3 Demand Forecast of Container Cargoes at Port of Walvis Bay

3.1 Socio-Economic Model for Demand Forecast

The demand forecast for container cargo is categorized into forecasts “Without-the-Project” and forecasts “With-the-Project”. The captured demand is estimated, in the case of “With-the-Project”, when the new container terminal is constructed in the year 2015, and is added to the demand in the case of “Without-the-Project” for the same year. It is assumed that the captured demand increase according to the growth scenarios based on a socio-economic model. Hereafter, the methodology of the “Without-the-Project” case is explained.

3.1.1 Target Year

The target year for demand forecast is set at 2025 and the years for forecasting are set as 2010, 2015, 2020 and 2025.

3.1.2 Selection of Countries for Development of Socio-Economic Model

The demand of container cargo is related to the socio-economic conditions not only of Namibia but also the surrounding countries, including land-locked countries and other countries that serve as international trade partners from the global viewpoint. In this study, the main countries selected were countries of origin and destination in the cargo statistics for Namport for the calendar year of 2008 and the category of transport type—i.e. deep sea cargo landed (DSL), deep sea cargo shipped (DCS), Southern African Development Community cargo landed (SADCL), Southern African Development Community cargo shipped (SADCS), cross-border cargo landed (CRBL), cross-border cargo shipped (CRBS) and transhipment cargo (TRSH).

The time series container cargo statistics are classified into “imports”, “exports” and “transhipment”. Imports consist of DSL, SADCL and CRBS. The exports consist of DCS, SADCS and CRBS. Transit cargo is included in imports as CRBL and in exports as CRBS. The countries selected to be set up for the socio-economic model are categorized into (i) imports, (ii) exports and (iii) transhipment as shown in Table 3.1.1.

The countries relating to CRBS and ARBL are the countries of which container cargoes pass through their own countries. More concretely, these countries are the land locked countries such as Botswana, Zambia and Zimbabwe and the neighbouring countries such as Angola and South Africa. The category of transport type are shown in Figure 3.1.1

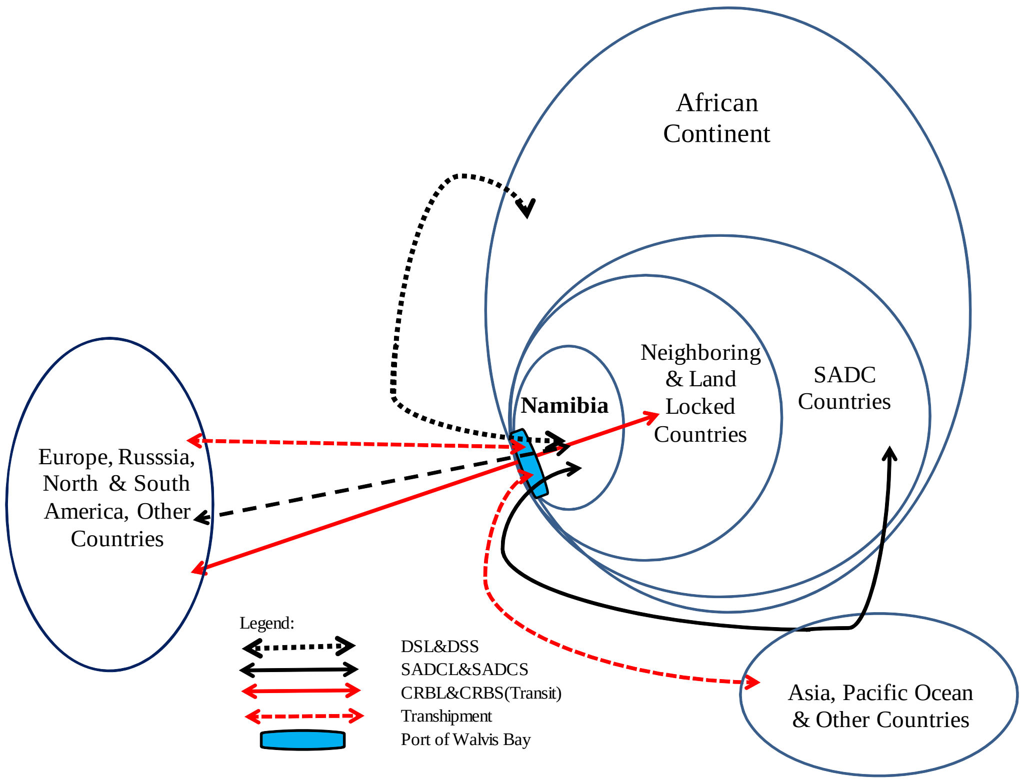
The countries under imports are the countries of origin, which export to Namibia as well as neighbouring and other SADC countries, and the countries under exports are the countries of destination, which import from Namibia, her neighbouring countries and other SADC countries.

The table below shows Imports “landed cargo” Export “shipped cargo” represent. (By way of taking statistics Namport)

Table 3.1.1 Principle Countries for Socio-Economic Model

No.	Imports	Exports	Transhippment
1	Angola	Angola	Angola
2	Brazil	Belgium	Brazil
3	Botswana	Botswana	China
4	China	China	France
5	Congo(DRC)	Congo(Brazaville)	Indonesia
6	Germany	Congo(DRC)	Japan
7	India	Italy	Malaysia
8	Indonesia	Kenya	Nigeria
9	Iran	Mozambique	South Africa
10	Japan	Namibia	Spain
11	Kenya	Netherlands	Switzerland
12	Namibia	Nigeria	Thailand
13	Netherlands	Portugal	
14	Portugal	South Africa	
15	Singapore	Spain	
16	South Africa	Tanzania	
17	United Arab Emkirates	United Kingdom	
18	United Kingdom	USA	
19	USA	Zambia	
20	Zambia	Zimbabwe	
21	Zimbabwe		

Source: JICA Study Team



Source : JICA Study Team
Note: 1 Direction of arrows to inland indicates the landed containers
2. Direction of arrows to oceans indicates the shipped containars.

Figure 3.1.1 Form

3.1.3 Population

(1) General

The predictive model of population is set up by taking into account the historical trend in each country mentioned above from 1996 to 2008, as well as estimates by the International Monetary Fund (IMF) from 2009 to 2014 in "World Economic Outlook Database 2008 and 2009", which has taken into account the impact of the worldwide financial crisis in 2008. The Policy Model for Long-Term National Development, released by the National Planning Commission in "NAMIBIA VISION 30", and the National and Regional Figures, Jan. 2006 in "POPULATION PROJECTION, 2001–2031", released by the Central Bureau of Statistics of Namibia are also reviewed for Namibia.

(2) Namibia and Neighbouring Countries

Tables 3.1.2 and 3.1.3 show the historical (1995–2008) and projected (2009–2014) figures as well as annual growth rates of the population of Namibia and neighbouring countries including the land-locked countries. From 1995 to 2008, the highest growth rate is recorded by Angola with an average annual growth rate (AAGR) of 2.98% followed by Congo (DRC) with 2.61%, Zambia with 2.43% and Namibia with 1.67%. The lowest growth rate is shown by Zimbabwe with 0.14%. On the other hand, the AAGR during the latest four years from 2004 to 2008 shows quite a different growth rate from that between 1995 and 2008. The highest AAGR is recorded by DRC with 3.01% followed by Angola with 2.93%, Zambia with 2.40%, South Africa with 1.14% and Namibia with 0.60%. Results of the projection for 2008 to 2014, conducted by IMF, reflects mainly similar AAGRs as during the latest years from 2004 to 2008, with the exception of Botswana with 1.17%, as compared to 0.97 from 2004 to 2008.

Table 3.1.2 Historical and Projected Population of Namibia and Neighbouring Countries

(Unit : Million Persons)

Year	Namibia	Angola	Botswana	Congo(DRC)	South Africa	Zambia	Zimbabwe	Total
1995	1.65	11.48	1.47	44.98	41.01	9.11	11.53	119.58
1996	1.70	11.90	1.50	46.12	41.82	9.45	11.91	122.69
1997	1.76	12.24	1.53	47.10	42.58	9.78	11.79	125.02
1998	1.81	12.60	1.57	48.00	43.29	10.10	11.76	127.32
1999	1.85	12.96	1.62	48.96	43.94	10.20	11.73	129.41
2000	1.89	13.34	1.64	50.05	44.52	10.30	11.70	131.55
2001	1.93	13.73	1.66	51.31	45.03	10.55	11.67	133.94
2002	1.96	14.13	1.68	52.71	45.54	10.80	11.64	136.49
2003	1.99	14.55	1.70	54.23	46.01	11.06	11.76	139.31
2004	2.01	14.97	1.72	55.85	46.46	11.32	11.73	142.06
2005	1.96	15.41	1.73	57.55	46.89	11.60	11.73	144.91
2006	1.99	15.86	1.75	59.28	47.39	11.87	11.73	147.88
2007	2.03	16.33	1.76	61.05	47.85	12.16	11.73	150.88
2008	2.05	16.81	1.78	62.89	48.69	12.45	11.73	154.34
2009	2.06	17.31	1.80	64.77	49.22	12.75	na.	145.86
2010	2.08	17.83	1.82	66.72	49.76	13.06	na.	149.19
2011	2.10	18.37	1.85	68.72	50.31	13.37	na.	152.61
2012	2.11	18.92	1.87	70.78	50.87	13.69	na.	156.12
2013	2.13	19.49	1.89	72.90	51.42	14.02	na.	159.72
2014	2.15	20.07	1.91	75.09	51.99	14.35	na.	163.41

Source 1.:World Economic Outlook Database, October 2008 (1995-2008), IMF
2.: World Economic Outlook Database, October 2009 (2009-2014), IMF

Table 3.1.3 Annual Growth Rate of Population of Namibia and Neighbouring Countries

(Unit:%)

Year	Namibia	Angola	Botswana	Congo (DRC)	South Africa	Zambia	Zimbabwe	Total
1996	3.09	3.61	1.84	2.54	1.98	3.73	3.31	2.60
1997	3.05	2.90	2.47	2.11	1.83	3.50	-1.00	1.90
1998	2.91	2.90	2.54	1.92	1.67	3.26	-0.25	1.84
1999	2.60	2.90	3.24	1.99	1.50	0.99	-0.27	1.64
2000	2.21	2.93	1.11	2.23	1.32	0.98	-0.26	1.65
2001	1.90	2.93	1.16	2.51	1.14	2.40	-0.26	1.82
2002	1.55	2.93	1.14	2.72	1.13	2.40	-0.27	1.90
2003	1.33	2.93	1.13	2.89	1.03	2.39	1.10	2.06
2004	1.16	2.93	1.12	2.99	0.98	2.40	-0.26	1.98
2005	-2.59	2.93	0.82	3.04	0.92	2.40	0.00	2.00
2006	1.79	2.93	0.81	3.00	1.07	2.40	0.00	2.05
2007	1.81	2.93	0.92	3.00	0.97	2.40	0.00	2.03
2008	0.84	2.93	1.19	3.00	1.75	2.40	0.00	2.29
2009	0.83	3.00	1.18	3.00	1.10	2.40	na.	-5.50
2010	0.82	3.00	1.16	3.00	1.10	2.40	na.	2.28
2011	0.82	3.00	1.15	3.00	1.10	2.40	na.	2.29
2012	0.86	3.00	1.14	3.00	1.10	2.40	na.	2.30
2013	0.80	3.00	1.18	3.00	1.10	2.40	na.	2.31
2014	0.84	3.00	1.17	3.00	1.10	2.40	na.	2.31
Average Annual Growth Rate (%)								
1995/2008	1.67	2.98	1.50	2.61	1.33	2.43	0.14	1.98
2004/2008	0.60	2.93	0.97	3.01	1.14	2.40	-0.05	2.07
2008/2014	0.83	2.99	1.17	3.00	1.19	2.40	0.00	1.18

Source: JICA Study Team

(3) Other Main Countries

The population of the other main countries is also studied on the basis of the same data as for Namibia and its neighbouring countries with regards to their historical and projected trends.

