50% larger than those of Plan 1. Plan 1 has the same port capacity with Plan 2, however the required cost for Plan 2 is 22% larger than those of Plan 1. This increase could attribute to the fact that Plan 2 requires a large scale dredging works at the existing shallow water of Zangi Channel. The required dredging volume at the channel amounts to 20 million cubic meters in order to allow the vessel calling through DL-13.0 m to -14.0 m basin.

Table 12.7.2.1 shows the required costs for each plan which are divided into seven major work categories.

Cost distribution ratio of Plan 1 shown in the table indicates that the marine works need the largest investment sharing 61.8% of the required costs. Architectural works and the on-land works are placed at the second sharing 18.8% and the third sharing 12.9% respectively.

The share distribution of required cost by work is similar by each plan.

Table 12.7.2.1 Cost Summary of New Development (LTD) by Major Work Categories

Unit: Million US$

Works	Plan-1	Plan-2	Plan-3
a. General works	12.31 (3.9%)	12.31	13.50
b. Marine works	196.57 (61.8%)	276.35	261.03
c. On-land works	40.87 (12.9%)	35.33	52.60
d. Building	59.62 (18.8%)	56.67	86.11
e. Utilities	8.52 (2.6%)	8.67	12.48
f. Supplemental works	0	0	0
g. Other	0	0	0
Total	317.89 (100%)	389.33	425.72

Note: Figures are rounded so that the total amounts may not be the same as accumulated one.

12.8 Upgrading of Existing Facilities

This section deals with required costs for the upgrading of existing facilities. Master Plan elements are divided into two groups, the Short Term Plan (STD) and Long Term Plan (LTD).

12.8.1 Cost Summary for Upgrading of Existing Facilities

The total amounts required for each alternative plans are shown in Table 12.8.1.1.

Table 12.8.1.1 Cost Summary for Upgrading of Existing Facilities

Unit: Million US$

	Plan 1		Plan 2	Plan 3
STD	61.00	(19.0%)	61.00	61.00
LTD	260.54	(81.0%)	260.54	153.94
Total	321.54	(100%)	321.54	214.94
Index(%)		(150%)	(150%)	(100%)

As shown in the table, the required costs of Plan 3 is about 50% lower than both Plan 1 or Plan 2.

This difference in 106.60 million US$ comes from the planning concept that Plan 3 requires rather minor works than other two plans in respect of the utilization of existing facilities. Contrary, both Plan 1 and Plan 2 require the same costs since the works to be provided are the same arrangement.

The same arrangement is provided to all the plans in respect of short term development, thus the required cost is same to all plans.

Required costs for the short term development share 19.0% of the total cost either Plan 1 or Plan 2.

12.8.2 Cost of Major Work

(1) Major works by plan

Table 12.8.2.1 shows the required costs for each plan which are divided into seven major work categories.

Cost distribution ratio of Plan 1 (LTD) shown in the table indicates that the marine works need the largest investment sharing 51.3% of the total costs. Architectural works and the on-land works are sharing the second in 19.8% and the third position in 12.6% respectively. This order is same with those of the new development. However the share of marine works goes down by 10.5% and that of architectural works raises up by 1.0%.

The cost distribution during STD gives the highest share on the marine works then followed by the buildings.

Table 12.8.2.1 Cost Summary of Existing Facility Upgrading by Major Work Categories

Unit: Million US$

Works	Plan 1 or Plan 2 (LTD)	Plan 3 (LTD)	All Plans (STD)
a. General works	9.78 (3.8%)	7.41	5.15
b. Marine works	133.75 (51.3%)	58.01	31.20
c. On-land works	32.38 (12.6%)	20.16	5.55
d. Building	51.55 (19.8%)	42.09	18.20
e. Utilities	10.28 (3.9%)	7.91	0.60
f. Supplemental works	15.08 (6.0%)	14.86	0.30
g. Other	7.00 (2.6%)	3.50	0
Total	260.54 (100%)	153.94	61.00

(2) Major works by port area, Plan 1 and Plan 2: LTD

Table 12.8.2.2 indicates the required costs for Plan 1 by each port area and previous development group. The existing port facilities are divided into three zones, definition of which is provided in the table.

As seen in the table, 77.7% of the total costs should be invested at the zone 1. Thus the required costs for the zones 2 and 3 are relatively minor. This indicates that the intensive upgrading works will be conducted at both the old port area and the previous Four Berth Extension area. Both zones 2 and 3 have no marine work at all since the waterfront facility at these areas have been fully developed. Thus, the required improvement at these areas will be architectural works together with the utilities and the minor on-land works.

Table 12.8.2.2 Cost Summary of Existing Facility Upgrading by Port Area (Plan 1 or Plan 2, LTD)

Unit: Million US$

Works	Zone 1 Old port plus Four Berth	Zone 2 Ten Berth	Zone 3 Fourteen Berth	Total
a. General works	8.06	1.72	0	9.78 (3.8%)
b. Marine works	122.62	11.13	0	133.75 (51.3%)
c. On-land works	23.03	9.35	0	32.58 (12.6%)
d. Building	23.92	27.01	0.62	51.55 (19.8%)
e. Utilities	5.47	4.81	0	10.28 (3.9%)
f. Supplemental	13.22	0.78	1.80	15.80 (6.0%)
works	6.00	1.00	0	7.00 (2.6%)
g. Other	202.32	55.80	2.42	260.54
Total	(77.7%)	(21.4%)	(0.9%)	(100%)

Notes: 1. "Old port" means a area the Western Jetty and its eastern.
2. "Four Berth" means the previous Four Berth Extension area.
3. "Ten Berth" means the previous Ten Berth Extension area.
4. "Fourteen Berth" means the previous Fourteen Berth Extension area.

(3) Major works by port area, Plan 3: LTD

Similar to Plan 1 and Plan 2, major works by port area for Plan 3, LTD is shown in Table 12.8.2.3. The table indicates the required costs for Plan 3 by each port area. As seen in the table, 53.5% and 44.9% of the required costs should be invested at the zone 1 and zone 2 respectively. The investment for upgrading of zone 3 shares only 1.6% of the total.

The required costs in zone 1 is decreased by 119.94 million US$ from those of Plan 1. However, the investment to zone 2 is increased by 13.34 million US$ comparing to those of Plan 1.

Table 12.8.2.3 Cost Summary of Existing Facility Upgrading by Port Area (Plan 3, LTD)

Unit: Million US$

Works	Zone 1 Old port plus Four Berth	Zone 2 Ten Berth	Zone 3 Fourteen Berth	Total
a. General works	5.69	1.72	0	7.41 (4.8%)
b. Marine works	50.45	7.56	0	58.01 (37.7%)
c. On-land works	9.38	10.78	0	20.16 (13.1%)
d. Building	10.57	30.90	0.62	42.09 (27.3%)
e. Utilities	2.43	5.48	0	7.91 (5.1%)
f. Supplemental works	1.76	11.30	1.80	14.86 (9.7%)
g. Other	2.10	1.40	0	3.50 (2.3%)
Total	82.38 (53.5%)	69.14 (44.9%)	2.42 (1.6%)	153.94 (100%)

(4) Major works by port area, Plans 1, 2 and 3: STD

Table 12.8.2.4 indicates the required investments during the short term development. This arrangement can be applied for all the alternative plans.

The total required costs amount to 61.00 million US$ consisting of 15.87 million US$ and 45.13 million US$ for the short term development of existing facility scope 1 and those of scope 2 respectively. The former is mainly for both urgent rehabilitation and upgrading of existing facilities. The latter constitutes the significant part of short term development to meet the cargo demands in 2000.

Among 61.00 million US$, marine works require 31.20 million US$ sharing 51.1%. The second largest item is the building works amounting to 18.20 million US$.

Required costs for zone 1 and zone 3 are significant sharing 38.10% and 41.0% respectively.

STD-EF1 consists of five work components as follows.

1) Marine works, structural repair
2) Dredging
3) On-land works, provisional
4) Utilities, provisional
5) Supplemental works, provisional

Contrary, STD-EF2 covers a wide scope in order to conduct more positive countermeasures on the existing facilities. It will include following eight work components. Refer to Table 12.8.2.6.

1) Dredging
2) A dolphin construction at the grain jetty. This work is excluded from the project, since PSO is currently undertaking a contract for this structure.
3) NB1. General and bagged cargo berth. A part of permanent structures will be constructed taking the future wharf into consideration.
4) NB4. Mineral berth. The same type of work with NB 1 will be provided.
5) On-land works. Pavement for the yard and access will be conducted.
6) Buildings, Two unit of 9,000 m^2 cold storage
7) Utilities, provisional
8) Supplemental works, provisional

Table 12.8.2.4 Cost Summary of Existing Facility Upgrading by Port Area (Plan 1, Plan 2 and Plan 3, STD)

(1/3) Summary

Unit: Million US$

Works	Zone 1 Ole port plus Four Berth	Zone 2 Ten Berth	Zone 3 Fourteen Berth	Total
a. General works	2.56	0.53	2.06	5.15 (8.5%)
b. Marine works	19.41	5.23	6.56	31.20 (51.1%)
c. On-land works	-	5.55	-	5.55 (9.1%)
d. Building	1.00	1.00	16.20	18.20 (29.8%)
e. Utilities	0.10	0.30	0.20	0.60 (1.0%)
f. Supplemental works	0.20	0.10	0	0.30 (0.5%)
g. Other	-	-	-	-
Total	23.27 (38.1%)	12.71 (20.9%)	25.02 (41.0%)	61.00 (100%)

(2/3) STD-EF1, Scope 1

Unit: Million US$

Works	Zone 1 Ole port plus Four Berth	Zone 2 Ten Berth	Zone 3 Fourteen Berth	Total
a. General works	1.28	0.53	-	1.81
b. Marine works	5.76	5.23	1.52	12.51
c. On-land works	-	1.45	-	1.45
d. Building	-	-	-	0
e. Utilities	-	0.10	-	0.10
f. Supplemental works	-	-	-	0
g. Other	-	-	-	0
Total	7.04	7.31	1.52	15.87

(3/3) STD-EF2, Scope 2

Unit: Million US$

Works	Zone 1 Ole port plus Four Berth	Zone 2 Ten Berth	Zone 3 Fourteen Berth	Total
a. General works	1.28	-	2.06	3.34
b. Marine works	13.65	-	5.04	18.69
c. On-land works	-	4.10	-	4.10
d. Building	1.00	1.00	16.20	18.20
e. Utilities	0.10	0.20	0.20	0.50
f. Supplemental works	0.20	0.10	-	0.30
g. Other	-	-	-	0
Total	16.23	5.40	23.50	45.13

Table 12.8.2.5 Cost for Rehabilitation of Existing Facility by Work

STD - EF1 (Plan 1, Plan 2 and Plan 3, STD)

(1/3) Zone 1 Unit: Million US$

	Structural Repair	Dredging	On-land Works	Utilities	Supplemental Works	Total
a. General works	0.75	0.53	-	-	-	1.28
b. Marine works	1.63	4.13	-	-	-	5.76
c. On-land works	-	-	-	-	-	-
d. Building	-	-	-	-	-	-
e. Utilities	-	-	-	-	-	-
f. Supplemental works	-	-	-	-	-	-
g. Other	-	-	-	-	-	-
Total	2.38	4.66	0	0	0	7.04

(2/3) Zone 2 Unit: Million US$

	Structural Repair	Dredging	On-land Works	Utilities	Supplemental Works	Total
a. General works	-	0.53	-	-	-	0.53
b. Marine works	1.10	4.13	-	-	-	5.23
c. On-land works		-	1.35	0.10	-	1.45
d. Building	-	-	-	-	-	0
e. Utilities	-	-	-	-	0.10	0.10
f. Supplemental works	-	-	-	-	-	0
g. Other	-	-	-	-	-	0
Total	1.10	4.66	1.35	0.10	0.10	7.31

(3/3) Zone 3 Unit: Million US$

	Structural Repair	Dredging	On-land Works	Utilities	Supplemental Works	Total
a. General works	-	-	-	-	-	-
b. Marine works	1.52	-	-	-	-	1.52
c. On-land works		-	-	-	-	-
d. Building	-	-	-	-	-	-
e. Utilities	-	-	-	-	-	-
f. Supplemental works	-	-	-	-	-	-
g. Other	-	-	-	-	-	-
Total	1.52	0	0	0	0	1.52

(15.87)

Table 12.8.2.6 Cost Breakdown of Existing Facility Upgrading by Work

STD - EF2 (Plan 1, Plan 2 and Plan 3, STD)

(1/3) Zone 1 — Unit: Million US$

	Dredging	Grain Jetty Dolphin	NB1	NB4	On-land works	Building	Utilities	Supplemental works	Total
a. General works	-	-	0.51	0.77	-	-	-	-	1.28
b. Marine works	-	(excluded)	5.37	8.28	-	-	-	-	13.65
c. On-land works	-	-	-	-	-	-	-	-	-
d. Building	-	-	-	-	-	1.00	-	-	1.00
e. Utilities	-	-	-	-	-	-	0.10	-	0.10
f. Supplemental works	-	-	-	-	-	-	-	0.20	0.20
g. Other	-	-	-	-	-	-	-	-	-
Total	0	0	5.88	9.05	0	1.00	0.10	0.20	16.23

(2/3) Zone 2 — Unit: Million US$

	Dredging	Grain Jetty Dolphin	NB1	NB4	On-land works	Building	Utilities	Supplemental works	Total
a. General works	-	-	-	-	-	-	-	-	-
b. Marine works	-	-	-	-	-	-	-	-	-
c. On-land works	-	-	-	-	4.10	-	-	-	4.10
d. Building	-	-	-	-	-	1.00	-	-	1.00
e. Utilities	-	-	-	-	-	-	0.20	-	0.20
f. Supplemental works	-	-	-	-	-	-	-	0.10	0.10
g. Other	-	-	-	-	-	-	-	-	-
Total	0	0	0	0	4.10	1.00	0.20	0.10	5.40

(3/3) Zone 3 — Unit: Million US$

	Dredging	Grain Jetty Dolphin	NB1	NB4	On-land works	Building	Utilities	Supplemental works	Total
a. General works	0.44	-	-	-	-	1.62	-	-	2.06
b. Marine works	3.55	-	-	-	-	-	-	-	3.55
c. On-land works	-	-	-	-	-	-	-	-	-
d. Building	-	-	-	-	-	16.20	-	-	16.20
e. Utilities	-	-	-	-	-	-	0.20	-	0.20
f. Supplemental works	-	-	-	-	-	-	-	-	-
g. Other	-	-	-	-	-	-	-	-	-
Total	3.99	0	0	0	0	17.82	0.20	0.00	22.01

(43.64)

12.9 Detailed Cost Information of Short-term Development

This section deals with the required cost information for further evaluation in respect of the short term development of alternative Plan 1. Cost information includes the followings.

- Cost subdivision to both local currency portion and foreign currency portion
- Reduction of non-eligible cost portions such as tax and land cost
- Unskilled laborer cost
- Laborer requirement by project

The required costs for the procurement of cargo handling equipment and navigation aids are taken from the lists in Chapters 9 and 10 and section 12.15.

These cost information will reappear in Chapters 14 and 15 for final evaluation.

12.9.1 Currency Portions

The total costs for the short term development before contingency are 103.55 million US$ which consists of 61.00 million US$ required for the construction works and 40.55 million US$ required for the procurements of cargo handling equipment and navigation aids.

Construction works	61.00 million US$
Procurements	
- Cargo handling equipment	40.55 million US$
- Navigation aids, etc.	2.00 million US$
Total	103.55 million US$

Table 12.9.1.1 shows a summary of related cost information for project evaluation in respect of the short term development.

Table 12.9.1.1 Summary Cost Information of Short Term Development

Unit: Million US$

Works	U	LCP	FCP	TP	ELCP	EU	ULP
Construction work	61.00	19.77	41.23	9.25	10.52	51.75	5.03
Cargo handling equipment	40.55	3.85	36.70	2.31	1.54	38.24	0.77
Navigation aids, etc.	2.00	0.19	1.81	0.11	0.08	1.89	0.04
Total	103.55	23.81	79.74	11.67	12.14	91.88	5.84

Note: *U* : *Total costs including tax portion*
FCP : *Foreign currency portion*
LCP : *Local currency portion including tax portion*
TP : *Tax portion*
ELCP : *Eligible local currency portion*
EU : *Eligible total costs excluding tax portion*
ULP : *Unskilled laborer portion*

(1) Currency portion

Among the total costs of 103.55 million US$, the foreign currency portion is 79.74 million US$ sharing 77.0% and the local currency portion is 23.81 million US$.

Construction works			
	Foreign currency portion	41.23 million US$	67.6%
	Local currency portion	19.77 million US$	32.4%
	Subtotal	61.00 million US$	100%
Procurements			
	Foreign currency portion	38.51 million US$	90.5%
	Local currency portion	4.04 million US$	9.5%
	Subtotal	42.55 million US$	100%
Total			
	Foreign currency portion	79.74 million US$	77.0%
	Local currency portion	23.81 million US$	23.0%
	Total	103.55 million US$	100%

(2) Eligible costs

Eligible costs are calculated reduction of taxes out of the total costs.

Construction works		
	Foreign currency portion	41.23 million US$
	Local currency portion	10.52 million US$
	Subtotal	51.75 million US$
Procurements		
	Foreign currency portion	38.51 million US$
	Local currency portion	1.62 million US$
	Subtotal	40.13 million US$
Total		
	Foreign currency portion	79.74 million US$
	Local currency portion	12.14 million US$
	Total	91.88 million US$

(3) Unskilled laborer costs

The total estimated amount for employing the unskilled laborers is 5.84 million US$ sharing 5.64% of the total project cost. Breakdown of this cost is shown below.

Construction works,	5.03 million US$
Procurement	0.81 million US$
Total	5.84 million US$

12.9.2 Estimated Laborer Requirement by Project

The daily laborer requirement is roughly calculated based on the following conditions.

