

7.4 Benefits

7.4.1 Benefit Items

Considering the "With" and "Without" situations mentioned above, the following items are identified as the benefits of the Short-term Development Plan for the New Port:

- 1) Savings in the waiting costs of vessels.
- 2) Savings in time costs.
- 3) Savings in land transportation costs.
- 4) Earnings of foreign currency in handling container cargoes.
- 5) Promotion of regional development in Sohar as well as national development in Oman.
- 6) Increase in employment opportunities/incomes.
- 7) Multiplier effect from the investment of the new port.

Of the above, items 1) to 4) are considered as tangible benefits in terms of the cost-benefit analysis in this Study.

7.4.2 Savings in the Waiting Costs of Vessels

The volume of conventional cargo handled at Mina Qaboos and the new port will increase in future, as mentioned in Chapter 3. If the new port were not constructed, the increased volume would have to be handled at Mina Qaboos only and the waiting time of calling ships would increase in accordance with port congestion. (Container cargo volume would not increase, as mentioned in section 7.3.2.)

Implementing the project will prevent this problem. Investment in the new port will reduce the waiting time of calling ships and this cost reduction is one of the major benefits of the project.

Benefits that will accrue to Oman from the project can be calculated by comparing the "With" case to the "Without" case.

The formula used to calculate this benefit is as follows:

$$\boxed{\text{Savings in ships' waiting costs}} = \boxed{\text{Difference in waiting time between "with" \& "without" cases}} \times \boxed{\text{Ship cost (unit cost)}} \times \boxed{\text{Share of benefits accruing to Oman}}$$

(1) Difference in Waiting Time

The difference in ships' waiting time between the "With" case and the "Without" case can be obtained by using a queuing simulation. Waiting time under the "With" case is set at the same level as in the Mina Qaboos Development Plan.

The results are shown in Tables 7-4-1 and 7-4-2. (The details are shown in Tables 7-4-4 and 7-4-5.)

Table 7-4-1 Ships' Waiting Time between "With" Case and "Without" Case in 2000

Ship type	Average Waiting Time (hrs/ship)		Total Waiting Time (days/year)		Difference (days/year)
	"Without"	"With"	"Without"	"With"	
Steel	19.6	3.5	120.9	21.9	99.1
Timber	8.4	0.9	21.0	2.4	18.6
Vehicle	4.5	1.5	54.2	18.2	36.0
Livestock	6.5	1.4	12.2	2.7	9.5
General Cargo	12.3	0.8	167.0	11.0	156.0
TOTAL	10.0	1.5	375.2	56.1	319.1

Table 7-4-2 Ships' Waiting Time between "With" Case and "Without" Case in 2004

Ship type	Average Waiting Time (hrs/ship)		Total Waiting Time (days/year)		Difference (days/year)
	"Without"	"With"	"Without"	"With"	
Steel	24.7	3.5	190.4	27.3	163.1
Timber	11.6	0.9	31.5	2.5	29.0
Vehicle	10.3	1.5	149.0	21.8	127.2
Livestock	15.7	1.4	34.1	3.1	31.0
General Cargo	21.5	0.8	337.2	12.5	324.6
TOTAL	17.4	1.6	742.1	67.3	674.9

(2) Ship Cost (Unit Cost)

Ship cost is estimated by accumulating the component factors of cost such as depreciation, wages, maintenance cost and so forth.

Although it is conceivable to estimate ship cost based on charter rate, this rate has been fluctuating so much according to the market conditions that it is not appropriate for economic price of ship cost.

Table 7-4-3 shows the ship waiting cost estimated by the Study Team based on the estimation made by some Japanese shipping companies.

Table 7-4-3 Ship Cost by Ship Size
(General Cargo Ships)

Ship Size(DWT)	3,000	10,000	21,000	37,000
Ship Cost(US\$/ship/day)	4,000	10,000	15,000	17,000

(3) Share of Benefits Accruing to Oman

The savings in waiting costs of vessels are primarily realized by shipping companies. Since Oman has no national shipping company at present, these benefits accrue to other countries. However, some portion of these benefits should be returned to Oman after some time-lag. It is possible for Oman to acquire some of the benefits by, for instance, decreasing freight rates reflecting the reduced incidence of delays at the port. In this Study it is assumed that 50% of the benefits attributed to foreign ship operators will be transferred to the Omani economy.

(4) Calculation Results (Savings in Waiting Costs of Vessels)

Tables 7-4-4 and 7-4-5 show the results of the calculation of savings in ships' waiting costs by ship size. Since the figures are shown in border prices, they are economic prices themselves.

Table 7-4-4 Savings in Ships' Waiting Costs in 2000

No.	Ship Type	Ship Size (DWT)	Ship Costs (US\$ /Ship/Day)	Waiting Time			Ship's Waiting Costs (US\$ '000)	Ship's Waiting Costs ('000 RO)	Benefits Accruing to Oman ('000 RO)
				Without Case (Hrs.)	With Case (Hrs.)	Difference (Hrs.)			
1	Steel (I)	2,000	3,000	856	12	844	106	41	20
2	Steel (II)	17,000	13,000	706	31	675	366	141	70
3	Steel(III)	30,000	16,000	1,340	482	859	572	220	110
4	Timber (I)	14,000	12,000	403	6	396	198	76	38
5	Timber (II)	37,000	17,000	101	50	51	36	14	7
6	Vehicle (I)	3,000	4,000	438	44	395	66	25	13
7	Vehicle (II)	10,000	10,000	355	195	160	67	26	13
8	Vehicle(III)	27,000	15,500	507	198	309	200	77	38
9	Livestock (I)	9,000	8,000	231	27	204	68	26	13
10	Livestock (II)	21,000	15,000	61	38	24	15	6	3
11	General Cargo (I)	1,000	2,000	2,098	0	2,098	175	67	34
12	General Cargo (II)	3,000	4,000	161	0	161	27	10	5
13	General Cargo(III)	12,000	11,000	999	46	953	437	168	84
14	General Cargo (IV)	20,000	14,000	750	218	532	311	120	60
	TOTAL			9,006	1,346	7,659	2,641	1,017	508

Table 7-4-5 Savings in Ships' Waiting Costs in 2004

No.	Ship Type	Ship Size (DWT)	Ship Costs (US\$ /Ship/Day)	Waiting Time			Difference (Days)	Ship's Waiting Costs (US\$ '000)	Ship's Waiting Costs ('000 RO)	Benefits Accruing to Oman ('000 RO)
				Without Case (Hrs.)	With Case (Hrs.)	Difference (Hrs.)				
1	Steel (I)	2,000	3,000	1,304	15	1,289	53.7	161	62	31
2	Steel (II)	17,000	13,000	899	39	860	35.8	466	179	90
3	Steel(III)	30,000	16,000	2,366	602	1,764	73.5	1,176	453	226
4	Timber (I)	14,000	12,000	548	7	541	22.6	271	104	52
5	Timber (II)	37,000	17,000	208	54	154	6.4	109	42	21
6	Vehicle (I)	3,000	4,000	776	51	724	30.2	121	46	23
7	Vehicle (II)	10,000	10,000	1,372	233	1,139	47.5	475	186	91
8	Vehicle(III)	27,000	15,500	1,428	238	1,190	49.6	769	296	148
9	Livestock (I)	9,000	8,000	629	32	598	24.9	199	77	38
10	Livestock (II)	21,000	15,000	190	43	146	6.1	91	35	18
11	General Cargo (I)	1,000	2,000	3,372	0	3,372	140.5	281	108	54
12	General Cargo (II)	3,000	4,000	2,353	0	2,353	98.1	392	151	76
13	General Cargo(III)	12,000	11,000	1,315	53	1,262	52.6	578	223	111
14	General Cargo (IV)	20,000	14,000	1,052	248	804	33.5	469	181	90
	TOTAL			17,811	1,615	16,197	674.9	5,558	2,140	1,070

7.4.3 Savings in Time Costs

The reduction of ships' waiting time due to the construction of the new port brings about a reduction in the time required for imports and exports.

This will bring about a reduction in usance interest because invested funds will be called in faster. Converted into monetary terms, this reduced time can be estimated by the following equation:

$$\text{Saving in Time Costs} = Q \times D \times V \times I / 365$$

Where, Q : Average Parcel Size (tons/ship)
 D : Reduction of Ships' Waiting Time (days)
 V : Average Cargo Value (RO/ton)
 I : Interest Rate (%/year)

Average cargo value is calculated by commodity based upon the actual value and quantity of imports/exports in 1988, the data for which is available in the "Statistical Year Book 1988". The results of the calculation are shown in Table 7-4-6.

Table 7-4-6 Unit Price of Cargo

(Unit: RO/ton)

Cargo	Steel	Timber	Vehicle	Livestock	Other Cargo
Unit Price (RO/ton)	236.4	154.6	3,400.6	407.1	556.5

Usance interest rate is estimated at 8.5% per annum based on the London interbank offered rate (LIBOR) in April 1990.

Tables 7-4-7 and 7-4-8 show the estimated reductions in time costs. Since the figures are also shown in border prices, they do not need to be converted to economic prices.

Table 7-4-7 Savings in Time Costs in 2000

Ship Type	No. of Ships	Average Parcel Size (ton/ship)	Cargo Value (RO/ton)	Interest Rate (%/year)	Reduction of Ship Waiting (Days)	Saving of Time Costs (RO '000)
Steel (I)	40	716	236.4	8.50	35.2	1
Steel (II)	52	1,971	236.4	8.50	28.1	3
Steel(III)	56	4,111	236.4	8.50	35.9	8
Timber (I)	32	1,767	154.6	8.50	16.5	1
Timber (II)	28	2,409	154.6	8.50	2.1	0
Vehicle (I)	23	104	3,400.6	8.50	16.4	1
Vehicle (II)	177	306	3,400.6	8.50	6.7	2
Vehicle(III)	90	335	3,400.6	8.50	12.9	3
Livestock (I)	18	394	407.1	8.50	8.5	0
Livestock (II)	27	507	407.1	8.50	1.0	0
General Cargo (I)	150	221	556.5	8.50	87.4	3
General Cargo (II)	56	548	556.5	8.50	6.7	0
General Cargo(III)	92	1,558	556.5	8.50	39.7	8
General Cargo (IV)	29	3,652	556.5	8.50	22.2	10
TOTAL	870				319.1	42

Table 7-4-8 Savings in Time Costs in 2004

Ship Type	No. of Ships	Average Parcel Size (ton/ship)	Cargo Value (RO/ton)	Interest Rate (%/year)	Reduction of Ship Waiting (Days)	Saving of Time Costs (RO '000)
Steel (I)	50	716	236.4	8.50	53.7	2
Steel (II)	65	1,971	236.4	8.50	35.8	4
Steel(III)	70	4,111	236.4	8.50	73.5	17
Timber (I)	35	1,767	154.6	8.50	22.6	1
Timber (II)	30	2,409	154.6	8.50	6.4	1
Vehicle (I)	27	104	3,400.6	8.50	30.2	2
Vehicle (II)	212	306	3,400.6	8.50	47.5	11
Vehicle(III)	108	335	3,400.6	8.50	49.6	13
Livestock (I)	21	394	407.1	8.50	24.9	1
Livestock (II)	31	507	407.1	8.50	6.1	0
General Cargo (I)	173	221	556.5	8.50	140.5	4
General Cargo (II)	64	548	556.5	8.50	98.1	7
General Cargo(III)	106	1,558	556.5	8.50	52.6	11
General Cargo (IV)	33	3,652	556.5	8.50	33.5	16
TOTAL	1,025				674.9	90

7.4.4 Savings in Land Transportation Costs

As mentioned in 7.2.4, under the "Without" case some of the local container cargo is assumed to deviate to the Dubai ports and to be imported from Dubai by land, while all the other cargo but containers is assumed to be handled at Mina Qaboos.

Therefore, the land transportation costs in the "Without" case can be considered as one of the benefits of the project.

The unit cost of land transportation is calculated based on the actual operation performance in Oman about which the Study Team has obtained some pieces of information by interviewing a few Omani land transport companies.

The unit cost is first estimated in the market prices which can be broken down into component costs such as depreciation, working expenses, fuel costs and so forth. Then, the economic pricing is applied to each of these factors in estimating the economic price of land transportation costs.

Taking into consideration that the distance from Dubai to Sohar is approximately 250km, the unit cost of land transportation (trailer) is estimated as 64.3 RO/TEU.

The benefit from savings in land transportation costs can be obtained by multiplying the above unit cost by cargo volume (TEUs) of containers, which are assumed to be transported by land. Table 7-4-9 shows the results from 2000 to 2005 year by year:

Table 7-4-9 Savings in Land Transportation Costs

Year	Cargo Volume (TEUs)	Land Transportation Costs('000 RO)
2000	42,054	2,704
2001	49,516	3,184
2002	56,875	3,657
2003	64,150	4,125
2004	71,350	4,588
2005	78,486	5,047

7.4.5 Foreign Currency Earnings in Handling Container Cargoes

While 348,412 TEUs of containers will be handled at both Mina Qaboos and the new port in 2000 under the "With" case, it is assumed that under the "Without" case only 246,058 TEUs would be handled at Mina Qaboos.

This means that the foreign currency earnings in handling the balance of the cargo volumes between both cases (102,354 TEUs) would be lost to Oman in 2000. Therefore, recouping these lost earnings is another major benefit of the project.

Foreign currency revenue related to container handling in the new port can be calculated based upon the figures given in the next chapter. Since this revenue can be considered as border prices, there is no need of converting to economic prices.

Table 7-4-10 shows the benefit of foreign currency earnings from 2000 to 2005.

Table 7-4-10 Benefit of Foreign Currency Earnings

Year	Cargo Volume (TEUs)	Foreign Currency Revenue('000 RO)
2000	102,354	1,565
2001	121,721	1,835
2002	141,087	2,110
2003	160,454	2,382
2004	179,820	2,658
2005	199,187	2,933

7.4.6 Other Benefits

As mentioned in 7.4.1, there are other important benefits stemming from this project even though they are not calculated as benefits in the cost-benefit analysis in this chapter.

1) Promotion of regional development in Sohar

As detailed in Chapter 4, there are many proposed projects, such as a Free Trade Zone (FTZ), industries based upon natural gas resources, an industrial estate, agro-related industries and so forth, which are

crucially dependent upon the existence of the new port. Were it not for the new port, it would be impossible to carry out projects that will promote regional development in Sohar and achieve the diversification of Oman's industries.

2) Increase in employment opportunities/income

The construction of the new port and the subsequent port operation will increase employment opportunities for construction and port workers.

According to cost estimation, construction work will require 232,046 man-days and the total amount of the compensation of employees during construction will be RO 1,619,000.

According to the next chapter, the number of employees of the port management body will be 925 and annual personnel costs after 2000 will be RO 3,181,000.

This can be considered as one of the benefits of the project.

3) Multiplier effect from the project

The construction and the operation of a port create a large amount of added value in the national economy. Although it is very difficult to evaluate this added value, an analysis partly based upon some assumption is made in Annex 7-4-1, which reaches the conclusion that the total added value created by construction of the new port will be RO 23,468,000 for the six years during construction and that the added value produced by the port service industries will be RO 2,889,000 in 2000, which will increase to RO 6,713,000 in 2005.

7.5 Costs

7.5.1 Cost Items

The items that should be considered as costs of the project are: construction costs, personnel costs, operating/maintenance costs, administration costs and renewal investment costs.

7.5.2 Construction Costs

The construction costs are estimated in Chapter 6. However, these costs include facilities/works such as breakwater, dredging and so forth, which are provided not only for the Short-term Development Plan but also used as existing facilities/works in the Master Plan for 2015. Therefore, it would be excessive to consider all of these costs as those of this short-term project only. In the economic analysis, the costs of these common-use facilities/works are allocated between the short-term plan and the subsequent Master Plan for 2015 according to the number of berths at each stage. (That is, since the number of berths planned in 2000 and in 2015 is three and seven, respectively, the costs for the short-term plan are assumed to be three-sevenths of the total costs of the above facilities/works.)

The costs estimated in Chapter 6 are shown at market prices. As mentioned in 7.3.1, in the economic analysis these costs have to be divided into foreign currency portion, skilled labour, unskilled labour, foreign labour and other local currency portions.

Since the foreign currency portion is shown in CIF prices, there is no need of conversion to economic prices. The labour costs should be converted into economic prices by using the respective conversion factors mentioned in 7.3.3.

Of the local currency portion, cement, the import of which a high protective duty is applied to, should be converted into a border price. The rest of the local currency portion should be converted into economic prices by multiplying the SCF.

Tables 7-5-1 and 7-5-2 show the construction costs at economic prices.

Table 7-5-1 Calculation of Construction Costs at Economic Prices

Item	Construction Cost at Market Prices ('000 RO)	Foreign Portion	Local Portion						Foreign Labour	Custom Duties	Overall Conversion Factor	Construction Cost at Economic Prices ('000 RO)
			Non-traded Goods	Cement	Skilled Labour		Unskilled Labour	Foreign Labour				
					0.971	0.865							0.974	0.446
Dredging	6,000	1.00	0.971	0.865	0.974	0.446	1.00	0.00	0.993	5,956		
Quaywall	9,353	75.42%	24.21%	0.00%	0.30%	0.02%	0.05%	0.00%	0.951	8,891		
Breakwater	4,289	0.13%	75.33%	10.75%	1.35%	1.66%	3.31%	0.00%	0.957	4,105		
Small Craft Harbour	1,463	13.05%	87.17%	8.02%	1.08%	1.20%	2.40%	0.35%	0.959	1,403		
Yard Pavement	1,986	0.00%	77.50%	3.59%	1.26%	1.32%	2.64%	0.01%	0.930	1,847		
Road	301	0.00%	61.70%	36.25%	0.34%	0.57%	1.13%	0.64%	0.968	291		
Buildings/Facilities	1,641	0.00%	97.61%	0.00%	0.40%	0.66%	1.33%	0.00%	0.946	1,553		
Cargo Handling Equipment	13,216	31.26%	50.15%	11.88%	1.46%	1.22%	2.44%	0.00%	0.952	12,587		
Others	82	95.20%	0.00%	0.00%	0.03%	0.01%	0.01%	1.58%	0.982	81		
Consultant Fee	2,570	39.02%	60.98%	0.00%	0.00%	0.00%	0.00%	4.76%	1.000	2,570		
Indirect Cost	13,717	100.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.984	13,503		
Grand Total	54,618	61.16%	34.94%	1.76%	0.54%	0.54%	1.07%	0.00%	0.966	52,786		

Table 7-5-2 Annual Investment Schedule at Economic Prices

Item	Unit: '000 RO							Total
	1994	1995	1996	1997	1998	1999	1999	
Dredging	0	0	1,125	1,744	1,744	1,344	5,956	
Quaywall	0	0	0	1,365	4,092	3,434	8,891	
Breakwater	0	0	909	1,294	1,294	608	4,105	
Small Craft Harbour	0	0	224	0	1,179	0	1,403	
Yard Pavement	0	0	0	0	114	1,733	1,847	
Road	0	0	291	0	0	0	291	
Buildings/Facilities	0	0	0	0	553	1,000	1,553	
Cargo Handling Equipment	0	0	0	0	0	12,587	12,587	
Others	0	0	0	0	0	81	81	
Consultant Fee	500	500	300	400	470	400	2,570	
Indirect Cost	0	0	3,559	3,264	3,264	3,416	13,503	
Grand Total	500	500	6,408	8,067	12,710	24,601	52,786	

7.5.3 Personnel Costs

The personnel costs for the new port are shown in the next chapter. After being divided into skilled labour and unskilled labour, the costs are converted to economic prices by multiplying the respective conversion factors.

The result is that the personnel costs at economic prices are RO 2,886,000 in 2000.

7.5.4 Operating/Maintenance Costs

The operating/maintenance costs are also shown in the next chapter. Since these costs contain various indefinite elements, the conversion factor is estimated as equal to the SCF (0.971).

7.5.5 Administration Costs

In the next chapter the administration costs are estimated to be 20% of the total amount of the personnel costs and the operating/maintenance costs. Economic prices of these costs are calculated in the same manner.

7.5.6 Renewal Investment Costs

The next chapter presents the schedule of renewal investment. Economic prices of these costs are calculated by multiplying the respective overall conversion factors shown in Table 7-5-1.

7.6 Evaluation

7.6.1 Calculated Results of Costs and Benefits

Table 7-6-1 shows the calculated results of the costs and benefits of the project.

7.6.2 Calculation of EIRR

The economic internal rate of return (EIRR) based upon a cost-benefit analysis is used in order to appraise the economic feasibility of the project.

The EIRR is a discount ratio which makes the costs and benefits of a project during the project life equal. It is calculated by using the following formula:

$$\sum_{i=1}^n \frac{B_i - C_i}{(1+r)^{i-1}} = 0$$

n : Period of economic calculation

B_i : Benefit in i-th year

C_i : Cost in i-th year

r : Discount rate

The EIRR of the Short-term Development of the New Port is calculated as 5.02 %.

7.6.3 Conclusion

There are various views concerning the appropriate EIRR level used to determine whether a project is feasible or not. The leading view is that the project is feasible if the EIRR exceeds the opportunity cost of capital.

The opportunity cost of capital in Oman is not known. However, the opportunity cost of capital in various countries is considered to range from 8% to 15%. It is generally considered that an EIRR of more than 10% is economically feasible for infrastructure or social service projects.

Compared with this, the result of the EIRR calculation, 5.02%, is not high enough to convince us that this project is feasible from the viewpoint of the national economy. (It is very difficult to judge from the result

one way or another whether the project is beneficial to Oman's economy in the absence of comparable figures of other investment.)

However, it should be noted that this analysis is taking into consideration only four items of benefits, as mentioned in 7.4. Adjacent to the new port, there are many proposed projects, such as a free trade zone, an industrial estate, industries based upon natural gas resources and so forth. At the present time, no concrete plans have been made yet and there is no way at all of knowing the scale, output, earnings/costs or profits of these projects. Although it is difficult to quantify how these kinds of projects could benefit from a port development project in terms of a cost-benefit analysis, the EIRR will become considerably higher when the added value or net gain of these projects is calculated as a benefit of the new port project.

The new port will undoubtedly contribute to promoting the regional development as well as to diversifying industries in the country. However, more comprehensive consideration is required in order to decide whether the new port should be constructed or not.

Table 7-6-1 Costs and Benefits of the Project

(Unit: '000 RO)

Year	Costs						Benefits				Total	Benefits - Costs	
	Construction Costs	Personnel Cost	Operation/Maintenance Cost	Administration Cost	Renewal Investment	Residual Value	Total	Savings in Ships' Waiting Costs	Savings in Time Costs	Savings in Transportation Costs			Foreign Currency Earnings
1994	500						500						-500
1995	500						500						-500
1996	6,408						6,408						-6,408
1997	8,067						8,067						-8,067
1998	12,710						12,710						-12,710
1999	24,601	1,443			289		26,332						-26,332
2000		2,586	477		673		4,035	508	42	2,704	1,565	4,819	784
2001			558		699		4,132	612	51	3,184	1,835	5,682	1,550
2002			638		705		4,228	738	62	3,657	2,110	6,566	2,338
2003			718		721		4,324	888	75	4,125	2,382	7,470	3,146
2004			798		737	216	4,636	1,070	90	4,588	2,658	8,406	3,770
2005			847		747		4,479			5,047	2,933	9,140	4,661
2006						1,024	5,504						3,836
2007							4,479						4,661
2008						216	4,695						4,445
2009							4,479						4,661
2010													
2011													
2012													
2013													
2014						216	4,695						4,445
2015						1,024	5,503						3,637
2016							4,479						4,661
2017													
2018						1,258	5,737						3,403
2019							4,479						4,661
2020													
2021													
2022													
2023						1,024	5,504						3,636
2024						17,225	21,705						-12,565
2025							4,479						4,661
2026													
2027													
2028													
2029													
Total	52,786	88,014	24,336	22,476	22,204	-15,207	194,638	30,564	2,580	144,424	83,875	261,443	66,805

CHAPTER 8 FINANCIAL ANALYSIS

Chapter 8 FINANCEIAL ANALYSIS

8.1 Purpose of the Financial Analysis

The purpose of the financial analysis is to appraise the financial feasibility of the short-term development plan for the new port. This analysis focuses on the viability of the project itself and the financial soundness of the port management body (PMB) during the project life.