(4) Growth Scenario

Three growth scenarios for population models are set up as low, medium and high. The medium growth scenario for Namibia is set up by taking into account the historical trend, the short term projection by IMF (2009–2014) mentioned above, “NAMIBIA VISION 30” (2001–2030), as well as “POPULATION PROJECTION, 2001–2031”, under National and Regional Figures, Jan. 2006, released by the Central Bureau of Statistics of Namibia. The population projection by the latter two reports prepared by the Government of Namibia (GON) is based on the year 2001. A comparison is carried out between actual population data and projected population for the period between 2001 and 2008. It became clear that the actual growth rate is lower than that projected by the GON. The population projection in this study for the period 2008 to 2015 is based on IMF’s study of the period 2008 to 2014, and for 2015 onwards, on a growth rate adjusted from the projections of the GON. The medium growth scenario of neighbouring countries and other main countries for the period 2008 to 2015 are based on the projection for 2008 to 2014 conducted by IMF, and for 2015 onwards, on gradually decreasing growth rates.

The low and high growth scenarios are set up by taking into account the annual growth rate of each country from 1995 to 2008 and by subtracting from or adding to the growth rate of the medium growth scenario by 0.15%–0.20%. The three growth scenarios for Namibia and her neighbouring countries, and for other main countries, are shown in Tables 3.1.4 and 3.1.5 respectively.

Table 3.1.4 Growth Scenarios of Population for Namibia and Neighbouring Countries

(Average Annual Growth Rate:%)

Country	IMF Projection		2008/2010			2010/2015			2015/2020			2020/2025		
	2008/2010	2010/2014	Low	Medium	High	Low	Medium	High	Low	Medum	High	Low	Medium	High
Angola	3.0	3.0	2.8	3.0	3.2	2.0	3.0	2.4	2.7	2.9	3.1	2.6	2.8	3.0
Botswana	1.2	1.2	1.0	1.2	1.4	1.0	1.2	1.4	1.0	1.2	1.4	0.9	1.1	1.3
Congo, Democratic Republic of	3.0	3.0	2.8	3.0	3.2	2.8	3.0	3.2	2.8	3.0	3.2	2.8	3.0	3.2
Namibia	0.8	0.8	1.1	1.3	1.5	1.2	1.4	1.6	1.3	1.5	1.7	1.4	1.6	1.8
South Africa	1.1	1.1	0.9	1.1	1.3	0.9	1.1	1.3	0.8	1.0	1.2	0.7	0.9	1.1
Zambia	2.4	2.4	2.2	2.4	2.6	2.2	2.4	2.6	2.2	2.4	2.6	2.2	2.4	2.6
Zimbabwe	na.	na.	0.01	0.02	0.03	0.01	0.02	0.03	0.01	0.02	0.03	0.01	0.02	0.03

Source : World Economic Outlook Database, October 2009 by IMF
Note : 1. The figures of Zimbabwe is not available after the year of 2008, then they are assumed by the JICA Study Team.
2. The figures of Namibia are modified by the JICA Study Tema on the basis of "POPULATION PFROJECTION, 2001-2031", National and Regional Figures, Jan. 2006, Central Bureau of Statistics of Namibia and "NAMIBIA VISION 30", Policy Framework for Long-Term National Dvelopment.

Table 3.1.5 Growth Scenarios of Population for Main Countries

(Average Annual Growth Rate:%)

No.	Country	IMF Projection		2008/2010			2010/2015			2015/2020			2020/2025		
		2008/2010	2010/2014	Low	Medium	High	Low	Medium	High	Low	Medum	High	Low	Medium	High
1	Belgium	-1.8	2.1	-2.3	-1.3	0.7	0.1	2.1	4.1	-0.3	1.7	3.2	-0.6	1.4	2.9
2	Brazil	4.4	4.1	2.9	4.4	6.4	2.1	4.1	6.1	1.3	3.3	4.8	0.6	2.6	4.1
3	China	9.5	9.9	8.0	9.5	11.5	7.9	9.9	11.9	6.0	8.0	9.5	4.4	6.4	7.9
4	Congo, Democratic Republic of	4.1	7.7	2.6	4.1	6.1	5.7	7.7	9.7	4.2	6.2	7.7	3.0	5.0	6.5
5	France	-1.3	2.0	-1.9	-0.9	1.1	0.0	2.0	4.0	-0.4	1.6	3.1	-0.7	1.3	2.8
6	Germany	-3.3	1.9	-3.3	-2.3	-0.3	-0.1	1.9	3.9	-0.5	1.5	3.0	-0.8	1.2	2.7
7	India	7.4	7.9	5.9	7.4	9.4	5.9	7.9	9.9	4.3	6.3	7.8	3.1	5.1	6.6
8	Indonesia	5.8	6.5	4.3	5.8	7.8	4.5	6.5	8.5	3.2	5.2	6.7	2.1	4.1	5.6
9	Iran, Islamic Republic of	3.1	2.3	1.6	3.1	5.1	0.3	2.3	4.3	0.2	1.8	3.3	0.1	1.5	3.0
10	Italy	-2.4	1.4	-2.7	-1.7	0.3	0.3	1.4	3.4	-0.9	1.1	2.6	-1.1	0.9	2.4
11	Japan	-2.9	2.7	-3.0	-2.0	0.0	0.7	2.7	4.7	0.1	2.1	3.6	-0.3	1.7	3.2
12	Kenya	3.5	6.0	2.0	3.5	5.5	4.0	6.0	8.0	2.8	4.8	6.3	1.9	3.9	5.4
13	Malaysia	-1.1	5.4	-1.8	-0.8	1.2	3.4	5.4	7.4	2.3	4.3	5.8	1.4	3.4	4.9
14	Mozambique	4.1	5.7	2.1	4.1	6.1	3.7	5.7	7.7	2.6	4.6	6.1	1.7	3.7	5.2
15	Netherlands	-2.7	2.2	-2.9	-1.9	0.1	0.2	2.2	4.2	-0.2	1.8	3.3	-0.6	1.4	2.9
16	Nigeria	2.7	5.8	0.7	2.7	4.7	3.8	5.8	7.8	2.7	4.7	6.2	1.7	3.7	5.2
17	Portugal	-2.3	1.4	-2.6	-1.6	0.4	0.2	1.4	3.4	-0.9	1.1	2.6	-1.1	0.9	2.4
18	Saudi Arabia	5.1	4.9	3.6	5.1	7.1	2.9	4.9	6.9	1.9	3.9	5.4	1.1	3.1	4.6
19	Singapore	-5.2	5.1	-4.6	-3.6	-1.6	3.1	5.1	7.1	2.1	4.1	5.6	1.3	3.3	4.8
20	Spain	-1.9	1.4	-2.3	-1.3	0.7	0.3	1.4	3.4	-0.8	1.2	2.7	-1.1	0.9	2.4
21	Switzerland	-1.7	1.3	-2.2	-1.2	0.8	0.1	1.3	3.3	-1.0	1.0	2.5	-1.2	0.8	2.3
22	Tanzania	5.3	7.4	3.8	5.3	7.3	5.4	7.4	9.4	3.9	5.9	7.4	2.7	4.7	6.2
23	Thailand	4.6	5.7	3.1	4.6	6.6	3.7	5.7	7.7	2.6	4.6	6.1	1.6	3.6	5.1
24	United Arab Emirates	6.5	5.6	5.0	6.5	8.5	3.6	5.6	7.6	2.5	4.5	6.0	1.6	3.6	5.1
25	United Kingdom	-2.3	2.7	-2.8	-1.8	0.2	0.7	2.7	4.7	0.1	2.1	3.6	-0.3	1.7	3.2
26	United States	-1.4	3.2	-2.1	-1.1	0.9	1.2	3.2	5.2	0.6	2.6	4.1	0.1	2.1	3.6

Source :World Economic Outlook Database, October 2009 by IMF
Note : 1. The figures of Zimbabwe is not available after the year of 2008, then they are assumed by the JICA Study Team.
2. The figures of Namibia were modified by the JICA Study Tema on the basis of "NAMIBIA VISION 30", Policy Framework for Long-Term prepared by National Planning Commission and Third National Dvelopment Plan (NDP3) by National Planning Comission.

3.1.4 Gross Domestic Products (GDP)

(1) General

The predictive model for GDP is set up by taking account the historical performance of each country mentioned above from 1996 to 2008 from the "Global Key Indicators" prepared by United Nations Statistics Division, and the "World Economic Outlook Database 2008 and 2009", which includes estimates by the International Monetary Fund (IMF) for the period from 2009 to 2014. The model takes into account the impact of the worldwide financial crisis in 2008. "NAMIBIA VISION 30", Third National Development Plan (NDP3) – 2007/08–2011/12 – Office of the President, National Planning Commission, and "The Targets of Macroeconomic Convergence Programme" prepared by SADC are also reviewed for Namibia and her neighbouring countries.

(2) Namibia and Neighbouring Countries

Tables 3.1.6 and 3.1.7 show the historical performance (1995–2008) and projection (2009–2014) of annual growth rates of the gross domestic product (GDP) of Namibia and her neighbouring countries including land-locked countries. From 1995 to 2008, the highest growth rate is recorded by Angola with an AAGR of 9.5% followed by Botswana with 6.5%, Zambia with 4.4%, and Namibia with 3.7%. A negative growth rate is recorded by Zimbabwe with −2.5%. On the other hand, AAGRs during the last four years from 2004 to 2008 show relatively higher growth rates than those from 1995 to 2008. The highest growth rate is shown by Angola with 16.7% followed by Zambia with 5.4%, Botswana and DRC with 5.1%, South Africa with 4.8% and Namibia with the lowest positive AAGR at 4.4%, while Zimbabwe had a negative growth rate of −4.0%.

The worldwide financial crisis should not be disregarded in terms of the future socio-economic model forecasting traffic demand. In Africa and the Middle East, it is reported that economic growth is predicted to be slow, but less so than in other regions. In Africa, the growth is expected to slow down, particularly in commodity exporting countries, and several countries are already experiencing reduced demand for their exports, lower remittances, and foreign direct investment, while aid flows are also under threat. The IMF has revised its growth projection downwards and has forecast an economic growth rate between 5.1% and 3.5% for 2009 and between 5.7% and 5.0% for 2010.[1] Table 3.1.6 shows the updated projections of the growth rates of the GDP of Namibia and her neighbouring countries done by IMF. These updated GDP growth rates are taken into account in the socio-economic model.

The most drastic decrease in growth rate is recorded by Angola with 16.7% during the period from 2004 to 2008 and 7.3% afterwards, followed by Namibia with 4.4% and 2.3% respectively, and South Africa with 4.8% and 3.2% respectively.