Conditions:

a. Total initial cost, before contingencies in the Short Term Plan
   $103,550,000Total
   $ 61,000,000Construction works
   $ 42,550,000Procurement including cargo handling equipment

b. Average daily wage including social charge and overhead (33%)
   8 hour/day × 1.5$/man·hour × 1.33 = 16$/man·day

c. Required construction period
   It is estimated that the short term plan will be executed within four years 1997/2000.

Laborer requirement in both the civil and fixed facility constructions is calculated assuming that the laborers cost shares about 20.0% of the construction works. Refer to Table 12.4.1.
Labors total cost = 0.20 × 61,000,000 = 12,200,000 US$

As average daily laborers cost is calculated considering the total construction period.

In case 23 days working a month,
$12,200,000/(365 days × 4 years × 0.77) = 10,852$/day

Thus, the required laborers a day will be:
10,852$/16$/man·day = 678 workers

It is assumed this figure might be double during the peak of works.

Please refer to Tables 12.9.2.1 and 12.9.2.2.

Table 12.9.2.1 Cost Information, Short Term Development Construction Works
(1/3) Total

Unit: Million US$

Works	U	LCP	FCP	TP	ELCP	EU	ULP
a. General works	5.15	2.45	2.70	0.47	1.98	4.68	0.88
b. Marine works	31.20	8.90	22.30	3.90	5.00	27.30	1.78
c. On-land works	5.55	2.11	3.44	0.92	1.19	4.63	0.54
d. Building	18.20	6.06	12.14	3.77	2.29	14.43	1.73
e. Utilities	0.60	0.14	0.46	0.14	0	0.46	0.07
f. Supplemental works	0.30	0.11	0.19	0.05	0.06	0.25	0.03
g. Other	0	0	0	0	0	0	0
Total	61.00	19.77	41.23	9.25	10.52	51.75	5.03

(2/3) STD-EF1 (Scope 1)

Unit: Million US$

Works	U	LCP	FCP	TP	ELCP	EU	ULP
a. General works	1.81	0.86	0.95	0.13	0.73	1.68	0.31
b. Marine works	12.51	3.57	8.94	1.56	2.01	10.95	0.71
c. On-land works	1.45	0.55	0.90	0.24	0.31	1.21	0.14
d. Building	0	0	0	0	0	0	0
e. Utilities	0.10	0.02	0.08	0.02	0	0.08	0.01
f. Supplemental works	0	0	0	0	0	0	0
g. Other	0	0	0	0	0	0	0
Total	15.87	5.00	10.87	1.95	3.05	13.92	1.17

(3/3) STD-EF2 (Scope 2)

Unit: Million US$

Works	U	LCP	FCP	TP	ELCP	EU	ULP
a. General works	3.34	1.59	1.75	0.34	1.25	3.00	0.57
b. Marine works	18.69	5.33	13.36	2.34	2.99	16.35	1.07
c. On-land works	4.10	1.56	2.54	0.68	0.88	3.42	0.40
d. Building	18.20	6.06	12.14	3.77	2.29	14.43	1.73
e. Utilities	0.50	0.12	0.38	0.12	0	0.38	0.06
f. Supplemental works	0.30	0.11	0.19	0.05	0.06	0.25	0.03
g. Other	0	0	0	0	0	0	0
Total	45.13	14.77	30.36	7.30	7.47	37.83	3.86

Table 12.9.2.2 Applied Standard Factors for Cost Subdivision

Work Categories	Local Portion 0.95(Mℓ+L)	Foreign Portion 1.0-Local	Tax Portion 0.057U+0.272Mf	Unskilled Laborer 0.38L
A. General works	0.475	0.525	0.071	0.171
B. Marine works	0.285	0.715	0.125	0.057
C. On-land works	0.380	0.620	0.166	0.098
D. Building	0.333	0.667	0.207	0.095
E. Utilities	0.238	0.762	0.234	0.112
F. Supplemental works*	0.380	0.620	0.166	0.098
G. Others*	0.380	0.620	0.166	0.098
Independent Items				
a. Upgrading the existing structures	0.285	0.715	0.125	0.057
b. Structural repair	0.285	0.715	0.125	0.057
c. Road and yard	0.380	0.620	0.166	0.098
d. Dredging	0.067	0.933	0.065	0.019
e. Procurement of cargo handling equipment	0.095	0.905	0.057*	0.019
f. Procurement of navigation aids	0.095	0.905	0.057*	0.019
g. Repair of cargo handling equipment	0.285	0.715	0.220	0.095
h. Others	0.327	0.673	0.151	0.076

12.9.3 Data to Disbursement Schedule

This subsection deals with the breakdown of costs which are subdivided into two scopes, namely STD-EF1 and STD-EF2.

Construction works

STD-EF1	15.87 million US$	(26.0%)
STD-EF2	45.13 million US$	(74.0%)
Subtotal	61.00 million US$	(100%)

Procurements

STD-EF1		
Cargo handling equipment	0 million US$	
Navigation aids, etc.	1.00 million US$	(2.4%)
STD-EF2		
Cargo handling equipment	40.55 million US$	(95.2%)

Navigation aids, etc.	1.00 million US$	(2.4%)
Subtotal	42.55 million US$	(100%)
Total	103.55 million US$	

Table 12.9.3.1 Summary Cost Information for Short Term Development for Disbursement Schedule

Unit: million$

	U	LCP	FCP	TP	ELCP	EU	ULP
STD-EF1							
Construction work	15.87	5.00	10.87	1.95	3.05	13.92	1.17
Cargo handling equipment	0	0	0	0	0	0	0
Navigation aids, etc.	1.00	0.10	0.90	0.06	0.04	0.94	0.02
Subtotal	16.87	5.10	11.77	2.01	3.09	14.86	1.19
STD-EF2							
Construction work	45.13	14.77	30.36	7.30	7.47	37.83	3.86
Cargo handling equipment	40.55	3.85	36.70	2.31	1.54	38.24	0.77
Navigation aids, etc.	1.00	0.09	0.91	0.05	0.04	0.95	0.02
Subtotal	86.68	18.71	67.97	9.65	9.05	77.02	4.65
Total	103.55	23.81	79.74	11.67	12.14	91.88	5.84

12.10 Rehabilitation of the Existing Facilities

This subsection deals with the required cost for rehabilitation of existing facilities. Rehabilitation means that repair works in large scale in comparison with both the annual and routine maintenance efforts. For the time being, the main objective of rehabilitation works in Imam Khomeini port should be the existing damaged waterfront facilities.

The required costs for upgrading the exisiting structures will be discussed separately.

12.10.1 Introduction

In subsection 2.8, the present structural conditions of existing 24 berths are given on the basis of the damage classification namely, the Damage Grade. The grades are subdivided into five degrees from light ones to heavy ones. It is understood that the parts of damage classified as both Damage Grades 4 and 5 will be main objectives for rehabilitation.

Refer to Table 2.7.4.1 for the Damage Grade by which the Study Team carried out the visual inspection. Table 2.7.3.1 and Appendix III-2.1 provide present rate of

occurrence of damages for each type of structural members.

Typical unit repair cost for the Damage Grade 3 is assumed as 100 $/m^2 on the basis of similar project in the past. Typical repair methods were provided in subsections 8.11.5 and 8.11.6.

12.10.2 Basic Cost Estimation Procedure

The required repair works depend on the damage scope of each structure. The required repair cost for deck structures will be estimated by the following formula:

C = Sum (Ci x Ai)

where,

C : Required repair cost for the same member of group ($/pier)
Ci : Unit repair cost by Damage Grade (DG)
= ai x C(III)

C(III): Unit cost per Damage Grade III = 100 $/m^2
ai : Constant figure by Damage Grade

Grade 0	ai= 0
Grade I	ai= 0
Grade II	ai= 0.5
Grade III	ai= 1.0
Grade IV	ai= 2.0
Grade V	ai= 4.0

Ai : Area which should be repaired by Damage Grade (m^2)
= bi x ni x Ao
Ao : Unit area of member (m^2/ea)
bi : Constant figure by Damage Grade

Grade 0	bi= 0
Grade I	bi= 0
Grade II	bi= 20%
Grade III	bi= 40%
Grade IV	bi= 60%
Grade V	bi= 100%

ni : Number of damaged member by Damage Grade (ea/pier)
Refer to Table 2.8.5.

Thus, C = Sum (Ci x Ai)
= Sum (ai x C(III)) x (bi x ni x Ao)
= C(III) x Ao x Sum (ai x bi x ni)
= 100$/$m^2$ x Ao x (0.1xn2 + 0.4xn3 + 1.2xn4 + 4.0xn5)

Repair work on the pile foundation will be estimated by using C(III) = 400 $/$m^2$.

Similar to deck structure,

Thus, C = 400 x Ao x (0.1xn2 + 0.4xn3 + 1.2xn4 + 4.0xn5)

12.10.3 Rehabilitation Cost for Previous Ten and Fourteen Berth Extensions

(1) Pile Caps for Single Pile

Total surface areas exposed to free air in one direction; Ao
Ao = 1.4 x 0.7 = 0.98 m^2

from the Table 2.8.5, the number of damaged pile caps are
n2 = 140, n3 = 370, n4 = 629, n5 = 75.

Thus, C =C(III) x Ao x Sum (ai x bi x ni)
=100 \$/m^2 x 0.98 x (0.1 x 140 + 0.4 x 370 + 1.2 x 629
+ 4.0 x 75)
=98 x 1,217
=119,000 US\$

(2) Cap Connecting Beams for Dual Piles

Total surface areas exposed to free air : Ao
Ao = (2 x 0.7 + 1.4) x 5.7 + 2 x 0.7 x 1.4 = 17.92 m^2

From the Table 2.8.5, n2 = 10, n3 = 26, n4 = 30, n5 = 70

Thus, C = 100 x 17.92 x (0.1 x 10 + 0.4 x 26 + 1.2 x 30 + 4.0 x 70)
= 1,792 x 327
= 586,000 US\$

(3) Beams of Precast Elements

Total surface areas exposed to free air : Ao
Ao = (2 x 0.7 + 1.1) x 38 = 9.50 m^2

From the Table 2.8.5, N2 = 75, N3 = 312, N4 = 649, B5 = 24

Thus, C =100 x 9.50 x (0.1 x 75 + 0.4 x 312 + 1.2 x 649 + 4.0 x 24)
=950 x 1,007
=957,000 US\$

(4) Piles above the mean sea water

Total surface areas exposed to free air : Ao
Ao = 3.0 x 3.14 x 0.8 = 7.54 m^2

From the Table 2.8.5, n2 = 66, n3 = 54

Thus, C = 400 x 7.54 x (0.2 x 66 +0.4 x 54)
= 3,016 x 34.8
= 105,000 US$

(5) Front Walls and Fender Parapets

The front wall and fender parapet are also seriously damaged. The rate of damage is about 25%. Unit cost for this repair work is estimated about 200 $/m^2$.

Total surface areas exposed to free air : Ao
Ao = 3.0 x 5.0 x 4,500 + 15 + 3.5 x (4,500 - 300 x 3.0)
= 4,500 + 12,600
= 17,100 m^2

Thus, C = 200 x 17,100 x 0.25
= 855,000 US$

(6) Total Rehabilitation Costs

Thus total required rehabilitation cost for the existing 24 berths, from No.11 to No.34 will be summarized as follows.

Pile caps	119,000 US$
Cap beams	586,000 US$
Beam of precast elements	957,000 US$
Piles	105,000 US$
Front wall	855,000 US$
Total	2,622,000 US$

Since the total length of these berths is about 4,500 m, average rehabilitation cost per meter is 583 US$ or 11.70 US$/$m^2$. This cost is about one percent of the previous initial investment costs of 251.4 million US$ in the current price.

12.10.4 Rehabilitation Cost for Previous Four Berth Extension

General structural condition of these four berths is better than 24 berths as discussed above. However the construction of two berths at the western end haven't been completed yet and the existing conjunction point of this suspension is not maintained well. Thus, a tentative rehabilitation cost is given as below. Unit cost per meter berth is estimated as 250 US$.

C = 250 x 520 m
= 130,000 US$

This cost is not included the required repair cost of existing 45 cm concrete piles, since there is no observation records of damaged piles. For the cost estimation

purpose, it is assumed that about 10% of them require rehabilitation of two meter long for each pile. Total number of piles is about 3,000. Unit repair cost is estimated as 400 US$/m^2.

$$C = 400 \times 0.1 \times 3{,}000 \text{ piles} \times 2.0 \times 4 \times 0.45$$
$$= 432{,}000 \text{ US\$}$$

Thus, the total rehabilitation costs are 562,000 US$.

12.10.5 Rehabilitation cost for Eastern Jetty and Western Jetty

These jetties are rather old, 50 to 60 years after construction. PSO provided them with the repair works not only in the past but also at present, however the fundamentals of them are not changed.

As discussed in Chapter 7, only two berths located at both western ends of jetties will provide the users with the port service during the short term development. Proposed Master Plan Alternative-1 has no expectation that these jetties will remain as the main facilities. They will be completely replaced by the modern marginal wharf by 2006.

Thus, it is proposed that rehabilitation works on them should be minimum to meet these limited requirement.

PSO recently carried out rehabilitation works of Western Jetty for superstructures, and will continue the same to Eastern Jetty. The required costs for this work are excluded from the project.

It is reported that PSO recently conducted the structural investigation on the steel piles, however no data is available to the Study Team.

It is recommended to repair the damaged steel piles especially in the splash zone. It is assumed that 20% of 4,000 piles require rehabilitation against corrosion. Unit cost is estimated as 200 US$/m^2 for the exposed steel surface.

$$C = 200 \text{ \$/m}^2 \times 0.20 \times 4{,}000 \text{ piles} \times 3.0 \text{ m} \times 4 \times 0.5 \text{ m}$$
$$= 960{,}000 \text{ US\$}$$

However, it is also recommended that the actual rehabilitation should be carried out after the careful study on the investigation of piles.

12.10.6 Barge Harbor and Grain Terminal

Present structural condition of Barge Harbor is so excellent that rehabilitation won't be required.

On the other hand, PSO is performing rehabilitation works of all the reinforced

concrete structure above MSL including concrete piles of the Grain Terminal. Performance of these works is good due to the careful work under supervision of consultants. Thus, it is assumed that rehabilitation works for superstructures beyond these will not be required. For the substructures it is recommended to investigate submerged part of existing piles.

Although there is no data on the pile damage, it is recommended to repair such pile. It is assumed that ten percents of 600 piles require rehabilitation. Unit cost is estimated as 400 US$/m^2.

$$C = 400\ \$/m^2 \times 0.10 \times 600\ \text{piles} \times 3.0\ m \times 4 \times 0.4\ m$$
$$= 115{,}200\ US\$$$

It is reported that PSO concluded a contract with a contractor to install a detached dolphin. It is expected that this dolphin will prevent the existing pier from an excessive impact of vessels.

12.10.7 Summary of Rehabilitation Costs for Waterfront Structures

The required rehabilitation costs for the existing waterfront structures are summarized below.

24 Berths (No.11 to No.34)	2,622,000 US$
Four Berths (No.7 to No.8)	562,000 US$
Western and Eastern Jetties	960,000 US$
Barge Harbor	0 US$
Grain Terminal	115,200 US$
Total	4,259,200 US$

In order to cover the cost increase due to unknown factors, provisional cost of 0.75 million US$ is added. Thus the total rehabilitation costs are 5.00 million US$.

12.11 Transitional Use of Existing Jetties

In the long term development of proposed Alternative Plan 1, the existing two jetties together with the ore dolphin will be completely replaced by a new marginal wharf. All the existing shallow water behind the jetties will be reclaimed.

Before this development, these jetties are expected to provide the port users with services. It is proposed three berths should be active until the long term development as follows.

- Existing Berth No.3 should be extended for a 200 m long berth of DL-9.0 m depth. This will constitute a part of permanent marginal wharf of a 250 m long of DL-13.0 m depth, NB1.

- Existing ore dolphin should remain until the construction of marginal wharf.

- Existing Berth No.6 should be extended for a 260 m long berth of DL-13.0 m depth. This will constitute a part of permanent marginal wharf of DL-14.0 m, NB4.

Among these elements, structures of the existing ore dolphin will not be provided of any structural improvement but the repair works to the existing cargo handling equipment.

12.11.1 Options

There are tree options for transitional use during the short term development.

Option 1
No work will be provided. The steel piles should be investigated and repaired.

Option 2
All the structure should be replaced by the entirely new jetties.

Option 3
The steel pile should be investigated and repaired. A protection pier should be provided in front of the existing faceline.

Among these options, option 3 is selected for implementation.

12.11.2 Works to be provided

It is proposed that the western ends of two jetties will be strengthened by countermeasures as follows.

a. Repair works should be provided to the existing substructures namely H-shaped steel piles which might be damaged by corrosion.

b. New open structures consisting of reinforced concrete deck supported by the piles will be constructed by the end of 2000 as a part of marginal wharfs for the long term development. These will absorb the impact forces of vessel berthing and will protect the aged structures accordingly. During the long term development stage, existing structures will be demolished and completely replaced by new marginal wharfs.

The required cost estimation on item (a) will be provided in subsection 12.10.5. Thus, cost estimation on item (b) should be carried out.

12.11.3 Required Costs

The required costs are estimated to the following structures.

NB1: General and bagged cargo berth
- 200 m long, DL-9.0 m (initial stage)
- 250 m long, DL-13.0 m (long term stage)

NB4: Mineral berth
- 260 m long, DL-12.0 m (initial stage)
- The same length but DL-14.0 m (long term stage)

The required costs for NB1 is 5.00 million US$. Since the deck area is 2,600 m^2, unit cost per square meter is 1,950 US$. Refer to Appendix III-3.6.

The total deck areas of NB2 is 4,000 m^2.
1/2 (25+15) × 200 = 4,000 m^2

Applying the same unit price to this improvement, the required costs are 7.80 million US$.