8.2 Approach and Methodology

8.2.1 Approach

The long-term development plan consists mainly of the following five functions:

- A Supplementary Port for Mina Qaboos
- Transshipment Port
- Industrial/Regional Development
- Free Trade Zone
- Fishery Port

In order to implement such a huge project as a whole, cooperation among related ministries/authorities should be requested. Therefore, establishment of a coordination committee consisting of related ministries/authorities should be taken into consideration.

As far as regional development is concerned, urban and related infrastructures development will be conducted by the organization other than port management body. And regional development does not have a direct connection with the production activities. Therefore, the cost of above development is excluded from the financial analysis.

As far as industrial estate and free trade zone development is concerned, the financial analysis for this sector is not included in this analysis, taking into account the present financial rules applied to such authorities as the Rusayl Industrial Estate Authority, as mentioned in Section 8.3.2 in this chapter.

8.2.2 Methodology

The viability of the project itself is analyzed using the Financial Internal Rate of Return (FIRR) by means of the discounted cash flow method. Sensitivity analysis is conducted to measure the impact of changing conditions on the financial status of the project.

The financial soundness of the PMB is appraised using the projected financial statements and some indices calculated based upon these statements. The financial indices employed are as follows:

(1) Working Ratio and Operating Ratio

$$\text{Working Ratio (\%)} = \frac{\text{Operating Expenses}}{\text{Operating Revenue}} * 100$$

$$\text{Operating Ratio (\%)} = \frac{\text{Total Operating Expenses}}{\text{Operating Revenue}} * 100$$

The working ratio and operating ratio show the operational efficiency of the body implementing the project.

$$(2) \text{ Rate of Return on Net Fixed Assets (\%)} = \frac{\text{Net Operating Income}}{\text{Net Fixed Assets}} * 100$$

This indicator shows the profitability of the investment.

(3) Debt Service Coverage Ratio =

$$\frac{\text{Net Operating Income before Depreciation}}{\text{Repayment of and Interest on Long-term Loans}}$$

This indicator shows the ability of repaying the loans.

Sensitivity analysis is also carried out so as to measure the impact of changing conditions on the financial performance of the PMB.

8.3 Presuppositions

8.3.1 Project Life

Considering the economic service lives of facilities/equipment, the project life for the financial analysis is determined as 36 years, which consists of 6 years for the engineering service and construction and 30 years of operation.

8.3.2 Self-sustaining Basis

According to the rules for public authorities as set out in financial circular No. 6/85 from the Office of the H.E. (The Deputy Prime Minister for Financial and Economic Affairs), any surplus or deficit arising as a result of the operations of authorities is payable to or recoverable by the Government, and the proposed operating entity is a government organization.

In this study, however, the rules mentioned above cannot be adopted because the purpose of the financial analysis is to examine financial feasibility of the body implementing the project. The PMB should be managed on a self-sustaining basis to the best of its ability. Therefore, the principal accounting policies adopted by the PSC are also basically used for this analysis.

8.3.3 Financial Management

(1) Fund Management

The amount of cash on hand is assumed to be 3% of operating expenses based upon the actual percentage of cash on hand calculated from the financial statements of Mina Qaboos, and the rest is assumed to be in banks with 7.5% interest rate per annum.

On the other hand, annual deficit will be covered by short-term loans with 11.5% interest rate.

(2) Corporate Income Tax

The corporate income tax is as follows:

(a)	0 - 30,000 RO	Nil
(b)	30,000 - 200,000	5%
(c)	200,000 -	7.5%

However, this tax is assumed not to be levied on the PMB, which is proposed to be a public authority.

(3) Investment for Renewal

The investment funds for the renewal of facilities/equipment will be covered by internal resources reserved as accumulated depreciation cost.

8.3.4 Effect of Inflation

In this analysis, revenues and expenditures are calculated at constant December 1989 prices, and the effect of inflation is neglected. Instead, cost escalation is examined as one of the cases for the sensitivity analysis.

8.4 Appraisal of the Project

8.4.1 Fund-raising Plan

Funds necessary for this project will be assumed as follows:

(1) Government Funds

In case of Mina Qaboos, the construction cost of basic port facilities/equipment was paid by the Government and these facilities/equipment were owned by the Government. The costs covered by these funds are the cost of dredging, construction of quays, breakwaters, quayside gantry cranes and so on. Instead, 50% of the franchise payment as well as R.O. 100,000 as an annual rent is paid to the Government.

In this study, funds necessary for construction of the breakwater, quay, fishery port, quayside gantry cranes and dredging is assumed to be covered by Government funds as investment in the project and stated in the financial statements in order to clarify the sources of funds used for this project. These funds, therefore, are assumed to be free from repayment and interest.

Based upon the cost estimate, Government funds for this project will reach 57,245 thousand Rial Omani, i.e., 83.8% of the total cost for the project.

(2) Other Portion

The other portion of the funds for this project is assumed to be raised as follows:

Loan Period : 20 Years
Grace Period : 5 Years
Interest Rate : 4.4% per annum
Repayment : Fixed Amount Repayment of Principal

In addition to this, the case of 8% interest rate will be examined in order to evaluate the impact of interest rates on the body implementing the project.

8.4.2 Bases for Revenue Projection

The revenue sources for this project are revenue from ships (port dues), revenue from cargo (stevedoring, shorehandling and storage charges) and other miscellaneous charges. These charges are calculated based upon the present tariffs used in Mina Qaboos. There should not be so-called "cut-throat" competition between Mina Qaboos and the new port. Actual rates are summarized in Table 8-4-1. The cargo volume that can be handled in the new port will reach the limit in 1994 in case of conventional cargoes and in 1995 in case of containers.

8.4.3 Bases for Expenditure Projection

The expenditures of the PMB consist of personnel costs, repair/maintenance and operating costs, administration cost, cost of the depreciation of fixed assets, cost of the amortization of the deferred assets, interest on long-term loans and interest on short-term loans. The bases for calculation are mainly derived from the financial data of the PSC and are summarized in Table 8-4-2.

Table 8-4-1 Port Tariff of Mina Qaboos

(Unit : RO)

MARINE CHARGES				
CHARGE	UNIT	RATE	REMARKS	
Port Dues	per GRT	0.015	After 5 days for each day 0.005 per GRT	
Tug Charges	per hour	55		
Harbour Launch	per hour	40		
Pilotage	Vessels up to 3000GRT	25		
	Vessels from 3000 to 7000	50		
	Vessels above 7000 GRT	75		
Pilot Boat		20	Boarding and disembarking	
Line Handlers	per vessel	30	Berthing and unberthing	

STEVEDORING CHARGES				
CHARGE	UNIT	RATE	REMARKS	
DISCHARGING				
General cargo		2.25	1. Discharging rates will be reduced by	
Foodstuff and medicines		1.15	1/3 on palletised cargo (minimum 100	
Iron or steel bar, pipe, etc		2.8	tonnes)	
Plywood, hardboard etc		2		
Loose plywood etc.		4		
Timber			2. Discharging rates will be reduced by	
Packed		2	1/4 on pre-slung cargo (minimum 100	
Loose		4	tonnes)	
Unpacked vehicle				
under 2.5 tonnes	per unit	10.5		
2.5 and under 5 tonnes	per unit	16		
5 tonnes and over	per tonne	4		
Refrigerated cargo	per gang hour	25		
Bagged cement / hydrated lime		1.5		
LOADING FOR EXPORT				
General cargo		7	Same as 1. and 2. above	
Unpacked vehicle				
under 2.5 tonnes	per tonne	2		
2.5 and under 5 tonnes	per tonne	2		
5 tonnes and over	per tonne	2		
Live animal	per head	0.3		
EXTRA SERVICES				
Shifting lashing/unlashing etc	per gang hour	25		

QUAY HANDLING AND STORAGE CHARGES				
CHARGE	UNIT	RATE	REMARKS	
IMPORT				
General cargo		2		
Foodstuff and medicines		1		
Iron or steel bar, pipe, etc		2		
Plywood, hardboard etc		2		
Loose plywood etc.		3		
Timber				
Packed	per cubic meter	2		
Loose	per cubic meter	3		
Unpacked vehicle				
under 2.5 tonnes	per unit	10		
2.5 and under 5 tonnes	per unit	20		
5 tonnes and over	per unit	25		
Heavy lifts-5 tonnes and over		2		
Bagged cement / hydrated lime		1.2		
Live animal	per head	0.3		
DEMURRAGE (Import/export)				
For the first 7 days		0		
General cargo, foodstuff, medicine, iron/steel, timber/plywood	1st and 2nd period	0.4	1st period: For a period of 14 days after the free period	
	3rd period onwards	1.2		
Unpacked vehicle			2nd period: For a period of 7 days after the 1st period	
Under 5 tonnes	1st and 2nd period	5		
per unit	3rd period onwards	15		
5 tonnes and over	1st and 2nd period	10	3rd period: For a each period of 7 days after the 2nd period	
per unit	3rd period onwards	30		
Bagged cement / hydrated lime	1st and 2nd period	0.3		
	3rd period onwards	1		

CONTAINER

CHARGE	UNIT	RATE	
HANDLING CHARGES			
FCL - Import	20' Container	33	60% by consignee (RO 19/20', RO 25/40')
	Over 20' Container	43		40% by shipowner (RO 14/20', RO 18/40')
LCL - Import	20'	14	
	Over 20'	18	
Loaded container - Export	20'	33	
	Above 20'	43	
Empty - Import/export	20'	17	
	Above 20'	22	
STUFFING/UNSTUFFING			
Unstuffing(LCL) - Import	20'	20	
	Above 20'	40	
Stuffing - Export	20'	20	
	Above 20'	40	
DENURRAGE			
Loaded container			
3 days		0	
For each day for period of	20'	1	
1st 7 days	Above 20'	2	
For each day for period of	20'	1.5	
2nd 7 days	Above 20'	3	
For each day for period of	20'	2	
3rd 7 days	Above 20'	4	
For each day after/before	20'	3	
3rd period	Above 20'	6	
Empty container - Export			
For each day	20'	0.5	
	Above 20'	1	
Empty container - Import			Import empty containers will incur the rates applicable to loaded containers
TRANSHIPMENT			
Handling	20'	15	Full containers when unstuffed in the port area will revert to the rates above
	Above 20'	25	
Demurrage			
For 30 days		0	

Table 8-4-2 Bases for Calculation

Item	Remarks
Personnel Cost	<p>1) Annual per capita cost</p> <p style="padding-left: 40px;">Managerial Staff 15,432 R.O.</p> <p style="padding-left: 40px;">Other Staff 3,192 R.O.</p> <p>2) Required number of employees</p> <p style="padding-left: 40px;">Managerial Staff 20</p> <p style="padding-left: 40px;">Other Staff 900</p> <p>These figures are calculated based upon the present situation at Mina Qaboos.</p>
Operating/ Maintenance Cost	<p>10% of the operating revenue. The revenue from sales of fuel and the expenses for the fuel sold are both excluded.</p> <p>The maintenance dredging cost will be required every 10 years taking into account the estimated siltation in the channel.</p>
Administration Cost	<p>20% of the personnel cost and the cost above excluding depreciation cost</p>
Cost of Depreciation of Fixed Assets	<p>Depreciation is calculated on a straight-line method to write off the cost over the economic service lives, which are shown in Table 8-4-3.</p>
Cost of Amortization of Deferred Assets	<p>The engineering service cost is amortized in 5 years from the start of the operations</p>

Table 8-4-3 Depreciation Period

Item	Period
a. Breakwater	50 Years
b. Quay	50
c. Dredging	100
d. Pavement	25
e. Road	25
d. Building	40
e. Quayside Gantry Crane	25
f. RTG Crane	25
g. Mobile Crane	15
h. Forklift	8
i. Tractor	8
j. Trailer	5
k. Truck Scale	20
l. Tug	20
m. Navigation Aid	25

8.4.4 Financial Soundness of the PMB

(1) Base Case

The projected profit and loss statement, cash flow statement and balance sheet of the PMB are shown in Table 8-4-6.

(a) Operational Efficiency

The working ratio is continuously below 60% from 2004 till the end of the project life. Generally speaking, this ratio should remain under 50 to 60%. On the other hand, the operating ratio slightly exceeds 75% almost the entire project life. The IBRD (International Bank for Reconstruction and Development) requests that it is preferable for this ratio to remain under 70 to 75%. Therefore, it would be better to increase the present tariff rates, especially in the case of rates for transshipment containers, to the greatest possible extent in order to recover the cost of fixed assets, taking into account the present tariff level, which is the lowest among the ports of the UAE and Oman as shown in Table 8-4-4.

In addition to this, the operating ratio can be reduced to about 71% if the PMB can reduce 10% of the personnel cost of the base case.

(b) Profitability

The profitability of the project can be appraised using the rate of return on net fixed assets. This rate exceeds 4.4%, which is the assumed interest rate for this project, from 2011. Therefore, this project will maintain the profitability during the project life.

(c) Loan Repayment Ability

As shown in Table 8-4-6, the projected debt service coverage ratio will maintain a portion far above 1.0 times during the study period.

Table 8-4-4 Comparison of Port Charges

ITEMS	MAIN CHARGES	QABOOS	FUJAIRAH	FAKKAN	KHALID	RASHID	SINGAPORE	COLOMBO
DUES ON VESSEL	Port Dues, Entering Dues	974	817	899	736	715	1,156	1,030
	Light Dues		245	266	750			773
	Pilotage	831	545	510	450	420	493	1,110
	Moorings	78	150	109	20	16		584
	Tugs	571	817	1,289	381	738	1,192	
	Berthings		163	180	109	245	1,413	500
	Total (Per Vessel)	2,455	2,738	3,252	2,446	2,132	4,254	3,997
DUES ON TRANSHIPMENT CONTAINER(20' Loaded/Import)	Per GRT	0.10	0.11	0.13	0.10	0.09	0.17	0.16
	Index (Qaboos=100)	100	112	132	100	87	173	163
	Loading/Discharging	39	114	123	123	125	102	52
UNSTUFFING CHARGE	Other Charges							
	Total (Per 20')	39	114	123	123	125	102	52
	Index (Qaboos=100)	100	294	315	315	322	262	133
EXCHANGE RATE (US\$)	Free Time	3(30)	20(30)	15(30)	15(30)	20(20)	(28)	(28)
	Over Time Surcharge	18	41	54	54	41		
		0.385	3.67	3.67	3.67	3.67	1.948	33.033

CONDITIONS FOR CALCULATION OF CHARGES

VESSEL :25,000 GRT,15,000 NRT,35,000 DWT, Weekly Service
 PILOT :2 hours for entering/departure each
 TUG :2 Tugs, 1 hour for entering/departure each
 BERTHING TIME :10 hours (8:00-18:00)
 SERVICE TIME :6 hours
 CYCLE TIME OF CRANE :30 Boxes/Hour
 TONNAGE PER CONTAINER :32 MT Per 20'

These charges are calculated based upon the present port Tariff of each port.

(2) Sensitivity Analysis

In order to examine the soundness of the PMB, sensitivity analysis is conducted in the following cases:

- Case I - Higher interest rate of 8%
- Case II - Cost increase by 10%
- Case III - Revenue decrease by 10%
- Case IV - Decrease of personnel cost by 10%

Calculation results of each case are shown in Tables 8-4-7, 8-4-8, 8-4-9 and 8-4-10, respectively. In Case III, the operating ratio exceeds 80% during the project life. Therefore, rate increase of handling charges for transshipment containers should be taken into consideration, as mentioned above.

The comparison of each is summarized as follows:

(a) Balance in Finance

	Year(Dificit)/Year(Surplus)	Retained Earinings in 2029
Base Case	2007/2008	169,086
Case I	2009/2010	131,899
Case II	2010/2011	107,568
Case III	2011/2012	90,994
Case IV	2005/2006	205,315

(b) Operating Efficiency in 2005

	Working Ratio	Operating Ratio
Base Case	55.76%	75.38%
Case I	55.76%	75.38%
Case II	60.13%	79.76%
Case III	60.62%	82.42%
Case IV	51.38%	71.01%

8.4.5 Viability of the Project Itself

The viability of the project is analyzed using the FIRR, which makes the costs and the benefits during the project life equal. The costs and benefits that are taken into account for the calculation of the FIRR are summarized as follows:

Costs	Benefits
<ul style="list-style-type: none"> • Initial investment cost, including reinvestment for renewal • Operating expenses 	<ul style="list-style-type: none"> • Port operating revenue • Residual value of the fixed assets at the end of the project life.

As far as initial investment is concerned, construction costs of breakwater and dredging are allocated between the short-term development plan and Master Plan based upon the number of births as mentioned in Chapter 7. And the construction cost of fishery port is also neglected because the revenue from this facilities is excluded from benefits.

In addition to the Base Case, the following two cases are calculated in order to examine the impact of construction cost and revenue on this project.

Case A : Cost increases by 10%

Case B : Revenue decreases by 10%

Table 8-4-5 shows the calculation results of each case and calculation sheets are shown in Tables 8-4-11, 8-4-12 and 8-4-13, respectively.

Table 8-4-5 The Result of FIRR Calculation

Case	FIRR	Lower Limit
Base Case	4.62%	0.71%
Case A	3.14%	(1.30%)
Case B	2.85%	

Note : () = Lower limit in case of 8% annual interest ratio.

Taking into account the fund-raising plan, the FIRR should exceed lower limit of 0.71% which is the weighted average interest rate for all the project funds. In all the cases, the FIRRs exceed not only this limit but also the limit in the case of 8% interest rate.

8.4.6 Conclusion

Judging from the above analysis, this project can be regarded as feasible provided that more than 80% of funds necessary for this project will be raised as Government funds with interest-free and no repayment. Instead, the Government can receive a certain percent of retained earnings as dividend payment after appropriation of necessary reserves in the future.

As clearly indicated through the financial analysis of operating efficiency, it is much difficult for the PMB to recover the cost for fixed assets based upon the present tariff rates. This is mainly due to the fund-raising method generally applied by GCC countries, that main port facilities are constructed by government and at least the operating cost should be earned through daily operations.

Taking into consideration the present competitive situation among ports in GCC countries, the induction of Government funds will be a must. Otherwise, this project cannot be regarded as feasible.

Table 8-4-6 Projected Financial Statements (Base Case)

Revenue Factor
Construction Cost Factor
Personnel Cost Factor
Interest Rate

Revenue Factor	0.044
Construction Cost Factor	
Personnel Cost Factor	
Interest Rate	

PROFIT AND LOSS STATEMENT	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029
Operating Revenue	0	0	0	0	0	0	448	505	583	678	718	718	718	718	718	718	718	718	718	718	718	718	718	718	718	718	718	718	718	718	718	718	718	718	718	718
Revenue from Ships	0	0	0	0	0	0	448	505	583	678	718	718	718	718	718	718	718	718	718	718	718	718	718	718	718	718	718	718	718	718	718	718	718	718	718	718
Revenue from Cargo	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Other Revenue	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Total	0	0	0	0	0	0	448	505	583	678	718	718	718	718	718	718	718	718	718	718	718	718	718	718	718	718	718	718	718	718	718	718	718	718	718	718
Operating Expenses	0	0	0	0	0	1,591	3,181	3,181	3,181	3,181	3,181	3,181	3,181	3,181	3,181	3,181	3,181	3,181	3,181	3,181	3,181	3,181	3,181	3,181	3,181	3,181	3,181	3,181	3,181	3,181	3,181	3,181	3,181	3,181	3,181	
Personnel Cost	0	0	0	0	0	481	962	962	962	962	962	962	962	962	962	962	962	962	962	962	962	962	962	962	962	962	962	962	962	962	962	962	962	962	962	
Operating/Maintenance Cost	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Administration Cost	0	0	0	0	0	310	734	734	734	734	734	734	734	734	734	734	734	734	734	734	734	734	734	734	734	734	734	734	734	734	734	734	734	734	734	734
Total	0	0	0	0	0	1,801	4,000	4,000	4,000	4,000	4,000	4,000	4,000	4,000	4,000	4,000	4,000	4,000	4,000	4,000	4,000	4,000	4,000	4,000	4,000	4,000	4,000	4,000	4,000	4,000	4,000	4,000	4,000	4,000	4,000	
Depreciation	0	0	0	0	0	1,712	1,712	1,712	1,712	1,712	1,712	1,712	1,712	1,712	1,712	1,712	1,712	1,712	1,712	1,712	1,712	1,712	1,712	1,712	1,712	1,712	1,712	1,712	1,712	1,712	1,712	1,712	1,712	1,712	1,712	
Amortization	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Total Operating Expenses	0	0	0	0	0	1,801	4,000	4,000	4,000	4,000	4,000	4,000	4,000	4,000	4,000	4,000	4,000	4,000	4,000	4,000	4,000	4,000	4,000	4,000	4,000	4,000	4,000	4,000	4,000	4,000	4,000	4,000	4,000	4,000	4,000	4,000
Net Operating Income	0	0	0	0	0	-1,353	-1,495	-1,495	-1,495	-1,495	-1,495	-1,495	-1,495	-1,495	-1,495	-1,495	-1,495	-1,495	-1,495	-1,495	-1,495	-1,495	-1,495	-1,495	-1,495	-1,495	-1,495	-1,495	-1,495	-1,495	-1,495	-1,495	-1,495	-1,495	-1,495	
Non-Operating Income	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Non-Operating Expenses	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Interest on Long-Term Loans	0	0	18	18	53	488	488	488	488	488	488	488	488	488	488	488	488	488	488	488	488	488	488	488	488	488	488	488	488	488	488	488	488	488	488	488
Interest on Short-Term Loans	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Net Income	0	0	-18	-18	-57	-2,408	-2,451	-2,451	-2,451	-2,451	-2,451	-2,451	-2,451	-2,451	-2,451	-2,451	-2,451	-2,451	-2,451	-2,451	-2,451	-2,451	-2,451	-2,451	-2,451	-2,451	-2,451	-2,451	-2,451	-2,451	-2,451	-2,451	-2,451	-2,451	-2,451	
Net Income after Tax	0	0	-18	-18	-57	-2,408	-2,451	-2,451	-2,451	-2,451	-2,451	-2,451	-2,451	-2,451	-2,451	-2,451	-2,451	-2,451	-2,451	-2,451	-2,451	-2,451	-2,451	-2,451	-2,451	-2,451	-2,451	-2,451	-2,451	-2,451	-2,451	-2,451	-2,451	-2,451	-2,451	
Retained Earnings	0	0	-18	-18	-57	-2,408	-2,451	-2,451	-2,451	-2,451	-2,451	-2,451	-2,451	-2,451	-2,451	-2,451	-2,451	-2,451	-2,451	-2,451	-2,451	-2,451	-2,451	-2,451	-2,451	-2,451	-2,451	-2,451	-2,451	-2,451	-2,451	-2,451	-2,451	-2,451	-2,451	
Accumulated Earnings	0	0	-18	-34	-91	-2,489	-4,940	-7,391	-9,842	-12,293	-14,744	-17,195	-19,646	-22,097	-24,548	-27,000	-29,451	-31,902	-34,353	-36,804	-39,255	-41,706	-44,157	-46,608	-49,059	-51,510	-53,961	-56,412	-58,863	-61,314	-63,765	-66,216	-68,667	-71,118	-73,569	