[1] IMF website

Table 3.1.6 Historical and Projected Performance of GDP for Namibia and Neighbouring Countries

(Unit : Million US$ At Market Price, Constant Price of 2000, World Bank Estimates)

Year	Namibia	Angola	Botswana	Congo (DRC)	South Africa	Zambia	Zimbabwe	Total
1995	2,872	6,699	4,139	5,257	115,812	2,872	7,148	141,927
1996	2,964	7,449	4,369	5,203	120,799	2,964	7,889	148,673
1997	3,089	8,037	4,813	4,911	123,997	3,089	8,100	152,948
1998	3,191	8,584	5,323	4,831	124,638	3,191	8,334	154,901
1999	3,298	8,862	5,707	4,625	127,577	3,298	8,034	158,104
2000	3,414	9,129	6,177	4,306	132,878	3,414	7,399	163,303
2001	3,495	9,416	6,500	4,215	136,512	3,495	7,199	167,338
2002	3,729	10,780	6,866	4,362	141,549	3,729	6,883	174,169
2003	3,858	11,137	7,290	4,614	145,761	3,858	6,167	178,827
2004	4,088	12,383	7,740	4,921	152,996	4,088	5,933	188,060
2005	4,258	14,935	8,046	5,239	160,793	4,258	5,618	198,889
2006	4,455	17,110	8,385	5,505	168,809	4,455	5,348	209,613
2007	4,617	20,725	8,865	5,418	177,452	4,735	5,024	222,220
2008	4,795	24,036	9,338	5,910	184,248	5,010	5,024	233,567
2009	4,760	23,175	8,364	6,070	183,662	5,212	n.a.	226,484
2010	4,846	25,333	9,564	6,406	187,155	5,450	n.a.	233,907
2011	4,962	28,061	10,092	6,916	194,469	5,723	n.a.	245,261
2012	5,099	29,650	10,776	7,379	202,880	6,063	n.a.	256,749
2013	5,255	31,589	11,720	8,030	211,998	6,426	n.a.	269,762
2014	5,417	33,511	12,134	8,631	221,325	6,808	n.a.	282,407

Source :1."Global Key Indicators" prepared by United Nations Statistics Division (1995-2008)
2.: World Economic Outlook Database, October 2009 (2009-2014), IMF

Table 3.1.7 Annual Growth Rate of GDP of Namibia and Neighbouring Countries

(Unit :%)

Year	Namibia	Angola	Botswana	Congo	South	Zambia	Zimbabwe	Total
1996	3.2	11.2	5.6	-1.0	4.3	3.2	10.4	4.8
1997	4.2	7.9	10.2	-5.6	2.6	4.2	2.7	2.9
1998	3.3	6.8	10.6	-1.6	0.5	3.3	2.9	1.3
1999	3.4	3.2	7.2	-4.3	2.4	3.4	-3.6	2.1
2000	3.5	3.0	8.2	-6.9	4.2	3.5	-7.9	3.3
2001	2.4	3.1	5.2	-2.1	2.7	2.4	-2.7	2.5
2002	6.7	14.5	5.6	3.5	3.7	6.7	-4.4	4.1
2003	3.5	3.3	6.2	5.8	3.0	3.5	-10.4	2.7
2004	6.0	11.2	6.2	6.6	5.0	6.0	-3.8	5.2
2005	4.2	20.6	4.0	6.5	5.1	4.2	-5.3	5.8
2006	4.6	14.6	4.2	5.1	5.0	4.6	-4.8	5.4
2007	3.6	21.1	5.7	-1.6	5.1	6.3	-6.1	6.0
2008	3.9	16.0	5.3	9.1	3.8	5.8	0.0	5.1
2009	-0.7	-3.6	-10.4	2.7	-0.3	4.0	na.	-3.0
2010	1.8	9.3	14.3	5.5	1.9	4.5	na.	3.3
2011	2.4	10.8	5.5	8.0	3.9	5.0	na.	4.9
2012	2.8	5.7	6.8	6.7	4.3	5.9	na.	4.7
2013	3.0	6.5	8.8	8.8	4.5	6.0	na.	5.1
2014	3.1	6.1	3.5	7.5	4.4	5.9	na.	4.7
Average Annual Growth Rate (%)								
1995/2008	3.7	9.5	6.5	1.2	3.6	4.4	-2.5	3.9
2004/2008	4.4	16.7	5.1	5.1	4.8	5.4	-4.0	5.5
2008/2014	2.3	7.3	4.8	6.9	3.2	5.3	0.0	3.5

Source :"Global Key Indicators" prepared by United Nations Statistics Division

(3) National Development Plan of Namibia

1) Vision 30

In Vision 30, the macro-economic indicators are projected. Real GDP is expected to increase at the average annual growth rate of 4.5% from 2011 to 2015. After 2015, the growth rates are projected to increase from 6.3% to 9.4% until 2026, and the growth rate during the period from 2001 to 2030 is projected to be 5.8%. These growth rates are considerably high in comparison to the historical and projected performance from 2008 to 2014 as recorded by IMF, in which the average growth rate was 2.3%.

2) Third National Development Plan (NDP3)

In NDP3, the growth scenarios for “Baseline” and “Higher” by the industrial sector are set and compared with the actual growth rates of NDP2 during the period from 2007/2008 to 2011/2012. The growth rate of primary industries is set at a lower level than that of the actual growth rates of NDP2 but those of secondary and tertiary industries are set at higher rates than those of NDP2. The growth rates of Baseline and Higher scenarios are set at 5.0% and 6.5% respectively. These growth scenarios are also higher than the average growth rate projected by IMF of 2.3%.

**Table 3.1.8 NDP3 Sub-Sector Growth Targets—
Baseline and Higher GDP Growth Scenario**

Sub-Sector/Industry	NDP2 Growth (%) (2001/2002 - 2005/2006)	NDP3 Growth Targets (%) (2007/2008 - 2011/2012)	
	Actual	Baseline Growth Scenario	Higher Growth Scenario
Agriculture	2.2	3.7	4.7
Fishing & Fish Processing on Board	-0.5	2.5	3.6
Mining and Quarrying	9.3	0.8	3.0
Primary Industries	**4.5**	**2.0**	**3.6**
Manufacturing	2.9	4.9	5.3
Electricity and Water	0.9	3.4	15.6
Construction	16.6	11.8	14.6
Secondary Industries	**4.8**	**6.7**	**9.0**
Wholesale and Reatail Trade and Repairs	6.5	8.0	10.0
Hotels and Restaurants	3.6	8.2	10.7
Transport and Communication	11.6	11.4	14.3
Financial Intermediation	8.5	8.1	10.8
Real Estate and Business Services	5.1	3.8	5.5
Other Community, Social and Personal Services Activiti	1.5	3.0	3.0
Producers of Government Services	2.6	2.5	2.5
Other Producers	2.1	2.1	2.1
Tertiary Industries	**5.4**	**6.2**	**7.7**
Taxes less subsidies on products	2.6	2.6	2.6
GDP at Market (1995) Prices	**4.7**	**5.0**	**6.5**

Source: Republic of Namibia, Third National Development Plan (NDP3), 2007/2008 - 2011/12, ,WINDHOEK 2008

(4) Growth Scenarios

Three growth scenarios for population as models are set up for low, medium and high. The medium growth scenario for Namibia is set up by taking account of the historical performance, the short term projection by IMF (2009–2014) mentioned above, “NAMIBIA VISION 30” (2001–2030), and “POPULATION PROJECTION, 2001–2031”, under National and Regional Figures, Jan. 2006. The latter two prepared by the Government of Namibia (GON) is based on the year 2001 and was released by the Central Bureau of Statistics of Namibia. The comparisons are carried out between actual population data and the projected population during the period from 2001 to 2008. It became clear that the actual growth rate is lower than the projection by the GON. The population projection in this study during the period from 2008 to 2015 is then based on that of IMF's for the period from 2008 to 2014 and for 2015 onwards, the adjusted growth rate is set by taking account of the projections of the GON. The medium growth scenario of neighbouring countries and other main countries during the period from 2008 to 2015 are also based on the projection during the period from 2008 to 2014 conducted by IMF. For 2015 onwards, a gradually decreasing growth rate was set.

The low and high growth scenarios are set up by taking account of the annual growth rates by country during from 1995 to 2008. The three growth scenarios for Namibia and her neighbouring countries, and those for other main countries are shown in Tables 3.1.9 and 3.1.10 respectively.

Table 3.1.9 Growth Scenario of GDP for Namibia and Neighbouring Countries

(Average Annual Growth Rate:%)

Country	IMF Projection		2008/2010			2010/2015			2015/2020			2020/2025		
	2008/2010	2010/2014	Low	Medium	High	Low	Medium	High	Low	Medum	High	Low	Medium	High
Angola	2.7	7.2	1.2	2.7	4.7	5.2	7.2	9.2	3.8	5.8	7.3	2.6	4.6	6.1
Botswana	1.2	6.1	0.2	1.2	3.2	4.1	6.1	8.1	2.9	4.9	6.4	1.9	3.9	5.4
Congo, Democratic Republic of	4.1	7.7	2.6	4.1	6.1	5.7	7.7	9.7	4.2	6.2	7.7	3.0	5.0	6.5
Namibia	0.5	2.8	1.0	2.0	4.0	2.3	4.3	6.3	3.8	5.8	7.3	4.8	6.8	8.3
South Africa	0.8	4.3	-1.2	0.8	2.8	2.3	4.3	6.3	1.4	3.4	4.9	0.7	2.7	4.2
Zambia	4.3	5.7	2.3	4.3	6.3	3.7	5.7	7.7	2.6	4.6	6.1	1.7	3.7	5.2
Zimbabwe	na.	na.	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1.5	0.0	0.0	1.5

Source : World Economic Outlook Database, October 2009 by IMF

Note : 1. The figures of Zimbabwe is not available after the year of 2008, then they are assumed by the JICA Study Team.

2. The figures of Namibia are modified by the JICA Study Tema on the basis of "POPULATION PFROJECTION, 2001-2031", National and Regional Figures, Jan. 2006, Central Bureau of Statistics of Namibia and "NAMIBIA VISION 30", Policy Framework for Long-Term National Dvelopment.

Table 3.1.10 Growth Scenario of GDP for Main Countries

(Annual Average Growth Rate : %)

No.	Country	IMF Projection		2008/2010			2010/2015			2015/2020			2020/2025		
		2008/2010	2010/2014	Low	Medium	High	Low	Medium	High	Low	Medum	High	Low	Medium	High
1	Belgium	-1.8	2.1	-2.3	-1.3	0.7	0.1	2.1	4.1	-0.3	1.7	3.2	-0.6	1.4	2.9
2	Brazil	4.4	4.1	2.9	4.4	6.4	2.1	4.1	6.1	1.3	3.3	4.8	0.6	2.6	4.1
3	China	9.5	9.9	8.0	9.5	11.5	7.9	9.9	11.9	6.0	8.0	9.5	4.4	6.4	7.9
4	Congo, Democratic Republic of	4.1	7.7	2.6	4.1	6.1	5.7	7.7	9.7	4.2	6.2	7.7	3.0	5.0	6.5
5	France	-1.3	2.0	-1.9	-0.9	1.1	0.0	2.0	4.0	-0.4	1.6	3.1	-0.7	1.3	2.8
6	Germany	-3.3	1.9	-3.3	-2.3	-0.3	-0.1	1.9	3.9	-0.5	1.5	3.0	-0.8	1.2	2.7
7	India	7.4	7.9	5.9	7.4	9.4	5.9	7.9	9.9	4.3	6.3	7.8	3.1	5.1	6.6
8	Indonesia	5.8	6.5	4.3	5.8	7.8	4.5	6.5	8.5	3.2	5.2	6.7	2.1	4.1	5.6
9	Iran, Islamic Republic of	3.1	2.3	1.6	3.1	5.1	0.3	2.3	4.3	0.2	1.8	3.3	0.1	1.5	3.0
10	Italy	-2.4	1.4	-2.7	-1.7	0.3	0.3	1.4	3.4	-0.9	1.1	2.6	-1.1	0.9	2.4
11	Japan	-2.9	2.7	-3.0	-2.0	0.0	0.7	2.7	4.7	0.1	2.1	3.6	-0.3	1.7	3.2
12	Kenya	3.5	6.0	2.0	3.5	5.5	4.0	6.0	8.0	2.8	4.8	6.3	1.9	3.9	5.4
13	Malaysia	-1.1	5.4	-1.8	-0.8	1.2	3.4	5.4	7.4	2.3	4.3	5.8	1.4	3.4	4.9
14	Mozambique	4.1	5.7	2.1	4.1	6.1	3.7	5.7	7.7	2.6	4.6	6.1	1.7	3.7	5.2
15	Netherlands	-2.7	2.2	-2.9	-1.9	0.1	0.2	2.2	4.2	-0.2	1.8	3.3	-0.6	1.4	2.9
16	Nigeria	2.7	5.8	0.7	2.7	4.7	3.8	5.8	7.8	2.7	4.7	6.2	1.7	3.7	5.2
17	Portugal	-2.3	1.4	-2.6	-1.6	0.4	0.2	1.4	3.4	-0.9	1.1	2.6	-1.1	0.9	2.4
18	Saudi Arabia	5.1	4.9	3.6	5.1	7.1	2.9	4.9	6.9	1.9	3.9	5.4	1.1	3.1	4.6
19	Singapore	-5.2	5.1	-4.6	-3.6	-1.6	3.1	5.1	7.1	2.1	4.1	5.6	1.3	3.3	4.8
20	Spain	-1.9	1.4	-2.3	-1.3	0.7	0.3	1.4	3.4	-0.8	1.2	2.7	-1.1	0.9	2.4
21	Switzerland	-1.7	1.3	-2.2	-1.2	0.8	0.1	1.3	3.3	-1.0	1.0	2.5	-1.2	0.8	2.3
22	Tanzania	5.3	7.4	3.8	5.3	7.3	5.4	7.4	9.4	3.9	5.9	7.4	2.7	4.7	6.2
23	Thailand	4.6	5.7	3.1	4.6	6.6	3.7	5.7	7.7	2.6	4.6	6.1	1.6	3.6	5.1
24	United Arab Emirates	6.5	5.6	5.0	6.5	8.5	3.6	5.6	7.6	2.5	4.5	6.0	1.6	3.6	5.1
25	United Kingdom	-2.3	2.7	-2.8	-1.8	0.2	0.7	2.7	4.7	0.1	2.1	3.6	-0.3	1.7	3.2
26	United States	-1.4	3.2	-2.1	-1.1	0.9	1.2	3.2	5.2	0.6	2.6	4.1	0.1	2.1	3.6

Source :World Economic Outlook Database, October 2009 by IMF

Note : 1. The figures of Zimbabwe is not available after the year of 2008, then they are assumed by the JICA Study Team.

