18	Ocean Explorler I	115	2000/3/25	Athens	Athens
19	Ocean Explorler I	118	2000/7/19	Athens	Athens

Source : Complete Guide to Cruising & Cruise Ships 2000

4) Number of Calling Cruise Ships

Based on the data given in "Complete Guide to Cruising & Cruise Ships", the average annual growth rate of the number of cruise passengers from 1990 to 1998 is more than 8 percent. This growth mainly depended on less than 7 night duration categories which were promoted by introducing low price cruise and Fly-Cruise packages. The duration of cruises calling Salalah port is, in general, longer than 7 nights at present, and this trend is assumed to continue in future because the embarking and disembarking ports in this area are limited to Safaga, Aqaba, Muscat, Dubai and Mumbai. Considering the above-mentioned facts, the growth rate of cruise ship calling in Salalah port is assumed to be between 4% and 6 % per annum.

Twenty-three cruise ships called Salalah port in 1999, but this number has varied from year to year because several numbers of Roaming Ships were included. For example Sultan Qaboos port was called by 13 ships in 1995, 8 ships in 1996, 23 ships in 1997, 16 ships in 1998 and 21 ships in 1999. In the forecast for Salalah port, it is assumed that the number of calling cruise ships is 20 in 2000.

Table 13.4.31 Number of Calling Cruise Ships (Unit : Ships)

Year	2000	2003	2010	2020
Cruise Ships	20	22-24	30-36	44-64

13.4.5 Vessel Size Forecast

(1) Vessel Size Forecast

Based on the statistics in 1999, the average and maximum sizes of calling vessel by type in Salalah port are shown in Table 13.4.32.

Table 13.4.32 Average and Maximum Size of Calling Vessels by Type in 1999

Vessel Type	No. of Calling (ships)	Average Size (GRT)	Maximum Size (GRT)
Bulk			
Cement	68	4,500	20,289
Wheat	11	20,000	27,981
Vegetable Oil	11	8,000	20,352
General			
All	148	4,400	
Steel Pipe	(10)	15,000	26,720
Vehicle	(1)		57,450
Container *			
All	196	28,000	
Mother	(66)	53,000	91,560
Feeder	(98)	11,500	31,920
Fuel	54	5,800	23,926

Note : * Data for container vessel is only from 1st Sep. 1999 to 30th Nov. 1999.

Source : SPS (Salalah Port Service)

The draft of existing berth in conventional port is 10 m for multi-purpose berth and 12 m for Oil pier. For the maximum size vessels of general cargo, namely steel pipe and vehicle, the full-loaded draft is about 12 m and therefore these vessels called with adjusted draft. The 16m draft new bulk terminal has already been constructed and 100,000 DWT bulk vessel can be accommodate with full-loaded draft.

Considering the enlargement trend of the vessel size and the draft of the new bulk terminal, the average sizes of vessel in target years and loading ratio are forecasted. (See Table 13.4.33) The size of bulk cargo vessel is estimated considering the volume of annual throughput from/to the recommended industries such as cement, cereals and animal feed. The new largest container vessel has always been employed on the Europe/Asia route and this trend will continue in future. The average size of container mother vessel on this route is estimated as 4,000 – 6,000 TEUs in 2005 and 6,000 – 8,500 TEUs in 2020, based on the past ship size enlargement trend. The loading/unloading ratio of container is about 20% for mother vessels and about 60% for feeder vessels at present. Considering the future share of container from/to the Middle East, loading/unloading ratio of mother and feeder vessel in target year is assumed to be 40% and 140%, respectively.

Table 13.4.33 Average Sizes of Calling Vessels and Loading Ratio by Type

Vessel Type	Loading Ratio (%)	Average Size (DWT)		
		2003	2010	2020
Bulk	70	15,000	30,000	30,000
General	60	3,000	3,500	4,200
Container				
Mother	40*	5,000(TEU)	5,700(TEU)	7,000(TEU)
Feeder	140*	1,000(TEU)	1,200(TEU)	1,400(TEU)
Fuel	80	10,000	10,000	10,000

Note : * Unloading + Loading

Source : Estimated by JICA Study Team

(2) Number of Calling Ship

Based on the average sizes of vessels by type and loading ratio given in Table 13.4.33, and the result of demand forecast Case 2, the number of calling vessels by type in target years is calculated. About one hundred non-trading vessels including military and fishery-related vessels called for the purpose of bunkering, sheltering and others. In addition about two hundred fifty launches called in 1999. The same number of non-trading vessels and launches is assumed to call up to the target year.