CASH FLOW STATEMENT	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	
Cash Beginning	0	0	0	-18	-34	-91	-2,117	-2,579	-2,258	-1,187	718	2,637	5,441	8,542	10,883	14,455	18,088	22,122	26,599	31,482	36,763	42,023	47,118	53,092	60,792	68,512	75,344	84,899	94,884	105,827	116,569	111,847	124,085	137,240	151,382	165,585	
Cash Inflow	0	0	0	0	0	-1,009	-1,712	-691	-283	481	1,187	2,148	2,148	2,148	2,148	2,148	2,148	2,148	2,148	2,148	2,148	2,148	2,148	2,148	2,148	2,148	2,148	2,148	2,148	2,148	2,148	2,148	2,148	2,148	2,148		
Net Operating Income	0	0	0	0	0	-1,009	-1,712	-691	-283	481	1,187	2,148	2,148	2,148	2,148	2,148	2,148	2,148	2,148	2,148	2,148	2,148	2,148	2,148	2,148	2,148	2,148	2,148	2,148	2,148	2,148	2,148	2,148	2,148	2,148	2,148	
Depreciation	0	0	0	0	0	0	1,712	1,712	1,712	1,712	1,712	1,712	1,712	1,712	1,712	1,712	1,712	1,712	1,712	1,712	1,712	1,712	1,712	1,712	1,712	1,712	1,712	1,712	1,712	1,712	1,712	1,712	1,712	1,712	1,712	1,712	
Amortization	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
Government Funds	500	500	8,480	11,183	16,178	22,388	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Long-term Loans	0	0	381	0	852	9,879	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
Other Current Liabilities	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
Other Long-term Liabilities	0	0	0	0	0	382	500	20	20	20	20	12	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
Incremental	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
Interest	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
Cash Inflow Total	500	500	6,851	11,183	17,028	30,738	1,007	1,258	1,883	2,708	3,485	4,070	4,257	4,480	4,684	4,932	5,081	5,472	5,844	6,210	6,508	6,801	7,001	7,383	7,878	8,405	8,967	9,355	10,185	10,864	11,788	12,592	13,155	14,142	15,203		
Cash Outflow	500	500	6,851	11,183	17,028	32,285	0	0	0	0	220	0	0	1,944	0	220	0	0	0	0	0	449	1,044	0	0	0	2,156	0	0	0	1,044	17,314	0	0	0	0	
Investment	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0		
Long-term Loan Repayment	0	0	0	0	0	0	0	24	24	81	739	739	739	739	739	739	739	739	739	739	739	739	739	739	739	739	739	739	739	739	739	739	739	739	739	739	
Interest on Long-term Loans	0	0	18	18	53	488	488	488	488	488	488	488	488	488	488	488	488	488	488	488	488	488	488	488	488	488	488	488	488	488	488	488	488	488	488	488	
Other Current Assets Incremental	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
Other Fixed Assets Incremental	0</																																				

Table 8-4-8 Projected Financial Statements (Case II)

Revenue Factor
Construction Cost Factor
Personnel Cost Factor
Interest Rate

0.014	1.1
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PROFIT AND LOSS STATEMENT

	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	
Operating Revenue	0	0	0	0	0	0	448	505	563	620	678	736	794	852	910	968	1,026	1,084	1,142	1,200	1,258	1,316	1,374	1,432	1,490	1,548	1,606	1,664	1,722	1,780	1,838	1,896	1,954	2,012	2,070	2,128	2,186
Revenue from Ships	0	0	0	0	0	0	448	505	563	620	678	736	794	852	910	968	1,026	1,084	1,142	1,200	1,258	1,316	1,374	1,432	1,490	1,548	1,606	1,664	1,722	1,780	1,838	1,896	1,954	2,012	2,070	2,128	2,186
Revenue from Cargo	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Other Revenue	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Total	0	0	0	0	0	0	448	505	563	620	678	736	794	852	910	968	1,026	1,084	1,142	1,200	1,258	1,316	1,374	1,432	1,490	1,548	1,606	1,664	1,722	1,780	1,838	1,896	1,954	2,012	2,070	2,128	2,186
Operating Expenses	0	0	0	0	0	1,750	3,499	3,499	3,499	3,499	3,499	3,499	3,499	3,499	3,499	3,499	3,499	3,499	3,499	3,499	3,499	3,499	3,499	3,499	3,499	3,499	3,499	3,499	3,499	3,499	3,499	3,499	3,499	3,499	3,499	3,499	3,499
Personnel Cost	0	0	0	0	0	0	491	574	657	739	822	904	987	1,070	1,153	1,236	1,319	1,402	1,485	1,568	1,651	1,734	1,817	1,900	1,983	2,066	2,149	2,232	2,315	2,398	2,481	2,564	2,647	2,730	2,813	2,896	2,979
Operating/Maintenance Cost	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
Administration Cost	0	0	0	0	0	350	796	815	831	848	864	881	897	914	930	947	964	980	997	1,014	1,030	1,047	1,064	1,080	1,097	1,114	1,130	1,147	1,164	1,180	1,197	1,214	1,230	1,247	1,264	1,280	1,297
Total	0	0	0	0	0	2,100	4,789	4,888	4,887	4,886	4,885	4,884	4,883	4,882	4,881	4,880	4,879	4,878	4,877	4,876	4,875	4,874	4,873	4,872	4,871	4,870	4,869	4,868	4,867	4,866	4,865	4,864	4,863	4,862	4,861	4,860	4,859
Depreciation	0	0	0	0	0	1,883	1,883	1,883	1,883	1,883	1,883	1,883	1,883	1,883	1,883	1,883	1,883	1,883	1,883	1,883	1,883	1,883	1,883	1,883	1,883	1,883	1,883	1,883	1,883	1,883	1,883	1,883	1,883	1,883	1,883	1,883	
Amortization	0	0	0	0	0	0	585	585	585	585	585	585	585	585	585	585	585	585	585	585	585	585	585	585	585	585	585	585	585	585	585	585	585	585	585	585	
Total Operating Expenses	0	0	0	0	0	2,100	7,237	7,337	7,438	7,538	7,638	7,739	7,839	7,939	8,039	8,139	8,239	8,339	8,439	8,539	8,639	8,739	8,839	8,939	9,039	9,139	9,239	9,339	9,439	9,539	9,639	9,739	9,839	9,939	10,039	10,139	10,239
Net Operating Income	0	0	0	0	0	-2,100	-2,323	-1,595	-887	-143	582	1,595	1,595	1,595	1,595	1,595	1,595	1,595	1,595	1,595	1,595	1,595	1,595	1,595	1,595	1,595	1,595	1,595	1,595	1,595	1,595	1,595	1,595	1,595	1,595	1,595	
Non-Operating Income	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0		
Non-Operating Expenses	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0		
Interest on Long-Term Loans	0	0	17	17	59	537	537	537	537	537	537	537	537	537	537	537	537	537	537	537	537	537	537	537	537	537	537	537	537	537	537	537	537	537	537		
Interest on Short-Term Loans	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0		
Net Income	0	0	-17	-19	-83	-2,848	-3,128	-2,501	-1,793	-1,007	-134	1,047	1,243	1,439	1,635	1,831	2,027	2,223	2,419	2,615	2,811	3,007	3,203	3,399	3,595	3,791	3,987	4,183	4,379	4,575	4,771	4,967	5,163	5,359	5,555		
Net Income after Tax	0	0	-17	-19	-83	-2,848	-3,128	-2,501	-1,793	-1,007	-134	1,047	1,243	1,439	1,635	1,831	2,027	2,223	2,419	2,615	2,811	3,007	3,203	3,399	3,595	3,791	3,987	4,183	4,379	4,575	4,771	4,967	5,163	5,359	5,555		
Retained Earnings	0	0	-17	-19	-83	-2,848	-3,128	-2,501	-1,793	-1,007	-134	1,047	1,243	1,439	1,635	1,831	2,027	2,223	2,419	2,615	2,811	3,007	3,203	3,399	3,595	3,791	3,987	4,183	4,379	4,575	4,771	4,967	5,163	5,359	5,555		
Accumulated Earnings	0	0	-17	-37	-100	-2,746	-5,878	-8,377	-10,170	-11,176	-11,310	-10,263	-9,020	-7,587	-5,875	-4,148	-2,287	55	2,884	5,583	8,281	12,420	16,298	20,584	25,307	30,504	35,873	41,989	48,602	55,997	63,938	71,188	79,122	87,792	97,255		

CASH FLOW STATEMENT

	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029
Cash Beginning	0	0	0	-17	-37	-100	-2,328	-3,207	-3,389	-2,884	-1,614	-459	1,585	3,808	5,283	7,944	10,800	13,587	16,942	20,622	24,613	28,445	31,948	36,921	42,303	48,185	54,694	60,183	68,128	78,702	84,773	95,552	104,885	114,503	125,687	
Cash Inflow	0	0	0	0	0	-2,100	-2,323	-1,595	-887	-143	582	1,595	1,595	1,595	1,595	1,595	1,414	1,595	1,595	1,595	1,595	1,595	1,595	1,595	1,595	1,595	1,414	1,595	1,595	1,595	1,595	1,595	1,595	1,595	1,595	
Net Operating Income	0	0	0	0	0	-2,100	-2,323	-1,595	-887	-143	582	1,595	1,595	1,595	1,595	1,595	1,414	1,595	1,595	1,595	1,595	1,595	1,595	1,595	1,595	1,595	1,414	1,595	1,595	1,595	1,595	1,595	1,595	1,595	1,595	
Depreciation	0	0	0	0	0	0	1,883	1,883	1,883	1,883	1,883	1,883	1,883	1,883	1,883	1,883	1,883	1,883	1,883	1,883	1,883	1,883	1,883	1,883	1,883	1,883	1,883	1,883	1,883	1,883	1,883	1,883	1,883	1,883	1,883	
Amortization	0	0	0	0	0	0	585	585	585	585	585	585	585	585	585	585	585	585	585	585	585	585	585	585	585	585	585	585	585	585	585	585	585	585	585	
Government Funds	550	550	7,138	12,312	17,794	24,825	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
Long-Term Loans	0	0	397	0	837	10,887	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
Other Current Liabilities	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
Other Long-Term Liabilities	0	0	0	0	0	420	538	20	20	20	20	12	0	0	0	0	36	-36	0	0	0	0	0	0	0	0	0	36	-36	0	0	0	0	0		
Accumulated Interest	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0		
Cash Inflow Total	550	550	7,536	12,312	18,731	33,811	683	874	1,602	2,328	3,051	3,480	3,588	3,760	3,883	4,082	4,117	4,449	4,737	5,013	5,312	5,600	5,882	6,235	6,638	7,080	7,280	7,444	8,578	9,219	9,818	10,554	11,348	12,197		
Cash Outflow	550</																																			

Table 8-4-10 Projected Financial Statements (Case IV)

Revenue Factor
Construction Cost Factor
Personnel Cost Factor
Interest Rate

0.8
0.844

	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029			
PROFIT AND LOSS STATEMENT																																							
Operating Revenue	0	0	0	0	0	0	448	505	583	620	678	718	716	718	718	718	718	716	718	716	718	718	716	716	716	716	716	716	716	718	718	718	718	718	718	718	718		
Revenue from Ships	0	0	0	0	0	0	448	505	583	620	678	718	716	718	718	718	718	716	718	716	718	718	716	716	716	716	716	716	716	718	718	718	718	718	718	718	718		
Revenue from Cargo	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0		
Other Revenue	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0		
Total	0	0	0	0	0	0	448	505	583	620	678	718	716	718	718	718	716	718	716	718	718	716	716	716	716	716	716	716	716	718	718	718	718	718	718	718	718	718	
Operating Expenses	0	0	0	0	0	1,437	2,893	2,863	2,883	2,883	2,883	2,883	2,883	2,883	2,883	2,883	2,883	2,883	2,883	2,883	2,883	2,883	2,883	2,883	2,883	2,883	2,883	2,883	2,883	2,883	2,883	2,883	2,883	2,883	2,883	2,883	2,883		
Personnel Cost	0	0	0	0	0	1,437	2,893	2,863	2,883	2,883	2,883	2,883	2,883	2,883	2,883	2,883	2,883	2,883	2,883	2,883	2,883	2,883	2,883	2,883	2,883	2,883	2,883	2,883	2,883	2,883	2,883	2,883	2,883	2,883	2,883	2,883	2,883	2,883	
Operating/Maintenance Cost	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
Administration Cost	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
Total	0	0	0	0	0	1,437	2,893	2,863	2,883	2,883	2,883	2,883	2,883	2,883	2,883	2,883	2,883	2,883	2,883	2,883	2,883	2,883	2,883	2,883	2,883	2,883	2,883	2,883	2,883	2,883	2,883	2,883	2,883	2,883	2,883	2,883	2,883	2,883	2,883
Depreciation	0	0	0	0	0	1,712	1,712	1,712	1,712	1,712	1,712	1,712	1,712	1,712	1,712	1,712	1,712	1,712	1,712	1,712	1,712	1,712	1,712	1,712	1,712	1,712	1,712	1,712	1,712	1,712	1,712	1,712	1,712	1,712	1,712	1,712	1,712	1,712	
Amortization	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
Total Operating Expenses	0	0	0	0	0	1,712	1,712	1,712	1,712	1,712	1,712	1,712	1,712	1,712	1,712	1,712	1,712	1,712	1,712	1,712	1,712	1,712	1,712	1,712	1,712	1,712	1,712	1,712	1,712	1,712	1,712	1,712	1,712	1,712	1,712	1,712	1,712	1,712	
Net Operating Income	0	0	0	0	0	-1,712	-1,337	-809	119	843	1,586	2,529	2,529	2,529	2,529	2,529	2,529	2,529	2,529	2,529	2,529	2,529	2,529	2,529	2,529	2,529	2,529	2,529	2,529	2,529	2,529	2,529	2,529	2,529	2,529	2,529	2,529	2,529	
Non Operating Income	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
Non Operating Expenses	0	0	16	16	53	488	488	488	487	488	482	450	417	385	352	320	287	255	222	180	157	124	92	60	29	0	0	0	0	0	0	0	0	0	0	0	0		
Interest on Long-term Loans	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0		
Interest on Short-term Loans	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0		
Net Income	0	0	-16	-16	-57	-2,217	-2,051	-1,334	-518	378	1,288	2,466	2,741	3,052	3,309	3,662	3,845	4,422	4,857	5,327	5,832	6,341	6,844	7,463	8,129	8,847	9,298	10,305	11,204	12,173	13,138	14,051	15,233	16,504	17,870	19,341			
Tax	0	0	-16	-16	-57	-2,217	-2,051	-1,334	-518	378	1,288	2,466	2,741	3,052	3,309	3,662	3,845	4,422	4,857	5,327	5,832	6,341	6,844	7,463	8,129	8,847	9,298	10,305	11,204	12,173	13,138	14,051	15,233	16,504	17,870	19,341			
Net Income after Tax	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0		
Retained Earnings	0	0	-16	-16	-57	-2,217	-2,051	-1,334	-518	378	1,288	2,466	2,741	3,052	3,309	3,662	3,845	4,422	4,857	5,327	5,832	6,341	6,844	7,463	8,129	8,847	9,298	10,305	11,204	12,173	13,138	14,051	15,233	16,504	17,870	19,341			
Accumulated Earnings	0	0	-16	-34	-91	-2,308	-4,359	-5,693	-6,211	-5,833	-4,544	-2,078	863	3,715	7,024	10,888	14,531	18,953	23,810	29,137	34,989	41,310	48,153	55,817	63,748	72,593	81,889	92,184	103,388	115,571	128,707	141,857	155,708	170,941	187,445	205,315			
CASH FLOW STATEMENT																																							
Cash Beginning	0	0	0	-16	-34	-91	-1,864	-2,065	-1,301	278	2,699	5,151	8,525	12,238	15,221	18,502	23,917	28,771	34,130	39,980	46,258	52,815	59,684	66,715	73,985	81,548	89,368	97,411	105,744	114,441	123,568	133,101	143,018	153,301	164,031	175,201			
Cash Inflow	0	0	0	0	0	-1,712	-1,337	-809	119	843	1,586	2,529	2,529	2,529	2,529	2,529	2,529	2,529	2,529	2,529	2,529	2,529	2,529	2,529	2,529	2,529	2,529	2,529	2,529	2,529	2,529	2,529	2,529	2,529	2,529	2,529	2,529		
Net Operating Income	0	0	0	0	0	-1,712	-1,337	-809	119	843	1,586	2,529	2,529	2,529	2,529	2,529	2,529	2,529	2,529	2,529	2,529	2,529	2,529	2,529	2,529	2,529	2,529	2,529	2,529	2,529	2,529	2,529	2,529	2,529	2,529	2,529	2,529		
Depreciation	0	0	0	0	0	1,712	1,712	1,712	1,712	1,712	1,712	1,712	1,712	1,712	1,712	1,712	1,712	1,712	1,712	1,712	1,712	1,712	1,712	1,712	1,712	1,712	1,712	1,712	1,712	1,712	1,712	1,712	1,712	1,712	1,712	1,712	1,712		
Amortization	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0		
Government Funds	500	500	6,480	11,183	16,178	22,388	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0		
Long-term Loans	0	0	391	0	852	2,879	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0		
Other Current Liabilities	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0		
Other Long-term Liabilities	0	0	0	0	0	344	481	70	20	20	20	12	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0		
Received Interest	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0		
Cash Inflow Total	500	500	6,851	11,193	17,028	30,890	1,350	1,837	2,305	3,110	4,017	4,640	4,871	5,150	5,373	5,694	5,881	6,353	6,791	7,228	7,701	8,178	8,648	9,123	9,602	10,085	10,578	11,081	11,594	12,117	12,650	13,193	13,746	14,309	14,882	15,465			
Cash Outflow	500	500	6,851	11,193	17,028	32,285	0	0	0	0	220	0	0	1,044	0	270	0	0	0	0	0	449	1,044	0	0	2,158	0	0	0	0	0	0	0	0	0	0	0		
Investment	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0			
Long-term Loan Repayment	0	0	0	0	0	0	0	24	24	81	739	739	739	739	739	739	739	739	739	739	739	739	715	715	659	0	0	0	0	0	0	0	0	0	0	0	0		
Interest on Long-term Loans	0	0	16	16	53	488	488	488	487	488	482	450	417	385	352	320	287	255	222	180	157	124	92	60	29	0	0	0	0	0	0	0	0	0	0	0			
Other Current Assets	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0		
Other Fixed Assets	0	0	0	0	0</																																		

Table 8-4-11 FIRR Calculation (Base Case)

FIRR : 0.046187993636 BASE CASE

NO.	YEAR	COST	BENEFIT	BNFT.-COST	P.COST	P.BNFT	P.VALUE
1.	1994	500	0	-500	500	0	-500
2.	1995	500	0	-500	478	0	-478
3.	1996	3,081	0	-3,081	2,815	0	-2,815
4.	1997	5,908	0	-5,908	5,160	0	-5,160
5.	1998	10,249	0	-10,249	8,555	0	-8,555
6.	1999	30,752	0	-30,752	24,537	0	-24,537
7.	2000	4,407	4,914	507	3,361	3,748	387
8.	2001	4,506	5,742	1,236	3,285	4,186	901
9.	2002	4,605	6,569	1,964	3,209	4,577	1,369
10.	2003	4,704	7,392	2,688	3,133	4,924	1,790
11.	2004	5,023	8,216	3,193	3,198	5,231	2,033
12.	2005	4,864	8,724	3,860	2,960	5,309	2,349
13.	2006	4,864	8,724	3,860	2,829	5,075	2,245
14.	2007	5,908	8,724	2,816	3,285	4,851	1,566
15.	2008	4,864	8,724	3,860	2,585	4,636	2,051
16.	2009	5,084	8,724	3,640	2,583	4,432	1,849
17.	2010	4,864	8,724	3,860	2,362	4,236	1,874
18.	2011	4,864	8,724	3,860	2,258	4,049	1,792
19.	2012	4,864	8,724	3,860	2,158	3,870	1,712
20.	2013	4,864	8,724	3,860	2,063	3,699	1,637
21.	2014	5,313	8,724	3,411	2,154	3,536	1,383
22.	2015	5,908	8,724	2,816	2,289	3,380	1,091
23.	2016	4,864	8,724	3,860	1,801	3,231	1,429
24.	2017	4,864	8,724	3,860	1,722	3,088	1,366
25.	2018	4,864	8,724	3,860	1,646	2,952	1,308
26.	2019	7,020	8,724	1,704	2,270	2,821	551
27.	2020	5,045	8,724	3,679	1,560	2,697	1,137
28.	2021	4,864	8,724	3,860	1,437	2,578	1,141
29.	2022	4,864	8,724	3,860	1,374	2,464	1,090
30.	2023	5,908	8,724	2,816	1,595	2,355	760
31.	2024	22,504	8,724	-13,780	5,807	2,251	-3,556
32.	2025	4,864	8,724	3,860	1,200	2,152	952
33.	2026	4,864	8,724	3,860	1,147	2,057	910
34.	2027	4864	8,724	3,860	1,096	1,966	870
35.	2028	4864	8,724	3,860	1,048	1,879	831
36.	2029	-23950	8,724	32,674	-4,931	1,796	6,728
TOTAL		190,299	250,933	60,634	104,026	104,026	0

Table 8-4-12 FIRR Calculation (Case A)

FIRR : 0.031399699571 CASE A

NO.	YEAR	COST	BENEFIT	BNFT.-COST	P.COST	P.BNFT	P.VALUE
1.	1994	550	0	-550	550	0	-550
2.	1995	550	0	-550	533	0	-533
3.	1996	3,766	0	-3,766	3,540	0	-3,540
4.	1997	7,027	0	-7,027	6,405	0	-6,405
5.	1998	11,951	0	-11,951	10,561	0	-10,561
6.	1999	34,170	0	-34,170	29,276	0	-29,276
7.	2000	4,789	4,914	125	3,978	4,982	104
8.	2001	4,888	5,742	854	3,937	4,825	688
9.	2002	4,937	6,569	1,582	3,894	5,130	1,235
10.	2003	5,086	7,392	2,306	3,851	5,597	1,746
11.	2004	5,405	8,216	2,811	3,968	6,031	2,063
12.	2005	5,246	8,724	3,478	3,734	6,209	2,475
13.	2006	5,246	8,724	3,478	3,620	6,020	2,400
14.	2007	6,290	8,724	2,434	4,208	5,837	1,628
15.	2008	5,246	8,724	3,478	3,403	5,659	2,256
16.	2009	5,466	8,724	3,258	3,438	5,487	2,049
17.	2010	5,427	8,724	3,297	3,309	5,320	2,010
18.	2011	5,246	8,724	3,478	3,101	5,158	2,056
19.	2012	5,246	8,724	3,478	3,007	5,001	1,994
20.	2013	5,246	8,724	3,478	2,916	4,848	1,933
21.	2014	5,695	8,724	3,029	3,069	4,701	1,632
22.	2015	6,290	8,724	2,434	3,286	4,558	1,272
23.	2016	5,246	8,724	3,478	2,857	4,419	1,762
24.	2017	5,246	8,724	3,478	2,576	4,284	1,708
25.	2018	5,246	8,724	3,478	2,498	4,154	1,656
26.	2019	7,402	8,724	1,322	3,417	4,028	610
27.	2020	5,427	8,724	3,297	2,429	3,905	1,476
28.	2021	5,426	8,724	3,298	2,355	3,786	1,431
29.	2022	5,246	8,724	3,478	2,207	3,671	1,463
30.	2023	6,290	8,724	2,434	2,566	3,559	993
31.	2024	22,560	8,724	-13,836	8,923	3,451	-5,473
32.	2025	5,246	8,724	3,478	2,012	3,346	1,334
33.	2026	5,246	8,724	3,478	1,951	3,244	1,293
34.	2027	5,246	8,724	3,478	1,891	3,145	1,254
35.	2028	5,246	8,724	3,478	1,834	3,049	1,216
36.	2029	-26,831	8,724	35,555	-9,093	2,956	12,048
TOTAL		205,595	250,933	45,428	135,257	135,257	0