4,000 m^2 × 1,950 $/m^2$ = 7,800,000 US$

Thus total costs for the structure are 12.80 million US$.

This construction work consists of various activities including piling, concrete work, fender setting and demolition of existing structures. Thus heavy constructional plants should be introduced.

Required costs during STD-FE2.

- Mobilization and demobilization	1,280,000 US$
- Construction of NB1 (partly)	5,000,000 US$
- Construction of NB4 (partly)	7,800,000 US$
- Demolition of existing structures	
	100$/$m^2$ × 20,000 m^2 = 200,000 US$
- Others	5% x 13,00,000 = 650,000 US$
Total	14,930,000 US$

- For NB1. 2,600 m^2/6,600 m^2 x 14,930,000 = 5,880,000 US$
- For NB4. 4,000 m^2/6,600 m^2 x 14,930,000 = 9,050,000 US$

12.12 Dredging and Reclamation

This section deals with the required dredging and reclamation works. These works will be conducted at three channels namely East Musa, Dorag and Zangi. East Musa Channel covers the basin between the entrance to Dorag Channel to the existing grain jetty. The main purpose of these works are both to provide the vessels with necessary waterways and basins and to create new lands by reclamation. The required work quantities are estimated for each alternative plan.

These works will basically be performed in two stages, short term development (STD) and long term development (LTD).

12.12.1 Background Information

Required dredging volume varies from 18 million cubic meters to 38 million cubic meters by plan. While the reclamation volume changes from 3 million cubic meters to 9 million cubic meters. This means that the dredging volume is considerably large and imbalance to reclamation requirement. Contrary there is a plenty of surplus soil for other reclamation works.

Among these works, three million cubic meters of earth should be dredged in the short term development stage in order to wash out the sediments above the design depth of berths.

Considering the soil condition, working condition, transport to dumping areas and quantity of works, unit price of dredging and reclamation works are estimated as follows.

- Dredging and reclamation for normal earth	3.0 $/m^3
- Dredging and reclamation for hard earth	6.0 $/m^3
- Dredging and reclamation for rock and similar	48.0 $/m^3
- Dredging and disposal for normal earth	4.0 $/m^3
- Dredging and disposal for hard earth	7.0 $/m^3
- Borrowing and reclamation	6.7 $/m^3

It is assumed that there are dumping sites within 10 km from the dredging areas.

Table 12.12.1.1 shows summary of the dredging and reclamation works.

Table 12.12.1.1 Summary of Dredging and Reclamation Works

Plan/Channels	Initial Dredging			Reclamation			Maintenance Dredging	
	STD	LTD	TOTAL	STD	LTD	TOTAL	Annual	30 years
1. East Musa Ch.	1,378,000	1,086,450	2,464,450	-	3,139,370	3,139,370	200,000	6,000,000
Dorag Ch.	1,574,800	13,933,951	15,508,751	-	1,963,826	1,963,826	450,000	13,500,000
Total	2,952,800	15,020,401	17,973,201	0	5,103,196	5,103,196	650,000	19,500,000
2. East Musa Ch.	1,378,000	1,086,450	2,464,450	-	3,139,370	3,139,370	200,000	6,000,000
Dorag Middle	1,574,800	1,783,389	3,358,189	-	-	-	450,000	13,500,000
Dorag South cut	-	1,592,000	1,592,000	-	-	-	-	
Dorag North cut	-	3,872,732	3,872,732	-	-	-	-	
Zangi Ch.	-	26,548,300	26,548,300	-	5,758,950	5,758,950	350,000	10,500,000
Total	2,952,800	34,882,871	37,835,671	0	8,898,320	8,898,320	1,000,000	30,000,000
3. East Musa Ch.	1,378,000	1,521,700	2,899,700	-	691,440	691,440	200,000	6,000,000
Dorag Ch.	1,574,800	15,159,471	16,734,271	-	2,538,866	2,538,866	450,000	13,500,000
Total	2,952,800	16,681,171	19,633,971	0	3,230,306	3,230,306	650,000	19,500,000

12.12.2 Required Works for Alternative Plan 1

Dredging and reclamation volume were estimated by calculation of each 100 m section. Summary of the works is provided in tables. Volume balance of them in Alternative Plan 1 is given below.

Table 12.12.2.1 Dredging and Reclamation, Plan 1

unit: m^2

Channel	Dredging			Reclamation
	STD	LTD	Total	LTD
East Musa	1,378,000	1,086,450	2,464,450	3,139,370
Dorag	1,574,800	13,933,951	15,508,751	1,963,826
Total	2,952,800	15,020,401	17,973,201	5,103,196

The total dredging volume is the smallest among other plans. However the reclamation volume is the second largest after those of Plan 2. This is due to the large land reclamation at the old port area.

Required cost for STD

Dredging works during STD is rather independent activities comapring to those during LTD. Dredging and reclamation works in LTD are a part of large scale marine works. Dredging of 2,952,800 m^3 will be conducted continuously through STD-EF1 and STD-EF2.

- Mobilization and demobilization costs 1,500,000. US$
- Dreging and disposal, normal earth
  $4/m^3 \times 2,952,800\ m^3 = 11,811,000.$ US$
  Total 13,311,200. US$

- STD-EF1. 70% x 13,311,200 = 9,317,840. US$
- STD-FE2. 30% x 13,311,200 = 3,993,360. US$

Required cost for LTD

Both dredging and reclamation costs are included in the integrated marine works.

Refer to Appendix III-2.3 and Appendix III-2.4 for the required costs.

12.12.3 Required Works for Alternative Plan 2

Zangi development, Alternative Plan 2 requires the largest volume of 35 million m^3 of dredging, since the existing water depth of channel is rather shallow. Quantity of works in Alternative Plan 2 is shown in the table below.

Table 12.12.3.1 Dredging and Reclamation, Plan 2

unit: m^2

Channel	Dredging			Reclamation	
	STD	LTD	Total	I	II
East Musa	1,378,000	1,086,450	2,464,450	3,139,370	-
Zangi	0	26,548,300	26,548,300	5,758,950	3,587,100
Dorag South	0	1,592,000	1,592,000	-	-
Dorag Middle	1,574,800	1,783,389	3,358,189	-	-
Dorag North	0	3,872,389	3,872,389	-	-
Total	2,952,800	34,882,871	37,835,671	8,898,320	3,587,100

Reclamation - I means both the earth piling out the old port area and the south bank of Zangi Channel. Reclamation - II is for the earth deposit at the north bank of Zangi Channel to be required in the post master plan development.

Dredging work will be required at the Dorag Channel entrance by means of cutting the seabed of its west bank for navigation safety. Connection part of two channels, Dorag and Zangi will also be widened for the same purpose.

Surplus spoil will amount to 22.4 million m3 of earth and will be utilized further land reclamation as follows.

a. Existing port area but not reclaimed upto + 7.5 m.
   5,000,000 m^2 x 2.5 m = 12,500,000 m^3
b. Back-up area for Zangi north bank.
   5,000 m x 400 m x 2.5 m = 5,000,000 m^3
c. South-east area of the first bending point of Zangi Channel.
   1,500 m x 800 m x 4.0 m = 4,800,000 m^3

Required cost for STD

Similar to plan 1, required cost of dradging during STD is estimated.

- Dredging cost for STD. 13,311,200 US$

Required cost for LTD

Both dredging and reclamation costs are included in the integrated marine works.

12.12.4 Required Works for Alternative Plan 3

Alternative Plan 3 requires 19.6 Million m^3 of dredging, which is slightly large volume than Plan 1. Contents of required works are shown in the table below.

Table 12.12.4.1 Dredging and Reclamation, Plan 3

Unit: m^3

Channel	Dredging			Reclamation
	STD	LTD	Total	LTD
East Musa	1,378,000	1,521,700	2,899,700	691,440
Dorag	1,574,800	15,159,471	16,734,271	2,538,866
Total	2,952,800	16,681,171	19,633,972	3,230,306

The required dredging volume exceeds extensively volume of the reclamation. The required reclamation volume is only 3.2 million m^3 which is 1.9 million m^3 less than those of Plan 1.

Required cost for STD

Similar to plan 1, required cost of dradging during STD is estimated.

- Dredging cost for STD. 13,311,200 US$

Required cost for LTD

Both dredging and reclamation costs are included in the integrated marine works.

Tables 12.12.4.2, 12.12.4.3, 12.12.4.4 and 12.12.4.5 show the dredging and reclamation volumes by channel.

Table 12.12.4.2 East Musa Channel Summary

TYPICAL NOTES	SECTION AREA	NO.	LENGTH L (m)	DREDGING A m2	ΣA m2	L x ΣA m3	RECLAMATION - I B m2	ΣB m2	L x ΣB m3	RECLAMATION - II C m2	ΣC m2	L x ΣC m3	
Master plan													
Alternative - 1 or 2	EM	1~30				1,086,450			3,139,370			0	
Present siltation	EM	1~30				1,378,000			0			0	
Master plan													
Alternative - 3	EM	1~30				1,521,700			691,440			0	
Present siltation	EM	1~30				1,378,000			0			0	

Table 12.12.4.3 Dorag Channel Summary

TYPICAL NOTES	SECTION AREA	NO.	LENGTH L (m)	DREDGING A m2	ΣA m2	L x ΣA m3	RECLAMATION - I B m2	ΣB m2	L x ΣB m3	RECLAMATION - II C m2	ΣC m2	L x ΣC m3	
Basic Volume	D	-4~56				19,872,703			2,757,916				
Master Plan													
Alternative - 1	D	-4~33				13,933,951			1,963,826				
Alternative - 2	D	18~32				1,783,389			0				50%
Alternative - 3	D	-4~41				15,159,471			2,538,866				
South Cut						1,592,000			0				
North Cut						3,872,730			0				
Site Selection													
Alternative													
2,500m, C+D	D	1~33				13,933,951			1,963,826				
2,500m, D+E													
	D	-1~-4				726,500			0				
	D	1~18				9,389,948			0				
	D	19~45				5,883,523			1,593,542				
Total						15,999,971			1,593,542				
Present Siltation	D	-4~50				1,574,800			0				
(-11.0/-12.5)													

Table 12.12.4.4 West Musa Channel Summary

TYPICAL NOTES	SECTION AREA	NO.	LENGTH L (m)	DREDGING A m2	ΣA m2	L x ΣA m3	RECLAMATION - I B m2	ΣB m2	L x ΣB m3	RECLAMATION - II C m2	ΣC m2	L x ΣC m3	
Basic Volume	WM	1~45				5,335,000			6,730,000			0	
Alternative													
2,500 m wharf		1~23				1,740,000			3,560,000			0	
		24~33				1,160,000			1,550,000			0	
Total						2,900,000			5,110,000			0	

Table 12.12.4.5 Zangi Channel Summary

TYPICAL NOTES	SECTION AREA	NO.	LENGTH L (m)	DREDGING A m2	ΣA m2	L x ΣA m3	RECLAMATION - I B m2	ΣB m2	L x ΣB m3	RECLAMATION - II C m2	ΣC m2	L x ΣC m3	
Basic Volume	Z	1~41				26,548,300			5,758,950	North		3,587,100	
Dorag South Cut 550m x -13.0m	D	6~19				1,592,000			0			0	
Dorag Middle	D	18~32				1,783,389			0			0	50%
Dorag North Cut	D	46~56				3,872,732			0			0	
Total						33,796,421			5,758,950			3,587,100	
Alternative													
2,500m wharf						32,013,032			5,758,950			3,587,100	

12.13 On-land Facilities, Buildings and Utilities

This section deals with the cost aspects of on-land facilities, buildings and utilities.

12.13.1 General Arrangements

The required quantity of works are estimated based on the general layout as discussed in Chapters 6 and 7. The basic quantities are presented in the related sections as follows.

- Section 8.8 presented the required works for the new developments of all alternatives including the basic land use.
- Section 8.9 showed the required works for Alternative Plans 1 and 2 including the basic land use.
- Section 8.10 indicated the required works for Alternative Plan 3 including the basic land use.

12.13.2 Quantities of Works

As explained in previous subsection, the required quantities of major items are provided in the main report, however, the quantities for minor items are presented in the estimation summary in Appendix III-2.3 as follows.

Appendix 2B1 Imam Khomeini Port Estimation : Summary

- New Development, Plan 1 (LTD)
- New Development, Plan 2 (LTD)
- New Development, Plan 3 (LTD)
- Existing Facility Upgrading, Plans 1 and 2 (LTD)
  Zone 1, Old port and Former Four Berth Extension Areas
- Existing Facility Upgrading, Plans 1 and 2 (LTD)
  Zone 2, Former Ten Berth Extension Areas
- Existing Facility Upgrading, Plans 1 and 2 (LTD)
  Zone 3, Former Fourteen Berth Extension Areas
- Existing Facility Upgrading, Plans 3 (LTD)
  Zone 1, Old port and Former Four Berth Extension Areas
- Existing Facility Upgrading, Plan 3 (LTD)
  Zone 2, Former Ten Berth Extension Areas

These are all for the long term development (LTD). Applied unit price is also shown for each cost item, based on the proposed unit price list shown in Appendix III-3.2.

12.13.3 Short Term Development

Same unit price lists are applied for the cost estimation of the short term development. The short term development might be executed by a group of independent contracts, thus cost estimation is carried out by work item.

Total cost will amount to 26,27 million US$ consisting 1.55 million US$ in the scope 1 and 24.72 million US$ in the scope 2. The former is mainly for urgent rehabilitation, and the latter is for upgrading the existing facilities.

Breakdown of the required costs is shown below.

STD-EF1

- On-land works		
pavement for additional access		
20,000 m^2 x 67.7$/$m^2$	=	1,354,000 US$
- Utilities,		
provisional, zone 2.		100,000 US$
- Supplemental works		
provisional, zone 2.		100,000 US$
Total		1,554,000 US$

STD-EF2

- On-land works		
pavement for yards and access		
30,000 m^2 x 1/2 x (67.7 + 96.8)	=	2,467,500 US$
20,000 m^2 x 67.7	=	1,354,000 US$
Others, provisional		278,500 US$
Subtotal		4,100,000 US$
- Buildings		
2 x 9,000 m^2 x 900 $/$m^2$	=	16,200,000 US$
General works (10%)		1,620,000 US$
Subtotal		17,820,000 US$
Others, 2 zones x 1,000,000	=	2,000,000 US$
Subtotal		19,820,000 US$
Total		23,920,000 US$
- Utilities,		
provisional, 3 zones		500,000 US$
- Supplemental works		
provisional, 2 zones		300,000 US$
Total		24,720,000 US$
Grand Total		26,274,000 US$

12.14 New Main Access

This section deals with the required cost for a new external access to the new development site. The proposed new port area is located at the west bank of Dorag Channel to which there is no access at present. Preliminary discussion of route arrangement is carried out in section 8.12.

12.14.1 Introduction

Preliminary cost estimation was carried out for six routes in respect of both Plan 1 and Plan 3 and three routes for Plan 2.

Scope of works is the required facilities between the starting point and the ending point as follows.

- Starting point
The appropriate location on the existing external access to the port. This point varies by each route.

- Ending point
The certain point located at west bank of Dorag. This point is located at the inland about 600 meters from the coast at the opposite area against the channel branch to Zangi.

Beyond this ending point, the distribution access and both access will be provided. However the required costs for there are classified separately as a part of the berth construction.

As discussed previously, it is assumed that the required utility main for new development will be constructed along the new route. However, it is assumed that those required for Plan 2 will be installed in the northern part of existing port area.

It should be noted that method of channel crossing is one of decisive elements in respect of the required cost and the channel utilization by large boats. Thus three crossing alternatives were considered.

a. Tunnel to be constructed under the channel bed
b. Long span bridge, longer than 500 m
c. Short span bridge, 500 m combined bridge consisting of ten sets of 50 m unit span

12.14.2 Required Cost for New Main Access

Table 12.14.2.1 shows a summary of cost estimated for the main access and utility mains. The required cost for selected Route D5 for Plans 1 and 3 amounts to 131 million US$ for each. The selected route for Plan 2, Route Z1, requires only 9 million US$.

As seen in the table, the lowest cost route is Z1, since this route does not require any bridge construction over the channel.

The highest one is route D1 which will cross the channel by a submerged tunnel. The second highest route is D2 which will cross the channel by a long span bridge of 600 m. Remaining six routes have the same characteristics that they should cross two channels by two bridge each 500 m of 10 spans of 50 m short span. Thus the

difference of the required costs is minor.

Table 12.14.2.1 Cost Summary of Main Access and Utility Mains

Routes	Cost million US$	Index %	Length m	Channel crossing
D1	407.60	316	3,300	submerged tunnel crossing channel
D2	177.00	157	2,270	a bridge, long span 600 m
D3	128.81	100	5,350	two bridges, short span 500 m long each
D4	133.14	103	8,550	two bridges, short span 500 m long each
D5	131.11	102	7,050	two bridges, short span 500 m long each
D6	151.07	118	17,000	two bridges, short span 500 m long each
Z1	9.05	7	3,700	no channel crossing
Z2	104.68	81	5,700	two bridges, short span 500 m long each
Z3	130.44	101	20,000	two bridges, short span 500 m long each

Note: Index is a ratio of required cost to those of D3.

12.15 Cargo Handling Equipment

This section deals with the required procurement cost of cargo handling equipment. The required costs for the Master Plan are subdivided into two categories namely, the short term development and the long term development.

In Chapter 9 "Preliminary Design of Cargo Handling Equipment", preliminary cost estimation was carried out based on both the proposed strategy for Master Plan and the availability of existing equipment at present.

12.15.1 Introduction

Table 9.3.1 shows a list of cargo handling equipment to be procured to meet the Master Plan requirement. These equipment are for the new development and replacement of existing ones by advanced models. Thus, all of them will contribute to increase the port capacity.

The same arrangement of equipment is applied for all the alterative plans. Thus, there is no cost difference between them.