2. The figures of Namibia were modified by the JICA Study Tema on the basis of "NAMIBIA VISION 30", Policy Framework for Long-Term prepared by National Planning Commission and Third National Dvelopment Plan (NDP3) by National Planning Comission.

3.2 Future Transport Network Centred around Port of Walvis Bay

3.2.1 Future Maritime Transport Network

In view of the current maritime network discussed in Chapter 2 and the future demand of container cargos discussed above in the present Chapter, the new container terminal to be built at Walvis Bay will have the following impacts on the maritime transport network:

(1) Europe–Africa Route

As the Europe – West Africa Route and Europe – Southern Africa Route will be independently serviced, the new container terminal will not tranship the cargos from Europe to the west coast of Africa. However, it will be very likely that Walvis Bay becomes the gateway to the landlocked inland countries including the southern regions of Angola and DRC in transporting cargos from Europe and will capture some cargo from Luanda and Lobito on the west coast of Africa or even from Dar es Salaam or Mombasa on the east coast.

(2) South America–Africa Route

The more the economy of the countries of Southern and West Africa grows, the greater can be expected the trade between South America, especially those on the east coast of South America. Walvis Bay is at present the major transhipment port of cargo from South America to the countries of the west coast of Africa. However, the ships calling at the ports of South Africa currently do not call Walvis Bay. When the new container terminal is completed and a 5000 TEU container ship can use the terminal, several ships on this maritime route may call both at Walvis Bay and the ports in South Africa. Particularly, Walvis Bay will capture that container cargo currently transhipped at Cape Town.

(3) Asia–Africa Route

Among the five sub-routes of the Asia–Africa Route, there are two routes in which the new container terminal at Walvis Bay will play a role in maritime container transport. One is Asia–West Africa via South Africa/Walvis Bay Route and the other is Asia–West Direct Route.

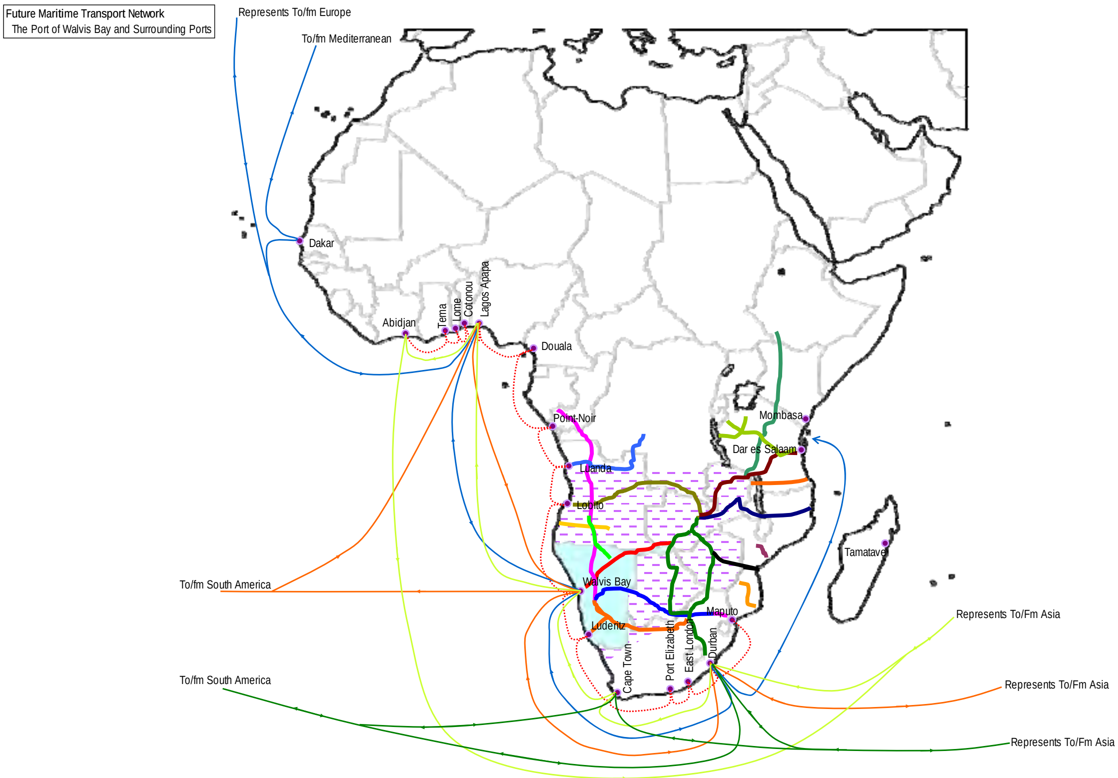
In case of the Asia–West Africa via South Africa/Walvis Bay Route, once Walvis Bay gains relative ascendancy over Cape Town due to better services that the new container terminal can provide and preference tariff that Namport can afford, it will capture from Cape Town a considerable amount of both the transhipment and transit container cargos transported between Asia to West Africa.

On the Asia–West Africa Direct Route, Walvis Bay will capture a huge amount of the container cargos which at present are directly transported to the ports on the west coast of Africa and those of West Africa. Once the new container terminal is completed and operational, a considerable amount of container cargos from Asia to Angola, Gabon, Cameron and Congo will be transhipped from container mother ships to feeders at Walvis Bay.

(4) Middle East/South Asia–Africa Route

On the maritime route, there will not be remarkable changes due to the new container terminal built at Walvis Bay since the route is not relevant to the west coast of Africa. However, a small amount of container cargos currently transported form the ports of the east coast of Africa to the land-locked inland countries like Burundi and Rwanda might be transhipped through Walvis Bay.

The future maritime transport network supplemented with the corridors of the southern Africa as deduced from the above probable changes is drawn in Figure 3.2.1 below.



Line=Trunk Service, Dot= Feeder Network, Corridor Connections

Figure 3.2.1 Future Prime Routings and the Respective Corridor Routes

3.2.2 Development of Inland Transport Network

(1) Hinterland of the Port of Walvis Bay

The majority of the container cargo handled at the Port of Walvis Bay is mostly transit and transhipment and the minority are the imports and exports of Namibia. The hinterland of the Port of Walvis Bay is a vast area which is not limited to Namibia for trade but also includes the surrounding countries for transit such as Angola, Zambia, Zimbabwe, Botswana and South Africa. Particularly, landlocked countries such as Zambia, Zimbabwe and Botswana are strategically essential hinterland to capture the demand of container cargoes for the Port of Walvis Bay. Besides, these landlocked countries overlap the hinterland not only of the Port of Walvis Bay but also of competitive ports such as Cape Town, Durban (South Africa), Beira and Maputo (Mozambique), and Dar es Salaam (Tanzania). These competitive ports are sharing the container cargo market of these landlocked countries with the Port of Walvis Bay.

(2) Walvis Bay Corridors

Figure 3.2.1 shows the Development Corridors of the Southern Africa. The roles of the four corridors making up the "Walvis Bay Corridors" as a whole will be more important for inland transport of container cargoes to and from the Port of Walvis Bay in the future.

1) Trans-Kalahari Corridor

The Trans-Kalahari Highway along Walvis Bay–Windhoek–Gaborone–Johannesburg/Pretoria will be more important as a potential artery between this industrial heartland and European /American markets. When the transport sector developments materialize, considerable traffic demand will be generated. There is a railway from Walvis Bay to Gobabis and a paved road from Gobabis to the border of Botswana. If the railway is extended and connected to Spoornet through Mafeking and Gauteng Province in South Africa, the automobile industry in Rosslyn in Gauteng and some mining industries including coal products in Botswana are expected to develop further and cargo demand will be created. It is expected that shipping from the Port of Walvis Bay through this future rail link will enable coal exporters to reach European markets a week earlier than exports from South Africa's Richards Bay Coal Terminal.[2]

2) Trans-Caprivi Corridor (TCC)

The Trans-Caprivi Highway links the Port of Walvis Bay to the inland areas of Zambia (Livingstone, Lusaka, Ndola and Kitwe) and the South Eastern Democratic Republic of Congo (Lubumbashi area) via the bridge across the Zambezi at Katima Mulilo, and supported by a railway line between Walvis Bay and Grootfontein, where facilities for modal shift between railway and trucks are available. The TCC covers the markets of Zambia, DRC and Zimbabwe. After completion of the bridge between Zambia and Namibia over the Zambezi River in 2004 and establishment of the first branch office in Lusaka by WBCG in 2005, marketing activities for Zambia and DRC (Lubumbashi) by WBCG has accelerated. After economic improvement of Zambia, the imports and exports via the Port of Walvis Bay has increased with an aggressive marketing campaign by the WBCG to divert market share of the North South Corridor to Durban and the Dar es Salaam Corridor. At this time, most cargo is carried by truck, but if rail track conditions were improved, it is likely that railway share will increase.

3) Trans-Cunene Corridor

The Trans-Cunene Corridor connects the Port of Walvis Bay to southern Angola up to Lubango. After rehabilitation of the highway of the corridor, the share of traffic volume has increased and accelerated to strengthen the role of Oshikango, the cross-border town, as the wholesale and retail centre for trade with Angola.

The railway line of the Trans-Cunene Corridor diverges from the line of the Trans-Caprivi Corridor at Otavi and runs up to Ondangwa. After the completion of construction between Ondangwa and Oshikango around 2011, operating the block-train, which is the shuttle service between the port and the cross-border town, will remarkably increase the transit container cargos to Angola.

4) Trans-Oranje Corridor

The Trans-Oranje Corridor Highway is an asphalt road linking the Port of Lüderitz and the Port of Walvis Bay to Johannesburg in South Africa and connects Lüderitz with the Northern Cape Province of South Africa. Upon completion of the railway restoration between Aus and Lüderitz in 2010, transport by railway between Namibia and South Africa will increase, but a drastic increase is not foreseen. As the Trans-Kalahari Corridor will remain the main corridor supported by road, the Trans-Oranje Corridor will continue to play a complementary role of the transit cargoes between the Port of Walvis Bay and South Africa.

[2] For a map of these areas please see Figure 2.4.1

(3) Other Corridors in Southern Africa

Other corridors have been playing their respective roles for regional integration, as manifestations of initiatives targeted at regional development within the framework of the Spatial Development Initiatives (SDIs). The following other corridors of Southern Africa have already been formulated to contribute to the regional development of Southern Africa and are expected to accelerate the inland transport for the effective transit cargo movement including the container cargoes to and from the Port of Walvis Bay in the future. These other corridors of the Southern Africa are considered to be essential infrastructure for the development of the Port of Walvis Bay.