Table 13.4.34 Summary of Number of Calling Vessels

Year / Type of Vessel	2003 (2005)*			2010			2020		
	Cargo Volume (1,000ton)	Average Size (DWT)	Number of ship call	Cargo Volume (1,000ton)	Average Size (DWT)	Number of ship call	Cargo Volume (1,000ton)	Average Size (DWT)	Number of ship call
Bulk									
Cement	303	10,000	43	369	15,000	35	492	15,000	47
Other Bulk	171	15,000	16	1,069	30,000	51	1,318	30,000	63
General									
Ships	192	3,000	110	243	3,500	116	283	4,200	112
Launches	50	-	250	50	-	250	50	-	250
Container	(1,000TEU)	(TEU)					(1,000TEU)	(TEU)	
Mother	1,580	5,000	790				3,140	7,000	1,121
Feeder	1,580	1,000	1,128				3,140	1,400	1,602
Fuel**									
Domestic	200	10,000	25	300	10,000	38	540	10,000	68
Bunkering	500	50,000	12	-	-	-	1,880	100,000	23
Cruise Ship***			22-24			30-36			44-64
Non-trading vessels			100			100			100

Note : * The figures for container is in the year 2005.

** See Table 13.4.27 *** See Table 13.4.31

14. Port Master Plan for 2020

14.1 Basic Requirements

The Study Team has identified the following basic requirements for the future development of Port Salalah. These requirements must be met to provide a satisfactory level of service and increase the number of calling vessels.

(1) Design ship for container terminals

Taking into account ever-enlarging vessel sizes, an 8,000TEUs container vessel is adopted as the design ship for transshipment terminals (See 13.1 Evolution of International Shipping). The dimensions of the design ship are 390m in length, 48m in width, and 16m in draft. To cater for this size of vessel, new transshipment terminals need to have an alongside depth of 18m. Each container berth needs to have a container yard of 12-15ha right behind the quay to ensure efficient operation.

(2) Navigational safety

The width of the approach channel should be equal to the length of the design ship to ensure safe and smooth vessel maneuvering. Consequently, an approach channel for 16m draft terminals requires a width of 350m and a channel for 18m draft terminals requires a width of 390m. A bend of greater than 30 degrees should be avoided. The minimum under-keel clearance is 10% of the design ship inside the harbor and 15% in the outer approach channel. A design ship with 16m in draft therefore requires a draft of18m inside the harbor and 18.5m in the outer approach channel.

If a large ship is subjected to following waves while navigating near a harbor entrance at a low speed, the speed of the ship relative to the water becomes slower, thereby hindering the steering of the ship. Therefore, channels should be designed to avoid tale waves with an angle $\leq 45°$ for ships entering the port.

(3) Harbor entrance

The navigable width at the present harbor entrance is 250m. With a growing number of calling vessels taken into consideration, the harbor entrance needs to be widened to enable the vessels to pass each other. The necessary width will be at least 300m and preferably 350m. The existing approach channel has a rather sharp bend just outside the entrance. When widening the entrance, the bend should be cut as well.

Breakwaters should be laid out so as to provide entering vessels with sufficient stopping

distance from the harbor entrance to the assigned quays.

(4) Turning Basin

When a ship makes a bow turning with tugboats assistance, the turning circle needs to have a diameter of double the length of the design ship. This is also the case with ships with thrusters.

(5) Calmness in the channels and basins

Breakwaters have to be provided to ensure smooth maneuvering in turning basins and safe mooring at quays. Quayside wave height ($H_{1/3}$) should be lower than 50cm during over 95 % of a year. The acceptable height of head wave and tale wave in channels is lower than 1.0m for larger vessels.