In the proposed Master Plan, there are 335 units to be procured, namely 79 units of heavy equipment including container wharf cranes, container transfer cranes, mobile cranes etc., and remaining 256 units of other equipment including fork-lift trucks, tractor heads, chassises, track scales etc.

In the short term development, there are 173 units to be procured, namely 40 units of heavy equipment and 133 for other equipment. Table 12.15.1.1 shows the number of equipment both required and procured.

Table 12.15.1.1 Number of Equipment by Stage

Type	Existing in 1994	STD		LTD		Total (MP)	
		Req.	Prc.	Req.	Prc.	Req.	Prc.
Heavy Eq.	40	72	40	40	39	112	79
Other Eq.	93	206	133	170	123	376	256
Total	133	278	173	210	162	488	335

Note: Req.: Required, Prc.: Procurement

12.15.2 Condition of Cost Estimation

As discussed in paragraph (2) of subsection 12.1, cargo handling equipment are classified into four groups namely.

Classification a.
New Investment for the new development
Classification b.
Renewal for the new development
Classification c.
Replacement of existing equipment
Classification d.
Renewal of existing equipment

Among them, the targets for the initial investment are Item (a) and Item (c).

Basic condition of cost estimation is as follows.

a. Required costs are for Item (a) and Item (c) of the basic classification, thus the required costs for Item (d) are excluded.
b. Cost should included all the expenses of procurement, factory testing, transport, installation, testing at site, appropriate spare parts.
c. Cost should also include indirect expenses of management fee, overheads, duties and taxes. However, import tax to Iran is excluded.
d. Cost should include the maintenance service during the maintenance period accordance with the contract.

Adopted unit prices for each equipment are provided in Table 9.3.1.

12.15.3 Required Cost

The required initial costs during the short term development will amount to 40.6 million US$, sharing about 23% of the total initial cost. Table 12.15.3.1 shows a summary of the required costs by stage.

Table 12.15.3.1 Summary of Cargo Handling Equipment Costs

Unit: Million US$

Type	STD	LTD	Total (MP)
Heavy Eq.	35.18	126.72	161.90 (91.27%)
Other Eq.	5.37	10.12	15.49 (8.73%)
Total	40.55	136.84	177.39 (100%)
	(22.86%)	(77.14%)	(100%)

12.16 Navigation Aides

Required facilities are recommended in Chapter 10. Refer to the same Chapter for the cost estimation.

12.17 Alternative Plans for New Development Site Selection

It is assumed that about ten new berths should be constructed at the new site for excess cargo traffics in 2,010 even after the reasonable upgrading of existing facility. These ten berths will require a new berth line of 2,400 meter long. As discussed in Chapter 6 and Chapter 7, basic candidates for new site are the northern coast line of existing port area along the Zangi Channel, thus Zangi South Bank, and the western coast line of Dorag Channel, thus Dorag West Bank. The former is located on the low flat land immediately north of the new railway sidings. Thus this area has a good access to the existing facilities but it takes 6 km approaching waterway to this. The latter is just opposite site of the existing 24 marginal berths, 10 pus 14, and shorter approach is required than the former site. However a completely new land transport access to the latter should be installed crossing the channels over by either bridges or channel bed tunnels.

Another difference to be evaluated between these two candidates is the required cost for utility mains.

This subsection deals with the cost aspect of alternative sites.

12.17.1 Basic Condition of Cost Estimation

In order to prepare a preliminary data for the preparation of Master Plan Alternatives, basic condition of cost estimation is fixed as follows.

a) Each alternative site can accommodate a total berth length of 2,400 meters with back-up area in 400 m wide.
b) Water depth is D1 -12.0 m (CESCO Datum).
c) Width of effective width of approach channel should be more than 550 m in Dorag and 450 m in Zangi. Entrance channel to Dorag should be 850 m or more.
d) New access to the Dorag West Bank and Zangi South Bank are the Route D5 and Z1 as discussed in subsection 10.14.
e) Access should provide the required facilities both roadways and railways.

Unit price for the study except wharf cost is as same as the Master Plan cost estimation. Refer to 12.14 and III-3.1,III-3.2. Basic figures above is not always the same one which adopted in the Master Plan.

The Dorag west site including West Musa and Zangi North are subdivided into seven blocks.

Dorag West Bank

Block, A	1,200 m	long facing to Musa Channel
Block, B	1,200 m	long facing to Musa Channel
Block, C	1,200 m	long the first block in Dorag Channel
Block, D	1,040 m	long the second block in Dorag Channel
Block, E	1,200 m	long the third block in Dorag Channel

Zangi South Bank

Block, F	1,200 m	long at the first block in Zangi Channel
Block, G	1,200 m	long at the second block in Zangi Channel

There are five combination to achieve 2,400 meter berth length.

A + B, B + C, C + D, D + E and F + G

Cost estimation was carried out for each block then combined later. Figure 12.17.1 shows the general subdivision of these seven blocks and five combinations. Cost is firstly estimated for each block then combined.

12.17.2 Summary of Cost Estimation

Table 12.17.1 shows the summary of required cost for each 2,400 m block combinations. As shown in the table, cost difference is just minor and contains only 5% change. This may imply that selection of new site should be made by other views such as channel maintenance affect to other users of upper stream of these sites by boats, future port development and etc.

Table 12.17.2.1 indicates the soil balance between the dredging and reclamation.

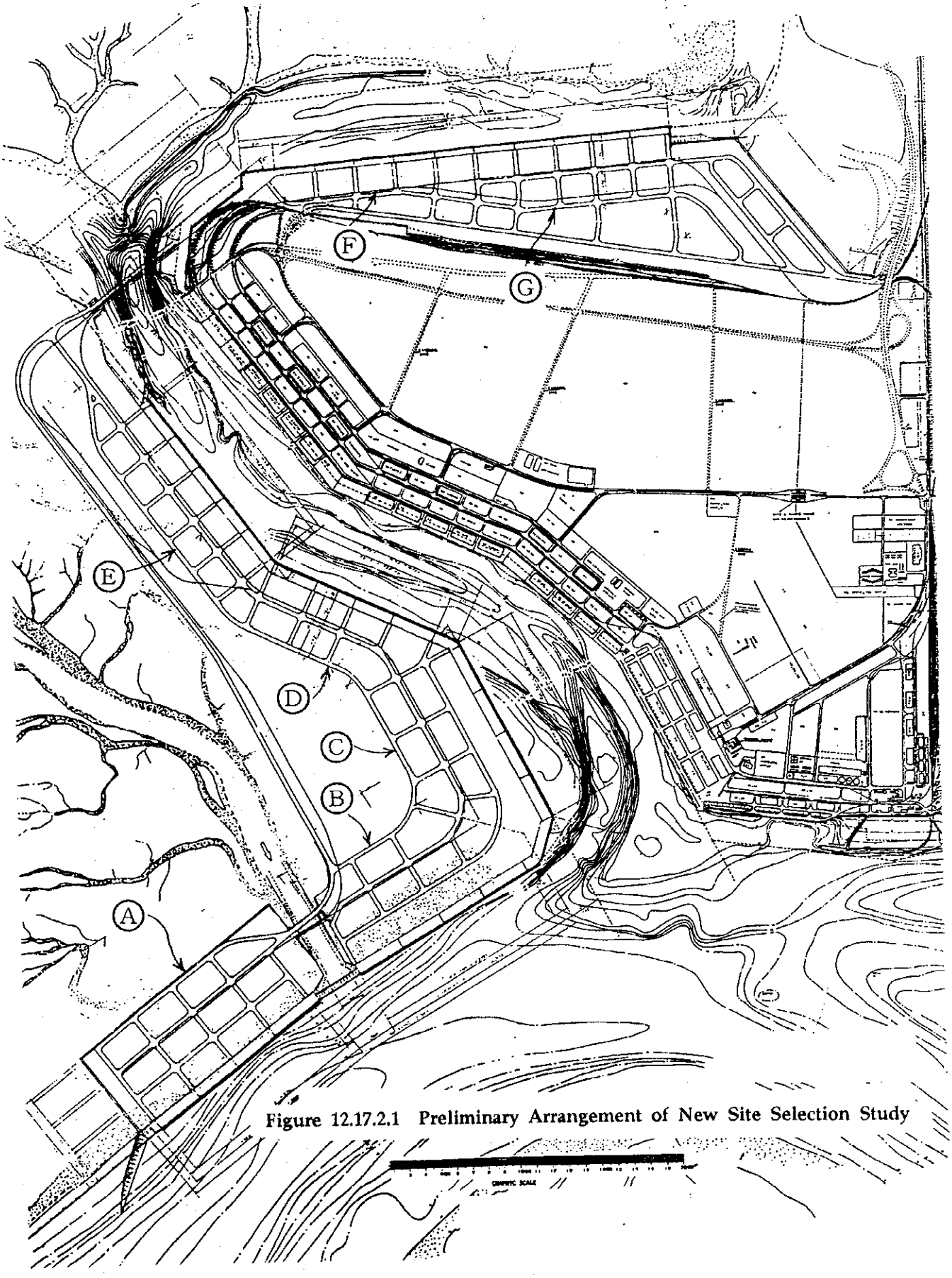

Figure 12.17.2.1 Preliminary Arrangement of New Site Selection Study

Table 12.17.2.1 Preliminary Cost Study for New Development Site

Unit: Million US$

Works and Area	A	B	C	D	E	F	G
Area ha	63.87	55.72	53.73	46.69	73.04	52.36	73.91
Effective Berth (m)	1,200	1,200	1,200	1,040	1,200	1,200	1,200
I. Berth Side Cost							
A. General Works	11.6	11.6	11.6	11.6	14.0	14.0	14.0
B. Marine Works	74.8	73.9	106.3	59.2	64.2	114.7	112.4
C. On-land Works	51.3	43.4	50.6	35.0	60.9	42.2	54.9
D. Buildings	25.3	25.2	24.8	25.1	31.5	31.5	31.6
E. Utilities	7.5	7.3	7.2	7.1	9.8	9.6	10.4
F. Supplemental Works	-	-	-	-	-	-	-
G. Subtotal (A ~ H)	170.5	161.5	200.5	137.9	180.4	212.0	223.3
II. Main Access and Utility		A + B	B + C	C + D	D + E		F + G
(1) Roads		134.5	120.0	120.2	118.6		0.0
(2) Railways		28.0	17.4	15.9	16.9		7.5
(3) Water Supply		1.7	1.7	1.6	1.4		-0.3
(4) Power Supply		1.4	1.3	1.2	0.9		-0.5
(5) Bunker Supply		6.5	5.2	3.9	1.1		4.8
(6) Subtotal		172.1	145.6	142.8	138.9		11.5
I plus II		504.1	507.6	481.2	457.2		446.8
III. Dorag Entr. Dredging*		0.0	0.0	0.0	40.0		36.5
IV. Grand Total Cost		504.1	507.6	481.2	497.2		483.3
Index (%)		105	105	100	104		100

Note: * 40,000,000 = 5$/m3 x 8,000,000 m3 for Dorag entrance dredging.
* 36,500,000 = 5$/m3 x (1,800,000 + 1,600,000 + 3,900,000) for Dorag dredging

Table 12.17.2.2 Soil Balance in Alternative Blocks

Unit: Million m3

Type of Dredging and Soil	A	B	C	D	E		F	G	
1. Required Volume									
Dredging 106m3	0.94	1.30	8.73	0.85	0.56	12.38	11.16	11.16	22.32
Reclamation 106m3	2.56	2.56	1.84	1.23	1.40	9.59	4.98	4.98	9.96
2. Soil Classification									
Soft	0.28	0.39	1.75	0.26	0.17	2.85	3.33	3.33	6.66
Normal	0.28	0.39	1.75	0.26	0.17	2.85	5.56	5.56	11.12
Hard	0.38	0.52	5.24	0.34	0.22	6.70	2.22	2.22	4.44
3. Borrow and Disposal									
Borrow	2.04	1.83	0.00	0.96	1.36	6.19	0.00	0.00	0.00
Disposal (S, N)	0.28	0.39	1.75	0.26	0.17	2.85	0.58	0.58	1.15
Disposal (H)	-	-	4.68	-	-	4.68	5.56	5.56	11.12
Summary for 2,400 m									
		A + B	B + C	C + D	D + E			F + G	
1. Required Volume					(C + D + E)			(C + F + G)	
Dredging		2.24	10.03	9.58	10.14			31.05	
Reclamation		5.12	4.40	3.07	2.63			9.96	
2. Soil Classification					(C + D + E)			(C + F + G)	
Soft		0.67	2.14	2.01	2.18			8.41	
Normal		0.67	2.14	2.01	2.18			8.41	
Hard		0.90	5.76	5.58	5.80			9.68	
3. Borrow and Disposal					(C + D + E)				
Borrow		3.78	1.83	0.96	2.32			0.00	
Disposal (S, N)		0.67	2.14	2.01	3.93			3.50	
Disposal (H)		-	4.68	4.68	5.24			16.36	

12.18 Operation and Maintenance Cost

This subsection deals with the scale of required routine maintenance cost for the fixed facilities and cargo handling equipment proposed in the Master Plan. For the basis of cost estimation, Alternative-1 of Master Plan is selected. In order to evaluate the scale of these maintenance costs, annual operation and maintenance cost is roughly estimated based on the similar projects.

12.18.1 Operation and Maintenance Cost: O/M Cost

The operation and maintenance costs are tentatively estimated by the following formula. More detailed information for the Short Term Development will be given in Chapters 14 and 15.

$C = U \times V$

Where, C : O/M cost per year ($)
U : Unit O/M cost per unit cargo - assuming 3.0$/ton
V : Cargo volume per year (tons/year)
Cargo volume for the existing facilities
Ve = 27.9 million tons
Cargo volume for the new development
Vn = 3.10 million tons

These cargo volume allocation is for Alternative Plan 1 as discussed in Chapter 5 and Chapter 6. Thus, the required operation and maintenance cost for each prospective category is;

Prospective 1,2	:	Ce = 83,700,000 $/year
Prospective 3	:	Cn = 9,300,000 $/year
Total		C = 93,000,000 $/year

12.18.2 Maintenance Costs

According to the past experience, the required annual maintenance cost mainly relates to the amount of initial investment cost. Average annual maintenance cost ratio adopted for Imam Khomeini port are as following:

Table 12.18.2.1 Proposed Rates of Annual Maintenance Cost to Investment Cost

	Type of Facility	% of Initial Cost
1.	Fixed Facilities	
a.	Aged and Flexible Structure	1.25
b.	New and Rigid Structure	0.75
2.	Cargo Handling Equipment	5.00

Note: Fixed facilities include the marine works, on-land works, buildings and utilities.

The required annual maintenance costs for fixed facilities and cargo handling equipment are roughly estimated as follows.

(1) Existing Port Facilities

According to the study report for the Fourteen Berth Extension, the total amount of previous projects is 802.65 million US dollars in 1994 price. Conversion factor adopted is 1.67 based on the changes of wharf cost and transit shed cost in the real market. However this amount is not completely disbursed due to delay of implementation. It is assumed that construction and procurement about 82% of that amount were carried out.

For the maintenance cost estimation, it is assumed that remaining 18% will be spent before the commencement of the Master Plan implementation.

Table 12.18.2 shows major contents of these previous investments

Table 12.18.2.2 Investment Cost for Existing Facilities

1994 price, Unit: Million US$

Works	Total	Progress	Remaining
a. Earthworks	100.82	99.2	1.62
b. Khor Musa Bar	15.90	15.90	0
c. Marine works	309.37	299.80	9.57
d. Roads and utilities	133.51	83.73	49.78
e. Railway works	41.84	20.93	20.91
f. Buildings	116.88	73.16	43.72
g. C.H. Equipment*	64.04	64.04	0
h. Others	20.29	3.27	17.02
Total	802.65	660.03	142.62
Share	100%	82%	18%

Source: Study Report for Fourteen Berth Extension prepared by Iran-Kampsax. Figures in item (g) is only a part of total investment.

Refer to the detailed table in Appendix III-2.3.

Based on the table, the required routine maintenance cost for the existing facilities is roughly estimated as follows. For the equipment cost, another 100.0 million US$ is tentatively added to the amount shown in the table.

Fixed facilities	1.25% x 738.61 = 9.23 million US$
C.H. Equipment (1)	5.00% x 64.04 = 3.02 million US$
C.H. Equipment (2)	5.00% x 100.00 = 5.00 million US$
Total	17.25 million US$

For the existing damaged structures, urgent rehabilitation should be made as soon as possible. Thus routine maintenance cost is limited to the ordinary repair works after rehabilitation of them as discussed in section 12.10.

(2) Upgrading and Replacement of Existing Facilities

According to Chapters 11 and 12, total costs for the upgrading of existing fixed facilities amounts to 321.54 million US$. Total investment cost of equipment for the upgrading and replacement of existing facilities together with new development amounts to 189.39 million US$. It is assumed that two-third of this amount is for the upgrading and replacement of existing equipment. Thus the required routine maintenance cost for the upgraded existing facilities will be as follows.

Fixed facilities	0.75% x 321.54 = 2.41 million US$
C.H. Equipment (1)	5.00% x 146.85 = 7.34 million US$
Total	9.75 million US$

(3) New Development

Total fixed facilities for the new development amounts to 449.00 million US$. Cargo handling equipment cost will be one-third of 146.84million US$.

Thus the required routine annual maintenance costs will be as follows.

Fixed facilities	0.75% x 449.00 = 3.37 million US$
C.H. Equipment (1)	5.00% x 42.55 = 2.13 million US$
Total	5.50 million US$

(4) Summary of Annual Maintenance Cost

Total annual maintenance cost amounts to 32.50 million US$ as following.

Table 12.18.2.3 Estimated Annual Maintenance Cost

Unit: Million US$

Prospective	Fixed Facility	C.H. Equipment	Total
1. Existing Facility at Present	9.23	8.02	17.25
2. Upgrading and Replacement of Existing Facility	2.41	7.34	9.75
3. New Development	3.37	2.13	5.50
Total	15.01	17.49	32.50

It is assumed that this amount shares about 35% of annual operation and maintenance cost (O/M costs).