Table 8-4-13 FIRR Calculation (Case B)

FIRR : 0.028509139303

CASE B

NO.	YEAR	COST	BENEFIT	BNFT. - COST	P. COST	P. BNFT	P. VALUE
1.	1994	500	0	-500	500	0	-500
2.	1995	500	0	-500	486	0	-486
3.	1996	3,081	0	-3,081	2,913	0	-2,913
4.	1997	5,908	0	-5,908	5,430	0	-5,430
5.	1998	10,249	0	-10,249	9,159	0	-9,159
6.	1999	30,752	0	-30,752	26,720	0	-26,720
7.	2000	4,407	4,423	16	3,723	3,737	14
8.	2001	4,506	5,168	662	3,701	4,245	544
9.	2002	4,605	5,912	1,307	3,678	4,721	1,044
10.	2003	4,704	6,653	1,949	3,653	5,166	1,513
11.	2004	5,023	7,394	2,371	3,792	5,582	1,790
12.	2005	4,864	7,852	2,988	3,570	5,764	2,193
13.	2006	4,864	7,852	2,988	3,471	5,604	2,132
14.	2007	5,908	7,852	1,944	4,100	5,448	1,349
15.	2008	4,864	7,852	2,988	3,282	5,297	2,016
16.	2009	5,084	7,852	2,768	3,335	5,151	1,816
17.	2010	4,864	7,852	2,988	3,102	5,008	1,906
18.	2011	4,864	7,852	2,988	3,016	4,869	1,853
19.	2012	4,864	7,852	2,988	2,933	4,734	1,802
20.	2013	4,864	7,852	2,988	2,851	4,603	1,752
21.	2014	5,313	7,852	2,539	3,028	4,475	1,447
22.	2015	5,908	7,852	1,944	3,274	4,351	1,077
23.	2016	4,864	7,852	2,988	2,621	4,231	1,610
24.	2017	4,864	7,852	2,988	2,548	4,113	1,565
25.	2018	4,864	7,852	2,988	2,477	3,999	1,522
26.	2019	7,020	7,852	832	3,476	3,888	412
27.	2020	5,045	7,852	2,807	2,429	3,781	1,352
28.	2021	4,864	7,852	2,988	2,277	3,676	1,399
29.	2022	4,864	7,852	2,988	2,214	3,574	1,360
30.	2023	5,908	7,852	1,944	2,615	3,475	860
31.	2024	22,504	7,852	-14,652	9,683	3,379	-6,305
32.	2025	4,864	7,852	2,988	2,035	3,285	1,250
33.	2026	4,864	7,852	2,988	1,978	3,194	1,215
34.	2027	4,864	7,852	2,988	1,921	3,105	1,182
35.	2028	4,864	7,852	2,988	1,870	3,019	1,148
36.	2029	23,950	7,852	-16,098	8,954	2,936	-11,890
TOTAL		190,299	225,850	35,551	128,410	128,410	0

CHAPTER 9 STRATEGY FOR DEVELOPMENT OF NEW PORT

Chapter 9 STRATEGY FOR DEVELOPMENT OF NEW PORT

1. Launching a port is really an ambitious project. Planning and design are both important factors, however, management and operation should also be emphasized to guarantee the success of a new port. In this chapter, this aspect will be examined in detail, although not exhaustively. In doing so, the team has tried to make a realistic approach rather than drawing up a theoretically ideal scheme, since in determining institutional aspects and operational practices, the existing social background of the nation is a more relevant factor than theory.

9.1 New Port Management Organization

2. Some of the points for management structure are indicated in Chapter 8-2 and 8-3 and here the work area of PMB is considered.

Generally speaking, the body should be streamlined with a view to maintaining high efficiency.

With this principle in mind, the port managing body of new port may be a separate organization from existing port service corporations. There are no standards throughout the world as to whether one PMB governs a single port or plural ports. Generally speaking, major European, North American and Japanese ports have their own port authorities. On the other hand, in some developing countries, a port authority or a government organization operates all or some of their ports.

However, as stated in 8-4, the construction costs of basic facilities/equipment are borne by the government, but the remainder is procured in the form of loans. *The PSC (Mina Qaboos) may not be able to do anything to financially assist the new port. Furthermore, although over a longer period the body should be self-sustaining, in the years after launching the port a huge deficit is envisaged, and it may be neither possible nor desirable for the PSC (Mina Qaboos) to share the burden.

* For the cost of fishery port, special consideration should be given since this contributes to the promotion of fishing.

3. There are a large number of variations throughout the world as to the extent of the work that PMBs actually conduct. Within the work, the most important one is whether a PMB conducts cargo handling by itself. The PSC (Mina Qaboos) owns handling equipment and conducts loading and unloading.

It is considered advisable that the organization for the new port follow the example of Mina Qaboos, at least in its initial stage, taking into account the advantage of learning from the experience of the existing PSC.

There are many examples in the world, in which independent companies undertake cargo-handling activities, and in the future these possibilities might be considered with a view to streamlined organization and efficiency.

The management of the FTZ and other factory sites should be separated from the PMB, although the PMB might act as the landlord of the FTZ, etc., and close cooperation maintained between the activities of port operation and manufacturing. This is because the characteristics of management are different and unifying them may cause inefficiency by mixing different types of business.

Since the area of work is similar to that of the existing PSC, the structure of the organization is similar with slight modifications, corresponding to different functions such as ship repairing, fishery port, and landlordship of the FTZ and other factory sites. Fig.9-1 shows an idea of the structure and sectionwise duty of the PMB, mainly following the example of the PMB (Mina Qaboos). Within its functions of the new port, that of contains handling is the most important in terms of port management. In this view, organization and its duty is shown in Fig.9-2, as an example.

9.2 Recruitment and Training

4. The new port requires some one thousand personnel and workers to be employed. Hard work is envisaged in recruiting the many kinds of persons needed, from top management to laborers, and training them will be even more difficult. The greatest attention should be paid to these matters, and thorough study to draft a comprehensive scheme for recruitment and training is needed.

Even with the above measures, it is envisaged that it will be difficult to hire a sufficient number of experts for higher-ranking management, and in that case foreign experts with much experience of port management, preferably including a general manager, might be recruited in order to assist in the port's smooth operation and to transfer expertise of port management in the inauguration period.

Besides the above, it may be advisable to learn from the experience of

the PSC (Mina Qaboos).

9.3 Coordination Measures

5. The new port should, when operating, cooperate with many kinds of related bodies. The relationship with Mina Qaboos should be taken up first. Both ports should cooperate and coordinate their activities in many fields. Particular importance should be attached to concerted action for cargo sharing, especially for general cargo, to which tends to be the subject of fierce competition. For maintaining cooperation, consideration should be given to establishing a council under the Ministry of Communications with a small secretariat and consisting of executives of the PSCs of Mina Qaboos and the new port. Meetings should be convened regularly with a view to exchanging information and to draft a ports policy.

Officials from other government organizations or other bodies may join the meetings where possible and necessary. The council may be named the National Port Council, following the example of the United Kingdom.

6. Another facet of coordination relates to various development projects in the region. Coordination in the planning and construction stages is no doubt important, but in the operating stage it is equally indispensable. In order to ensure concerted action between project-related organizations, some mechanism should be developed. Possible participants in such a mechanism may be municipalities, regional branches of central organizations dealing with energy, housing, education, customs, quarantine and immigration, the industrial estate authority, the governing body of the FTZ and petro-chemical factories.

9.4 Port Pricing Policy

7. The fundamental principles of port pricing are that (1) the client should pay for what he uses, i.e., charges should be levied on each place of equipment or service; (2) charges should provide the required income; (3) the pricing structure should promote the efficient utilization of port facilities. In reality, however, these principles tend to be not implemented because of various circumstances or constraints. For the new port, competition with neighboring ports will inevitably affect pricing. Despite this, when making tariffs, due consideration should be given to

avoid so-called "cut-throat competition".

As for the fishery port, charges may not be imposed on small fishing boats, if the cost of construction is borne by the fishing promotion budget (see paragraph 2).

9.5 Port Sales

8. In terms of geography, the ports of Oman are advantageously located among the ports in the Gulf. However, in recent years, from the customers point of view, economic benefits including quick transit time of vessels tend to be more attractive than mere geographical advantage. As a new comer, the PMB of the new port should carry out intensive port sales activities. Ports in the United Arab Emirates have been actively engaging in selling their ports and FTZs. For new comers, port sales activity is more important than for advanced ports. Without a positive approach, clients, who are essential for the port's survival, may not be attracted to the port. However, it should be noted that publicity does little on its own. A reputation for speedy and safe movement of goods is essential for attracting clients. In this context, quick customs, immigration and quarantine procedures are also vital.

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p.44

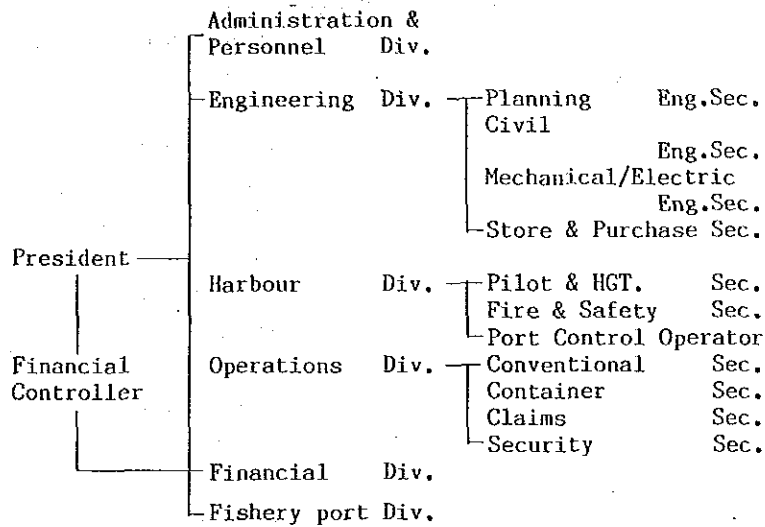
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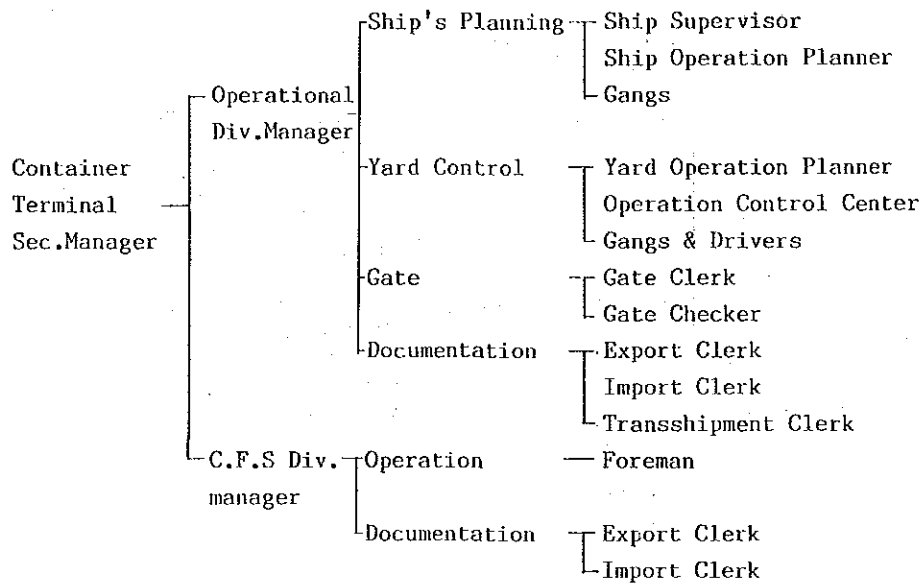
Fig.9-1 Organization Chart of the PSC in the New Port



The Duty of Each Division

- | | | |
|-------------------|------------------------------|--|
| Engineering Div. | Port Planning Eng. Sec. | : Port Planning/Port strategy survey/Port promotion |
| | Civil Eng.Sec. | : Design of port facilities/Cost estimate of construction |
| | | : Superintend of the construction work |
| | | : Dredging |
| | | : Maintenance of port facilities |
| | | : Survey, etc. |
| | Mechanical/Electric Eng.Sec. | : Purchase planning of machine/electric equipment |
| | | : Management of machine/electric equipment |
| | | : Maintenance of machine/electric equipment |
| | Store & purchase Sec. | : Storing & purchasing civil/electric/mechanical materials |
| Harbour Div. | Pilot & MGT Sec. | : Pilotage for entry/exist ship (using tugboats) |
| | Fire & Safety Sec. | : Fire service |
| | | : Safety control in the port area |
| | Port control operator | : Procedure for ship entry/exit |
| | | : Berth allotment |
| Operation Div. | Conventional terminal Sec. | : Management of transit shed |
| | | : Cargo handling operation of break bulk |
| | | : Allotment of the gang/cargo handling equipment |
| | Container Sec. | : See Fig.9-2 |
| | Claims Sec. | : Dealing with claims regarding cargos |
| | Security Sec. | : Security control in the port area |
| | | : Security training of the PMB |
| Fishery port Div. | | : Planning of the fishing port |
| | | : Berth allocation in the fisher port |
| | | : Maintenance/managenent of the fisher port facilities |
| | | : Management of the fishing market |

Fig.9-2 Detailed Chart of the "Container Section"



The Duty of the Container Terminal Section

- Ship's planning : Allocation of the stowage slots of import/export container according to the manifesto
- : Maker of container sequence checklist
- : Maker of loading ship stowage plan/loading container sequence checklist
- Yard control : Operator of the C.Y, according to the container sequence checklist
- : Checker of the container location
- : Reporter of the operating results to the documentation clerk
- : Allotment of gang/cargo handling equipment
- : Indicator of adequate operation in the C.Y
- Gate : Checking the delivery slip
- : Confirmation of the custom import clearance/custom export permission
- Documentation : Information of the arrival notice to consignee
- : Reporter of the confirmed discharging container list to the custom
- : Confirmation of the custom import/export clearance
- C.F.S Sec. : Maker of the container loading plan in C.F.S
- : Ensuring of good storage

APPENDICES

I. Appendix to Chapter 4-1

Appendix 4-1-1 Revised Cost Estimates for Further Expansion
of Mina Qaboos which Had Planned by CES

The CES recommended the scheme II for further expansion of Mina Qaboos as shown in Fig. A-4-1-1. They phased the scheme II to the phase I and the phase II. The berth length of the phase I is 1,120m which is just the same as our plan in 2000. In order to compare their plan with our plan, we revised their cost estimate as follows:

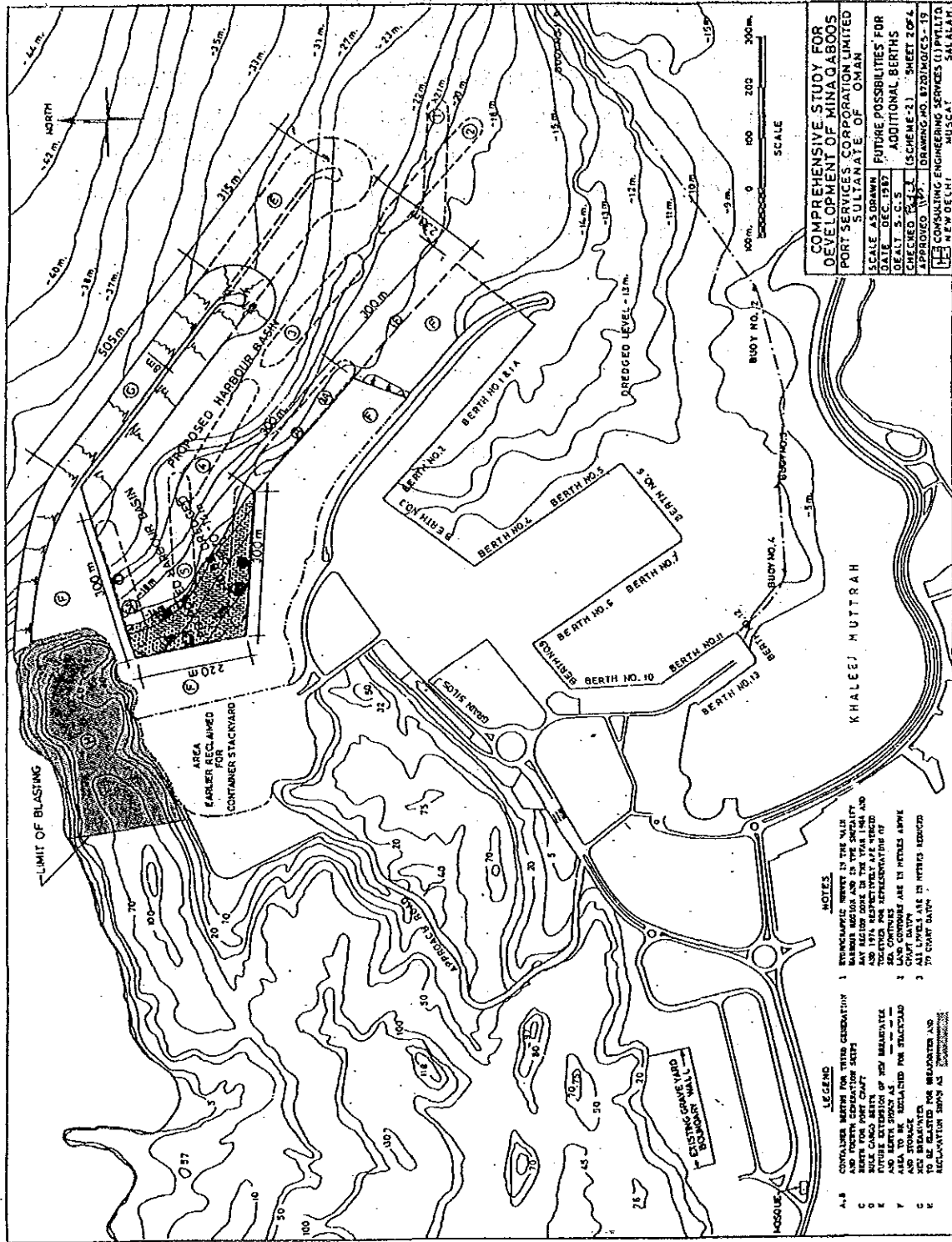


Fig.A-4-1-1 Scheme II of Further Expansion of Mina Qaboos

Table A-4-1-1 Breakup of Quantity and Cost of Items for Various Alternatives by CES

Phase	Item	Scheme I		Scheme II		Scheme III		Scheme IV					
		Qty.	Unit Rate (RO) M(RO)	Amount Qty.	Unit Rate (RO) M(RO)	Amount Qty.	Unit Rate (RO) M(RO)	Amount Qty.	Unit Rate (RO) M(RO)				
I	Reclamation with												
	i) Dredged soil	Nil	-	75,000 m3	4	Negligible	85,000 m3	4	Negligible	400,000 m3	4	2	
	ii) Blasted Jebel	30,00,000 m3	4	12	27,00,000 m3	4	11	29,50,000 m3	4	12	800,000 m3	4	3
	Total	30,00,000 m3	12	27,75,000 m3	11	30,35,000 m3	12	12,00,000 m3	5				
	Breakwater												
	i) Stone	10,00,000 m3	6	6	8,33,000 m3	6	5	10,00,000 m3	6	6	8,33,000 m3	6	5
	ii) Stabits	2,67,000 m3	30	8	2,33,000 m3	30	7	2,67,000 m3	30	8	2,00,000 m3	30	6
	Total	12,67,000 m3	14	10,66,000 m3	12	12,67,000 m3	12	12,67,000 m3	11	14	10,33,000 m3	11	11
	Blasting	40,00,000 m3	1.5	6	33,40,000 m3	1.5	5	40,00,000 m3	1.5	6	20,00,000 m3	1.5	3
	Dredging	Nil	-	-	75,000 m3	11	1	85,000 m3	11	1	4,00,000 m3	11	4
	Berth	810 m	10,000	8	1,120 m	10,000	11	1,200 m	10,000	12	1,120 m	10,000	11
Approach Road	1,000 m	1,000	1	1,000 m	1,000	1	1,000 m	1,000	1	1,000 m	1,000	1	
Grand Total		41		41		46		35					
II	Reclamation with												
	i) Dredged soil	Nil	-	Nil	-	Nil	-	Nil	-	Nil	-	-	
	ii) Blasted Jebel	7,50,000 m3	4	3	7,50,000 m3	4	3	7,50,000 m3	4	3	1,00,000 m3	4	
	Total	7,50,000 m3	3	7,50,000 m3	3	7,50,000 m3	3	1,00,000 m3	4				
	Breakwater												
	i) Stone	5,00,000 m3	6	3	5,00,000 m3	6	3	3,30,000 m3	6	2	6,66,000 m3	6	4
	ii) Stabits	1,67,000 m3	30	5	1,33,000 m3	30	4	1,00,000 m3	30	3	1,66,000 m3	30	5
	Total	6,67,000 m3	8	6,33,000 m3	7	4,30,000 m3	5	8,32,000 m3	9				
	Blasting	13,50,000 m3	1.5	2	13,30,000 m3	1.5	2	13,30,000 m3	1.5	2	13,30,000 m3	1.5	2
	Dredging	Nil	-	Nil	-	Nil	-	Nil	-	Nil	-	-	
	Berth	300 m	10,000	3	300 m	10,000	3	300 m	10,000	3	550 m	10,000	6
Grand Total		16		15		13		21					

Table A-4-1-2 Comparison of Further Expansion of Mina Qaboos with New Port Development

Item	Cost Estimate by CES for Phase I of Scheme II		Reversed Cost Estimate by JICA Team for Phase I of Scheme II		Cost Estimate by JICA Team Majlis Port Development in 2000	
	m	(505) (23,700) (11,988)	m	505 30,214 15,260	m	2,695 (3,714) 10,008
Breakwater			Breakwater		Breakwater	
1) Stone	m3 333,000	6 4,998	Revetment	m 350 24,171		
2) Stabits	m3 233,000	30 6,990	Blasting	m3 3,340,000 1.50 5,010		
Blasting	m3 3,340,000	1.5 5,010	Dredging	m3 75,000 2.13 160		
Dredging	m3 75,000	11 825	Berth			
Berth			-14m	m 590 8,483 5,005		
-14m			-18m	m 530 11,028 5,844		
-18m			Total			
Total			Approach Road	m 1,000 1		
Approach Road	m 1,120	10,000 11,200				
Ground Total	m 1,000	1 1	Direct Cost	40,524	Direct Cost	35,614
			Ground Total	(1.28) 51,870	Ground Total	(1.28) 45,586

II. Appendices to Chapter 4-3

Appendix 4-3-1 Long-Term Targets and Policies of the Omani Government

The long-term targets and policies in Oman were commissioned in February 1975. The contents are summarized as follows:

1. To diversify the resources of national income by developing new resources to augment and eventually to replace oil resources.
2. To increase the ratio of investment directed to income-generating projects particularly in the fields of manufacturing, mining, agriculture and fisheries.
3. Fair distribution of national investment among geographic regions with a view to spreading progress and prosperity to all districts of the Sultanate. Special priority is assigned to the less-developed areas in order to reduce differences in the standards of living between them and other areas.
4. To support and develop the existing population centers and communities, to safe-guard those communities from the danger of mass immigration to densely populated urban centers and to conserve the environment.
5. To give due attention to development of national water resources as a vital prerequisite for continued economic activities and growth.
6. To give due attention to local human resources and to improve their abilities of contributing to the national economy.
7. To complete infrastructure requirements.
8. To support national commercial activities by removing market deficiencies which affect their operation and reduce free competition.
9. To provide a proper basis for the creation of a national economy based on private enterprises and fair competition, free from monopolistic practices. All efforts and assistance would be provided to support this purpose.