1) Beira and Zambezi Development Corridors

The Beira and Zambezi development corridor initiatives aim to develop an economic region linking Malawi, Mozambique, Zambia and Zimbabwe, anchored to the port of Beira. Key objectives are to re-establish and upgrade the inland infrastructural linkages. Infrastructure development projects include: the upgrading of Beira port, electricity supply, gas and liquid fuel pipelines, the proposed Harare-Beira toll road, the Harare-Beira railway line upgrade, and upgrade of airports. Projects already being implemented include the Sena railway line commissioned in 2004. Development of the Shire and Zambezi rivers into navigable waterways is a strategic project aimed at increasing transport options for access to the sea for landlocked Malawi. The implementation of a number of natural resources-based projects include reopening of Moatize coking coalmine and development of a thermal power station, agricultural development in Dondo and Chimoio, as well as tourism in the Eastern Highlands of Zimbabwe and the Zambezi Valley.

2) Shrei Zambezi Waterway Corridor

This corridor is a waterway of 238 km connecting the Port of Nsanje on the south of Malawi, which has been closed by the civil war, and the Port of Chinede of Mozambique. If this waterway could be reopened, Malawi and the Indian Ocean would be connected to each other and would benefit other countries. The rehabilitation both for the waterway and for the roads is necessary and is now under construction on some parts.

3) Limpopo Development Corridor

This Special Development Initiative (SDI) by Mozambique, South Africa and Zimbabwe (and ultimately Botswana and Zambia) is spatially focused on the Limpopo river basin. The primary development and investment focus areas are in the agriculture, mining and mineral processing, tourism, and related infrastructure sectors. The mining and mineral processing projects are focused on mineral sand deposits at the Limpopo river mouth. The initiative also aims to establish an eco-tourism development zone of some 260,000 sq km. This will include the key anchor projects of the Great Limpopo Trans-Frontier Park. It is reported that the improvement of the road network is essential to maximize the economic effects through the development of this corridor.

4) Lubombo Spatial Development Initiative

The Lubombo SDI covers eastern Swaziland, the southern part of Maputo province in Mozambique and the north-eastern areas of Kwa Zulu Natal in South Africa. The construction of new roads and upgrading of other infrastructure are planned to open up the area to agriculture and tourism uses. The Lubombo region has six major interrelated ecosystems. The area has great diversity of plant and birdlife, game reserves and an extensive unspoiled coastline. Tourism projects planned in the area are the Machangulo Peninsula and Maputo Elephant Reserve, and Trans-Frontier Conservation Areas.

5) Mtwara Development Corridor

The Mtwara Development Corridor falls within the territories of Malawi, Mozambique, the United Republic of Tanzania and Zambia. The corridor runs from the port of Mtwara in the east to Mbamba Bay in the west on Lake Malawi. Transport projects include expansion and upgrading of the Indian Ocean port of Mtwara, and the ports of Mbamba Bay and Manda located on Lake Malawi/Nyasa/Niassa. Other projects include upgrading of Mtwara Airport, and road and railway infrastructure. The Unity Bridge, proposed to cross the Rovuma River, will contribute significantly to improved road network connectivity within the region. Other important projects are the Mchuchuma Thermal Power Station, the Mtwara-Mbamba Bay petroleum pipeline and Songo Songo gas.

6) Maputo Development Corridor

The Maputo Development Corridor was the first of the SDIs to be implemented in 1995. It links Gauteng province of South Africa to the port of Maputo in Mozambique. Developments along the corridor have focused on rehabilitation and upgrading of the traditional trade and transport links as a basis for broad economic development. The road, railway and port infrastructure and operations have been concessioned in Mozambique. The pavement of the roads is in relatively good condition. The plan for facilitation of regulation and construction for OSBP is ongoing by DfID. Private sector participation plays an important role in the corridor, particularly investment in the construction of a toll road linking Witbank in South Africa to Maputo (the N4 toll road) and the improvement of rail and port operations in Mozambique. Other major private sector investments include the Mozambique Aluminium Smelter (MOZAL), the Maputo Iron and Steel Plant, Beluluane Industrial Park and various natural gas industry projects. It is estimated that the corridor developments have created over 15,000 jobs. The Maputo Corridor Logistics Initiative (MCLI) was launched in 2004 as a public-private sector partnership institution to create greater awareness and utilisation of the corridor. The MCLI has emerged as one of the most vibrant and inclusive private-sector-driven corridor institutions in southern Africa.

The Maputo Development Corridor and The Trans-Kalahari Corridor connect the Port of Walvis Bay and the Port of Maputo via Johannesburg and the shortest route between the east coast and the west coast of Southern Africa. Then the improvement of transport infrastructure of these two corridors would have considerable impacts on the transit cargoes between the two ports.

7) Tazara Development Corridor

The Tazara Corridor (also called the Dar es Salaam Corridor) is a strategic artery linking southern Africa with east and central Africa. The conditions of roads and railway are good. The new bridge has been constructed at Nakonde border and the plan of OSBP is ongoing. Customs procedures are obligatory and take a longer time than at other borders. There is increasing traffic on this route from two directions: from South Africa, Zimbabwe and Zambia in the south, and from the Nacala Corridor in Malawi and Mozambique in the west. The traffic is largely sugar, cement, fuel and machinery. The Tazara Corridor, which provides the shortest distance by rail from the Copperbelt to a port (Dar es Salaam), is owned by Tanzania and Zambia. The corridor traverses some of the most fertile land in southern Tanzania and northern Zambia, and has potential for agriculture, tourism, mining, forestry and fishing.

8) Nacala Development Corridor

The Nacala Development Corridor aims to develop an economic corridor linking landlocked Malawi to the port of Nacala in Mozambique. About 70 percent of Malawi's population lives in the corridor. There is need to expand and rehabilitate the transport infrastructure to unlock the investment potential in the corridor. The road section between the Port and Nampula is two lanes and paved and the section between Nampla and the border of the western Malawi is necessary to be rehabilitated. The construction of facilities of one-stop border post (OSBP) is planned on the border of Chipata/Mchinji by the African Development Bank (AfDB). Railway systems in Malawi and Mozambique have already been concessioned and rehabilitation work has started on sections that are in poor condition.

9) Swaziland/South Africa Tourism and Biodiversity Corridor (STBC)

The south-eastern part of Mpumalanga province in South Africa and western Swaziland are endowed with rich plant and animal species, ancient geology and archaeology. The Barberton Greenstone Belt rocks in the area evolved between 3.5 and 3.2 billion years ago, making them the second oldest in the world. The STBC aims to combine these areas into a contiguous band for the protection of ecosystems, species and geology. The strategic objective is the promotion of sustainable and collaborative socio-economic development. Specific objectives aim to utilise tourism and conservation potential while benefiting rural communities.

10) Okavango Upper Zambezi International Tourism (Ouzit) SDI

The Ouzit was initially conceived and presented as a wildlife sanctuary to be located within the context of the Okavango and Zambezi wetland systems. The project centred on a core development area comprising 260,000 sq km incorporating game parks in Angola, Botswana, Namibia and Zimbabwe. Infrastructure development projects within the SDI comprise of the networking of the inland park regions, the fast tracking of improvements to the air traffic and transport infrastructure in participating countries, and establishment and management of a logistics platform linked to the improved regional air transport system. The Ouzit SDI connects to the Namibe Development Corridor in southern Angola.

11) Malange Development Corridor

This corridor connects Luanda and the northern and north eastern parts of Angola that contain rich mining resources and extends to the DRC. The multimodal corridor development for the roads, railways and ports is ongoing.

12) Lobito Development Corridor

The Lobito Development Corridor provides a strategic outlet to the sea through Angola for much of the DRC and Zambia and is the shortest route linking the major mining regions to their export markets. The corridor serves several regions of Angola—about 40 percent of the population. The main transport infrastructure is the port, the Benguela Railway line and the roads to the DRC and Zambia. Critical initiatives are the ongoing rehabilitation and upgrading of the Benguela Railway and the port of Lobito. The other key element is the rehabilitation of the existing road network that extends for about 1,800 km.

13) Namibe Development Corridor

This corridor connects Oshikango on the border of Namibia, Lubango and the Port of Namibe and has contributed to exports of iron ore from the iron mining of Angola. The roads between Lubango and Namibe are under construction with EU development assistance.

14) North–South Corridor (Durban Corridor)

This is a transport corridor linking South Africa to the countries to its north and is the busiest regional transit link in eastern and southern Africa. The North-South Corridor (also known as the Durban Corridor) is also the most extensive corridor in the region, linking the largest number of countries in eastern and southern Africa. It connects eight countries and interlinks to other corridors including the Trans-Kalahari, Beira, Lobito, Dar es Salaam and Nacala corridors.

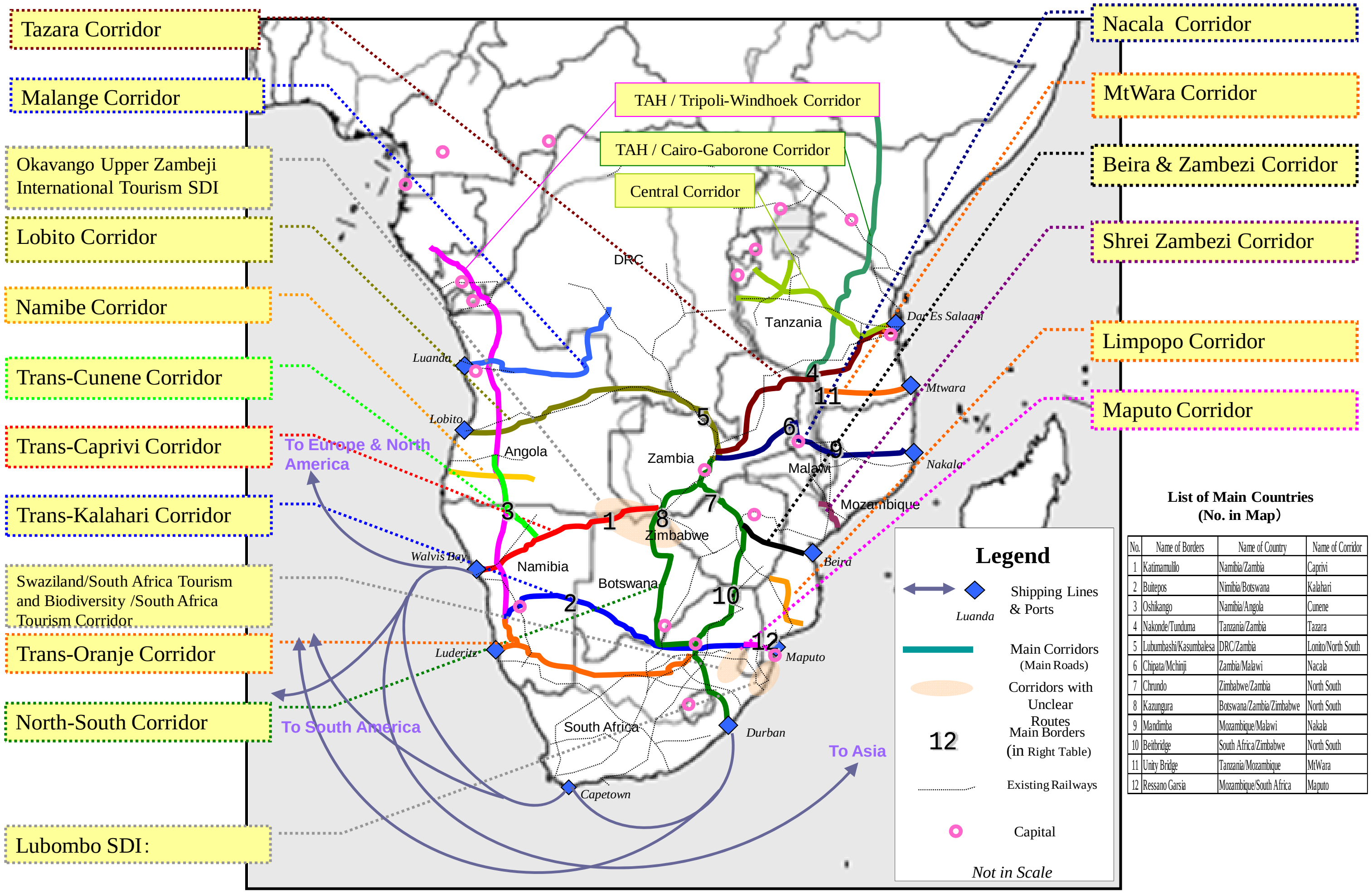
This corridor is critical because South Africa is the largest African trading partner for most of the countries in the region and the port of Durban handles a significant portion of transit traffic for the landlocked states. It is this corridor from which a large portion of captured demand will derive. The roads are in good condition. The infrastructure programs were agreed in order to reduce the costs of cross border trade based on the economic development corridor under the leadership of COMESA, SADC and EAC.