Chapter 13

Management and Operation for the Proposed Port Activities

Chapter 13 Management and Operation for the Proposed Port Activities

13.1 Overall Administration System

13.1.1 Required Functions for Iranian Commercial Ports

To be logistics centers for the national citizens, to support development of the national economy and to function as strategic centers in the international transportation network, the Iranian ports should be "attractive and profitable ports for users".

It is thought that (1) highly efficient, (2) cost saving, (3) safe and reliable services are priority requirements in becoming an attractive port for users.

The most important function of a port is to serve as a terminal where sea and land transportation meet. Efficiency and safety are thus vital in the transfer of cargo and passengers. For cargo handling, quickness, reliability and cost effectiveness are strongly required.

13.1.2 Government and PSO, De-Centralization

PSO can be called an independent organization, because

(1) PSO has its own special account,

(2) PSO has the competence to control national water area and a part of land area.

PSO is, however, under strict control of Government and the parliament, because

(1) PSO needs permission from the parliament when changing its tariff by more than 30 %,

(2) Government gives PSO subsidies for large scale development work.

In general, ports are important public infrastructures for the national economy. Therefore, it is necessary that ports be under administration of Government to a certain degree.
On the other hand, the participation of Government should be reduced especially in the field of port operation and investment for efficient port management and operation. Financial system based on economic principles should be established to realize financially sound port management and operation. It is important that PSO becomes financially independent from Government and has the competence to decide investments to realize more efficient and financially sound port management and operation. This will contribute to development of the national economy.
Therefore, the ports should be under the control of Government to a certain degree, but the ports should become independent in the field of port operation and investment as far as possible.

An example of the relationship between Government and the port management entity (PSO) is shown below.

(1) Port management entity (PSO) should be financially independent from Government.

(2) Port management entity (PSO) should have competence to decide its tariff.

(3) Permission of parliament should be needed to decide its yearly budget.

(4) Permission of parliament should be needed to decide the laws concerning its activities.

(5) Port management entity (PSO) should have a council which consists of the heads of the authorities concerned as a decision making organization.

(6) The head of Port management entity (PSO) should be chosen by the above mentioned council.

Proper institutional system should be created referring to the above mentioned example as far as circumstances permit.
Concerning the tariff, in particular, if modification of a part of the tariff is considered to contribute to proper and efficient port operation, such as modification of storage charge as mentioned below, PSO should have the competence to implement such a revision.

13.1.3 PSO head office and Port Authorities

The port authorities currently conduct port related activities according to direction of PSO head office. PSO head office strictly controls personnel, budget and procurement affairs of the port authorities.
To provide the port users with higher quality services in the future, it is desirable that each port competes with each other and devises the contents of the port service. This will contribute to development of the national economy by raising the quality of port services.
Therefore, it is desirable to gradually transfer some of the competence, which PSO head office has currently, to the port authorities.

(1) Procurement System

PSO should possess basic port infrastructure and facilities including major quay cranes to control the ports properly even after privatization, and PSO will conduct maintenance work of these port infrastructure and facilities.
Iranian ports should be able to repair cargo handling equipment quickly, especially in the case of container cargo handling equipment such as gantry cranes. To become hub ports in this area it is very important in operating modern container terminals to minimize idling time of cargo handling equipment, thus more effective procurement

activities for spare parts of maintenance works are required in order to avoid possible delay of cargo handling for highly time conscious container vessels.
It is desirable that each port be able to purchase their necessities such as spare parts for cargo handling equipment through a more simplified procedure. PSO head office should transfer its competence concerning procurement procedure and revision of the budget to the port authorities as far as possible.

(2) Finance

Each port should become a more independent entity to provide the port users with higher quality services in the future. It is desirable that the port authority or the complex of the port authorities become financially more self-supporting to have more competence to decide a part of tariff and investment. The port authorities of advanced ports in major countries have this self-supporting accounting system. Studying such a system is recommendable.

(3) Personnel

PSO head office has the competence to decide personnel affairs of the port authorities, such as appointment, movement and promotion at present.
It is desirable that each port be able to evaluate and appoint its own personnel to cope with the particular problems of each port. It is not rational that PSO head office decides all personnel affairs because the procedure usually takes a long time and the system can hardly reflect the actual condition of each port site.

Therefore, each port authority should have the competence to decide personnel affairs of staffs who are in charge of controlling port site activities.
However, smooth relationship between PSO head office and port authorities is necessary. In this sense, it is realistic that some posts are appointed by PSO head office.

The sample recommendation on roles of the PSO head office and the port authorities concerning personnel affairs are shown below.

1) The Port Director and the Deputy Port Directors should be chosen by PSO head office (the Board of Directors).
2) Employment and dismissal of all port authority staff who are lower than the above mentioned class is decided by PSO head office.
3) The director of each department should be chosen by the Managing Director of PSO head office.
4) Promotion and movement of port authority staff who are lower than the director of each department is decided by each Port Director.
5) Personnel transfer between the port authorities is decided by PSO head office based on mutual agreement.

Proper personnel system (appointment, movement and promotion) should be created referring to the above mentioned recommendation as far as circumstances permit.

In addition to this, personnel transfer between PSO head office and the port authorities should be increased. To realize development of port management and operation, PSO head office and the port authorities should cope with this theme in cooperation with each other. On the other hand, ports are unique spots where sea transport and land transport meet. Expert knowledge is needed to control port management and operation. All PSO staff should be well versed in actual condition of the ports. They all should be highly qualified and have experience in port operation and management. Therefore, persons who have experience at port operation sites should be sent to PSO head office under an appropriate transfer scheme.

(4) Port promotion

As mentioned later, PSO does not conduct conspicuous port promotion activities. PSO should conduct the activities aggressively. Currently PSO head office makes a port promotion plan and conducts it. It is desirable, however, that each port competes with one another to heighten the quality of services. Therefore, port promotion activities should be conducted by the port authorities in future. ABPA, ANPA, and IKPA, in particular, should conduct these activities at an earlier stage, because these ports compete with neighboring ports such as Dubai port.

(5) Construction Work

At present, large scale construction works are planned by PSO head office, detail design and supervision of them are contracted out by PSO head office. (The port authorities can make contracts of construction works.) In the future, PSO head office should transfer the jobs concerning construction works except planning, budgeting and formulation of design criteria, to the port authorities to reduce the procedures. At the ports which need large scale development such as Abbas port and Imam Khomeini port, this transference is more important.

(6) Operation of the Ports

PSO head office controls port operation activities of each port at present. In the future, PSO head office should transfer the jobs concerning port operation to the port authorities for them to operate their ports more flexibly. Specifically, the issuance of the licenses for cargo handling works to private entities and permission of land use in the port area should be assumed by the port authorities.

(7) Items which should be under control of PSO

While administrative competence should be transferred to the port authorities as far as possible, PSO must retain control of certain areas because ports are a strategic and important infrastructure of Iran. Major items of which PSO should be in charge are listed below.

1) Formulation of nation-wide port development policy and plan
2) Examination of development plan of individual port

3) Permission of exclusive use and reclamation of public water area
4) Permission of large scale development activities in port area
5) Revision of (a part of) port tariff
6) Formulation of budget of Iranian ports
7) Formulation of port related law and regulation
8) Formulation of technical standards for construction work of ports
9) International affairs

13.2 Development of the Port Organization

13.2.1 Basic Policy for Port Management and Operation

Alternative(A) and Alternative(B) in the Table 13.2.1.1 are considered the best selections for PSO.
Under alternative(A) and (B), early introduction of privatization in cargo handling operation is recommended. As is commonly understood, public sector is normally not flexible in providing personnel or investment in response to the actual fluctuation of demand. In this sense, full involvement of the port authority in cargo handling services is not always suitable for increasing of efficiency of such services under a competitive market, and increased situation of cargo flow in particular.
Therefore, it is sound for Iranian ports to privatize cargo handling function as soon as possible and improve their efficiency through competition among private companies. This will be a better solution to realize an efficient cargo handling system and to contribute to improvement of the Iranian economy in the future.
To realize above mentioned introduction of privatization, however, PSO has to make great efforts to attract more cargo so as to activate the port related private entities which will absorb PSO's operational staffs.

13.2.2 Imam Khomeini Port Authority (IKPA)

If cargo handling service is privatized, the sections for cargo verification, cargo handling, warehouse will be separated from IKPA. Eventually the organization for mooring, water supply, repair work of cargo handling equipment, should also be separated. Towage and pilotage can be separated if there is enough demand.

However, the organization which conducts management of port infrastructure and facilities should be left under their administration. The following management activities will be done by IKPA in such a case.

1) Permission of usage of port infrastructure and facilities, berth allotment.
2) Permission of usage of port area.
3) Calculation, billing and collection of usage charges of port infrastructure and facilities.

In the future, there is a possibility that railway trains will interface with cargo handling flow in the yard. So, railways should be controlled by IKPA to ensure efficient cargo handling.

Table 13.2.1.1 Alternatives of Terminal Operation

Alternative		Present		Short Term Plan (- 2000)		Long Term Plan (- 2010)	
		Major ports on Persian Gulf	Major ports on Caspian Sea	Major ports on Persian Gulf	Major ports on Caspian Sea	Major ports on Persian Gulf	Major ports on Caspian Sea
(A)	Owned by	Public	Public	Public	Public	Public	Public
	Provide service for	Open	Open	Open	Open	Open & Exclusive	Open
	Cargo handled by	Public & Private	Public & Private	Private	Private	Private	Private
(B)	Owned by	Public	Public	Public	Public	Public	Public
	Provide service for	Open	Open	Open & Exclusive	Open	Open & Exclusive	Open
	Cargo handled by	Public & Private	Public & Private	Private	Private	Private	Private

Note: Exclusive; The type of operation which allows only limited companies to use berths.

Open & Exclusive; In principle the berths are open to public use, but exclusive use berths will be partly introduced.

Environmental affairs will become an important issue. In IKPA, sections in charge of conducting monitoring and assessing environmental impact should be established in the future.

There is a possibility that IKPA could become financially independent and conduct port promotion activities by themselves in the future. IKPA should start to study these issues. It should conduct these activities at the earliest possible stage because Imam Khomeini port competes with neighboring ports such as Dubai port.

13.2.3 Exclusive Use Terminals

(1) Container Terminal

Container terminals, at Imam Khomeini port in particular, are better suited to the introduction of an exclusive use terminal system. In this case, it is very important to determine how to select the best entities for appropriate operation of the terminal. Examples of criteria for selection of such companies are shown as follows.

1) Companies which are able to perform efficient container cargo handling to fit customer demand.
2) Companies which can collect an adequate quantity of container cargo while keeping sound financial position.
3) Companies which can provide reliable services throughout their leasing term

(2) General Cargo Terminal

General cargo terminals are normally used by various users and handle a smaller amount of cargo compared with container terminals. Naturally, these terminals should be open to public use.

(3) Bulk Cargo Terminal

In the case of terminals for bulk cargo such as grain, iron powder and aluminum powder, on-land facilities can be used by a specified entity, while the berth will be used by many shipping companies. Therefore, the berths should be open to public use. PSO may lease a limited area of land to the specified entities, and allow them to construct on-land cargo handling facilities if these facilities do not obstruct public use of the berths. In this case, the lease periods should be limited.

13.2.4 Owner of Port Infrastructure and Facilities

IKPA should own major infrastructure and facilities such as water facilities (waterways anchorage), breakwater, wharves, open storage yard and transit sheds even after privatization of cargo handling services.
In addition to these, quay cranes fixed on the berths such as gantry cranes should be owned by IKPA so as not to obstruct public use of the berths. These cranes should be leased to private cargo handling entities in the future.

Other equipment such as forklifts and movable cranes should be owned by private entities because this equipment can be flexibly provided by private entities and IKPA can save time for procurement procedures and maintenance work. However, items of equipment which IKPA owns at present should be retained until their service lives have expired.

13.3 Financial System and Port Tariff

13.3.1 Financial System

(1) General

PSO has a modern financial system as it uses normal financial statements.
However, PSO is not financially independent from Government because its investment budget comes from the national general account.

The intervention of Government should be reduced especially in the field of port operation and investment for efficient port management and operation as much as possible. Financial system based on economic principles should be established to realize financially sound port management and operation.
It is important that PSO becomes financially independent from Government and has the competence to decide investments to realize more efficient and financially sound port management and operation. This will contribute to the development of the national economy.

To grasp and analyze financial situations accurately and quickly, it is necessary that PSO has more detailed financial statistics data - data by kind of cargo, by port etc.

(2) Imam Khomeini port authority (IKPA)

In future, port income is expected to greatly increase at Imam Khomeini port. Therefore, it is desired that IKPA has a self-supporting accounting system.
To put it concretely, in future, by the year 2010, IKPA should begin to allocate income for maintenance and repair expenditures.
The methods to raise investment funds are shown in Table 13.3.1-1.

Table 13.3.1.1 Methods to Raise Investment Funds

case	methods
A:	Iman Khomeini port authority accepts subsidies from PSO head office budget. Imam Khomeini port authority returns contributions from net income to PSO head office.
B:	Imam Khomeini port authority allocates its own income for investment. Imam Khomeini port authority returns no contibution. Approval by PSO head office conditions investment planning.

It is desired that IKPA targets case A temporarily, then shifts to case B as soon as profits get higher and the basis for a self-supporting accounting system is established.

On the other hand, IKPA should make efforts to restrain increase of fixed expense such as personnel expense. Especially, too much personnel employment causes unsound financial conditions. To reduce personnel expense, following methods are effective.

1) Efficient port management and operation.

By introduction of new equipment or improvement of staff's ability, required number of personnel for port management and operation (per fixed quantity) decrease.

2) Introduction of contract work

By changing work provided by IKPA to contract work by private entities, staff in charge of that work can practice other work. This supports privatization.(Contract expense is easier to reduce than personnel expense.)

3) Reconsidering the service previously provided by IKPA

In exchange for the start of new work such as port promotion activities in the future, previous unnecessary work should be abolished.

(3) Fund raising

Under a self-supporting accounting system, investment funds should be mainly raised from port income. Maintenance and repair expenditures of port equipment and facilities should be all raised from port income.

However, when a relatively large initial investment is necessary, for example - construction of new facilities and equipment, port income alone may be insufficient to meet the required investment. In this case, IKPA should obtain interest-free loans by external financing.
But, needless to say, even interesting-free loans should be applied for only under the following conditions.

1) The objective investments are essential to Imam Khomeini port.
2) Loan repayment will not seriously hamper the port authority's financial situation.

If necessary, IKPA should consider regular loans if repayment will not be a problem.

13.3.2 Port Tariff

(1) General

Financial system based on economic principles should be established to realize financially sound port management and operation. PSO should set its tariff at a proper level to obtain sufficient income to maintain sound financial condition and to make the necessary investments.
On the other hand, tariff should be set taking levels of neighboring ports into consideration to attract more port users. PSO should always study tariffs of neighboring ports and major hub ports in the world.

For reference, PSO tariff rates are compared with those of a representative Asian port(Port A) and Central American port (Port B) in Table 13.3.2-1.
Under the PSO tariff, costs to shipping companies are approximately 9.1 times higher that at Port A and 8.6 times higher than at Port B.
Oppositely costs born by cargo owners under the PSO tariff are 10.0 % of those at Port A and 11.9 % of those at Port B.
Consequently, PSO should vigilantly monitor and analyze tariffs of neighboring ports and major hub ports in the world, and revise its tariff when necessary.
Tariffs related to shipping companies must be reduced to a lower level. If the tariff structure is not competitive with other ports, it will be difficult to attract more users.

On the other hand, tariffs related to cargo owners must be raised so that PSO can gain enough income for port development, maintenance, management and operation. However, needless to say, when PSO raises the tariff level, competitiveness with other ports should be checked carefully.

(2) Privatization and Tariff

With the introduction of privatization, the income structure will be changed drastically. After privatization, the consignees will pay charges such as cargo handling charge to the private entities, then the private entities will pay port charge and duties such as charge for transit sheds to PSO (the port authorities).
The consignees will pay the port authorities the port duties such as wharfage.

Table 13.3.2.1 Tariff Comparison

Presuppositions

Container Ship	25,000 GRT	
Staying in Port	2 days	
Unloading Container(Import)	1,000 Units(Full, 20f)	10,000 Tonnage
Loading Container(Export)	500 Units(Full, 20f)	5,000 Tonnage
(Loading and Unloading at Berth)		

Tariff for Shipping Company	PSO		Port A (An Asian Port)		Port B (A Port in Central America)	
	Tariff Rate	Tariff	Tariff Rate	Tariff	Tariff Rate	Tariff
Entering Port Mouth	6 cent/GRT	1,500 US$	- cent/GRT	0 US$	- cent/GRT	0 US$
Entering Port	10 cent/GRT	2,500 US$	4.12 cent/GRT	1,030 US$	5 cent/GRT	1,250 US$
Pilotage	40 cent/GRT	10,000 US$	4.12 cent/GRT	1,030 US$	- cent/GRT	0 US$
For Dredging	41 cent/GRT	10,250 US$	- cent/GRT	0 US$	- cent/GRT	0 US$
Loading and Discharging	22 cent/GRT	5,500 US$	- cent/GRT	0 US$	- cent/GRT	0 US$
Side Wharfage	10 cent/GRT/day	5,000 US$	0.2 cent/GRT/hour	1,200 US$	6 cent/GRT/day	3,000 US$
For Lighthouses, Signs	4 cent/GRT	1,000 US$	3.09 cent/GRT	773 US$	- cent/GRT	0 US$
Gabage collection	3 cent/GRT	750 US$	- cent/GRT	0 US$	- cent/GRT	0 US$
Total		36,500 US$		4,033 US$		4,250 US$
Tariff for Cargo Owner						
Berth Charge on Cargo(Unloading)	180 RLs/ton	900 US$	- US$/ton	0 US$	40 US$/TEU	40,000 US$
Berth Charge on Cargo(Loading)	95 RLs/ton	238 US$	- US$/ton	0 US$	40 US$/ton	20,000 US$
Dues on Cargo(Inward)	45 RLs/ton	200 US$	1.0048 US$/ton	10,049 US$	- US$/ton	0 US$
Dues on Cargo(Outward)	10 RLs/ton	25 US$	0.9756 US$/ton	4,878 US$	- US$/ton	0 US$
					- US$/ton	
(Cargo Handling)						
Port Crane(Unloading)	22,000 RLs/Unit	11,000 US$	106.7 US$/ton	106,700 US$	60 US$/TEU	60,000 US$
Port Crane(Loading)	22,000 RLs/Unit	5,500 US$	106.7 US$/ton	53,350 US$	60 US$/TEU	30,000 US$
Port Dues(Import)	-	-	0.2512 US$/ton	2,512 US$	-	-
Port Dues(Export)	-	-	0.2439 US$/ton	1,220 US$	-	-
Total		17,863 US$		178,709 US$		150,000 US$
Grand Total		54,363 US$		182,742 US$		154,250 US$

The shipping companies will pay the port duties such as port entering duties and dockage to the port authorities.
If pilotage, towage and line handling services are privatized, the shipping companies will pay these charges to the private entities.