10. To improve the efficiency of the government administration system.
11. To intensify regional economic co-operation among G.C.C. member states. The establishment of the Council is considered a fundamental step towards the integration and coordination in strategies, policies and programmes of the member states, to guarantee the realization of progress, growth and prosperity for all the G.C.C. member states.

According to the above long-term targets and policies, the policies related to the new port development can be summarized as follows:

1. Diversification of commerce and industry to replace oil resources.
2. Diversification of manufacturing, mining, agriculture and fisheries.
3. Promotion of regional development.
4. Internationalization of the Omani economy.

In the third five-year development plan (1986-90), the important targets and policies of the sectors related to the above policies are summarized as follows:

(1) Mining and Quarrying Sector

- 1) To encourage the private sector to engage in industries relying upon copper raw materials, such as wires.
- 2) To encourage the private sector to expand activities in the field of quarrying, particularly with regard to the exploitation of marble deposits.
- 3) To encourage international companies to invest in prospecting for minerals in Oman.
- 4) To complete detailed a geological survey with a view to determining the mineral resources available in Oman.

(2) Agriculture and Animal Husbandry

- 1) To concentrate efforts on vertical expansion for improvement of productivity.
- 2) To continue a subsidy programme of providing farmers with improved seeds, fertilizers, insecticides, animal feed and hybrid breeds of livestock.
- 3) To develop the means of marketing agricultural produce and animals.

(3) Fisheries Sector

- 1) To assign top priority in the economic development policy to the development of the productivity of traditional fishermen.
- 2) To continue the support programme which is implemented by the fishermen's fund.
- 3) To expand the construction of docking facilities needed for landing fishing boats.
- 4) To expand the construction of fish storage and marketing centers.

(4) Industry Sector

- 1) To give strong stimulus to the private sector to invest in industry.
- 2) To give higher priority to industrial projects that utilized local raw materials, the food and beverage industries, which include the benefit of a relative advantage in the export market, and industries that could use a higher percentage of local manpower.
- 3) To encourage foreign investors to participate in projects that contribute to the economic development of the country.
- 4) To carry out feasibility studies of industrial projects that have a potential for success in Oman and to make these studies available free of charge to the private sector.

5) To provide comprehensive statistical data on industrial production in Oman.

(5) Commercial Sector

- 1) To expand transit trade activities.
- 2) To expand investment in the trade sector.
- 3) To promote trade co-operation with G.C.C. and other friendly countries.
- 4) To promote and encourage local trade to offset the effect of the collapse of oil prices.

(6) Tourism Sector

- 1) To utilize and beautify the coastline to make it a tourist attraction.
- 2) To develop and adopt new methods of encouraging and managing tourism.
- 3) To train and prepare Omani personnel in the field of tourism and in hotel management and service.
- 4) To continue to encourage the private sector to invest in the field of tourism

The above important targets and policies of the related sectors are in the line with the long-term targets and policies in Oman.

Appendix 4-3-2 Analysis on Import Cargo Handling Function

(1) Geographical Population Distribution in the Hinterland.

The total population of the Sultanate of Oman is estimated by DC as 1.5 million at present.

The geographical population distribution is presented in Table A-4-3-1. In this table, the distance from Muscat, Sohar and Barka is also presented.

Table A-4-3-1 Geographical Population Distribution and Distance

Population and Distance					
No.	Name	Muscat	Sohar	Barka	Present Population
1	Rustaq	159	163	85	49,654
2	Nakhal	109	181	35	20,839
3	Al Awabi	146	178	72	6,332
4	Sohar	230	0	150	68,641
5	Saham	205	35	131	52,035
6	Suweiq	136	106	62	63,438
7	Barka	84	156	0	46,124
8	Shinas	284	62	210	36,703
9	Khaburah	171	63	97	39,356
10	Msanaa	112	126	38	36,458
11	Liwa	256	34	182	16,918
Al Batinah Sub-total					436,498
1	Ibry	307	198	232	71,967
2	Buraimi	343	121	269	30,120
3	Dhank	367	235	292	14,972
4	Yanqal	324	216	250	11,999
5	Mhadha	322	100	248	6,527
Al Dhahirah Sub-total					135,585
1	Nizuwa	174	332	186	47,160
2	Bahla	208	297	220	32,765
3	Samail	92	250	104	33,541
4	Izki	138	296	150	22,938
5	Bidbid	71	229	87	16,556
6	Adam	223	381	235	11,416
7	Al Hmra	221	316	233	11,759
8	Mamh	167	325	179	9,336
9	Haima	541	636	553	4,793
Dakhliyah Sub-total					190,264
1	Al Modhaili	177	335	189	44,669
2	Ibra	178	336	190	16,475
3	Al Qabil	203	361	215	10,379
4	Bidiya	260	418	272	13,226
5	Al Kamil	280	438	292	13,566
6	Bani Bu Hass	302	460	314	17,487
7	Bani Bu Ali	308	466	320	34,145
8	Sur	337	495	349	44,972
9	W.Bani Kali	283	441	295	5,591
10	Dihal	185	343	197	11,776
11	Mahirah	185	343	197	5,802
Sharquiyah Sub-total					218,088
Grand Total					980,435
C.P.Area					333,354
Mussandam					23,825
Southern					162,410
All Oman					1,500,024

Source: Estimation by Development Council and Ministry of Communication

The following table shows the percentage of population of respective regions:

Table A-4-3-2 Population of Each Area

No.	Area	Population	Sub-total	% of Total Population
1	MCT REG	333,354	1,313,767	87.58%
3	Dakhliyah	190,263		
4	Al-Batinah	436,476		
5	Al-Dhahirah	135,586		
7	Sharquiyah	218,088		
6	Mussandam	23,825		
2	Southern	162,410		
	Total	1,500,000		

Note (1) Sub-total stands for the total population of MCT REG, Dakhliyah, Al-Batinah and Al-Dhahirah.

(2) MCT REG: This shows the region of the Muscat Region with Governorate of Muscat and the Wilayat of Quriyat.

The percentage of the regional population excluding Mussandam and Southern regions is 87.58% and the population of the region excluding Mussandam and the Southern region is 1,313,767. This population seems to be the hinterland population of Mina Qaboos at present.

Fig. A-4-3-1 shows the distance from Muscat, Sohar and Barka respectively. Fig. A-4-3-2 shows the distances from Dubai and Mina Qaboos.

From Fig. A-4-3-2, the willayat where the distance from Muscat is shorter than the distance from Dubai is up to Saham in Al-Batinah, and up to Bahla in Dakhliyah. On the other hand, the willayat where the distance from Dubai is shorter than the distance from Muscat is up to Sohar in Al-Batinah, and Ibri in Al-Dhahirah. If we estimate the influential area by the distance criterion, the population in the influential areas from Muscat and Dubai is as follows:

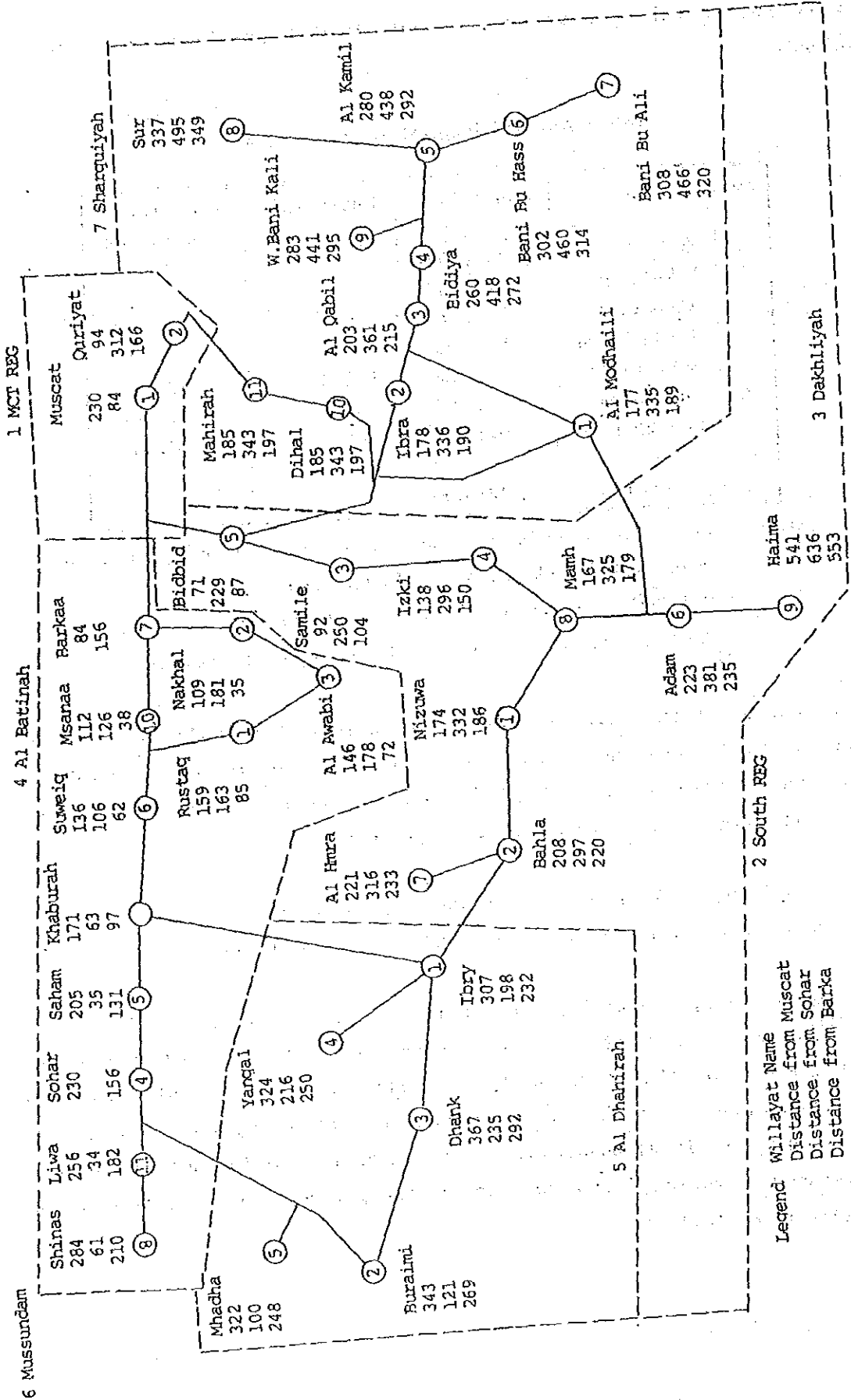


Fig. A-4-3-1 Distances from Muscat, Sohar and Barka

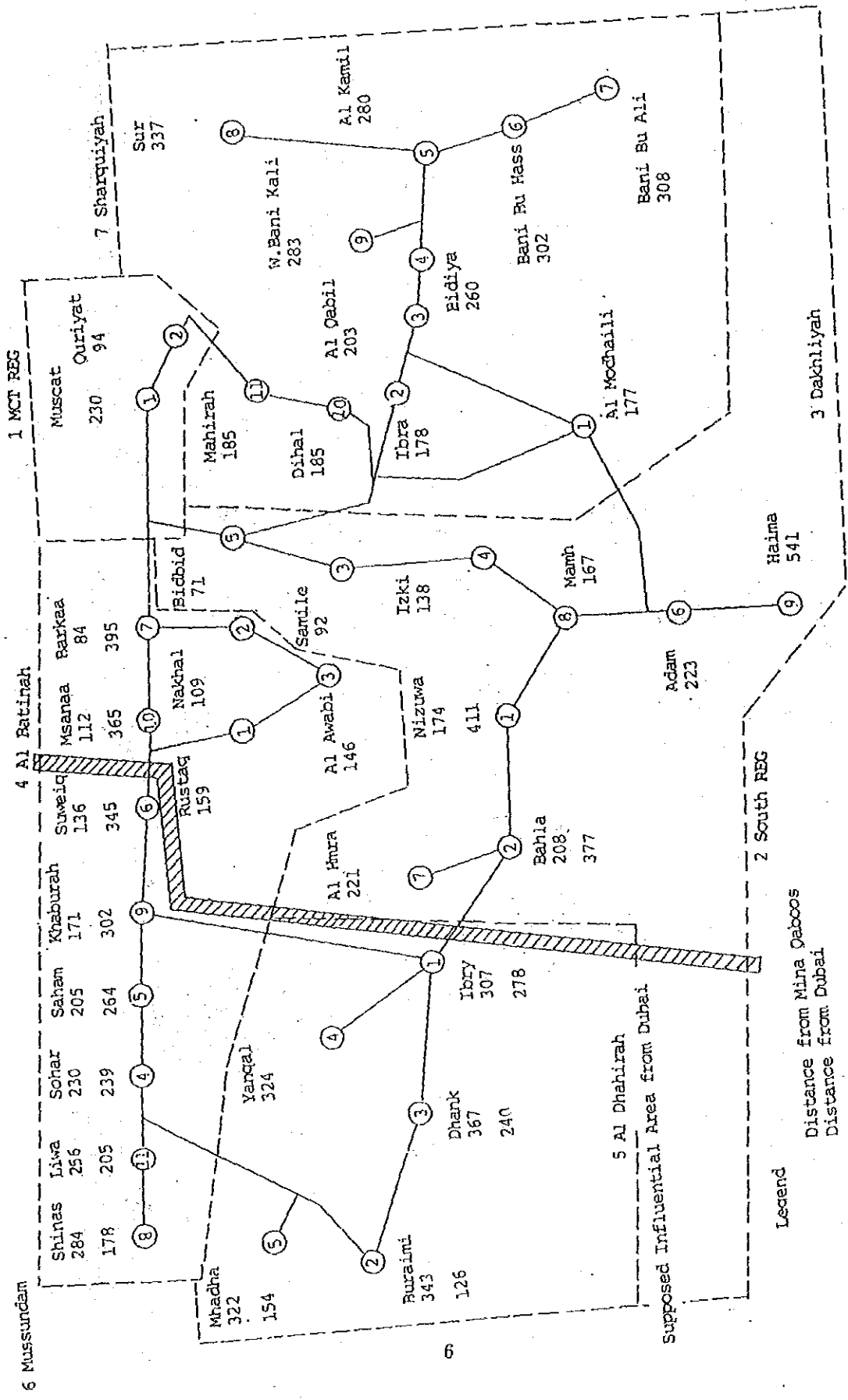


Fig. A-4-3-2 Distances from Dubai and Mina Qaboos

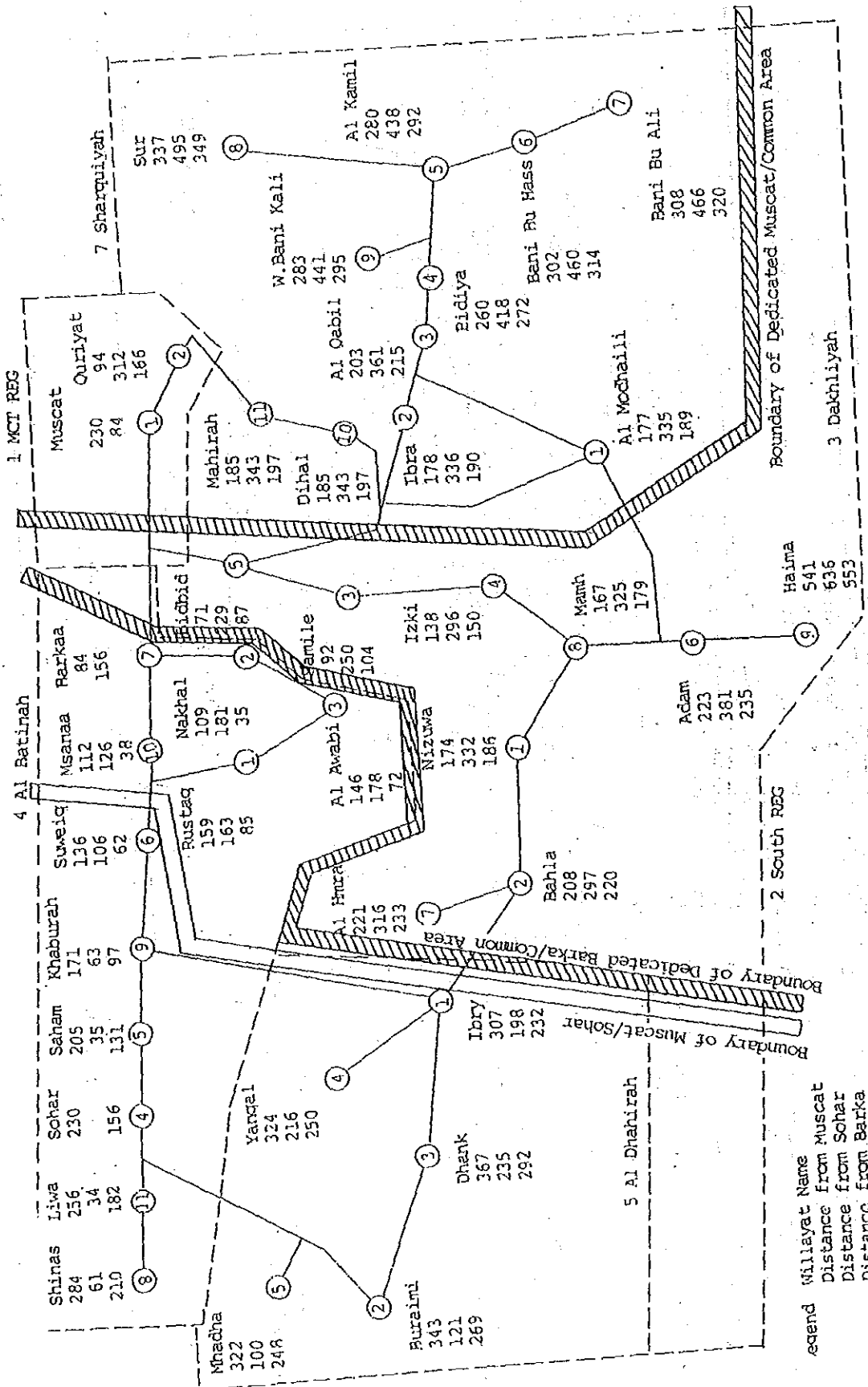


Table A-4-3-3 Population in the Influential Area from Dubai
Based on the Criterion of Distance

No.	Willayat	Population	Sub-total	% of Total Population
4	Sahar	68,641		
11	Liwa	16,918		
8	Shinas	36,703	122,262	
1	Ibry	71,967		
2	Buraimi	30,120		
3	Dhank	14,972		
4	Yanqal	11,999		
5	Mehadha	6,527	135,586	
	Total	257,848		17.19%

- Note: 1) Population in the Influential Area from Muscat is 1,055,919
2) % of Total Population in the Influential Area from Muscat is 70.39%

The population in the influential area from Dubai is 17.19% of the total population.

According to the result of interviews conducted by Weidleplan, the limit of the influential area from Dubai in Al-Batinah is up to Suweiq, that is 333 km from Dubai. The influential limit along Route 21 would be up to Bahla in the case where the influential limit is defined by a distance from Dubai shorter than 333 km.

The influential area of Dubai defined above is wider than that of the road distance. This means that Dubai has a strong economic influential force on Oman.

The population in the influential area from Dubai, in accordance with the interviews conducted by Weidleplan, is summarized in the following table.

Table A-4-3-4 Population in the Influential Area from Dubai
Based on the Criterion of Interview Results

No.	Willayat	Population	Sub-total	% of Total Population
4	Sohar	68,641		
11	Liwa	16,918		
8	Shinas	36,703		
5	Saham	52,035		
9	Khaburah	39,356		
6	Suweiq	63,438	277,091	
1	Ibry	71,967		
2	Buraimi	30,120		
3	Dhank	14,972		
4	Yanqal	11,999		
5	Mehadha	6,527	135,586	
2	Bahla	32,765		
	Total	445,442		29.70%

Note: 1) Population in the Influential Area from Muscat is 868,325
2) % of Total Population in the Influential Area from Muscat is 57.89%

On the other hand, the share of import cargoes by point of entry is as follows, according to foreign trade statistics.

Table A-4-3-5 Share of Import Cargoes by Point of Entry
(Unit : %)

Point of entry	1988	1987	1986	1985	1984
I By Sea Ports	69.7	67.8	56.0	46.4	49.5
A.Mina Qaboos	58.3	57.6	47.0	40.0	42.2
B.Raysut	11.4	10.2	9.0	6.4	7.3
II By Road	29.6	31.4	43.2	49.2	45.6
III Others	0.7	0.8	0.8	4.4	4.9
T o t a l	100.0	100.0	100.0	100.0	100.0

Comparing the share of import cargoes by point of entry in 1988 with the percentage of the population in the influential area from Dubai in Table A-4-3-4, the influential area interviewed by Weidleplan seems to be reasonable.

It is not possible to define the influential area after the establishment of a regional center in the Northern Part of Oman, because it is very difficult to predict the strength of influential center over the long term. Accordingly, we assumed that the influential area of a regional center will

be defined by the accessibility to respective districts, i.e., the distance from the regional center to respective districts.

If the new port is located in Sohar, the influential area from the new port and Mina Qaboos would be as follows, according to the distance from each center to respective districts:

- 1) The limit of the influential area along Route 01 from Sohar is up to Suweiq.
- 2) That along Route 21 from Sohar is up to Ibri.

In the case, the population in the influential area from Sohar is as shown in the following table.

Table A-4-3-6 Population of the Influential Area from Sohar

No.	Name of Willayat	Population	% of Total Population
4,5,6	Sohar, Saham, Suweiq	277,091	
8,9,11	Shinas, Khaburah, Liwa		
1-5	Ibry, Buraimi, Dhank, Yanqal, Bahla	135,586	
	Total	412,677		27.51%

- Note: 1) Population in the Influential Area from Mina Qaboos is 901,090.
- 2) % of Total Population in the Influential Area from Mina Qaboos is 60.07%.

If the new port is located in Barka, the influential area from the new port and Mina Qaboos is as follows:

- 1) The influential area from the new port only is Al-Batinah area and the Al-Dhahirah area.
- 2) The influential area from Mina Qaboos only is the Sharquiyah area.
- 3) The area of Dakhliyah is influenced by the new port and Mina Qaboos.
- 4) Some parts of MCT REG area also influenced by the new port.