(6) Surge

Effective countermeasures need to be proposed in the master plan. Surge occurs in ports open to the sea, when one of the natural frequency of the mooring system is almost equal to one of the peak frequency of long period waves. Therefore, Japanese researchers have proposed the following countermeasures:

1) Reduction of the energy of long period waves by means of additional breakwaters.
This measure has two problems, however. One is that long period waves can not easily be reduced. On the other hand, the additional breakwater will hamper ship navigation.

2) Change of the mooring system using harder mooring ropes.
Effectiveness of this measure was demonstrated in a field study in Japan. But this measure is not perfect either. It is less effective when long period waves have two or more peak frequency.

In any case, it is necessary to carry out computer simulation of long period waves and ship motions to understand the mechanism of surge and to find a solution to it. MOTH is currently carrying out a comprehensive site survey covering wave conditions and ship motions in the monsoon season of 2000. The Study Team will take into account the findings of Japanese researchers and, if provided timely, the results of this site survey in formulating alternative lay-out plans.

(7) Zoning

Port areas should be grouped according to the activities. A proper zoning plan has to be prepared to separate different port activities, thus avoiding congestion and ensuring efficient operation.

(8) Interface with the hinterland

Smooth interface of the port and the hinterland is indispensable to ensure the maximum efficiency of economic activities. A land-use plan and an access roads plan should be prepared accordingly.

(9) Flexibility in the pace of development

Layout plans need to ensure flexibility in the pace of the development. Urgent expansion projects should be compatible with the overall port development in the future. Therefore, phased planning has to be envisaged in layout plans from the start.

(10) Environmental concerns

Impacts of the port development on the environment need to be minimized. Mangrove culture and coastal erosion are some of the main concerns

(11) Construction costs

Configuration of the main port facilities needs to be proposed so as to minimize the construction costs. The balance between dredging volume and reclamation volume is one of the key factors impacting on the overall costs.

14.2 Specific Requirements

The Study Team held a series of interviews with port users during the first stage of the Study. The specific requirements from port users toward the future development of Port Salalah are summarized below.

14.2.1 Royal Navy

(1) Design ship

Future frigate	LOA: 125m, B: 13m, Draft: 5.5m, Displacement: 3,000t
Corvette	LOA: 84m, B:11.5m, Draft: 4.7m, Displacement: 1,450t
Landing ship	LOA: 95m, B: 16m, Draft: 3.5m, Displacement: 2,800t
Inshore patrol boat	LOA: 25m, B: 8m, Draft: 1.6m

(2) Approach

The approach to the harbor should provide a day and night capability for a light frigate. The channel needs to have a depth of at least – 7.5m C.D. and a sufficient width for easy and safe navigation.

(3) Harbor

The harbor is expected to provide a safe sheltered basin throughout the year. The entrance should be available 24hours a day and be provided with a minimum turning circle of 250m in diameter. The required water depth is – 6.2m C.D. for a corvette and – 7m for a future frigate, or 1.5m below the draft of the ship.

(4) Ramp

A ramp is required to allow landing ships to load and unload in most stages of the tide. Ideally, this ramp should be 16m wide, with a gradient of 1:10, and with a vertical cut-off at 1.2m above Chart Datum.

14.2.2 Royal Yacht Squadron

(1) Design ship

HMRY Al Said	LOA: 105m, B: 19m, Draft: 4.7m, Minimum alongside depth: 7.1m
HMSS Fulk Al Salamah	LOA: 135m, B: 21m, Draft: 5.6m, Minimum alongside depth: 8.4m

HMRB Zinat Al Bihaar	LOA: 65m, B: 10m, Draft: 4.0m, Minimum alongside depth: 6.0m
Future plan	LOA: 150m, B: 20m, Draft: 5.1m, Minimum alongside depth: 7.7m
Bertram 60C	LOA: 18.3m, B: 5.2m, Draft: 1.7m, Boarding Height: 1m
Powles 50	LOA: 15.2m, B: 4.6m, Draft: 1.5m, Boarding Height: 1.8m
P1200	LOA: 12m, B: 4m, Draft: 1.5m, Boarding Height: 1m

(2) Harbor

A minimum berth frontage of approximately 400m is required to provide suitable alongside berths for the three major ships. For the boats, a berth frontage of approximately 90m with boat mooring pontoons along the length of the jetty is needed. The water depth of the basin should be consistent with the dimension of the major ships.