13.4 Cargo Handling Operation

(1) Role of cargo handling operation at port for cargo transportation from origin to destination

The cargo handling operation is just one step operation on the way from origin to destination for cargo transportation.
Then, cargo handling system and operation could be considered separately.
It is not right recognition that the cargo handling operation at port consists of cargo handling from/to ship and from/to truck and/or rail wagon.
One of required role of cargo handling operation at port is to connect smoothly and economically between different cargo handling system (sea-side and land-side) and to establish the most economical transportation system.
Each cargo handling operation at port shall be done considering later handling operation including final handling at destination.
Of course, if necessary, it shall be considered to store provisionally the cargo to be handled from/to ship and from/to truck and/or rail wagon at the port site.

(2) Role of port authority for cargo handling operation at the port

Irrespective of cargo handling operator, most of handling operators will plan to handle the cargo easily and economically without any consideration for handling to be done later by another cargo handling operator.
Then all the cargo handling operation at port shall be carried out under the control of port authority.
Port authority shall consider the economical cargo handling operation in total and the pollution of the environment at port.

(3) Cargo Handling Operator

All the cargo handling operation at each stage at port carried out by private company or third-sector to achieve the economical and efficient cargo handling operation.
In this case, large or expensive cargo handling equipment will be lent by the port authority and minor cargo handling equipment will be owned by himself
Furthermore, port authority shall consider to bring up private cargo handling operators to increase their competitive power.

13.5 Engineering System

This subsection deals with the possible engineering system for efficient management and economical port operation on the proposed port activities in respect of the technical aspect, "engineering". The engineer should have responsibilities in various

technical activity including, site investigation, planning, design, construction super vision and periodical maintenance. Giving training to young engineers is one of important duties of senior engineer.

13.5.1 General background Concepts

Imam khomeini port forms an important element in the economic and social development of Iran. Accordingly, port study should not only concern the port itself but also consider the wider economic, social and physical factors in determining the role of the port in the overall regional and national development plans.

Factors that may be involved are, for example:

- space and land requirements;
- economic development of the hinterland of the port;
- port related industrial development;
- existing and expected cargo flows and composition per trade;
- type and size of vessels per trade;
- land and water transport links with the hinterland;
- access to and from the sea;
- physical development potential;
- nautical and hydraulic aspects;
- safety and environmental impact;
- economic and financial analyses;
- existing structures and facilities.

The above list of typical aspects serves to illustrate that port study is a complex and multidisciplinary activity. The different aspects or discipline are very much interrelated and no conclusion in one field can be drawn and maintained without taking cognisance of the findings in other fields.

There is a great diversity in sizes, types and functions of ports. In one type one may distinguish, for example, coastal ports and river ports, natural tidal harbors and enclosed docks.

In terms of function there are multi-purpose ports (e.g., general cargo, container, ferry, bulk ports) like Imam Khomeini port, dedicated ports (Handling one specific cargo e.g., ore, oil or ro-ro),leisure ports, fishing ports and naval ports, etc.

Many port planning studies as the master Plan study for Imam Khomeini port does seek to increase the capacity and/or efficiency or existing facilities, prior to start to design new ones. Consideration should always be given to optimization of existing facilities by improved operational control of both port and through transport systems or by relatively minor improvements/modernization of those facilities. Worldwide experience has often shown that substantial increases in throughput can thus be achieved economically and that major infrastructure improvements can be avoided or postponed.

If the demands cannot be met by optimization it is necessary to consider plans for expansion or development of new facilities within or adjacent to the port.
Port planning will generally start with an economic assessment to establish cargo flow forecasts by commodity and origin/destination. Regional and national development studies and, possibly, marketing studies for particular commodities will be required as a basis for the forecasts. Statistics on cargo and ship movements at existing ports are also required.

Then the engineers will commence the required technical studies in physical layout plan, traffic circulation study, cargo handling system analysis together with various alternative studies. Finally, design of facility will be carried out for construction purpose together with the tender documents.

It is important that the manager of engineering group keeps always the various factors as shown in previous list in his or her mind.

13.5.2 Organization with Respect to Engineering Aspects

During several visits to Iran, the Study Team was kindly allowed by PSO to participate in the PSO technical sessions, one of which was with regard to the balance between the cargo demands and scale of facilities and the other was with respect to the general wave characteristics generating in the Capian Sea and Persian Gulf. Each session was held for two hours during which earnest discussions were held. A group of external economists and an engineering consultant led those meetings and provided PSO personnel with basic ideas and recent topics. Of course all the questions were not always answered, however it was understood by the participants that there were many ways to conduct economic and engineering analyses and that each person had different knowledge, ideas and experience.

Another impression of the sessions was that few young personnel participated in the discussion, most of them kept silent. This may imply that the grade of discussions is too sophisticated for young economists and engineers to understand.

The Study Team was also allowed by PSO to visit the construction site of fishing ports near Busher port. According to PSO counterparts, PSO was requested by the central government to watch and evaluate the progress of these two port constructions managed by another governmental agency.

The port basin of both ports was protected by rock-mound breakwaters, however, the port basis of one of them was nearly filled up by fine materials due to siltation. Since the main body of breakwater was seriously damaged, silty sand could easily invade into the port basin through the loosened mound of rocks.

Damage to port basin or channel by siltation has unfortunately occurred at many ports in the past. It is assumed that this type of defect could be minimized by conducting study of siltation together with analyzing occurrences at other ports.

In order to solve various technical problems, PSO employed the consultants in addition to PSO technical personnel. This can be justified since PSO should maintain a large number of technical personnel if no consultant was employed.

In order to carry out an appropriate future major port development, PSO's organization with respect to engineering aspects can be improved further. The followings are suggestions on such improvement based on the experience of the Study Team working with PSO.

(1) It is recommended to continue the PSO technical sessions. However it might be better to be classified by technical fields and length of experience of participants.

(2) Technology of other counties should be introduced especially the technical analysis by computers. Wave calmness, siltation and ship navigation are most useful programs.

(3) It is recommended that PSO provide opportunities for young engineers to visit other countries and observe the modern port technology.

(4) Use of consultants should be continued. However PSO head office should have its own technical standards and common design criteria for planning of safety and economical port.

(5) If communication between the departments is enhanced, technical knowledge of PSO personnel will be improved.

(6) If communications between the young engineers and senior engineers is maintained more than present situation, valuable experience can be transferred to the next generation.

Please refer to subsection 2.5 "Engineering System" for more information.

Chapter 14

Economic Analysis

Chapter 14 Economic Analysis

14.1 Purpose and Methodology of Economic Analysis

14.1.1 Purpose

The purpose of the economic analysis is to appraise the economic feasibility of the Short Term Plan for the new port facilities of the port from the viewpoint of the national economy.
Therefore, the purpose of this chapter is to investigate the economic benefits as well as the economic costs which will arise from the project and to evaluate whether the net benefit of the project exceed those which could be obtained from other investment opportunities in Iran.

14.1.2 Methodology

(1) EIRR

The economic internal rate of return (EIRR) based on a cost-benefit analysis is used in order to appraise the feasibility of the project. The EIIR is a discount rate which makes the costs and benefits of the project during the project life equal.

(2) "With" and "Without" Analysis

The EIRR value is obtained from the annual economic benefit-cost value. The economic benefits are obtained from the difference between the "With the project" case (hereinafter referred to as "With" case) and "Without the project case (hereinafter referred to as "Without" case).

(3) Measurement of Costs and Benefits

In estimating the costs and benefits of the project, "economic pricing" is applied. Economic pricing means that costs and benefits are appraised in terms of international prices (border prices).

The general procedure of the economic analysis is shown in Figure 14.1.1.1

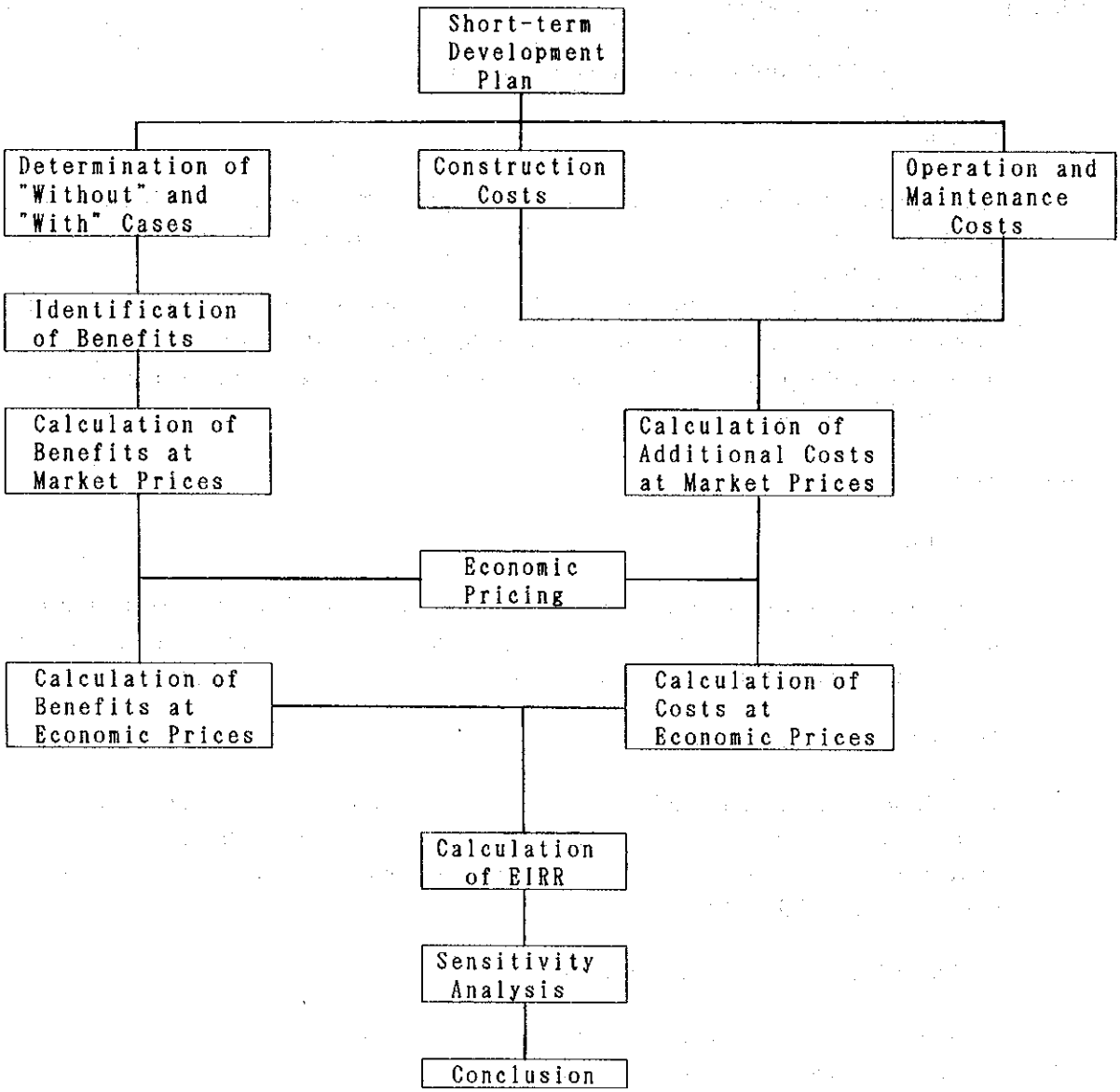

Figure 14.1.1.1 Flow Chart of Economic Analysis

14.2 "Without" Case and "With" Case

In the cost-benefit analysis, the benefits and the project costs are defined as the difference between the "Without" and the "With" cases. Therefore, it is very important to define the difference between the "Without" and the "With" cases in the economic analysis in order to evaluate the feasibility of the development project. In this study, the following conditions are adopted as the "Without" case considering the existing situation.

14.2.1 "Without" Case

In this Study, after having discussed various possibilities, the following conditions are adopted as the "Without" case.

(1) No investment is made for the new berth.

(2) Rehabilitation plans are executed at the existing berth.

(3) Excess portion of potential cargo flow over handling capacity of the existing facilities will be lost.

The berth and cargo handling conditions of "Without" case are assumed as shown in Table 14.2.1.1, 14.2.1.2

Table 14.2.1.1 Berth Condition of "Without" Case

Without Case		
New Berth Number	Depth (m)	Number of Berth
NB-1	-13	1
NB-5,6	-10	2
NB-8~10	-10	3
NB-11~14	-11	4
NB-15~25	-10	8

Table 14.2.1.2 Cargo Handling Conditions

	Dry Bulk	Conventional	Container	Bulk (ore)
Ave. Vessel (DWT)	50,000	30,000	30,000	50,000
Handling Capacity (t/day)	7,252	20,225	16,395	5,233
Ave.Berthing Time (days)	9.08	8.76	2.01	10.15

14.2.2 "With" Case

In the "with" case, it is assumed that the short term plan for the port development is completed and efficiency of loading and unloading, available berth length and so on at the post are improved. The conditions of "With" case are assumed as follows.

Table 14.2.2.1 Berth Condition of "With" Case

With Case		
New Berth Number	Depth (m)	Number of Berth
NB-1	-13	1
NB-5,6	-10	2
NB-8~10	-13	3
NB-11~14	-11	4
NB-15~25	-11	8

Table 14.2.2.2 Cargo Handling Conditions (2000)

	Dry Bulk	Conventional	Container	Bulk (ore)
Ave. Vessel (DWT)	50,000	30,000	30,000	50,000
Handing Capacity (t/day)	11,490	25,395	16,395	8,918
Ave. Berthing Time (days)	5.63	9.34	2.01	2.65

14.3 Prerequisites of Economic Analysis

14.3.1 Base Year

The base year means the starting year of the calculation of economic costs and benefits. In this Study, 1994 is set as the base year taking the construction and investment schedule of the project into account.

14.3.2 Project Life

The period of the calculation for the economic analysis is assumed to be thirty years after completion of the construction work. The target term of economic analysis is 1997 to 2030 accordingly.

14.3.3 Scope of the project

The scope of the project (Short Term Plan) for the economic analysis consists of the following.

(1) New berths are constructed at Imam Khomeini port.

(2) Modernization plans are carried out at the existing berths
(including procurement of additional cargo handling equipment)

14.4 Economic Prices

14.4.1 Methodology

The purpose of the economic analysis is to examine the value of the project, that is, to see if it represents an optimum allocation of resources in the national economy.

In general, the value of goods quoted at market prices does not always represent the true value of those goods from the viewpoint of the national economy. The local currency portion of the goods and materials at market prices often includes customs duties, and the labor cost at market prices is often influenced by the minimum wage system in the country. Therefore, "economic pricing" should be conducted for the economic analysis in order to exclude these influences.

There are several ways for "economic pricing" to be conducted. In this study, the prices of domestic goods and services are modified to border prices in an effort to determine a more rational valuation. These border prices are generally intended to represent the international market values, or the world prices, of these goods and services.

The market prices are changed to border prices by various conversion factors such as "Standard Conversion Factor", "Conversion Factor for Consumption" and so on.

14.4.2 Transfer Items

In general, all costs and benefits are divided into traded goods, non-traded goods labor and transfer items. Labor is further divided into skilled and unskilled labor.

(1) Traded Goods (CIF,FOB)

Traded goods are expressed at CIF (cost, insurance and freight) prices for imports and at FOB (free on board) prices for exports, which are border prices themselves.

(2) Non-traded Goods and Services (SCF)

Since the local currency after deducting the costs of the traded goods, labor and transfer items are considered as non-traded goods, the economic prices of these goods are calculated by multiplying the Standard Conversion Factor (SCF). The SCF is used

to determine the economic prices of certain non-traded goods and services that cannot be directly valued at border prices. By using the SCF, price differential between the domestic market and the international market caused by import duties and export subsidies can be avoided.

SCF is expressed by the following formula:

$$SCF = \frac{I + E}{(I + Di) + (E - De)}$$

where, I : Total amount of imports in CIF
E : Total amount of exports in FOB
Di : Total amount of import duties
De : Total amount of export duties

In this study, the SCF of 0.862 is adopted according to the past records of trade and customs as shown in Table 14.4.2.1.

Table 14.4.2.1 Standard Conversion Factor(SCF) (Mn.$)

Items	1987	1988	1989	1990
I	13,236	11,519	14,666	20,526
E	11,916	10,709	13,081	08,768
Di	3,261	2,363	5,668	8,143
De	0	0	0	0
SEC	0.885	0.904	0.830	0.828

SCF Average=0.862
Source : IRI Customs

(3) Conversion Factor for Consumption(CFC)

This conversion factor is used to convert the market prices of consumption goods into the border prices. The conversion factor for consumption goods is usually calculated in the same manner as the SCF, replacing total import and export by those of consumption goods only.