If we suppose that 50% of Dakhliyah and 10% of MCT REG belong to the influential area of the new port, the populations in the influential areas from the new port and Mina Qaboos are as follows:

Table A-4-3-7 Population of the Influential Areas from Barka

No.	Area Name	Population	Popu. New Port	Popu. Mina Qaboos
4	Al-Batinah	436,476	436,476	
5	Al-Dhahirah	135,586	135,586	
3	Dakhliyah	190,263	95,132	95,131
1	MCT REG	333,354	33,335	300,019
7	Sharquiyah	218,088		218,088
	Total	1,313,767	700,529	613,238
	% of Total Population	87.58%	46.70%	40.88%

Note 1) Popu. New Port stands for the population in the influential area from the new port.

2) Popu. Mina Qaboos stands for the population in the influential area from Mina Qaboos.

Fig. A-4-3-3 shows the distance from Muscat, Sohar and Barka to the respective districts, and the boundary of respective influential areas of Muscat-Sohar Case and Muscat Haradi Case.

Accordingly, if the new port in Sohar were playing its role in import cargo handling, the population in the influential population from Sohar would be almost the same as the influential population from Dubai as defined in Table A-4-3-4, so the population in the influential area from Mina Qaboos is the same as the population without the new port.

If the new port in Barka were playing a role in import cargo handling, the population in the influential area from Mina Qaboos would decrease from 868,325 to 613,238.

The distance from the new port in Barka to the willayats in Al-Dhahirah is greater than that from Dubai, so Al-Dhahirah would be in the influential area from Dubai even if the new port in Barka were operating now.

(2) Future Geographical Population Distribution in the Hinterland

There is no clear projection of population distribution. But the total population of Oman was projected such that the increase rate p.a. will be 3.5% during the next decade.

Under the assumption that the increasing rate will continue up to 2010, the total population of Oman can be calculated as follows:

Population in 2010: $x = 1,500,000(1+0.035)^{22}$
 $= 3,197,267$

(Population in 2015 = 3,797,351)

The population in MCT REG was 53,000 in 1970, and increased to 123,000 in 1975, 241,000 in 1983 and 333,000 in 1988.

The rate of increase during these periods is as follows:

Table A-4-3-8 Population Rate Increase in MCT REG

Year	1970	1975	1983	1988	Units
Population	53,000	123,000	241,000	333,000	people
Rate to 1970	-	2.3208	4.5474	6.2830	times
Duration	-	5	13	18	years
Average Growth Rate	-	18.3	12.4	10.7	%
Rate to 1975	-		1.9593	2.7073	times
Duration	-		8	13	years
Average Growth Rate	-		8.8	8.0	%
Rate to 1983	-		-	1.3817	times
Duration	-		-	5	years
Average Growth Rate	-		-	6.7	%

If the population in MCT REG increases at the same rate during 1983 and 1988, the population in 2010 will be as follows:

$$x = 333,354 (1 + 0.067)^{22} = 1,388,427$$

In this case, the share of MCT REG will be 43.4%

The following table shows the population in MCT REG under various rates of increase.

Table A-4-3-9 Population Increase in MCT REG
According to Various Rates of Increase

I. Ratio	Population MCT	MCT Share %	Times/1988
6.5%	1,332,285	41.7%	3.9966
6.0	1,201,254	37.6	3.6035
5.5	1,082,579	33.9	3.2475
5.0	975,147	30.5	2.9253
4.5	877,938	27.5	2.6337
4.0	790,022	24.7	2.3699
3.5	710,548	22.2	2.1315
3.0	638,741	20.0	1.9161
2.5	573,893	17.0	1.7216
2.0	515,359	56.1	1.5460

As Fig. A-4-3-4 shows, the case in which the rate of increase of the population in MCT REG is 4% is the strong population concentration to MCT REG. In this case, the population in other region in the range of the objective area excluding MCT REG will be 2,011,245.

The case in which the increasing rate of the population in MCT REG is 3.0% represents weak population concentration in MCT REG. In this case, the population in other regions in the range of the objective area will be 2,162,526.

The case in which the increasing rate of the population in MCT REG is 3.5% represents medium concentration in MCT REG. In this case, the population in other regions in the range of the objective area will be 2,089,809.

We will assume the three following cases as population growth scenarios:

- Scenario A : Medium Concentration
- scenario B : Weak Concentration
- Scenario C : Strong Concentration

The population and the population increasing rate are summarized in the following table.

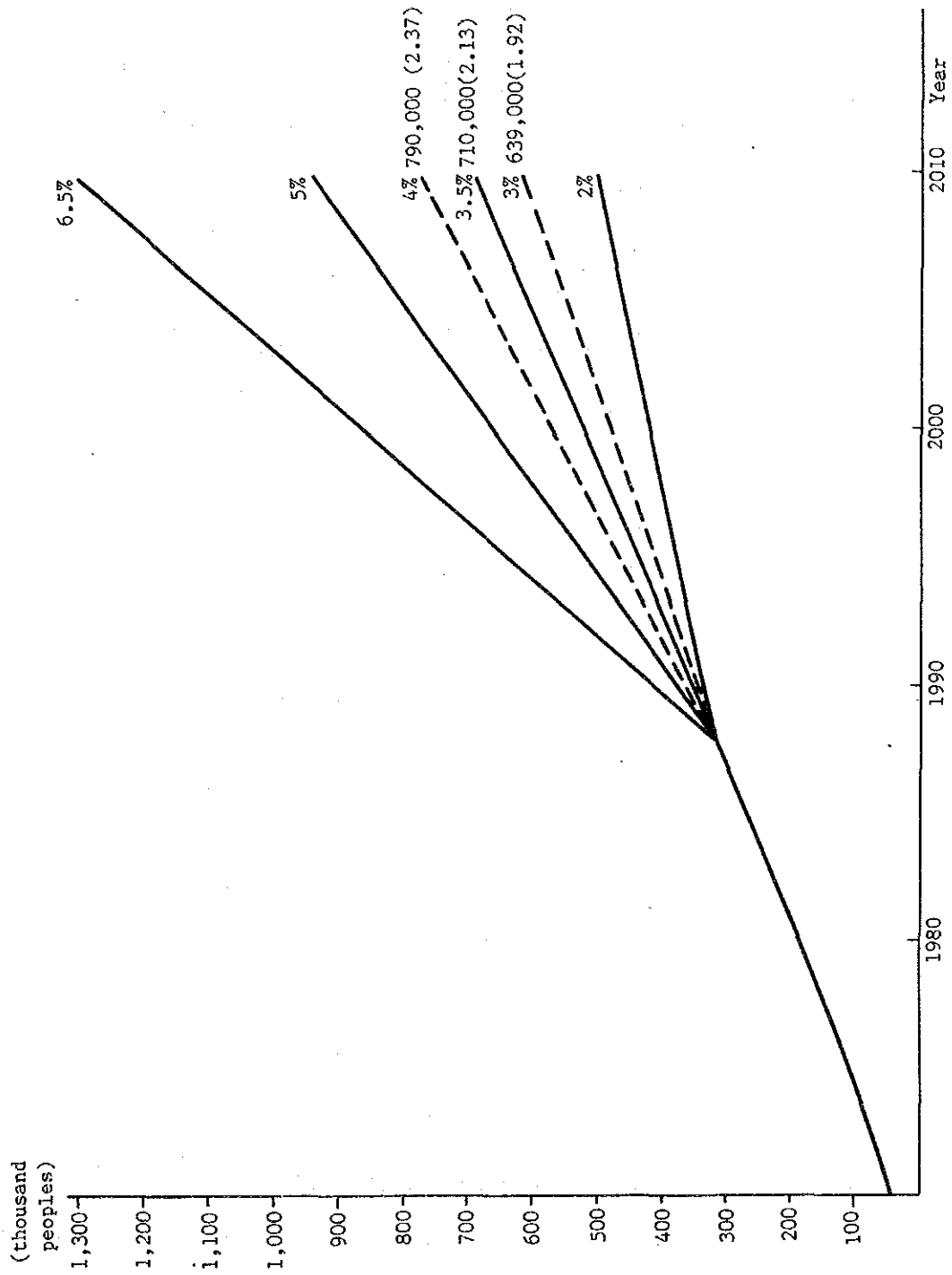


Fig. A-5-3-4 Population Increase in MCT REG According to Various Rates of Increase

Table A-4-3-10 Scenario of Population Growth Rate

No.	Case	Population in MCT REG	Inc. rate	Population in other REG	Inc. Rate	Note
1	Scenario A	710,548	3.5%	2,089,809	3.50%	Medium
2	Scenario B	638,741	3.0%	2,162,526	3.65%	Weak
3	Scenario C	790,022	4.0%	2,011,245	3.31%	Strong
	Present	333,354		980,435		

In the above table, we assumed also that the rate of population increase in Southern and Mussundam is 3.5%, so the population of Southern and Mussundam would be 348,000 and 51,000, respectively, in 2010.

In considering the future geographical population distribution, the use of the same population increase rate is not realistic. From Table A-4-3-1, we see that the population of the willayats varies from willayat to willayat.

The following table shows the numbers of willayats in various population ranges:

Table A-4-3-11 Distribution of Present Willayat Population

No.	Range of Population	No. of Willayat
1	0 -- 10,000	6
2	-- 20,000	12
3	-- 30,000	2
4	-- 40,000	7
5	-- 50,000	5
6	-- 60,000	1
7	-- 70,000	2
8	-- 80,000	1
9	80,000 --	0
	Total	36

The average population increase rate should not be used for all willayats equally, because willayats with rather bigger populations have more growth potential than other willayats.

The difference between the population increasing rates of respective willayats is not clear. So we assumed that the difference between a range

1 willayat and range 8 willayat would be 2% and 1% by taking into consideration various population increase reports.

By introducing the above assumption, the population increasing rate in each population range is obtained as follows:

Table A-4-3-12 Population Increase Rate in Each Case

No.	Range of Population	Scenario A	Scenario B	Scenario C
1	0 - 10,000	2.50(3.00)	2.65(3.15)	2.31(2.81)
2	- 20,000	2.79(3.14)	2.94(3.29)	2.60(2.95)
3	- 30,000	3.07(3.29)	3.22(3.44)	2.88(3.10)
4	- 40,000	3.36(3.43)	3.51(3.58)	3.17(3.24)
5	- 50,000	3.64(3.57)	3.79(3.72)	3.45(3.38)
6	- 60,000	3.93(3.71)	4.08(3.86)	3.74(3.52)
7	- 70,000	4.21(3.86)	4.36(4.01)	4.02(3.67)
8	- 80,000	4.50(4.00)	4.65(4.15)	4.31(3.81)
	Mean	3.5%	3.65%	3.31%

(3) Potential Evaluation of Import Cargoes

Most import cargoes in Oman are consumer's goods. They are transported to where people live, though they are tentatively transported to traders' offices. The traders' intention to trade import goods also minimizes the cost of trade, so unnecessary transportation will be reduced. After formulating well-developed regional centers, the distribution centers would be established in the vicinity of the regional centers. Import cargoes must be handled in a port area because of the sea route. If the well-developed port functions, the traders would like to locate their distribution centers in the vicinity of the new port area. Therefore the product of the distance from the new port to the consumer's residences multiplied by the population of respective willayats shall represent the negative locational potential regarding import goods from the view-point of the national economy.

We will call this criterion the negative locational potential. Then the definition of the negative locational potential regarding import goods when two ports will be in operation is as follows:

$$C = \sum P_i * D_{1i} + \sum P_i * D_{2i}$$

where C : Negative locational potential

P_i: Population of region "i"

D_{1i}: Distance from Mina Qaboos to region "i"

D_{2i}: Distance from a new port to region "i"

The negative locational potential represents the total transportation cost of import consumer goods from two ports, namely Mina Qaboos and the new port, to the respective final consumption places.

The following tables show the calculated results in various cases:

Table A-4-3-13 Calculation Results
Scenario A (2%)

Population and Distance		A-Rev.	A-M*Dis	A-S*Dis	A-M*Dis	A-B*Dis
No.	Name					
1	Rustaq	108081	17184.893	0	0	9186.8925
2	Nakhal	40177	4379.3134	0	0	1406.2015
3	Al Awabi	10806	1577.6526	0	0	778.02046
4	Sohar	168571	0	0	0	26297.077
5	Saham	120445	0	4215.5727	0	15778.286
6	Suweiq	155793	0	16514.089	0	9659.1844
7	Barka	100397	8433.381	0	0	0
8	Shinas	75275	0	4667.0327	0	15807.691
9	Khaburah	80716	0	5085.0952	0	7829.4324
10	Msanaa	74772	8374.4916	0	0	2841.3454
11	Liwa	30723	0	1044.5749	0	5591.5478
AlBatinah Sub-total		965756	0	0	0	0
1	Ibry	187882	0	37200.567	0	43588.543
2	Buraimi	61774	0	7474.5995	0	16617.085
3	Dhank	27189	0	6389.3887	0	7939.1553
4	Yanqal	21790	0	4706.6341	0	5447.4931
5	Mhadha	11139	0	1113.8616	0	2762.3767
AlDhahirah Sub-total		309773	0	0	0	0
1	Nizuwa	102652	17861.524	0	8930.7621	9546.6767
2	Bahla	67198	13977.23	0	6988.6148	7391.8041
3	Samail	68790	6328.655	0	3164.3275	3577.0659
4	Izki	44224	6102.9145	0	3051.4572	3316.8013
5	Bidbid	30065	2134.6437	0	1067.3218	1307.8451
6	Adam	20731	4623.0698	0	2311.5349	2435.9224
7	AlHmra	21354	4719.2642	0	2359.6321	2487.7569
8	Mamh	15932	2660.694	0	1330.347	1425.9408
9	Haima	8179	4425.092	0	2212.546	2261.6228
Dakhliyah Sub-total		379127	0	0	0	0
1	AlModhaili	97230	17209.766	0	17209.766	0
2	Ibra	29918	5325.4591	0	5325.4591	0
3	AlQabil	18848	3826.1605	0	3826.1605	0
4	Bidiya	24018	6244.7276	0	6244.7276	0
5	AlKamil	24636	6897.9727	0	6897.9727	0
6	BaniBuHass	31756	9590.3373	0	9590.3373	0
7	BaniBuAli	70028	21568.772	0	21568.772	0
8	Sur	97890	32988.88	0	32988.88	0
9	W.BaniKali	9541	2700.1851	0	2700.1851	0
10	Dihal	21385	3956.2266	0	3956.2266	0
11	Mahirah	9901	1831.7537	0	1831.7537	0
Sharquiyah Sub-total		435153	0	0	0	0
Grand Total		2089809	214923.06	88411.416	143556.78	205281.77
C.P.Area		710548				5968.60
Mussandam		50783				
Southern		346179				
Oman All		3197319				
Comparison				303334.48		348838.55
						354807.15

Negative locational potential = 354,807,150 man•km

Table A-4-3-14 Calculation Results
Scenario B (2%)

Population and Distance						
No.	Name	B-Rev.	B-M*Dis	B-S*Dis	B-M*Dis	B-B*Dis
1	Rustaq	111792	17775.001	0	0	9502.3593
2	Nakhal	41564	4530.4902	0	0	1454.7446
3	Al Awabi	11181	1632.4044	0	0	805.02135
4	Sohar	174329	0	0	0	27195.357
5	Saham	124570	0	4359.9435	0	16318.646
6	Suweiq	161115	0	17078.193	0	9989.1317
7	Barka	103845	8722.973	0	0	0
8	Shinas	77866	0	4827.7087	0	16351.917
9	Khaburah	83495	0	5260.1643	0	8098.9831
10	Msanaa	77346	8662.8076	0	0	2939.1669
11	Liwa	31786	0	1080.7284	0	5785.0755
AlBatinah Sub-total		998890	0	0	0	0
1	Ibry	194282	0	38467.922	0	45073.525
2	Buraimi	63900	0	7731.9341	0	17189.176
3	Dhank	28130	0	6610.5304	0	8213.9356
4	Yanqal	22544	0	4869.5343	0	5636.035
5	Mhadha	11525	0	1152.5177	0	2858.2439
AlDhahirah Sub-total		320382	0	0	0	0
1	Nizuwa	106177	18474.867	0	9237.4336	9874.498
2	Bahla	69512	14458.436	0	7229.2179	7646.2882
3	Samail	71158	6546.5372	0	3273.2686	3700.2167
4	Izki	45751	6313.5912	0	3156.7956	3431.2995
5	Bidbid	31106	2208.5254	0	1104.2627	1353.1106
6	Adam	21449	4783.0778	0	2391.5389	2520.2316
7	AlHmra	22093	4882.6016	0	2441.3008	2573.8601
8	Mamh	16485	2753.0323	0	1376.5162	1475.4275
9	Haima	8463	4578.6631	0	2289.3316	2340.1116
Dakhliyah Sub-total		392194	0	0	0	0
1	AlModhaili	100569	17800.729	0	17800.729	0
2	Ibra	30954	5509.7773	0	5509.7773	0
3	AlQabil	19500	3958.5868	0	3958.5868	0
4	Bidiya	24849	6460.8624	0	6460.8624	0
5	AlKamil	25488	7136.7169	0	7136.7169	0
6	BaniBuHass	32855	9922.2662	0	9922.2662	0
7	BaniBuAli	72439	22311.339	0	22311.339	0
8	Sur	101251	34121.678	0	34121.678	0
9	W. BaniKali	9872	2793.894	0	2793.894	0
10	Dihal	22125	4093.1546	0	4093.1546	0
11	Mahirah	10245	1895.324	0	1895.324	0
Sharquiyah Sub-total		450150	0	0	0	0
Grand Total		2161616	222327.34	91439.176	148503.99	212326.36
C.P.Area		638741	0	0	0	5365.42
Mussandam		50783	0	0	0	0
Southern		346179	0	0	0	0
Oman All		3197319	0	0	0	0
Comparison		0	0	313766.51	0	360830.35
						366195.77

Negative locational potential = 366,195,771 man•km

Table A-4-3-15 Calculation Results
Scenario C (2%)

Population and Distance						
No.	Name	C-Rev.	C-M*Dis	C-S*Dis	C-M*Dis	C-B*Dis
1	Rustaq	103974	16531807	0	0	8837759
2	Nakhal	38642	4211943	0	0	1352459
3	Al Awabi	10391	1517014	0	0	748117
4	Sohar	162201	0	0	0	25303288
5	Saham	115881	0	4055823	0	15180368
6	Suweiq	149906	0	15890008	0	9294156
7	Barka	96582	8112883	0	0	0
8	Shinas	72406	0	4489178	0	15205279
9	Khaburah	77640	0	4891308	0	7531062
10	Msanaa	71923	8055350	0	0	2733065
11	Liwa	29545	0	1004542	0	5377252
AlBatinah Sub-total		929089	0	0	0	0
1	Ibry	180802	0	35798717	0	41945972
2	Buraimi	59419	0	7189752	0	15983828
3	Dhank	26147	0	6144516	0	7634888
4	Yanqal	20955	0	4526253	0	5238719
5	Mhadha	10710	0	1071050	0	2656203
AlDhahirah Sub-total		298033	0	0	0	0
1	Nizuwa	98751	17182724	0	8591362	9183870
2	Bahla	64637	13444574	0	6722287	7110111
3	Samail	66168	6087478	0	3043739	3440748
4	Izki	42534	5869671	0	2934835	3190038
5	Bidbid	28913	2052834	0	1026417	1257722
6	Adam	19937	4445891	0	2222946	2342566
7	AlHmra	20536	4538399	0	2269200	2392414
8	Mamh	15320	2558428	0	1279214	1371134
9	Haima	7865	4255010	0	2127505	2174696
Dakhliyah Sub-total		364661	0	0	0	0
1	AlModhaili	93535	16555735	0	16555735	0
2	Ibra	28772	5121362	0	5121362	0
3	AlQabil	18126	3679523	0	3679523	0
4	Bidiya	23098	6005399	0	6005399	0
5	AlKamil	23691	6633609	0	6633609	0
6	BaniBuHass	30539	9222789	0	9222789	0
7	BaniBuAli	67360	20746812	0	20746812	0
8	Sur	94170	31735187	0	31735187	0
9	W.BaniKali	9175	2596402	0	2596402	0
10	Dihal	20565	3804605	0	3804605	0
11	Mahirah	9521	1761349	0	1761349	0
Sharquiyah Sub-total		418551	0	0	0	0
Grand Total		2010335	206726778	85061146	138080276	197485713
C.P.Area		790022	0	0	0	6636200
Mussandam		50783	0	0	0	0
Southern		346179	0	0	0	0
Oman All		3197318	0	0	0	0
Comparison		0	0	291787924	0	335565989
						342202189

Negative locational potential = 342,202,189 man·km

Table A-4-3-16 Calculation Results
Scenario A (1%)

No.	Name	AI	M*Dis	S*Dis	M*Dis	B*Dis
1	Rustaq	107158.34	17038176	0	0	0 9108458.7
2	Nakhal	42311.896	4611996.7	0	0	0 1480916.4
3	Al Awabi	12099.079	1766465.5	0	0	0 871133.68
4	Sohar	157389.67	0	0	0	0 24552789
5	Saham	115754.21	0	4051397.3	0	0 15163801
6	Suweiq	145459.51	0	15418708	0	0 9018489.3
7	Barka	99540.242	8361380.3	0	0	0 0
8	Shinas	76839.689	0	4764060.7	0	0 16136335
9	Khaburah	82393.886	0	5190814.8	0	0 7992206.9
10	Msanaa	76326.768	8548598.1	0	0	0 2900417.2
11	Liwa	33327.516	0	1133135.5	0	0 6065607.9
AlBatinah Sub-total		948600.8	0	0	0	0 0
1	Ibry	170082.38	0	33676311	0	0 39459112
2	Buraimi	63057.827	0	7629997.1	0	0 16962556
3	Dhank	29494.004	0	6931091	0	0 8612249.3
4	Yanqal	23637.36	0	5105669.8	0	0 5909340.1
5	Mhadha	12471.682	0	1247168.2	0	0 3092977.1
AlDhahirah Sub-total		298743.25	0	0	0	0 0
1	Nizuwa	101776.03	17709030	0	8854515	9465171.2
2	Bahla	68595.276	14267817	0	7133908.7	7545480.3
3	Samail	70219.873	6460228.3	0	3230114.2	3651433.4
4	Izki	46573.745	6427176.9	0	3213588.4	3493030.9
5	Bidbid	32614.396	2315622.1	0	1157811.1	1418726.2
6	Adam	22488.883	5015020.9	0	2507510.4	2642443.7
7	AlHmra	23164.574	5119370.8	0	2559685.4	2698672.8
8	Mamh	17839.072	2979124.9	0	1489562.5	1596596.9
9	Haima	9158.3837	4954685.6	0	2477342.8	2532293.1
Dakhliyah Sub-total		392430.24	0	0	0	0 0
1	AlModhaili	96400.205	17062836	0	17062836	0
2	Ibra	32454.831	5776959.8	0	5776959.8	0
3	AlQabil	20446.051	4150548.3	0	4150548.3	0
4	Bidiya	26054.482	6774165.3	0	6774165.3	0
5	AlKamil	26724.263	7482793.6	0	7482793.6	0
6	BaniBuHass	34448.414	10403421	0	10403421	0
7	BaniBuAli	71484.379	22017189	0	22017189	0
8	Sur	97054.11	32707235	0	32707235	0
9	W.BaniKali	10683.189	3023342.4	0	3023342.4	0
10	Dihal	23198.063	4291641.6	0	4291641.6	0
11	Mahirah	11086.364	2050977.3	0	2050977.3	0
Sharquiyah Sub-total		450034.35	0	0	0	0 0
Grand Total		2089808.6	221315803	85148353	148365148	202370237
C.P.Area		710547.91	0	0	0	0 5968602.4
Mussandam		50783.263	0	0	0	0 0
Southern		346178.79	0	0	0	0 0
Oman All		3197318.6	0	0	0	0 0
Comparison		0	0	306464156	0	0 350735385
		0	0	0	0	0 356703988