(4) Railway Network in Southern Africa

Figure 3.2.2 shows the railway network of Southern Africa. The railway network in Southern Africa spans across eleven countries namely: Angola, Botswana, DRC, Malawi, Mozambique, Namibia, South Africa, Swaziland, Tanzania, Zambia, and Zimbabwe. The network has some 36,000 route-km, operates 150,000 freight wagons using 4,000 locomotives and conveys over 200 million tons of traffic per annum. The network, with an estimated capacity of 350 million tons per annum, constitutes the biggest proportion of the 51,000 route-km in the whole of the African continent

The characteristics of this railway network are as follows:

- Most railways have been developed to connect the ports. The network was originally planned to transport seaborne cargoes to/from inland areas.
- The railway network has not yet been completed and has not realized seamless and smooth transport by railway. It is essential to connect with the road network. Particularly, the central part of Southern Africa including Botswana, a part of Namibia, Zambia and Angola has not yet been connected. The lack of a railway has become one of the obstacles to connect the ports of the east and west coast. If the railway were connected among Angola, Namibia, Zambia, Botswana, the exports and imports from these landlocked countries are expected to increase rapidly and to contribute to the economic development of SADC countries through greater efficacy in terms of cost and time in intermodal transportation. Many benefits stemming from the completion of railway network would be enjoyed by the Port of Walvis Bay since the railway of Namibia is not connected with land locked countries.



List of Main Countries (No. in Map)

No.	Name of Borders	Name of Country	Name of Corridor
1	Katimamulilo	Namibia/Zambia	Caprivi
2	Buitepos	Nimibia/Botswana	Kalahari
3	Oshikango	Namibia/Angola	Cunene
4	Nakonde/Tunduma	Tanzania/Zambia	Tazara
5	Lubumbashi/Kasumbalesa	DRC/Zambia	Lonito/North South
6	Chipata/Mchinji	Zambia/Malawi	Nacala
7	Chrundo	Zimbabwe/Zambia	North South
8	Kazungura	Botswana/Zambia/Zimbabwe	North South
9	Mandimba	Mozambique/Malawi	Nakala
10	Beitbridge	South Africa/Zimbabwe	North South
11	Unity Bridge	Tanzania/Mozambique	MtWara
12	Ressano Garsia	Mozambique/South Africa	Maputo

Source: JICA Study Team

Figure 3.2.2 Southern African Development Corridors

In order to achieve cost-efficiency and provide the customer with a competitive service, the railways in the region have to resolve to consolidate their operations and streamline the provision of rail transport services. In 1993 a Regional Action Plan (RAP) was agreed upon. The implementation of RAP was later spearheaded by the Southern African Railway Association (SARA) after its formation in 1996. The RAP entailed a redesign of rail services in line with customer requirements and provision of service at a reasonable and competitive cost. The objectives are the following:

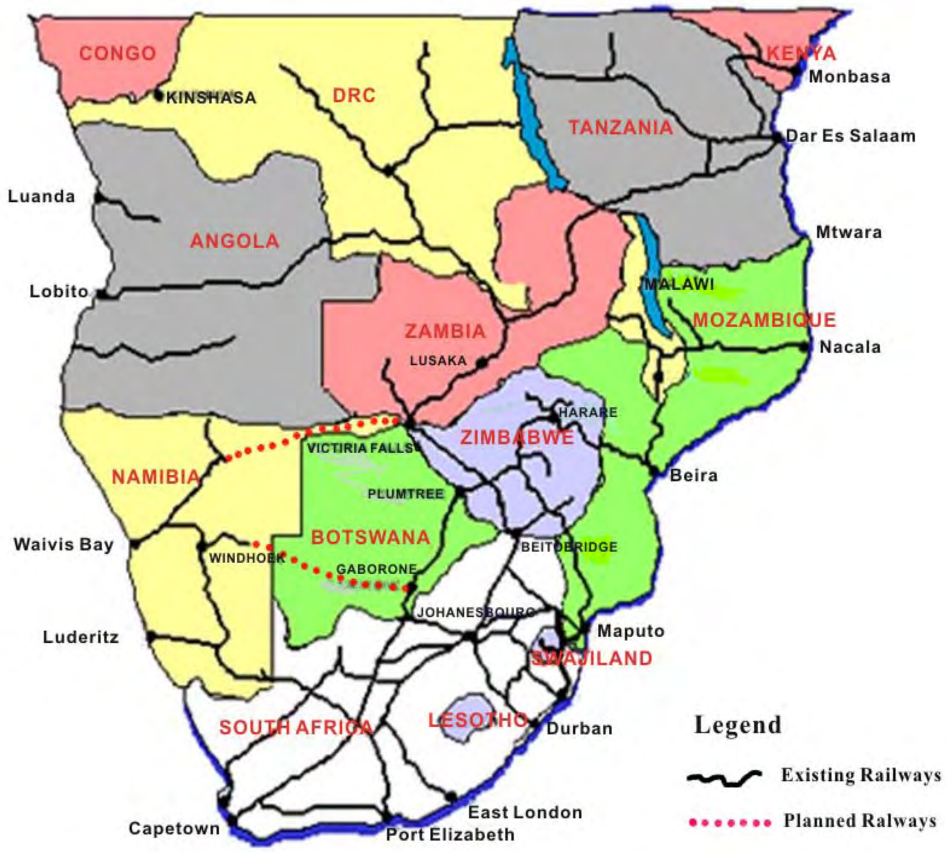
- Improve predictability and safety of rail transport services;
- Offer a seamless one-stop service throughout the region irrespective of national borders; and
- Promote the sharing of resources, among other interventions, to reduce costs while maximizing revenues.

These objectives made it imperative to harmonize standards for Technical, Operating, Commercial, Marketing, Costing, and Staff training practices. Harmonized standards and practices were also seen as contributing to the promotion of trade within the region as well as on the international global market by reducing the contribution of transport to the cost of production by facilitating:

- Common and reciprocal replacement of spare parts on rolling stock;
- Fluid exchange of equipment including pooling of resources thereby increasing utilization that will in turn reduce the levels of asset holding;
- Uniform maintenance cycles for equipment thereby allowing for maximum utilization;
- Joint staff training hence economies of scale;
- Through-running of locomotives, wagons, and crew across borders for maximum productivity;
- Single or joint train inspection at border stations thereby reducing delays; and
- Comparable cost regimes that would permit uniform rating.

While general harmonization of practices was recognized as a key to improved services, the variances in the nature of traffic flows in the different sections of the region, usually from source to destination, entailed that some railways had to work more closely with one another than with others. It was thus decided that the railways be categorized into corridor groups.

The corridors were to consist of railways that formed a route conveying consistently similar flows of road traffic. Eleven corridors were identified in Table 3.2.1 and the eight regional economic corridors that were later designated by the SADC governments to spearhead development by attracting investment coincided with the railway corridors and will ensure that the railways play a vital role in the trade and economic activities of the region.



Source: SARA Corridor Background, South African Railway Association (SARA)

Figure 3.2.3 Railway Network of Southern Africa

Table 3.2.1 Relationship among Rail Corridor, Sea Port and Development Corridor

Rail Corridor	Sea Port	Development Corridor
1. Dar es salaam-L/Victoria	Dar es Salaam	North Corridor/Great Lakes region
2. Dar es Salaam-TAZARA		TAZARA Development Corridor
		Lobito Development Corridor
3. Nacala	Nacala	Nacala Development Corridor
		Mtwara Development Corridor
4. Beira	Beira	Beira Development Corridor
5. Plumtree	Maputo	Maputo Development Corridor
6. Beitbridge	Richards Bay	
7. Limpopo	Durban	
8. Ressano Garcia	East London	
9. Goba		
10. Richards Bay		
11. Namibian	Walvis Bay	Maputo Development Corridor
		Walvis Bay Spatial Dev. Initiative
		Coast to Coast Spatial Dev. Initiative

Source : THE SOUTHERN AFRICAN RAILWAYS EXPERIENCE:AN OPERATIONS AND POLICY OVERVIEW by Maxwell Mlenga , South African Railway Association (SARA), Harare, Zimbabwe, presented at the Asia Pacifica Rail 2003 Conference and Exibition, 18– 21 March 2003

(5) Relationship of Container Cargo Demand with the Corridors

1) Modal Split of Container Cargoes

For Namibia, it is expected that the railway network will extend to Angola through the Trans-Cunene Corridor, to Zambia through the Trans-Caprivi Corridor, and to Botswana through the Trans-Kalahari Corridor. Under this situation, the share of railway could increase to accelerate transit to/from the land locked countries and the neighbouring countries. For other southern African countries, the rehabilitation and construction of railways are partly planned and ongoing but the smaller capacity of rail and the lack of reliability of railway services in the present condition will not considerably improve in the near future. In this case, the share of inland transport by railway would increase very slowly and the share of road would continue to occupy the majority of inland transport. However, it is strongly desired that the railway network take a greater role for inland transport as the most environmentally friendly mode of transport and most economical transport mode of commodities, if well maintained and operated for a long distance. The SADC countries must strive to cooperate to overcome the obstacles in close cooperation with the SARA organization.

2) Relative Superiority of Road Transportation of the Walvis Bay Corridors

There are development plans for the new railways for three Walvis Bay corridors and the Sena railway line for Beira Corridor. On the contrary, the rehabilitation of the road has positively progressed and further rehabilitation is envisaged in the Nacala Corridor, for example. That being said, the superiority of road transport over railway transport will remain unchanged in the near future. In the future, transit container cargo is expected to increase taking share from the Port of Lobito, a highly congested port. In this context, the Port of Walvis Bay is the nearest port and could capture container cargo for the imports and exports of Angola. This captured demand would be supported by an inland transport network that is dominated by road transport. As shown in Figure 3.8.2, the Trans-Cunene Corridor on the Trans-African Highway connects the section between Windhoek and Negege in Angola and is planned to be completely paved by 2010.

3) Time Savings of Border Crossings

The OSBP is expected to save on the cost of inland transport. The F/S of the OSBP was done for Katima Mulilo on the border between Namibia and Zambia but is not yet realized. The OSBPs of Nakonde on the border of Tanzania and of Ressano of the border of Mozambique are planned or under implementation. When these OSBPs are completed, effective inland transport will be triggered and contribute to the increase of transit cargos transported by both roads and railways. Particularly, the OSBP for Katima Mulilo will accelerate copper exports through the Port of Walvis Bay from Zambia and DRC by shortening the current route through either the Port of Dar es Salaam or the Port of Durban.

It can be concluded that an increase will not come only from the future inland transport network but also from the expansion of the relative capacity of the Port of Walvis Bay to compete with other ports such as the Port of Cape Town. The cargo increase will materialized in tandem with an aggressive marketing drive by the Walvis Bay Corridor Group. These elements can develop the demand from landlocked and neighbouring countries.

3.3 Forecast of Imports and Exports

The Study Team reviewed the forecast for container handling volumes of import and export prepared by Namport. It was estimated based on regression analysis using the actual performance of total cargo volume of container cargo from 1997 to 2008. However, there was no demarcation of transit/trans-shipment cargo in the forecast, which recently increased dramatically due to the handling price.