(4) Conversion Factor for Labor

1) Skilled labor

The economic cost of skilled labor is obtained by multiplying its market prices by the Conversion Factor for Consumption(CFC),assuming that the market mechanism is functioning properly. The CFC is used for converting the prices of consumer goods from domestic market prices to border prices. The CFC is usually calculated in the same manner as the SCF, replacing figures of the formula mentioned above by that

of consumer goods only.

In this study, the CFC of 0.791 is adopted according to the past records of trade and customs as shown in Table 14.4.2.2.

Table 14.4.2.2 The Conversion Factor for Consumption(CFC) (Mn.$)

Items	1987	1988	1989	1990
Ic	12,171	10,685	13,456	17,545
Ec	1,081	860	980	1,123
Dci	2,739	1,985	4,761	6,840
Dce	0	0	0	0
CFC	0.829	0.853	0.752	0.731

CFC Average=0.791

2) Unskilled labor

For the economic analysis, cost of unskilled labor should be measured in terms of their opportunity costs, that is, the value of lost marginal production that the employment of laborers for a given project would create for other purposes.

When a project is executed, the inflow of unskilled labors to the project is mainly from the agricultural sector which is relatively elastic in its use of labor and where wages are normally lowest. Therefore, it is often assumed in a simplified manner that the economic cost of unskilled labor is equal to the per capita income of the agricultural sector. According to the data from 1989 to 1992 prepared by Statistic center 1991, the average income of a rural family in 1990 is 1.251 Mn.RIs, and it can be considered as a proper indicator of marginal productivity, that is, the opportunity cost of unskilled labor. The average worker's cost of construction 1991 is 1.547 Mn.RIs according to the Ministry of Labor and Social Affairs.

$$\text{The Conversion Factor for Unskilled labor} = \frac{\text{Opportunity Cost}}{\text{Worker's Cost of Construction}} \times \text{CFC}$$

$$= \frac{1.251 \text{ Mn.RIs}}{1.547 \text{ Mn.RIs}} \times 0.791 = 0.64$$

14.5 Costs of the Project

The items that are considered as costs of the project are; construction costs, procurement costs of equipment, operation costs (including administration and personnel costs) and renewal investment costs.

14.5.1 Investment Costs

In the economic analysis, investment costs have to be divided into the foreign currency portion and the local currency portion. Moreover, the local currency portion can be divided into non-traded goods, skilled labor and unskilled labor. Since the foreign currency portion is shown in CIF prices, there is no need for conversion into economic prices. The labor costs (skilled and unskilled) should be converted into economic prices by using the conversion factors.The annual construction costs at economic prices are shown in Table 14.5.1.1, 14.5.1.2

14.5.2 Maintenance and Operation Costs

The maintenance and operation costs are shown in chapter 15. Since these costs are expressed in market prices and contain various indefinite elements, the conversion factors should be applied.

(1) Maintenance Costs

In this study, 1% of the construction costs of structures and 2% of the procurement costs of equipment are to be considered as annual maintenance costs. The maintenance costs in economic prices are calculated in the same manner as the investment costs.

(2) Operation Costs

The operation costs consist of administration, operation and personnel costs. These are shown in Chapter 15 in market prices and they should be converted to economic prices by using CFC, since personnel costs, which comprise the bulk of the operation costs, can be regarded as costs of skilled labors.

14.5.3 Renewal of Investment Costs

The facilities and equipment will be renewed according to their economic lives. As described hereunder, and also indicated in Chapter 15, cargo handling equipment will be renewed through out the project life.

14.6 Benefits of the Project

14.6.1 Benefit Items

Considering the "With" and "Without" scenarios above, the following items are identified as the benefits of the Short Term Plan for Imam Khomeini port.

(1) Saving in ships' staying costs.

(2) Saving in interest of cargo costs.

(3) Saving in cargo handling labor costs.

Table 14.5.1.1 Investment Cost in Economic Prices (Imam Khomeini Port)

Unit 1,000US$

Work	Cost of Investment in Market Prices	Foreign Portion (CIF)	Local Portion			Overall Conversion Factor	Investment Costs in Economic Prices
			Non-Traded Goods (SCF)	Skilled Labor (CFC)	Unskilled Labor (CFL)		
		1	0.862	0.791	0.64		
1997							
Structural Repair Dredging	16,870	0.7	0.24	0.04	0.02	0.95	16,049
1998							
Equipment Repaire Structural Repair	13,540	0.7	0.24	0.04	0.02	0.95	12,881
1999							
Mineral Berth Container Yard	30,160	0.7	0.24	0.04	0.02	0.95	28,692
2000							
Grain Jetty Ore Berth	42,980	0.7	0.24	0.04	0.02	0.95	40,888
2001							
2002							
Grand Total	103,550						98,509

Table 14.5.1.2 Total Costs in Economic Prices (Imam Khomeini Port)

Unit: 1,000 US$

	Years	Costs			Total
		Container/Dry Bulk Berth			
		Investment	Maintenance	Operation	
1	1997	16,049			16,049
2	1998	12,881			12,881
3	1999	28,692			28,692
4	2000	40,888			40,888
5	2001		1,231	1,970	3,202
6	2002		1,231	1,970	3,202
7	2003		1,231	1,970	3,202
8	2004		1,231	1,970	3,202
9	2005		1,231	1,970	3,202
10	2006	6,058	1,231	1,970	9,260
11	2007		1,231	1,970	3,202
12	2008		1,231	1,970	3,202
13	2009		1,231	1,970	3,202
14	2010		1,231	1,970	3,202
15	2011		1,231	1,970	3,202
16	2012	6,058	1,231	1,970	9,260
17	2013		1,231	1,970	3,202
18	2014		1,231	1,970	3,202
19	2015		1,231	1,970	3,202
20	2016	39,683	1,231	1,970	42,885
21	2017		1,231	1,970	3,202
22	2018	6,058	1,231	1,970	9,260
23	2019		1,231	1,970	3,202
24	2020		1,231	1,970	3,202
25	2021		1,231	1,970	3,202
26	2022		1,231	1,970	3,202
27	2023		1,231	1,970	3,202
28	2024	6,058	1,231	1,970	9,260
29	2025		1,231	1,970	3,202
30	2026		1,231	1,970	3,202
31	2027		1,231	1,970	3,202
32	2028		1,231	1,970	3,202
33	2029		1,231	1,970	3,202
34	2030	6,058	1,231	1,970	9,260
	Total	168,483	36,941	59,106	264,530

(4) Saving in land transportation costs

Intangible Benefits

(1) Development of port related industries.

(2) Increase in employment opportunities.

(3) Improvement of cargo handling safety and reduction of cargo damage.

(4) Promotion of national economic development through the formulation of an efficient transportation system.

If the increased volume of cargo were to be handled only by the existing facilities, then the number of ships waiting for berth space would increase to the point where port congestion would become a serious problem.

Implementing the project will avert this problem, namely it will reduce the staying time of ships that is the time waiting for berth space and handling cargo, and this ships' cost reduction is a benefit of the project. This benefit can be calculated by multiplying the difference in ships' staying time between both cases by ships' staying costs (per unit time).

14.6.2 Calculation of Benefits

(1) Saving in ships' staying costs

In accordance with implementation of project, the total ships' staying time will be greatly decreased. The reduction of the ships' staying time under the "With" case is one of the main benefits of the project. In this study, the benefits derived from the reduction of the ships' staying costs is calculated by the following formula.

$S = D \times V \times I$

where; S : Saving in ships' staying costs
D : Difference of ships' staying time between "Without" and "With" cases
V : Ships' staying cost
I : Percentage accruing to Iran

Benefits derived from savings of ships' staying costs due to the implementation of this project are calculated in Table 14.6.2.1, 14.6.2.2

1) Ships' Staying Time

Ships' staying time at the port comprises the waiting time for berthing and the mooring time for unloading/loading. As for the ships' waiting time, the total waiting time for "Without" and "With" cases is calculated using queuing simulations based on

Table 14.6.2.1 Calculation for Saving Ships' Staying Costs

Khomeini Port — Unit: Days 1,000 US$

	Conventional (30,000 DWT)				Benefit	Benefit for Iran
	Ships	Staying	Cost/day	Total		
2000	537	1.1	24	14,177	14,177	12,050
2001	559	1.1	24	14,758	14,758	12,544
2002	580	1.1	24	15,312	15,312	13,015
2003	602	1.1	24	15,893	15,893	13,509
2004	623	1.1	24	16,447	16,447	13,980
2005	645	1.1	24	17,028	17,028	14,474
2006	666	1.1	24	17,582	17,582	14,945
2007	688	1.1	24	18,163	18,163	15,439
2008	709	1.1	24	18,718	18,718	15,910
2009	731	1.1	24	19,298	19,298	16,404
2010	752	1.1	24	19,853	19,853	16,875

Table 14.6.2.2 Calculation for Saving Ships' Staying Costs

Khomeini Port — Unit: Days 1,000 US$

	Dry Bulk (50,000 DWT)				Benefit	Benefit for Iran
	Ships	Staying	Cost/day	Total		
2000	92	3.5	36	11,592	11,592	9,853
2001	93	3.5	36	11,718	11,718	9,960
2002	94	3.5	36	11,844	11,844	10,067
2003	94	3.5	36	11,844	11,844	10,067
2004	95	3.5	36	11,970	11,970	10,175
2005	96	3.5	36	12,096	12,096	10,282
2006	97	3.5	36	12,222	12,222	10,389
2007	98	3.5	36	12,348	12,348	10,496
2008	98	3.5	36	12,348	12,348	10,496
2009	99	3.5	36	12,474	12,474	10,603
2010	100	3.5	36	12,600	12,600	10,710

the estimated number of calling ships' in both cases respectively.

2) Ships' Staying Costs

Usually ships' staying costs are estimated by compiling the depreciation, personnel expenses, fuel cost, interest and other expenses, based on the ship building prices, and the fuel consumption rate of vessels presently operating.

3) Percentage Accruing to Iran

The benefit derived from the savings of ships' staying costs will belong to the shipping companies. Therefore,for foreign ships the benefits accrue to foreign shipowner and for Iranian ships benefits accrue to Iran. However, it is now standard practice to include some of the benefits accruing to foreign shipowners in the appraisal on the understanding that in the long run this benefit will filter through to the national economy, for example, trough lower freight rates. Thus, in this study, it is assumed that 50% of savings of ocean going ships' staying costs and 100% of domestic ships' accrue to the Iran economy.

(2) Saving in Interest of Cargo Costs

In accordance with the implementation of the project, the total ships' staying time under the "With" case, interest of cargo costs will be decreased. In this study, the benefits of savings in interest of cargo costs is calculated by the following formula.

$$S = (Q \times D \times V \times I)/ 365$$

where; S : Saving in interest of cargo costs
Q : Value of cargo
D : Reduction of staying time between "Without" and "With" cases
V : Value of cargo in US$
I : Interest rate

According to the above benefits derived from savings of interest of cargo costs due to the implementation of this project are calculated in Table 14.6.2.3

14.6.3 Uncountable Benefits

1) Development of Port Related Industries

Without the implementation of the development project, Imam Khomeini port will be operating at a capacity that simply maintains the existing cargo flow. Industries in the hinterland require the development of the port as a prerequisite to their smooth operations. Therefore the value added by such industries is an economic benefit of this project.

Table 14.6.2.3 Calculation for Saving Interest of Cargo Costs

Khomeini Port

Unit: Days 1,000US$ 1,000t

	Conventional (30,000 DWT)				Dry Bulk (50,000 DWT)				Benefit
	Volume	Staying	VxI/365	Total	Ships	Staying	VxI/365	Total	
2000	7,129	1.1	0.19	1,490	3,711	3.5	0.19	2,468	3,958
2001	7,529	1.1	0.19	1,574	3,790	3.5	0.19	2,520	4,094
2002	7,930	1.1	0.19	1,657	3,870	3.5	0.19	2,574	4,231
2003	8,330	1.1	0.19	1,741	3,949	3.5	0.19	2,626	4,367
2004	8,730	1.1	0.19	1,825	4,029	3.5	0.19	2,679	4,504
2005	9,131	1.1	0.19	1,908	4,108	3.5	0.19	2,732	4,640
2006	9,531	1.1	0.19	1,992	4,187	3.5	0.19	2,784	4,776
2007	9,931	1.1	0.19	2,076	4,267	3.5	0.19	2,838	4,913
2008	10,331	1.1	0.19	2,159	4,346	3.5	0.19	2,890	5,049
2009	10,732	1.1	0.19	2,243	4,426	3.5	0.19	2,943	5,186
2010	11,132	1.1	0.19	2,327	4,505	3.5	0.19	2,996	5,322

2) Increase in Employment Opportunities

As for the additional employment arising from the project, employment for construction during the construction period and for operation after the facilities are completed are considered.

There is excess supply of unskilled labor in the region, and the construction will provide employment for those people who would remain unemployed if the project does not take place.

Also, with the activation of port related industries, employment opportunities for the local population are expected to increase.

3) Improvement of Cargo Handling Safety and Reduction of Cargo Damage.

The existing yards are too narrow for safe and efficient cargo handling. Furthermore, there are no sufficient back-up facilities (warehouses, transit shed, etc.). It is very difficult to assess the benefits of increased safety and reduction of damage in cargo handling in monetary terms. However, by construction of new terminal and related facilities, safe cargo handling will be ensured, and the cargo damage that seems to occur frequently will be substantially reduced.

14.7 Evaluation and Conclusion

14.7.1 Calculation of EIRR

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

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

$$\sum_{n=1}^{m} \frac{Rn}{(1+r)^{n-1}} = 0$$

Where, Rn : Profits in the n-th year
r : Discount rate
m : Period of project life

Annual costs and benefits in economic prices and The calculation for the EIRR are shown in Table 14.7.1.1 and the results is as follows : EIRR = 19.67%

Table 14.7.1.1 Calculation of EIRR for Short Term Plan (Imam Khomeini Port)

EIRR(%)= 19.665
UNIT 1,000 US$

	Years	Costs				Benefits (Saving Cost)				Cash Flow
		Container/Dry Bulk Terminal			Total	Save Convention	Save Dry Bulk	Decrease Time Cost	Total	Benefits -Costs
		Invest	Mainte	Operation						
1	1997	16,049			16,049					-16,049
2	1998	12,881			12,881					-12,881
3	1999	28,692			28,692					-28,692
4	2000	40,888			40,888					-40,888
5	2001		1,478	2,955	4,433	12,544	9,960	4,094	26,598	22,165
6	2002		1,478	2,955	4,433	13,015	10,067	4,231	27,313	22,880
7	2003		1,478	2,955	4,433	13,509	10,067	4,367	27,943	23,510
8	2004		1,478	2,955	4,433	13,980	10,175	4,504	28,659	24,226
9	2005		1,478	2,955	4,433	14,474	10,282	4,640	29,396	24,963
10	2006	6,058	1,478	2,955	10,491	14,945	10,389	4,776	30,110	19,619
11	2007		1,478	2,955	4,433	15,439	10,496	4,913	30,848	26,415
12	2008		1,478	2,955	4,433	15,910	10,496	5,049	31,455	27,022
13	2009		1,478	2,955	4,433	16,404	10,603	5,186	32,193	27,760
14	2010		1,478	2,955	4,433	16,875	10,710	5,322	32,907	28,474
15	2011		1,478	2,955	4,433	16,875	10,710	5,322	32,907	28,474
16	2012	6,058	1,478	2,955	10,491	16,875	10,710	5,322	32,907	22,416
17	2013		1,478	2,955	4,433	16,875	10,710	5,322	32,907	28,474
18	2014		1,478	2,955	4,433	16,875	10,710	5,322	32,907	28,474
19	2015		1,478	2,955	4,433	16,875	10,710	5,322	32,907	28,474
20	2016	39,683	1,478	2,955	44,116	16,875	10,710	5,322	32,907	-11,209
21	2017		1,478	2,955	4,433	16,875	10,710	5,322	32,907	28,474
22	2018	6,058	1,478	2,955	10,491	16,875	10,710	5,322	32,907	22,416
23	2019		1,478	2,955	4,433	16,875	10,710	5,322	32,907	28,474
24	2020		1,478	2,955	4,433	16,875	10,710	5,322	32,907	28,474
25	2021		1,478	2,955	4,433	16,875	10,710	5,322	32,907	28,474
26	2022		1,478	2,955	4,433	16,875	10,710	5,322	32,907	28,474
27	2023		1,478	2,955	4,433	16,875	10,710	5,322	32,907	28,474
28	2024	6,058	1,478	2,955	10,491	16,875	10,710	5,322	32,907	22,416
29	2025		1,478	2,955	4,433	16,875	10,710	5,322	32,907	28,474
30	2026		1,478	2,955	4,433	16,875	10,710	5,322	32,907	28,474
31	2027		1,478	2,955	4,433	16,875	10,710	5,322	32,907	28,474
32	2028		1,478	2,955	4,433	16,875	10,710	5,322	32,907	28,474
33	2029		1,478	2,955	4,433	16,875	10,710	5,322	32,907	28,474
34	2030	6,058	1,478	2,955	10,491	16,875	10,710	5,322	32,907	22,416
	Total	168,483	44,329	88,659	301,472	484,595	317,445	153,522	955,562	654,091

14.7.2 Sensitivity Analysis

In order to estimate the EIRR, When certain conditions change, a sensitivity analysis is conducted.

Case A : The costs increase by 10%
Case B : The benefits decrease by 10%
Case C : Combination of the above A and B cases

The results of the sensitivity analysis are shown in Table 14.7.2.1, 14.7.2.2, 14.7.2.3

14.7.3 Results and Conclusion

From the above calculations, the EIRR of this project is in all cases more than 15%. There are various views concerning the appropriate EIRR level used to guide the judgement as to 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 results of the EIRR calculation, only taking into account the two major quantitative benefits, shows more than 10% under every probable case. Therefore, this Short-term Development Project is feasible from the viewpoint of the national economy.

the EIIR calculation, only taking into account the two major quantitative benefits, shows more than 10% under every probable case. Therefore, this Short-term Development Project is feasible from the viewpoint of the national economy.