Negative locational potential = 356,703,988 man·km

Table A-4-3-17 Calculation Results
Scenario B (1%)

No.	Name	Bl-Rev.	M*Dis	S*Dis	M*Dis	B*Dis
1	Rustaq	110838	17623	0	0	9421
2	Nakhal	43778	4772	0	0	1532
3	Al Awabi	12517	1827	0	0	901
4	Sohar	162779	0	0	0	25394
5	Saham	119723	0	4190	0	15684
6	Suweiq	150441	0	15947	0	9327
7	Barka	102958	8648	0	0	0
8	Shinas	79481	0	4928	0	16691
9	Khaburah	85227	0	5369	0	8267
10	Msanaa	78951	8843	0	0	3000
11	Liwa	34476	0	1172	0	6275
AlBatinah Sub-total		0	0	0	0	0
1	Ibry	175899	0	34828	0	40809
2	Buraimi	65226	0	7892	0	17546
3	Dhank	30511	0	7170	0	8909
4	Yanqal	24452	0	5282	0	6113
5	Mhadha	12902	0	1290	0	3200
AlDhahirah Sub-total		0	0	0	0	0
1	Nizuwa	105271	18317	0	9159	9790
2	Bahla	70954	14758	0	7379	7805
3	Samail	72634	6682	0	3341	3777
4	Izki	48187	6650	0	3325	3614
5	Bidbid	33739	2395	0	1198	1468
6	Adam	23264	5188	0	2594	2734
7	AlHmra	23963	5296	0	2648	2792
8	Mamh	18455	3082	0	1541	1652
9	Haima	9475	5126	0	2563	2620
Dakhliyah Sub-total		0	0	0	0	0
1	AlModhaili	99710	17649	0	17649	0
2	Ibra	33574	5976	0	5976	0
3	AlQabil	21151	4294	0	4294	0
4	Bidiya	26953	7008	0	7008	0
5	AlKamil	27645	7741	0	7741	0
6	BaniBuHass	35636	10762	0	10762	0
7	BaniBuAli	73942	22774	0	22774	0
8	Sur	100386	33830	0	33830	0
9	W.BaniKali	11052	3128	0	3128	0
10	Dihal	23998	4440	0	4440	0
11	Mahirah	11469	2122	0	2122	0
Sharquiyah Sub-total		0	0	0	0	0
Grand Total		2161616	228930	88069	153470	209319
C.P.Area		638741	0	0	0	5365
Mussandam		50783	0	0	0	0
Southern		346179				
Oman All Comparison		3197319		316999		362788
						368154

Negative locational potential = 368,154,000 man•km

Table A-4-3-18 Calculation Results
Scenario C (1%)

No.	Name	CIRev.	M*Dis	S*Dis	M*Dis	B*Dis
1	Rustaq	103084	16390.401	0	0	8762.1642
2	Nakhal	40707	4437.102	0	0	1424.7575
3	Al Awabi	11636	1698.9251	0	0	837.82609
4	Sohar	151423	0	0	0	23621.943
5	Saham	111360	0	3897.5843	0	14588.101
6	Suweiq	139945	0	14834.154	0	8676.5804
7	Barka	95756	8043.489	0	0	0
8	Shinas	73914	0	4582.68	0	15521.98
9	Khaburah	79257	0	4993.1864	0	7687.9219
10	Msanaa	73421	8223.1297	0	0	2789.9904
11	Liwa	32055	0	1089.8717	0	5834.0193
AlBatinah Sub-total		0	0	0	0	0
1	Ibry	163643	0	32401.37	0	37965.241
2	Buraimi	60657	0	7339.5023	0	16316.745
3	Dhank	28368	0	6666.4578	0	8283.4284
4	Yanqal	22735	0	4910.7323	0	5683.7179
5	Mhadha	11995	0	1199.483	0	2974.7178
AlDhahirah Sub-total		0	0	0	0	0
1	Nizuwa	97907	17035.75	0	8517.8752	9105.3148
2	Bahla	65984	13724.603	0	6862.3014	7258.2034
3	Samail	67546	6214.2699	0	3107.1349	3512.4134
4	Izki	44808	6183.4475	0	3091.7237	3360.5693
5	Bidbid	31369	2227.2103	0	1113.6051	1364.5584
6	Adam	21630	4823.5444	0	2411.7722	2541.5536
7	AlHmra	22280	4923.9101	0	2461.9551	2595.6359
8	Mamh	17157	2865.2188	0	1432.6094	1535.5514
9	Haima	8808	4765.2443	0	2382.6222	2435.4715
Dakhliyah Sub-total		0	0	0	0	0
1	AlModhaili	92735	16414.124	0	16414.124	0
2	Ibra	31216	5556.392	0	5556.392	0
3	AlQabil	19665	3992.0779	0	3992.0779	0
4	Bidiya	25060	6515.5236	0	6515.5236	0
5	AlKamil	25704	7197.096	0	7197.096	0
6	BaniBuHass	33133	10006.212	0	10006.212	0
7	BaniBuAli	68763	21178.935	0	21178.935	0
8	Sur	93364	31463.739	0	31463.739	0
9	W.BaniKali	10275	2907.7456	0	2907.7456	0
10	Dihal	22312	4127.7842	0	4127.7842	0
11	Mahirah	10662	1972.5587	0	1972.5587	0
Sharquiyah Sub-total		0	0	0	0	0
Grand Total		2010335	212888.43	81915.021	142713.79	194678.41
C.P.Area		790022	0	0	0	6636.184
Mussandam		50783	0	0	0	0
Southern		346179	0	0	0	0
Oman All		3197319	0	0	0	0
Comparison		0	0	294803.45	0	337392.19
		0	0	0	0	344028.38

Negative locational potential = 344,028,380 man*km

The comparison is listed in the following table.

Table A-4-3-19 Comparison of Various Cases

(Unit: 1,000 man·km)

Other Region's Growth Range	2%		1%	
	Qaboos/Sohar	Qaboos/Haradi	Qaboos/Sohar	Qaboos/Haradi
Scenario A	303,334	354,808	306,464	356,704
Scenario B	313,767	366,196	316,999	368,154
Scenario C	291,788	342,202	294,803	344,028

In every case, a new port in Sohar is more economical than a port in Haradi.

Appendix 4-3-3 Transshipment Cargo Function

(1) General

Presently, transshipment cargoes are handled mainly by CMA (Compagnie Maritime & Affretement) in Mina Qaboos. Also, ports in the UAE are now handling transshipment cargoes, as shown in the following tables.

Table A-4-3-20 Transshipment Cargoes in Mina Qaboos and Ports in the UAE

	(Unit: thousand tonnes/TEUs)			
	1986	1987	1988	1989
Mina Qaboos (TEU)	28	77	80	
(FRT)	287	713	604	
Port Rashid (FRT)	1,840	*2,453	**2,643	** 3,069
(Dubai)(TEU)	146	72	70	**** 66
Jebel Ali Port (FRT)	****1,332	665	505	**** 478
Port of Fujairah(TEU)	64	73	75	** 89
Port Khor Fakan (TEU)	NA	NA	NA	30

* January/November

** January/October

*** Includes Restowed Containers

**** January/May

From the above table, Port Rashid (Dubai) has an overwhelming share of transshipment cargoes and many major shipping lines use Port Rashid as a transshipment base. But Oman has a geographically locational advantage over all other Gulf countries as a transshipment base. Accordingly, in this section, we intend to analyze the potential of a new port as a transshipment port as follows:

- 1) From the view-point of the possibility of allocating the new port to the present users in Mina Qaboos.
- 2) From the view-point of the relationship between mother vessels and feeder vessels.

(2) Analysis from the View-Point of the Possibility to Allocate the New Port to the Present Users in Mina Qaboos.

At present, the CMA is operating container services on the following trade routes with regard to Mideast Trade:

- 1) Europe - Mideast - Far East Service
- 2) Mideast Feeder Service
- 3) Far East - Mideast - Indian Subcontinent Service.

The first service is operated by the following 8 vessels:

1. Ville de Mercure 1,600 TEUs Full C 17.2 knots Built 1986
2. Ville de Pluton 1,600 TEUs Full C 17.2 knots Built 1987
3. Ville de Saturn 1,600 TEUs Full C 17.2 knots Built 1987
4. Ville de Jupiter 1,600 TEUs Full C 17.2 knots Built 1986
5. Ville de Neptune 1,800 TEUs Full C 17.2 knots Built 1988
6. Ville de Mars 1,800 TEUs Full C 17.2 knots Built 1988
7. Ville de Venus 1,800 TEUs Full C 17.2 knots Built 1988
8. Ville de Vega 1,950 TEUs Full C 18.0 knots Built 1984

The service frequency at present is once per every 10 days, as shown in the following timetable:

Table A-4-3-21 Time Table of CMA

VESSEL		BAR	LEH	ROY	HAM	FLX	ANT	MRS	NAP	JED	MNQ	DXB	AUH	BAH	KWT	DAM
JUPITER	9114	24.10	28.10	29.10	31.10	02.11	03.11	09.11	11.11	17.11	23.11	27.11	28.11	29.11	30.11	01.12
VEGA	9214	04.11	08.11	09.11	11.11	13.11	14.11	20.11	22.11	28.11	04.12	08.12	09.12	10.12	11.12	12.12
MERCURE	9414	15.11	19.11	20.11	22.11	24.11	25.11	01.12	03.12	09.12	15.12	19.12	20.12	21.12	22.12	23.12
NEPTUNE	9514	25.11	29.11	30.11	02.12	04.12	05.12	11.12	13.12	19.12	25.12	29.12	30.12	31.12	01.01	02.01
PLUTON	9614	05.12	09.12	10.12	12.12	14.12	15.12	21.12	23.12	29.12	04.01	08.01	09.01	10.01	11.01	12.01
SATURNE	9714	15.12	19.12	20.12	22.12	24.12	25.12	31.12	02.01	08.01	14.01	18.01	19.01	20.01	21.01	22.01
MARS	9814	25.12	29.12	30.12	01.01	03.01	04.01	10.01	12.01	18.01	24.01	28.01	29.01	30.01	31.01	01.02
VENUS	9914	04.01	08.01	09.01	11.01	13.01	14.01	20.01	22.01	28.01	03.02	07.02	08.02	09.02	10.02	11.02

VESSEL			AUH	BAH	KWT	DAM	DXB	MNQ Local	MNQ T/S	SIN	HKG	KEE	YOK	KOB	PUS	KAO
VEGA	9214		18.11	19.11	20.11	21.11	22.11	24.11	04.12	14.12	18.12	20.12	24.12	25.12	27.12	01.01
MERCURE	9414		28.11	29.11	30.11	01.12	02.12	05.12	15.12	25.12	29.12	31.12	04.01	05.01	07.01	12.01
NEPTUNE	9514		09.12	10.12	11.12	12.12	13.12	16.12	25.12	04.01	08.01	10.01	14.01	15.01	17.01	22.01
PLUTON	9614		20.12	21.12	22.12	23.12	24.12	26.12	04.01	14.01	18.01	20.01	24.01	25.01	27.01	01.02
SATURNE	9714		30.12	31.12	01.01	02.01	03.01	05.01	14.01	24.01	28.01	30.01	03.02	04.02	06.02	11.02
MARS	9814		09.01	10.01	11.01	12.01	13.01	15.01	24.01	03.02	07.02	09.02	13.02	14.02	16.02	21.02
VENUS	9914		19.01	20.01	21.01	22.01	23.01	25.01	03.02	13.02	17.02	19.02	23.02	24.02	26.02	03.03
JUPITER	9115		29.01	30.01	31.01	01.02	02.02	04.02	13.02	23.02	27.02	01.03	05.03	06.03	08.03	13.03

VESSEL		YOK	KOB	PUS	KEE	KAO	HKG	SIN	COL	DXB	MNQ	AUH	BAH	KWT	DAM	
PLUTON	9613	01.11	02.11	04.11	07.11	09.11	10.11	15.11	19.11	25.11	26.11	28.11	29.11	30.11	01.12	
SATURNE	9713	11.11	12.11	14.11	17.11	19.11	20.11	25.11	29.11	05.12	07.12	09.12	10.12	11.12	12.12	
MARS	9813	22.11	23.11	25.11	28.11	30.11	01.12	06.12	10.12	16.12	18.12	20.12	21.12	22.12	23.12	
VENUS	9913	03.12	04.12	06.12	09.12	11.12	12.12	17.12	21.12	27.12	28.12	30.12	31.12	01.01	02.01	
JUPITER	9114	13.12	14.12	16.12	19.12	21.12	22.12	27.12	31.12	06.01	07.01	09.01	10.01	11.01	12.01	
VEGA	9214	24.12	25.12	27.12	30.12	01.01	02.01	07.01	11.01	17.01	18.01	19.01	20.01	21.01	22.01	
MERCURE	9414	04.01	05.01	07.01	10.01	12.01	13.01	18.01	22.01	28.01	29.01	29.01	30.01	31.01	01.02	
NEPTUNE	9514	14.01	15.01	17.01	20.01	22.01	23.01	28.01	01.02	07.02	08.02	08.02	09.02	10.02	11.02	

The routes of the vessels are as follows, as shown in the above tables.

Barcelona - Le Havre - Rotterdam - Hamburg - Felixstowe - Antwerp
 - Marseilles - Naples - Jeddah - Mina Qaboos - Singapore - Hong Kong -
 Keelung - Yokohama - Kobe - Pusan - Kaohsiung - Hong Kong - Singapore -
 Colombo - Dubai - Mina Qaboos - to Europe

In order to provide the service at intervals of every 10 days by using 8 vessels, the period for round trips shall be as follows, as shown in Fig.

A-4-3-5:

$$P \text{ (for round trips)} = 8 \times 10 \text{ days} = 80 \text{ days}$$

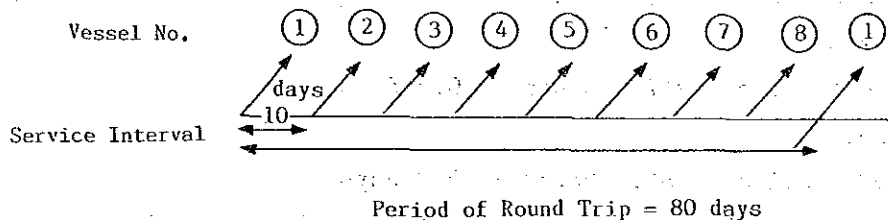


Fig. A-4-3-5 Relationship between Regular Service Interval and Period of Round Trip and Number of Fleet.

From the above schedule, the Vega started from Mina Qaboos on 04/12 on 9214 voyage to the Far East. The Vega arrived in Yokohama and started on 24/12. It took 20 days to travel from Mina Qaboos to Yokohama. It again arrived in Mina Qaboos and started on 18/01. It took 25 days to travel from Yokohama to Mina Qaboos. Accordingly, 45 days are allocated for the Far East trip.

Based on the relationship between regular service interval and period of round trips and number of fleets, the period for the Europe trips shall be 35 days. On the other hand, the Vega started from Barcelona on 04/11. Then, 30 days are used for the trip from Barcelona to Mina Qaboos. Is it possible to travel within 5 days from Mina Qaboos to Barcelona? The distance from Mina Qaboos to Port Said is 2,629 N Miles and that from Port Said to Barcelona is 1,629 N Miles. The distance from Mina Qaboos to Barcelona is 4,258 N Miles. The necessary period for travelling this distance can be calculated as follows:

(1) At 17.2 knots

4,258 N Miles = 247.6 hours = 10.3 days

(2) At 23 knots

4,258 N Miles = 185.1 hours = 7.7 days

Therefore, it is not possible to make a round trip to Europe within 35 days based on the following schedule:

Barcelona	)4 days
Le Harve	)1
Rotterdam	)2
Hamburg	)2
Felixstowe	)1
Antwerp	)6
Marseille	)2
Naples	)6
Jedda	)6
Mina Qaboos	)6
Total	30 days

In this case, one more vessel is necessary for continuing the present service. So the service shall be as shown in Fig. A-4-3-6.

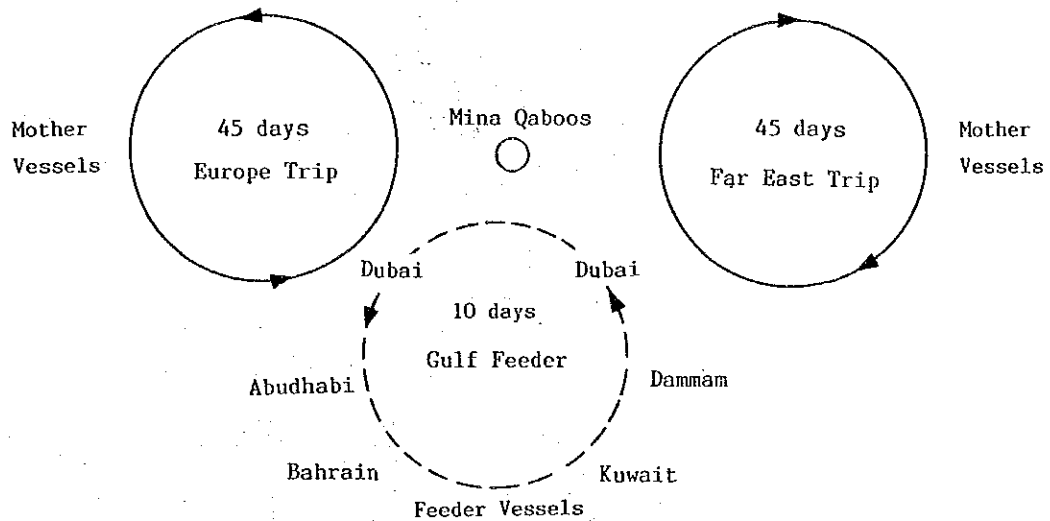


Fig. A-4-3-6 Transshipment Pattern

The CMA now takes an irregular route for the return trip from the Far East. Mother vessels first come to Dubai and then to Mina Qaboos because of the draft restriction in Mina Qaboos. Fig. A-4-3-7 shows the pattern of Gulf Trade.

Presently, mother vessels come from Jeddah to Mina Qaboos and are bound for Singapore. From the above timetable, the following schedules are fixed:

Jeddah - Mina Qaboos 6 days
 Mina Qaboos - Singapore 10 days

The distances between Jeddah, Mina Qaboos and Singapore are as follows:

Jeddah - Mina Qaboos 1,941 N Miles
 Mina Qaboos - Singapore 3,168 N Miles

The necessary voyage time based on the speed of 17.2 knots shall be as follows:

Jeddah - Mina Qaboos 112.8 hours = 4.7 days
 Mina Qaboos - Singapore 184.2 hours = 7.7 days

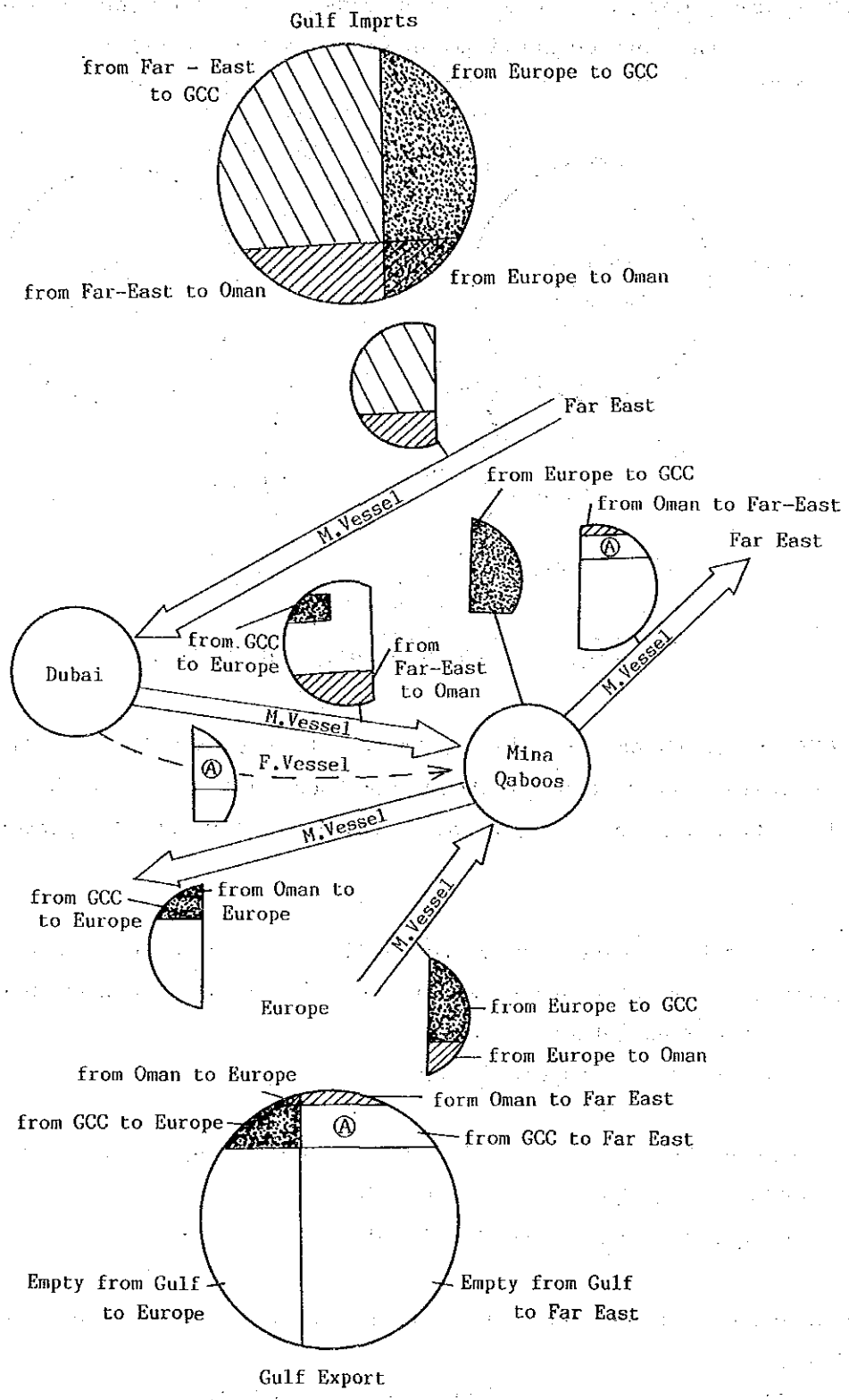


Fig. A-4-3-7 Pattern of Gulf Trade

By using the speed of 15.0 knots, the required times are as follows:

Jeddah - Mina Qaboos 129.4 hours = 5.4 days

Mina Qaboos - Singapore 211.2 hours = 8.8 days

If the new port is located in Majis, mother vessels would have to travel into the Gulf 240 km (130 N Miles) more.

If the new port is located in Haradi, mother vessels would have to travel into the Gulf 75 km (40.5 N Miles) more.