The study team considers the recent increase of transit/trans-shipment cargo in the total volume should be carefully taken into account, therefore, the study team proposes a four-steps-methodology for the demand forecast;

1) Export and Import amount: Using regression analysis based on recent trend of total cargo volume for export and import to/from Namibia. This approach is explained in Section 3.3.
2) Trans-shipment amount: applied three methodologies for this estimation, including regression analysis (macro approach) and estimates of capturing volume from other port (micro approach). See Section 3.4.
3) Transit amount: analyzed expected amount transit from the Port to inland countries. See Section 3.5
4) Aggregation: summarize the estimated amount of three categories, and modify the total amount of the demand. See Section 3.6.

Hereafter, the total volume for import and export are estimated.

3.3.1 Volume Estimation of Container Cargoes for Imports

Imports are composed of deep sea landed (DSL) and landed cargoes from the Southern African Development Community (SADCL) and cross border landed (CBL) cargoes. The forecast model for the imports of total cargoes is built up by a regression model analysis on the basis of the correlation analysis, and the best fit model is selected not only from the statistical viewpoint but also the socio-economic feasibility viewpoint. The imports of total cargoes (TIM) as the dependent variable is explained by the GDP per capita of Namibia (GPCN) with the GDP of major countries of cargo origin (GOMC) as the independent variables, the latter of which have been selected on the basis of the OD statistics of Namport. The total imports model is estimated by the following linear multi-regression equation:

$$TIM = -1,387,600.942 + 85.9038 \times GPCN + 146.7890 \times GOMC \quad (R=0.8779)$$

The "R" here is the correlation coefficient which is the degree of strength of relationship between TIM as the dependent variable and the total of GPCN and GOMC as the independent variables. If the "R" is near to 1.000, it means that the TIM value is closely related to the total values of GPCN and GOMC. The results of analysis show that "R" is 0.8779. Thus TIM is highly correlated to the total of GPCN and GOMC, and this model is suitable as a model for imports.

The table below shows Imports "landed cargo" Export "shipped cargo" represent. (By way of taking statistics Namporto) The data for model building is shown in the following table.

Table 3.3.1 Data for Model Building of the Imports

Year	GDP Per Capita of Namibia (US$)	GDP of Major Originated Countries (Billion US$)	Imported Cargo (Freight Ton)
1996	1,741	18,638	1,215,166
1997	1,760	19,309	1,187,786
1998	1,767	19,772	1,089,507
1999	1,780	20,386	1,144,888
2000	1,802	21,165	1,523,026
2001	1,811	21,470	1,639,671
2002	1,902	21,849	1,492,749
2003	1,943	22,461	1,352,361
2004	2,035	23,377	1,496,566
2005	2,176	24,193	1,599,383
2006	2,236	25,119	1,936,969
2007	2,277	25,985	2,053,733
2008	2,345	26,648	2,725,532

Source: a) Statistics by Country for the economic indicators;
b) Namport for Imported Cargo

The originated neighbouring countries as the variables use in the model building are Angola, Botswana, Brazil, China, Congo (DRC), India, Indonesia, Iran, Japan, Kenya, Netherland, Portugal, South Africa, United Arab Emirates, United Kingdom, USA, Zambia and Zimbabwe.

3.3.2 Volume Estimation of Container Cargoes for Exports

The exports are composed of deep sea shipped (DSS), shipped cargoes to Southern African Development Community (SADCS) and cross border shipped cargo (CRBS). The forecast model for the export of total cargoes is built up by regression model analysis on the basis of correlation analysis and the best fit model is selected not only from the statistical viewpoint but also from the socio-economic feasibility standpoint. The exports of total cargoes (TEX) as the dependent variable is explained by the GDP of Namibia and neighbouring and land-locked countries (GNN) and per capita GDP of major countries of cargo destination (GDMC) as the independent variables, of which the latter was selected on the basis of OD statistics for Namport. The total exports model is estimated by the following linear multi regression equation:

$$TEX = -528{,}901.1195 + 4{,}966.3473 \times GNN + 75.2365 \times GDMC \quad (R=0.8972)$$

If the “R” is near to 1.000, it means that TEX is closely related to the total of GNN and GDMC. The results of analysis show that “R” is 0.8972. Thus TEX is highly correlated to the total of GNN and GDMC, and this model is suitable as a model for exports.

The table below shows Imports “landed cargo” Export “shipped cargo” represent. (By way of taking statistics Namport) Data for the model building is shown in the following table.

Table 3.3.2 Data for Model Building of the Exports

Year	GDP of Namibia and Neighboring Countries (Billion US$)	GDP Per Capita of Major Destinated Countries (US$)	Exported Cargo
1996	152	6,406	637,652
1997	156	6,613	704,854
1998	158	6,812	715,162
1999	161	7,028	686,557
2000	167	7,247	745,385
2001	171	7,302	811,141
2002	178	7,393	912,514
2003	183	7,550	898,348
2004	192	7,806	1,171,988
2005	203	8,005	1,058,127
2006	214	8,250	880,361
2007	227	8,453	1,168,257
2008	238	8,587	1,300,941

Source: a) Statistics by Country for the economic indicators;
b) Namport for Imported Cargo

The originated neighbouring countries as the variables use in the model building are Angola, Botswana, Congo (DRC), South Africa, Zambia and Zimbabwe. The destinated major countries are Angola, Belgium, Botswana, China, Kenya, Mozambique, Netherland, Nigeria, Portugal, South Africa, Spain, Tanzania, United Kingdom, USA, Zambia, and Zimbabwe.

3.3.3 Future Demand of Container Cargoes

(1) Forecast of Imports by Type of Transport

The types of transport of imports are classified into landed cargo from deep sea (DSL), landed cargo from the Southern African Development Community (SADCL) and cross border landed cargo (CRBL). These types of the transport of imports are forecasted by setting up their shares on the basis of time series data.

(2) Forecast of Exports by Type of Transport

The types of transport of exports are classified into shipped cargo to deep sea (DSS), shipped cargo to the Southern African Development Community (SADCS) and cross border shipped cargo (CRBS). These types of cargo are forecast by setting up their shares on the basis of time series data.

The results of the forecast are shown in the following tables.

Table 3.3.3 Forecast of Cargo Volume(Inbound & Outboud) of the Port of Walvis Bay

(Unit : Freight Ton)

Year	Inbound											
	DSL			SADCL			CRBL			Subtotal		
	Low	Medium	High	Low	Medium	High	Low	Medium	High	Low	Medium	High
2008	1,524,040			807,079			394,415			2,725,533		
2010	1,482,549	1,535,691	1,628,270	782,308	810,350	859,202	385,107	398,912	422,960	2,649,965	2,744,953	2,910,431
2015	1,706,496	2,006,595	2,585,765	851,409	1,001,136	1,290,097	475,900	559,591	721,107	3,033,806	3,567,321	4,596,969
2020	1,949,503	2,581,654	3,319,817	881,243	1,166,998	1,500,673	557,713	738,558	949,732	3,388,459	4,487,210	5,770,221
2025	2,082,496	3,093,476	4,284,998	938,138	1,393,571	1,930,336	640,358	951,230	1,317,617	3,660,992	5,438,276	7,532,951
Year	Outbound											
	DSS			SADCS			CRBS			Subtotal		
	Low	Medium	High	Low	Medium	High	Low	Medium	High	Low	Medium	High
2008	877,878			419,370			3,693			1,300,941		
2010	849,185	891,247	938,741	404,806	424,857	447,497	4,444	4,664	4,913	1,258,435	1,320,768	1,391,151
2015	1,002,547	1,172,802	1,382,780	451,997	530,849	625,892	6,957	8,170	9,633	1,461,501	1,711,821	2,018,305
2020	1,139,996	1,453,839	1,851,258	476,783	623,078	793,401	8,528	11,144	14,190	1,625,307	2,088,061	2,658,849
2025	1,193,829	1,722,718	2,364,519	478,469	698,422	958,620	11,098	16,199	22,235	1,683,396	2,437,339	3,345,374
Year	Total						Transit (CRBL+CRBS)					
	Low	Medium	High				Low	Medium	High			
2008	4,026,474						398,108					
2010	3,908,399	4,065,721	4,301,583				389,552	403,576	427,873			
2015	4,495,306	5,279,143	6,615,274				482,857	567,761	730,740			
2020	5,013,766	6,575,271	8,429,070				566,241	749,703	963,922			
2025	5,344,388	7,875,616	########				651,456	967,429	1,339,852			

Note: 1.Outbound is Export and Transit outbound consists of, Inbound in Import and Transit inbound consisting.
2.The figures do not include the empty containers.
3. DSL : Landed cargoes from deepsea; SADCL:Landed cargoes from the South Africn Development Community (SADC);
CBRL: Landed cargoes to cross border.
DSS : Shipped cargoes to deepsea; SADCS:Shippeded cargoes to SADC; CBRS: Shipped cargoes from cross border.

Source : JICA Study Team

(3) Forecast of Container Cargo

1) Rate of Containerized Cargo

The container cargo includes the empty container itself. The rates of containerized cargo are calculated for the laden container cargo and the laden total cargo. The future rates of containerized cargo are set up by the type of transport on the basis of the past data (Tables 3.3.4 and 3.3.5).

Table 3.3.4 Estimation for Rate of Containerized Cargo

(Unit : Freight Ton)

Year	Itemas	Inbound				Outbound				TRSH	Total
		DSL	SADCL	CRBL	Subtotal	DSS	SADCS	CRBS	Subtotal		
2002	Cargo Handled	581,787	887,929	N.A	1,469,716	490,185	420,509	N.A	910,693	60,395	2,440,804
	Containerized Cargo Handled	203,798	81,471	N.A	285,268	152,665	41,675	N.A	194,340	11,996	491,604
	Empty Container Cargo Handled	0	0	N.A	0	0	0	N.A	0	0	0
	Laden Containerized Cargo	203,798	81,471	N.A	285,268	152,665	41,675	N.A	194,340	11,996	491,604
	Laden Cargo Handled	581,787	887,929	N.A	1,469,716	490,185	420,509	N.A	910,693	60,395	2,440,804
	Ratio of Containerization (%)	35.0	9.2	NA	19.4	31.1	9.9	NA	21.3	19.9	20.1
2005	Cargo Handled	631,444	868,132	98,326	1,597,902	749,230	317,747	1,439	1,068,416	354,853	3,021,170
	Containerized Cargo Handled	167,107	110,237	84,312	361,656	211,089	48,120	1,380	260,589	339,218	961,462
	Empty Container Cargo Handled	650	3,406	0	4,056	768	4,466	5	5,239	197	9,492
	Laden Containerized Cargo	166,457	106,831	84,312	357,600	210,321	43,654	1,375	255,350	339,021	951,970
	Laden Cargo Handled	630,794	864,726	98,326	1,593,846	748,462	313,281	1,434	1,063,177	354,656	3,011,678
	Ratio of Containerization (%)	26.4	12.4	85.7	22.4	28.1	13.9	95.9	24.0	95.6	31.6
2008	Cargo Handled	1,524,571	1,697,399	394,415	3,616,384	888,822	424,620	3,693	1,317,135	781,597	5,715,116
	Containerized Cargo Handled	403,985	64,299	375,054	843,338	265,718	58,920	3,674	328,312	767,297	1,938,947
	Empty Container Cargo Handled	531	1,609	0	2,140	10,944	5,250	0	16,194	12,440	30,774
	Laden Containerized Cargo	403,454	62,690	375,054	841,198	254,774	53,670	3,674	312,118	754,857	1,908,173
	Laden Cargo Handled	1,524,040	807,079	394,415	2,725,533	877,878	419,370	3,693	1,300,941	769,157	4,795,631
	Ratio of Containerization (%)	26.5	7.8	95.1	30.9	29.0	12.8	99.5	24.0	98.1	39.8

Note: Outbound is Export and Transit outbound consists of, Inbound in Import and Transit inbound consisting.
Rate of containerisation stands for the rate of containerized cargoes of all cargoes including the bulky cargoes but for the rate of containerized cargoes of ainerisable cargoes.