Table 14.7.2.1 Calculation of EIRR for Short Term Plan Case A (Imam Khomeini Port)

EIRR(%)= 17.809
UNIT 1,000 US$

	Years	Costs				Benefits (Saving Cost)				Cash Flow
		Container/Dry Bulk Terminal			Total	Save	Save	Decrease	Total	Benefits
		Invest	Mainte	Operation		Convention	Dry Bulk	Time Cost		-Costs
1	1997	17,654			17,654					-17,654
2	1998	14,169			14,169					-14,169
3	1999	31,561			31,561					-31,561
4	2000	44,977			44,977					-44,977
5	2001		1,625	3,251	4,876	12,544	9,960	4,094	26,598	21,722
6	2002		1,625	3,251	4,876	13,015	10,067	4,231	27,313	22,437
7	2003		1,625	3,251	4,876	13,509	10,067	4,367	27,943	23,067
8	2004		1,625	3,251	4,876	13,980	10,175	4,504	28,659	23,783
9	2005		1,625	3,251	4,876	14,474	10,282	4,640	29,396	24,520
10	2006	6,664	1,625	3,251	11,540	14,945	10,389	4,776	30,110	18,570
11	2007		1,625	3,251	4,876	15,439	10,496	4,913	30,848	25,972
12	2008		1,625	3,251	4,876	15,910	10,496	5,049	31,455	26,579
13	2009		1,625	3,251	4,876	16,404	10,603	5,186	32,193	27,317
14	2010		1,625	3,251	4,876	16,875	10,710	5,322	32,907	28,031
15	2011		1,625	3,251	4,876	16,875	10,710	5,322	32,907	28,031
16	2012	6,664	1,625	3,251	11,540	16,875	10,710	5,322	32,907	21,367
17	2013		1,625	3,251	4,876	16,875	10,710	5,322	32,907	28,031
18	2014		1,625	3,251	4,876	16,875	10,710	5,322	32,907	28,031
19	2015		1,625	3,251	4,876	16,875	10,710	5,322	32,907	28,031
20	2016	43,651	1,625	3,251	48,528	16,875	10,710	5,322	32,907	-15,621
21	2017		1,625	3,251	4,876	16,875	10,710	5,322	32,907	28,031
22	2018	6,664	1,625	3,251	11,540	16,875	10,710	5,322	32,907	21,367
23	2019		1,625	3,251	4,876	16,875	10,710	5,322	32,907	28,031
24	2020		1,625	3,251	4,876	16,875	10,710	5,322	32,907	28,031
25	2021		1,625	3,251	4,876	16,875	10,710	5,322	32,907	28,031
26	2022		1,625	3,251	4,876	16,875	10,710	5,322	32,907	28,031
27	2023		1,625	3,251	4,876	16,875	10,710	5,322	32,907	28,031
28	2024	6,664	1,625	3,251	11,540	16,875	10,710	5,322	32,907	21,367
29	2025		1,625	3,251	4,876	16,875	10,710	5,322	32,907	28,031
30	2026		1,625	3,251	4,876	16,875	10,710	5,322	32,907	28,031
31	2027		1,625	3,251	4,876	16,875	10,710	5,322	32,907	28,031
32	2028		1,625	3,251	4,876	16,875	10,710	5,322	32,907	28,031
33	2029		1,625	3,251	4,876	16,875	10,710	5,322	32,907	28,031
34	2030	6,664	1,625	3,251	11,540	16,875	10,710	5,322	32,907	21,367
	Total	185,331	48,762	97,525	331,619	484,595	317,445	153,522	955,562	623,943

Table 14.7.2.2 Calculation of EIRR for Short Term Plan Case B (Imam Khomeini Port)

EIRR(%)= 17.618
UNIT 1,000 US$

	Years	Costs				Benefits (Saving Cost)				Cash Flow
		Container/Dry Bulk Terminal			Total	Save	Save	Decrease	Total	Benefits
		Invest	Mainte	Operation		Convention	Dry Bulk	Time Cost		-Costs
1	1997	16,049			16,049					-16,049
2	1998	12,881			12,881					-12,881
3	1999	28,692			28,692					-28,692
4	2000	40,888			40,888					-40,888
5	2001		1,478	2,955	4,433	12,544	9,960	4,094	23,938	19,505
6	2002		1,478	2,955	4,433	13,015	10,067	4,231	24,582	20,149
7	2003		1,478	2,955	4,433	13,509	10,067	4,367	25,149	20,716
8	2004		1,478	2,955	4,433	13,980	10,175	4,504	25,793	21,360
9	2005		1,478	2,955	4,433	14,474	10,282	4,640	26,456	22,023
10	2006	6,058	1,478	2,955	10,491	14,945	10,389	4,776	27,099	16,608
11	2007		1,478	2,955	4,433	15,439	10,496	4,913	27,763	23,330
12	2008		1,478	2,955	4,433	15,910	10,496	5,049	28,310	23,877
13	2009		1,478	2,955	4,433	16,404	10,603	5,186	28,974	24,541
14	2010		1,478	2,955	4,433	16,875	10,710	5,322	29,616	25,183
15	2011		1,478	2,955	4,433	16,875	10,710	5,322	29,616	25,183
16	2012	6,058	1,478	2,955	10,491	16,875	10,710	5,322	29,616	19,125
17	2013		1,478	2,955	4,433	16,875	10,710	5,322	29,616	25,183
18	2014		1,478	2,955	4,433	16,875	10,710	5,322	29,616	25,183
19	2015		1,478	2,955	4,433	16,875	10,710	5,322	29,616	25,183
20	2016	39,683	1,478	2,955	44,116	16,875	10,710	5,322	29,616	-14,500
21	2017		1,478	2,955	4,433	16,875	10,710	5,322	29,616	25,183
22	2018	6,058	1,478	2,955	10,491	16,875	10,710	5,322	29,616	19,125
23	2019		1,478	2,955	4,433	16,875	10,710	5,322	29,616	25,183
24	2020		1,478	2,955	4,433	16,875	10,710	5,322	29,616	25,183
25	2021		1,478	2,955	4,433	16,875	10,710	5,322	29,616	25,183
26	2022		1,478	2,955	4,433	16,875	10,710	5,322	29,616	25,183
27	2023		1,478	2,955	4,433	16,875	10,710	5,322	29,616	25,183
28	2024	6,058	1,478	2,955	10,491	16,875	10,710	5,322	29,616	19,125
29	2025		1,478	2,955	4,433	16,875	10,710	5,322	29,616	25,183
30	2026		1,478	2,955	4,433	16,875	10,710	5,322	29,616	25,183
31	2027		1,478	2,955	4,433	16,875	10,710	5,322	29,616	25,183
32	2028		1,478	2,955	4,433	16,875	10,710	5,322	29,616	25,183
33	2029		1,478	2,955	4,433	16,875	10,710	5,322	29,616	25,183
34	2030	6,058	1,478	2,955	10,491	16,875	10,710	5,322	29,616	19,125
	Total	168,483	44,329	88,659	301,472	484,595	317,445	153,522	860,006	558,534

Table 14.7.2.3 Calculation of EIRR for Short Term Plan Case C (Imam Khomeini Port)

EIRR(%)= 15.846
UNIT 1,000 US$

	Years	Costs				Benefits (Saving Cost)				Cash Flow
		Container/Dry Bulk Terminal			Total	Save	Save	Decrease	Total	Benefits
		Invest	Mainte	Operation		Convention	Dry Bulk	Time Cost		-Costs
1	1997	17,654			17,654					-17,654
2	1998	14,169			14,169					-14,169
3	1999	31,561			31,561					-31,561
4	2000	44,977			44,977					-44,977
5	2001		1,625	3,251	4,876	12,544	9,960	4,094	23,938	19,062
6	2002		1,625	3,251	4,876	13,015	10,067	4,231	24,582	19,705
7	2003		1,625	3,251	4,876	13,509	10,067	4,367	25,149	20,272
8	2004		1,625	3,251	4,876	13,980	10,175	4,504	25,793	20,917
9	2005		1,625	3,251	4,876	14,474	10,282	4,640	26,456	21,580
10	2006	6,664	1,625	3,251	11,540	14,945	10,389	4,776	27,099	15,559
11	2007		1,625	3,251	4,876	15,439	10,496	4,913	27,763	22,887
12	2008		1,625	3,251	4,876	15,910	10,496	5,049	28,309	23,433
13	2009		1,625	3,251	4,876	16,404	10,603	5,186	28,974	24,097
14	2010		1,625	3,251	4,876	16,875	10,710	5,322	29,616	24,740
15	2011		1,625	3,251	4,876	16,875	10,710	5,322	29,616	24,740
16	2012	6,664	1,625	3,251	11,540	16,875	10,710	5,322	29,616	18,076
17	2013		1,625	3,251	4,876	16,875	10,710	5,322	29,616	24,740
18	2014		1,625	3,251	4,876	16,875	10,710	5,322	29,616	24,740
19	2015		1,625	3,251	4,876	16,875	10,710	5,322	29,616	24,740
20	2016	43,651	1,625	3,251	48,528	16,875	10,710	5,322	29,616	-18,911
21	2017		1,625	3,251	4,876	16,875	10,710	5,322	29,616	24,740
22	2018	6,664	1,625	3,251	11,540	16,875	10,710	5,322	29,616	18,076
23	2019		1,625	3,251	4,876	16,875	10,710	5,322	29,616	24,740
24	2020		1,625	3,251	4,876	16,875	10,710	5,322	29,616	24,740
25	2021		1,625	3,251	4,876	16,875	10,710	5,322	29,616	24,740
26	2022		1,625	3,251	4,876	16,875	10,710	5,322	29,616	24,740
27	2023		1,625	3,251	4,876	16,875	10,710	5,322	29,616	24,740
28	2024	6,664	1,625	3,251	11,540	16,875	10,710	5,322	29,616	18,076
29	2025		1,625	3,251	4,876	16,875	10,710	5,322	29,616	24,740
30	2026		1,625	3,251	4,876	16,875	10,710	5,322	29,616	24,740
31	2027		1,625	3,251	4,876	16,875	10,710	5,322	29,616	24,740
32	2028		1,625	3,251	4,876	16,875	10,710	5,322	29,616	24,740
33	2029		1,625	3,251	4,876	16,875	10,710	5,322	29,616	24,740
34	2030	6,664	1,625	3,251	11,540	16,875	10,710	5,322	29,616	18,076
	Total	185,331	48,762	97,525	331,619	484,595	317,445	153,522	860,006	528,387

Chapter 15

Financial Analysis

Chapter 15 Financial Analysis

15.1 Purpose and Methodology of Financial Analysis

15.1.1 Purpose of the Financial Analysis

The purpose of the financial analysis is to appraise the financial feasibility of the port facility development plan. The analysis focuses on the viability of the project itself and the influence on the soundness of the port management body during the project life.

The project in this study is defined as construction and repair in the short term plan.

15.1.2 Methodology of the Financial Analysis

(1) Viability of the Project

The viability of the project is analyzed using the Discount Cash Flow Method and appraised by the FIRR (financial internal rate of return). The FIRR is a discount rate that makes the costs and the revenues during the project life equal, and it is calculated using the following formula:

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

n : project life
Bi : revenues in the i-th year
Ci : costs in the i-th year
r : discount rate

Revenues and costs which are taken into account for the calculation of the FIRR are summarized as follows:

Revenues: (i) Port operating revenue
(ii) Residual value of the fixed assets at the end of the project

Costs: (i) Investments for the project (Initial investments for the project and its re-investment
(ii) Operating expense such as maintenance, repair, personnel and other costs

When the calculated FIRR exceeds the interest rate of the funds for the investments of the project, the project is regarded as financially feasible.

(2) Financial Soundness of the port management body

The influence on the financial soundness of the port management body is appraised based on projected financial statements regarding the project (Income Statements, Cash Flow Statements and Balance Sheets). The appraisal is generally made from the viewpoints of profitability, loan repayment capacity and operational efficiency, using

the following ratios:

1) Profitability

Rate of Return on Net Fixed Assets:

(Net Operating Income / Total Fixed Assets) x 100 %

This indicator shows the profitability of the investments, which are presented as net total fixed assets. It is preferable to keep the rate higher than the average interest rate of the funds for the investments.

2) Loan Repayment Capacity

Debt Service Coverage Ratio:

(Net Operating Income + Depreciation Cost) / (Repayment of and Interest on Long-Term loans)

This indicator shows whether the operating income can cover the repayment of principal and interest on Long-Term Loans. It must be more than 1 and it is preferable that it is over 1.75.

3) Operating Efficiency

Operating Ratio:

(Operating Expenditure / Operating Revenue) x 100 %

Working Ratio:

((Operating Expenditure - Depreciation Cost) / Operating Revenue) x 100 %

The operating ratio shows the operational efficiency of the organization as an enterprise, and the working ratio shows the efficiency of the routine operations of the port. When the calculated operating ratios are less than 70 - 75 %, and the working ratios are less than 50 - 60 %, the operations are considered as being efficient.

15.2 Prerequisites of Financial Analysis

15.2.1 Project Life

Taking account of the conditions of the long-term loans and the service lives of the port facilities, the project life for the financial analysis is determined as the construction period and 30 years after construction.

15.2.2 Base Year

For the estimation of expenditures and revenues analyzed quantitatively here, constant prices at 1994 are predominantly used. Neither price inflation nor increases in nominal wages are consider during the project life.

15.2.3 Cargo handling volume and number of vessels

The cargo handling volume and number of vessels at the projected wharf in 2000 is estimated based on the demand forecast in Chapter 3 as shown in Appendix III-7.1.

15.2.4 Fund raising

Funds for both construction and repair are all raised by foreign loans. Funds for renewal investment are all raised by internal funds of the port management body.

The following conditions apply to the above funds.

(1) Foreign funds

Loan period: 30years, including a grace period of 3 years
Interest rate: 3% per annum
Repayment: fixed amount repayment of principal and interest

(2) Internal funds of the port management body

Internal funds are allocated from retained earnings of the port management body.

15.3 Revenue and Expenditure

15.3.1 Revenue

The revenues from the port activities are calculated based on the assumed tariff and on the cargo handling volume and number of vessels. The assumed tariff is of a lower level than the current one because it is considered that the container operating cost per 1 TEU will decrease with increase of container cargo volume, and the cost included in current tariff will also decrease. The revenue per year during the project life is shown in Appendix 15-1.

15.3.2 Expenditure

1) Cost for initial investments

The initial investments of the project are estimated in Chapter 12. These are summarized in Appendix III-7.2.

2) Reinvestment

The facilities and equipments will be renewed based on their services lives. The funds for reinvestment will be financed by internal resources of PSO.

3) Operating expense

The annual operating expense for the project is assumed as follows.

a) Personnel
To cover personnel expense to cope with the establishment of new a organization or increase of cargo volume, 15.4% of the annual operating revenue is allocated based on the actual data of income and expenditure. (With the advance of privatization, this expense may change to other expense such as contract expense, however, it is calculated as personnel expense in this estimate.)

b) Maintenance and Repair
The annual maintenance and repair costs for the port facilities are calculated as follows:
Infrastructure: 1% of the original construction cost
Cargo handling equipment: 5% of the original construction cost

c) Other expense
To cover expense such as cost for fuel and general administration, 12.1% of the annual operating revenue is included to the operating expense based on the actual data of income and expenditure.

d) Depreciation costs
The annual depreciation costs of the port facilities and equipments are calculated by the straight line method based on their service lives as shown in Appendix 15-2. Residual values after all depreciations are estimated as zero.

4) Tax and Contribution to Government

Income tax ratio is assumed as zero. Contribution to Government is assumed as 50% of income after tax.

15.4 Sensitivity Analysis

Sensitivity analysis is conducted to examine the impact of unexpected future changes. The following three cases are envisioned:

Case A : The income decreases by 10%
Case B : The project cost increases by 10%
Case C : The income decreases by 10% and the project cost increases by 10%

15.5 Evaluation and Conclusion

15.5.1 Results of the FIRR calculation and Appraisal

The results are shown in Table 15.5.1.1 and the FIRR calculation and its details are shown in Appendix III-7.3.

Weighted average interest rate of the funds, which is the floor limit, is 3% in this study. Including above three cases of sensitivity analysis, FIRR exceeds this rate, even in Case C of the sensitivity analysis, therefore we can judge this project to be financially feasible. (See Table 15.5.1.1)

Table 15.5.1.1 Result of FIRR Calculation

Original Case	22.5%	
Sensitivity Analysis A	19.9%	Revenue 10%Down
Sensitivity Analysis B	20.2%	Cost 10%Up
Sensitivity Analysis C	17.5%	Revenue 10%Down, Cost 10%Up

15.5.2 Financial Soundness of the Port Management Body

The projected financial statement for the project and financial indicators are shown in Appendix III-7.4.

(1) Profitability

Rate of Return on Net Fixed Assets maintains higher rate than the average interest rate of the funds for the investments after 2001.

(2) Loan Repayment Capacity

Debt Service Coverage Ratio keeps over 1.75 after 2001.

(3) Operational Efficiency

Operating Ratio keeps below 70% after 2001 and Working Ratio keeps below 60% after 2001.

(4) Appraisal

Based on the above indicators, it can be judged that financial soundness of the port management body can be easily secured.

15.5.3 Conclusion

As mentioned above, result of financial analysis of the short term plan shows

excellent levels both in terms of the viability of the project and financial soundness of the port management body. However, considering the huge investment required for the Master Plan, it is necessary for the port management body to retain as much of its earnings as possible, at the same time, the project of the short-term plan must be advanced. Therefore, FIRR at the above level is necessary. In addition, Government should use contribution income for port development, granting subsidies or loans to the ports which have unsound financial conditions.