The additional required voyage times are as follows:

17.2 knots 15 knots

Majis 15.1 hours = 0.63 days 17.3 hours = 0.72 days

Haradi 4.7 hours = 0.20 days 5.4 hours = 0.23 days

The required voyage times in case of using new ports as a Hub port instead of Mina Qaboos are as follows:

Majis as a New Port

17.2 knots 15 knots

Jeddah - Majis 120.4 hours = 5.0 days 138.1 hours = 5.8 days

Majis - Singapore 191.8 hours = 8.0 days 220.0 hours = 9.2 days

Haradi as a New Port

17.2 knots 15 knots

Jeddah - Haradi 115.2 hours = 4.8 days 132.1 hours = 5.5 days

Haradi - Singapore 186.6 hours = 7.8 days 213.9 hours = 8.9 days

Comparing the above required times with the fixed schedule, the required voyage time in each new port does not seem to be so great a restriction. The following required time is calculated under the assumption of Dubai Hub Port instead of Mina Qaboos.

17.2 knots 15 knots

Jeddah - Dubai 130.9 hours = 5.5 days 150.1 hours = 6.3 days

Dubai - Singapore 202.3 hours = 8.4 days 231.9 hours = 9.7 days

Comparing this required times with that at a new port in Batinah coast, the

difference of required voyage times is about 1 day. Therefore, if it is possible to give incentives to shipping lines by introducing various strategies, there would be surely good potentials for transshipment in the new ports on the Batinah coast.

(3) Analysis from the Viewpoint of the Relationship between Mother Vessels and Feeder Vessels

A. General

At present, Dubai plays the role of a major hub port in the Gulf region. As analyzed above, Mina Qaboos also plays the role of a major hub port and has a geographically advantageous location for a hub port. In order to analyze the potential of transshipment in a new port, the cost comparison of mother vessels with feeder vessels will be treated by using a mathematical model in this section. To simplify the model, the following three trade patterns will be assumed:

- 1) Mina Qaboos and Dubai are both hub ports (Hub Hub Case)
- 2) Mina Qaboos is a hub port and Dubai is a feeder port (Mina Qaboos Hub Case)
- 3) Dubai is a hub port and Mina Qaboos is a feeder port (Dubai Hub Case)

The conceptual drawing is shown in Fig. A-4-3-8.

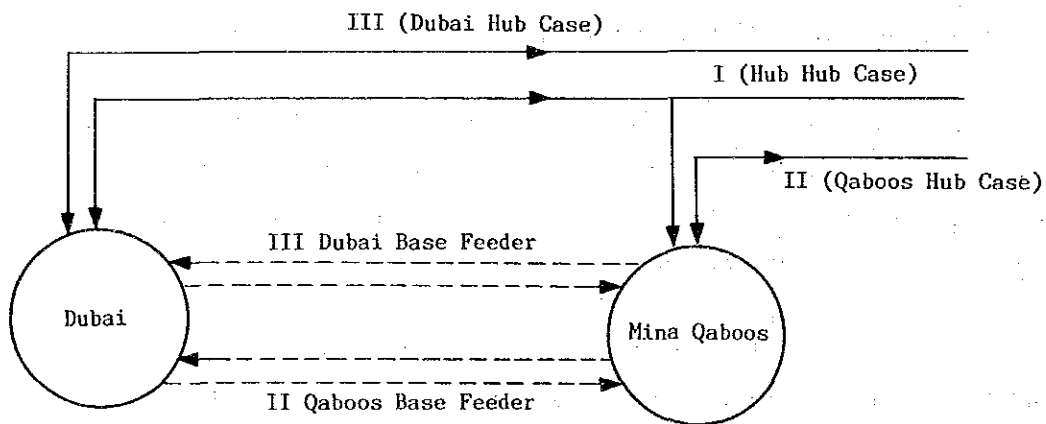


Fig. A-4-3-8 Conceptual Drawing for Examination

In comparing the costs of respective cases, costs common to all cases will be excluded. For example, the mother vessel cost up to the entrance of Mina Qaboos will be excluded. Also the cargo handling cost will be excluded, except for the special additional cost for transshipment.

B. Premises

The premises for the model are as follows:

	1) Mother vessels	2) Feeder vessels
a) Vessel type	1,900 TEU-type	600 TEU-Type
	33,000 DWT	13,000 DWT
	30,000 GRT	10,000 GRT
b) Charterage	U\$16,000/day	U\$6,000/day
c) Fuel consumption	US 4,941/day	U\$1,724/day
	(FO 60 KT/day	20 KT/day)
	(DO 1.5KT/day	1.0KT/day)
	(FO:U\$ 78.5 per KT)
	(DO:U\$154 per KT)

Fuel is assumed to be consumed only during navigation; not while the ship is in port.

d) Speed	18 knot	15 knot
e) Port Charge	U\$6,000	U\$3,00

The actual port charges for these vessels are as follows:

Mina Qaboos	U\$2,285	U\$1,496
Dubai	U\$2,504	U\$1,469

The above actual port charges are also used in the analysis.

The distance from Mina Qaboos and Dubai is supposed to be 311 N Miles. The declared distance tables by respective port authorities are different in some cases. so the distance table between ports in the Gulf of our estimation is shown in the following table:

Table A-4-3-22 Distance Table between Arabian - Bay Ports

(Unit: Nautical Miles)

Port Name	1	2	3	4	5	6	7	8	9	10	11	12	13
(1) Mina Qaboos													
(2) Fujairah	140												
(3) Khor Fakhan	203	13											
(4) Sharjah	297	177	164										
(5) Dubai	311	191	178	14									
(6) Jebel Ali	321	207	191	33	19								
(7) Abu Dhabi	365	253	240	80	77	45							
(8) Doha (Qatar)	478	360	350	210	195	185	175						
(9) Mina Sulman (Bahrain)	529	408	401	287	261	230	247	124					
(10) Dammam	578	460	431	310	284	250	297	174	50				
(11) Kuwait	713	591	578	462	456	456	457	344	284	250			
(12) Bushire	586	468	439	345	339	335	332	229	176	166	153		
(13) Bandar Abbas:	249	123	110	110	124	169	202	293	344	360	529	402	

By using this distance and the respective vessel speed the required navigation time can be calculated as follows:

f) Navigation Time 34.6 hrs. = 1.44 days 41.4 hrs. = 1.73 days
 (round trip) (round trip)

Cargo handling costs will be excluded, because of the above mentioned reason, but the vessel cost arising from cargo handling must be included because the vessel costs vary from mother vessels to feeder vessels.

The cargo handling productivity is assumed to be 70 TEUs/hour/berth and the required time for preparation for cargo handling and departure is assumed to be 3 hours. Accordingly, the vessel cost in a port can be calculated by using the following formula:

g) Vessel Cost in a Port.

$$VCP = \frac{(x/70 + 3) * Ci}{24}$$

Where; VCP: Vessel Cost in a Port (U\$)

x : Cargo Volume which shall be Handled in a Port
 (TEU)

Ci: Charterage for i vessel (U\$ / day)

For example, in case that the cargo volume is 100 TEUs, the vessel cost in a port can be calculated as follows:

1) For mother vessels

$$\begin{aligned} VCP_m &= \frac{(100/70 + 3) \times 16,000}{24} \\ &= \frac{4.43 \times 16,000}{24} = 0.185 \times 16,000 \\ &= \text{U\$ } 2,952 \end{aligned}$$

2) For feeder vessels

$$VCP_f = \frac{(100/70 + 3) \times 6,000}{24} = \text{U\$ } 1,107$$

For mother vessels, the vessel cost arising once in a port, but for feeder vessels, the vessel cost shall be double-counted, because the transshipment cargo handling shall be done both in a hub port and a feeder port.

One more other cargo handling cost must be taken into account. It is a cargo handling cost for transshipment, because this cost does not come out in the Hub Hub Case. We assumed then, the following cargo handling cost for transshipment:

h) Transshipment cost U\$100/TEU

This transshipment cost is for double handling, loading and unloading.

i) Navigation Cost

The navigation cost can be calculated by using the navigation time (f), the charterage (b), and the fuel consumption (c) as follows:

1) For mother vessels $V_m = (16,000 + 4,941) \times 1.44 = \text{U\$}30,155$

2) For feeder vessels $V_f = (6,000 + 1,724) \times 1.73 = \text{U\$}13,363$

C. Model

By using the above value and formulae in the premises, the formulation of model for comparison will be dealt with in the following cases:

a) Hub Hub Case

The costs in this case take into account the movements of mother vessels and cargoes. A mother vessel is supposed to approach to Mina Qaboos. The cost of the vessel up to the entrance of Mina Qaboos is excluded because of the above-mentioned reason. Port charges must be taken into account. The cargo handling cost should be excluded because it is necessary for all cases where the same volume cargo is handled. The navigation cost between Mina Qaboos and Dubai must be taken into account. Port charges in Dubai must also be included, and vessel costs in each port must be included. The necessary costs, accordingly, are as follows:

- 1) Port charge in two ports

2) Navigation cost between two ports

3) Vessel cost in each ports.

Therefore, the following formula is defined for required cost for shipping corporations.

$$C = Pq + Pd + Vm + Cm \left(\frac{x}{1,680} + 0.25 \right)$$

Where, C: Total Cost (U\$)

Pq: Port Charge for a Mother Vessel in Mina Qaboos (U\$)

Pd: Port Charge for a Mother Vessel in Dubai (U\$)

Vm: Navigation Cost of a Mother Vessel between Two Ports (U\$)

Cm: Charterage of a Mother Vessel per Day (U\$/day)

x: Total Cargo Volume Handled in Two Ports (TEUs)

Because the mother vessel cost is derived from the following calculation:

$$VCPq = Cm \frac{(xq/70 + 3)}{24}$$

$$VCPd = Cm \frac{(xd/70 + 3)}{24}$$

Where VCPq: Vessel Cost in Mina Qaboos (U\$)

VCPd: Vessel Cost in Dubai (U\$)

Cm: Charterage of a Mother Vessel per Day (U\$/day)

xq: Cargo Volume Handled in Mina Qaboos (TEUs)

xd: Cargo Volume Handled in Dubai (TEUs)

$$VCP = VCPq + VCPd = Cm \left(\frac{xq + xd}{1,680} + \frac{6}{24} \right)$$

$$= Cm \left(\frac{x}{1,680} + 0.25 \right)$$

The unit cost per TEU can be defined as follows:

$$\left(\frac{C}{x} \right)_{\text{Hub Hub}} = \frac{(Pq + Pd + Vm + 0.25 Cm) + \frac{Cm}{1,680}}{x}$$

b) Mina Qaboos Hub Case

In considering this case, the cost necessary for a mother vessel is at first taken into account.

As the mother vessel only visits and discharges/loads, the total cargoes includes transshipment cargoes and the base cargoes for Mina Qaboos. The necessary costs for the mother vessel are as follows:

- 1) Port charges in Mina Qaboos
- 2) Vessel costs in Mina Qaboos
- 3) Additional transshipment costs for cargo handling.

On the other hand, the necessary costs for feeder vessel are as follows:

- 1) Port charges in two ports
- 2) Vessel costs for transshipment in two ports
- 3) Navigation costs between two ports.

The transshipment cost can be classified either in a mother vessel cost or in a feeder vessel cost. In this case, we put it in the mother vessel cost.

The total mother vessel cost can be formulated as follows:

$$C1 = Pq + Cm \left(\frac{x}{1,680} + 0.125 \right) + 100 xd$$

Where C1 : Total Mother Vessel Cost (U\$)

Pq : Port Charge for a Mother Vessel in Mina Qaboos (U\$)

Cm : Charterage of a Mother Vessel per Day (U\$/day)

x : Total Cargo Volume Handled in Two Ports (TEUs)

xd : Transshipment Cargo Volume (TEUs)

The mother vessel must handle the total cargoes in Mina Qaboos. Then, the required time in Mina Qaboos is as follows:

$$Tq = \frac{x/70 + 3}{24} = \frac{x}{1,680} + 0.125$$

Where Tq : Required Time in Mina Qaboos (Day)

x : Total Cargo Volume Handled in Two Ports (TEUs)

Then the above formula will be a little bit different from that in the Hub Hub Case.

The total feeder vessel cost can be formulated as follows:

$$C2 = pq + pd + Vf + 2 \left(\frac{xd}{1,680} + 0.125 \right) * Cf$$

where, C2: total Feeder Vessel Cost (U\$)

pq: Port Charge for a Feeder Vessel in Mina Qaboos (U\$)

pd: Port charge for a Feeder Vessel in Dubai (U\$)

xd: Transshipment Cargo Volume for Dubai (TEU)

Cf: Charterage of a Feeder Vessel per Day (U\$/day)

Accordingly, the total cost can be calculated by the following formula:

$$C = C1 + C2 = Pq + pq + pd + Vf + 0.125 Cm + 0.25 Cf$$

$$+ \frac{Cm}{1,680} x + \left(\frac{2Cf}{1,680} + 100 \right) xd$$

The unit cost per TEU can be defined as follows.

$$\left(\frac{C}{x} \right)_{Qaboos} = \frac{(Pq + pq + pd + Vf + 0.125 Cm + 0.25 Cf)}{x}$$

$$+ \frac{Cm}{1,680} + \left(\frac{2Cf}{1,680} + 100 \right) \left(\frac{xd}{x} \right)$$

c) Dubai Hub Case

In the same way, the necessary cost for the mother vessel in this case is as follows:

- 1) Port charge in Dubai
- 2) Vessel cost in Dubai
- 3) Additional transshipment costs for cargo handling
- 4) Navigation cost between two ports

The necessary cost for the feeder vessel is as follows:

- 1) Port charges in two ports

- 2) Vessel costs for transshipment in two ports
- 3) Navigation cost between two ports

The formulae for each vessels can be derived as the same way as in the Qaboos Hub Case.

$$C1 = Pd + Cm \left(\frac{x + 0.125}{1,680} \right) + 100xq + Vm$$

$$C2 = pq + pd + Vf + 2 \left(\frac{xq + 0.125}{1,680} \right) * Cf$$

$$C = C1 + C2 = Pd + pq + pd + Vm + Vf + 0.125 Cm + 0.25 Cf + \frac{Cm}{1,680} x + \left(\frac{2 Cf + 100}{1,680} \right) xq$$

The unit cost per TEU can be defined as follows:

$$\left(\frac{C}{x} \right)_{\text{Dubai}} = \frac{(Pd + pq + pd + Vm + Vf + 0.125 Cm + 0.25 Cf) + \frac{Cm}{1,680} + \left(\frac{2Cf + 100}{1,680} \right) \left(\frac{xq}{x} \right)}{x}$$

D. Comparison with respective cases

1) Comparison of Hub Hub Case with Qaboos Hub Case.

By comparing the unit cost of Hub Hub Case with that of Qaboos Hub Case, which case is preferable for shipping corporations shall be analysed.

$$\left(\frac{C}{x} \right)_{\text{Hub Hub}} - \left(\frac{C}{x} \right)_{\text{Qaboos Hub}} = \frac{(Pd - pq - pd + Vm - Vf + 0.125 Cm - 0.25 Cf) - \left(\frac{2Cf + 100}{1,680} \right) \left(\frac{xd}{x} \right)}{x}$$

If the above value is positive, Qaboos Hub would be preferable for shipping corporation.

As x is positive, so shipping corporations would take Qaboos Hub Case under

the following conditions:

$$x_d < \frac{(P_d - p_q - p_d + V_m - V_f + 0.125 C_m - 0.25 C_f)}{(2 C_f + 100)} \\ 1,680$$

In other words, if the volume of transshipment cargoes to Dubai is less than the value of the right-hand side, the shipping corporations would prefer Qaboos Hub Case to Hub Hub Case.

By using the value in the premises, the result is as follows:

$$x_d < \frac{(6,000 - 3,000 - 3,000 + 30,155 - 13,363 + 2,000 - 1,500)}{2 \times 6,000 + 100} \\ 1,680 \\ = 17,292/107.1429 = 161.4 \text{ TEUs}$$

Therefore, in the cases where the transshipment cargo volume to Dubai is less than or equal to 161 TEUs, Qaboos Hub would be selected. In the cases where the transshipment cargo volume to Dubai is greater than 161 TEUs, two Hubs would be selected.

By using the actual port charge, the value of criteria will be as follows:

$$\frac{(2,504 - 1,496 - 1,469 + 30,155 - 13,363 + 2,000 - 1,500)}{107,1429} \\ = 16,831/107.1429 = 157.1 \text{ TEUs}$$

Therefore, in this case, the following selection would be done:

$x_d \leq 157 \text{ TEUs}$ Qaboos Hub

$x_d > 157 \text{ TEUs}$ Hub Hub

When we consider a new port along Batinah coast, V_m and V_f would be changed as follows:

a) Majis New Port:

Distance between Dubai and the New Port

$$= 311 - 130 = 181 \text{ N Miles}$$

Navigation Time (Round Trip) by Mother Vessels

$$= 2 \times 181 / 18 = 20.11 \text{ hrs.} = 0.84 \text{ days}$$

Navigation time (Round Trip) by Feeder Vessels

$$= 2 \times 181 / 15 = 24.13 \text{ hrs.} = 1.006 \text{ days}$$

$$V_m = (16,000 + 4,941) \times 0.84 = 17,548 \text{ U\$}$$

$$V_f = (6,000 + 1,724) \times 1.006 = 7,767 \text{ U\$}$$

The value of criteria under the same rest conditions, will be as follows:

$$9,820/107.1429 = 91.7 \text{ TEUs}$$

$x_d \leq 91 \text{ TEUs}$ Majis New Hub Port

$x_d > 91 \text{ TEUs}$ Two Hub Ports

b) Haradi New Port:

Distance between Dubai and the New Port

$$= 311 - 40.5 = 270.5 \text{ N Miles}$$

Navigation Time (Round Trip) by Mother Vessels

$$= 2 \times 270.5 / 18 = 30.06 \text{ hrs.} = 1.25 \text{ days}$$

Navigation Time (Round Trip) by Feeder Vessels

$$= 2 \times 270.5 / 15 = 36.08 \text{ hrs.} = 1.50 \text{ days}$$

$$V_m = (16,000 + 4,941) \times 1.25 = 26,225 \text{ U\$}$$

$$V_f = (6,000 + 1,724) \times 1.50 = 11,608 \text{ U\$}$$

Then the value of criteria is as follows:

$$14,656/107.1429 = 136.8 \text{ TEU}$$

$x_d \leq 136 \text{ TEUs}$ Haradi New Hub Port

$x_d > 136 \text{ TEUs}$ Two Hub Ports

2) Comparison of Qaboos Hub Case with Dubai Hub Case

In the same way as the above, the unit cost comparison is as follows:

$$\left(\frac{C}{x}\right)_{\text{Qaboos}} - \left(\frac{C}{x}\right)_{\text{Dubai}}$$

$$= \frac{(P_g - P_d + V_f - V_m)}{x} + \frac{(2C_f + 100)(x_d - x_q)}{1,680x}$$

The selection criterion of Mina Qaboos Hub rather than Dubai is as follows:

$$(x_d - x_q) < \frac{(P_d - P_q + V_m - V_f)}{\frac{(2C_f + 100)}{1,680}}$$

By using the values in premises, the result is as follows:

$$(x_d - x_q) < \frac{(6,000 - 6,000 + 30,155 - 13,363)}{\frac{2 \times 6,000 + 100}{1,680}}$$

$$= 16,792/107.1429 = 156.7 \text{ TEUs}$$

Therefore, if the difference between the transshipment cargo volume to Dubai and the transshipment cargo volume to Qaboos is less than or equal to 156 TEUs, the selection of Qaboos Hub would be made over Dubai Hub. In other words, in the cases where the difference between Dubai base cargoes and Qaboos base cargoes is less than or equal to 156 TEUs, Mina Qaboos would be selected as a hub port over Dubai.

By using the actual port charges, the criterion will be as follows:

$$(x_d - x_q) < \frac{(2,504 - 2,283 + 30,155 - 13,363)}{107.1429}$$

$$= 17,013/107.1429 = 158.8 \text{ TEUs}$$

a) Majis New Port

$$(x_d - x_m) < \frac{(2,504 - 2,283 + 17,548 - 7,767)}{107.1429}$$

$$= 10,002/107.1429 = 93.4 \text{ TEUs}$$

b) Haradi New Port

$$(xd-xh) < \frac{(2,504 - 2,283 + 26,225 - 11,608)}{107,1429}$$

$$= 14,838/107,1429 = 138.5 \text{ TEUs}$$

3) Comparison of Hub Hub Case with Dubai Hub case

In the same way as the above, the unit cost comparison is as follows:

$$\left(\frac{c}{x}\right)_{\text{Hub Hub}} - \left(\frac{c}{x}\right)_{\text{Dubai Hub}}$$

$$= \frac{(Pq - pq - pd - Vf + 0.125 Cm - 0.25 Cf)}{x}$$

$$- \frac{(2 Cf + 100) (xq)}{1,680 x}$$

The condition which Hub Hub Case is selected is as follows:

$$\frac{(Pq - pq - pd - Vf + 0.125 Cm - 0.25 Cf)}{(2 Cf + 100)} < xq$$

$$\frac{1,680}{1,680}$$

By using the values in the premises, the result is as follows:

$$\frac{(6,000 - 3,000 - 3,000 - 13,363 + 2,000 - 1,500)}{107,1429} < xq$$

i.e. $\frac{-12,863}{107,1429} < xq$

Therefore, the Hub Hub Case is always better than the Dubai Hub Case under the conditions of comparison with feeder services.

In case of using actual port charges, the result is as follows:

$$(2,283 - 1,496 - 1,469 - 13,363 + 2,000 - 1,500) < 0$$

The Hub Hub Case becomes always better than the Dubai Hub Case.

E. Conclusion

In the above section, we compared the Hub Hub case with the Qaboos Hub Case. But the above analysis is based on a simple model including only 2 ports. There are lots of ports in the Gulf and transshipment is now carried out in various ports. Accordingly, the comparison with Hub Hub Case is not so important, and the comparison of Qaboos Hub with Dubai Hub is more important.

From the result using the actual port charges, the following

conclusions are introduced:

- 1) Mina Qaboos; locational advantage vis-a vis Dubai is estimated at 158 TEUs. Even in case of lesser base cargo volumes than Dubai base cargoes by 158 TEUs, Mina Qaboos would have the advantage needed to become a hub port.
- 2) From the criterion formula, the difference between port charges is sensitive to the criterion value. But it is not preferable for port management. The sensitivity of the difference between navigation costs of mother and feeder vessels is greater than that of the difference between port charges.

Therefore, the bigger the mother vessels that are analysed, the more locational advantages are expected.

- 3) The transshipment cargo handling cost in a denominator of the criterion formula is very sensitive to the criterion value. If the transshipment cargo handling cost is reduced from U\$100/TEU in the formula to U\$50/TEU, the locational advantages would increase from 158 TEUs to 297 TEUs immediately.

For the potential of a new port, a similar conclusion is presented in the following cases:

a) For Majis New Port

- 1) Majis New Port's locational advantage over Dubai is estimated at 93 TEUs. The advantage is not bigger than that of Mina Qaboos. But there is still effective potential for transshipment.
- 2) As stated in the above conclusions regarding Mina Qaboos, the sensitivity of the difference between navigation costs of mother vessels and feeder vessels is greater than that of the difference between port charges. Accordingly, the new port must be equipped with well-developed facilities that can accommodate very large mother vessels. The advantages will then surely increase drastically.

3) The transshipment cargo handling costs shall be lowered as far as possible.

4) Marketing efforts needed to obtain base cargoes are very important in order to compete with Dubai.

b) For Haradi New Port

1) Haradi New Port's locational advantage over Dubai is estimated at 138 TEUs. This is surely more advantageous than Majis. But the value is very similar to the advantage of Mina Qaboos.

Accordingly, Haradi New Port might be competitive with Mina Qaboos after the completion of better facilities than those at Mina Qaboos.