Source: "Pmaesa Query Calender Year ", NAMPORT.

Table 3.3.5 Assumption of the Future Rates of Containerized Cargo

(Unit : %)

Year	Inbound				Outbound				TRSH	Total
	DSL	SADCL	CRBL	Subtotal	DSS	SADCS	CRBS	Subtotal		
2008	26.5	7.8	95.1	30.9	29.0	12.8	99.5	24.0	98.1	39.8
2010	27.6	8.9	95.7	32.0	29.9	13.9	98.6	25.0	98.0	40.9
2015	28.6	9.9	96.6	34.0	31.8	15.4	98.9	27.0	99.0	45.4
2020	29.7	10.9	97.9	36.0	33.6	17.0	99.3	29.0	99.0	48.0
2025	31.0	12.0	98.9	38.0	34.9	19.9	98.6	31.0	99.0	49.9

Note: 1.Outbound is Export and Transit outbound consists of, Inbound in Import and Transit inbound consisting.
2.The figures do not include the empty containers.
3. DSL : Landed cargoes from deepsea; SADCL:Landed cargoes from the South Africn Development Community (SADC); CBRL: Landed cargoes to cross border.
DSS : Shipped cargoes to deepsea; SADCS:Shippeded cargoes to SADC; CBRS: Shipped cargoes from cross border.
Rate of containerisation stands for the rate of containerized cargoes of all cargoes including the bulky cargoes but for the rate of containerized cargoes of ainerisable cargoes.
Source : JICA Study Team

3.3.4 Laden Container Cargo

The laden container cargo in freight tons is forecast by applying the rates of containerized cargo to the total laden cargo by type of transport (Table 3.3.6). The forecast of the average tonnage per TEU of the laden container cargo is shown in Table 3.3.7.

Table 3.3.6 Forecast of Laden Container Cargo of Port of Walvis Bay

(Unit : Freight Ton)

Year	Inbound											
	DSL			SADCL			CRBL			Subtotal		
	Low	Medium	High	Low	Medium	High	Low	Medium	High	Low	Medium	High
2008	403,454			62,690			375,054			841,198		
2010	409,756	424,444	450,032	69,499	71,990	76,330	368,733	381,950	404,976	847,989	878,385	931,338
2015	487,831	573,619	739,185	83,928	98,687	127,171	459,735	540,583	696,613	1,031,494	1,212,889	1,562,969
2020	578,178	765,660	984,582	95,831	126,905	163,191	545,836	722,831	929,507	1,219,845	1,615,396	2,077,280
2025	645,144	958,338	1,327,464	112,501	167,117	231,486	633,532	941,090	1,303,571	1,391,177	2,066,545	2,862,521
Year	Outbound											
	DSS			SADCS			CRBS			Subtotal		
	Low	Medium	High	Low	Medium	High	Low	Medium	High	Low	Medium	High
2008	254,774			53,670			3,674			312,118		
2010	253,772	266,342	280,535	56,454	59,250	62,408	4,383	4,600	4,845	314,609	330,192	347,788
2015	318,246	372,469	439,155	69,484	81,645	96,263	6,875	8,078	9,525	394,605	462,192	544,942
2020	381,854	488,282	621,758	81,044	106,194	135,223	8,441	11,061	14,085	471,339	605,538	771,066
2025	415,715	600,489	824,202	95,207	139,114	190,941	10,931	15,972	21,922	521,853	755,575	1,037,066

Note: 1.Outbound is Export and Transit outbound consists of, Inbound in Import and Transit inbound consisting.
2.The figures do not include the empty containers.
3. DSL : Landed cargoes from deepsea; SADCL:Landed cargoes from the South Africn Development Community (SADC); CBRL: Landed cargoes to cross
DSS : Shipped cargoes to deepsea; SADCS:Shippeded cargoes to SADC; CBRS: Shipped cargoes from cross border.
Source : JICA Study Team

Table 3.3.7 Average Tonnage per TEU

(Unit : FT/TEU)

DSL	No. of Laden Container(6m)	6,979
	No. of Laden Conmtainer(12m)	5,769
	Laden TEU	18,517
	Laden Containerized Cargo Handled (FT)	403,454
	FT/TEU	21.8
SADCL	No. of Laden Container(6m)	2,825
	No. of Laden Conmtainer(12m)	30
	Laden TEU	2885
	Laden Containerized Cargo Handled (FT)	62,690
	FT/TEU	21.7
CRBL	No. of Laden Container(6m)	1,900
	No. of Laden Conmtainer(12m)	7,599
	Laden TEU	17,098
	Laden Containerized Cargo Handled (FT)	375,054
	FT/TEU	21.9
Inbound	No. of Laden Container(6m)	11,704
	No. of Laden Conmtainer(12m)	13,398
	Laden TEU	38,500
	Laden Containerized Cargo Handled (FT)	841,198
	FT/TEU	21.8
DSS	No. of Laden Container(6m)	4,276
	No. of Laden Conmtainer(12m)	3,655
	Laden TEU	11,586
	Laden Containerized Cargo Handled (FT)	254,774
	FT/TEU	22.0
SADCS	No. of Laden Container(6m)	2,306
	No. of Laden Conmtainer(12m)	64
	Laden TEU	2,434
	Laden Containerized Cargo Handled (FT)	53,670
	FT/TEU	22.1
CRBS	No. of Laden Container(6m)	101
	No. of Laden Conmtainer(12m)	33
	Laden TEU	167
	Laden Containerized Cargo Handled (FT)	3,674
	FT/TEU	22.0
Outbound	No. of Laden Container(6m)	6,683
	No. of Laden Conmtainer(12m)	3,752
	Laden TEU	14,187
	Laden Containerized Cargo Handled (FT)	312,118
	FT/TEU	22.0
TRAS	No. of Laden Container(6m)	16,305
	No. of Laden Conmtainer(12m)	15,290
	Laden TEU	46,885
	Laden Containerized Cargo Handled (FT)	754,857
	FT/TEU	16.1
Total	No. of Laden Container(6m)	34,692.0
	No. of Laden Conmtainer(12m)	32,440.0
	Laden TEU	99,572.0
	Laden Containerized Cargo Handled (FT)	1,908,173.4
	FT/TEU	19.2

Note: 1.Outbound is Export and Transit outbound consists of, Inbound in Import and Transit inbound consisting.

2. 22ton per TEU is the inherent conversion method by Namport and not the actual freight ton per TEU.

Source : JICA Study Team

The laden container cargo in TEU is forecast by applying the empty rates of container cargo to the laden container cargo in freight tons by type of transport (Tables 3.3.8 and 3.3.9).

Table 3.3.8 Ratio of Empty Container

Type of Transport	Items	6m (20f)	12m(40f)	Total	TEU
DSL	Total Container	7,101	6,178	13,279	19,457
	Empty Container	122	409	531	940
	Laden Container	6,979	5,769	12,748	18,517
	Ratio of Empty Container(%)	1.7	6.6	4.0	4.8
SADCL	Total Container	3,310	1,154	4,464	5,618
	Empty Container	485	1,124	1,609	2,733
	Laden Container	2,825	30	2,855	2,885
	Ratio of Empty Container(%)	14.7	97.4	36.0	49
CRBL	Total Container	1,900	7,599	9,499	17,098
	Empty Container	0	0	0	0
	Laden Container	1,900	7,599	9,499	17,098
	Ratio of Empty Container(%)	0.0	0.0	0.0	0.0
Inbound	Total Container	12,311	14,931	27,242	42,173
	Empty Container	607	1,533	2,140	3,673
	Laden Container	11,704	13,398	25,102	38,500
	Ratio of Empty Container(%)	4.9	10.3	7.9	8.7
DSS	Total Container	5,520	13,355	18,875	32,230
	Empty Container	1,244	9,700	10,944	20,644
	Laden Container	4,276	3,655	7,931	11,586
	Ratio of Empty Container(%)	22.5	72.6	58.0	64.1
SADCS	Total Container	6,079	1,541	7,620	9,161
	Empty Container	3,773	1,477	5,250	6,727
	Laden Container	2,306	64	2,370	2,434
	Ratio of Empty Container(%)	62.1	95.8	68.9	73
CRBS	Total Container	101	33	134	167
	Empty Container	0	0	0	0
	Laden Container	101	33	134	167
	Ratio of Empty Container(%)	0.0	0.0	0.0	0.0
Outbound	Total Container	11,700.0	14,929.0	26,629.0	41,558
	Empty Container	5,017.0	11,177.0	16,194.0	27,371
	Laden Container	6,683.0	3,752.0	10,435.0	14,187
	Ratio of Empty Container(%)	57.1	25.1	39.2	65.9
TRSH	Total Container	20,290	19,102	39,392	58,494
	Empty Container	3,985	3,812	7,797	11,609
	Laden Container	16,305	15,290	31,595	46,885
	Ratio of Empty Container(%)	19.6	20.0	19.8	19.8
Toatal	Total Container	44,301.0	48,962.0	93,263.0	142,225
	Empty Container	9,609.0	16,522.0	26,131.0	42,653
	Laden Container	34,692.0	32,440.0	67,132.0	99,572
	Ratio of Empty Container(%)	21.7	33.7	28.0	30.0
Ratio of 12m(%)			52.5		

Note: 1.Outbound is Export and Transit outbound consists of, Inbound in Import and Transit inbound consisting.
Source : Statistics Division of Business Intelligence Departmnet of Namport.

Table 3.3.9 Forecast of Total Container Cargo of Port of Walvis Bay (Disregarding High Growth Rate of 2009)

(Unit : TEU)

Year	Inbound											
	DSL			SADCL			CRBL			Subtotal		
	Low	Medium	High	Low	Medium	High	Low	Medium	High	Low	Medium	High
2008	19,457			5,618			17,098			42,173		
2009	19,760	19,796	20,180	5,723	5,734	5,845	17,226	17,258	17,593	42,709	42,787	43,619
2010	20,067	20,138	20,931	5,830	5,851	6,081	17,356	17,417	18,103	43,253	43,406	45,115
2014	22,681	24,865	30,688	6,301	6,908	8,525	20,815	22,820	28,164	49,797	54,593	67,377
2015	23,386	26,211	33,769	6,424	7,200	9,276	21,783	24,415	31,455	51,593	57,826	74,500
2020	26,848	34,001	43,719	6,682	8,462	10,881	25,708	32,557	41,862	59,237	75,021	96,462
2025	28,824	41,057	56,866	7,149	10,184	14,105	29,790	42,433	58,772	65,762	93,674	129,743
Year	Outbound											
	DSS			SADCS			CRBS			Subtotal		
	Low	Medium	High	Low	Medium	High	Low	Medium	High	Low	Medium	High
2008	32,230			9,161			167			41,558		
2009	32,295	32,300	33,149	9,387	9,435	9,682	183	184	188	41,865	41,919	43,020
2010	32,361	32,371	34,093	9,619	9,716	10,234	200	202	213	41,866	42,289	44,540
2014	37,355	41,486	47,802	11,024	12,306	14,180	278	310	358	48,658	54,103	62,340
2015	38,720	44,140	52,016	11,407	13,055	15,385	302	346	407	50,428	57,541	67,808
2020	44,469	56,533	71,916	12,735	16,590	21,104	355	462	588	57,559	73,586	93,608
2025	47,549	67,988	93,182	14,693	21,252	29,127	452	653	895	62,694	89,894	123,204

Note: 1.Outbound is Export and Transit outbound consists of, Inbound in Import and Transit inbound consisting.
2.The figures do not include the empty containers.
3. DSL : Landed cargoes from deepsea; SADCL:Landed cargoes from the South Africn Development Community (SADC); CBRL: Landed cargoes to cross
DSS : Shipped cargoes to deepsea; SADCS:Shippeded cargoes to SADC; CBRS: Shipped cargoes from cross border.

Source : JICA Study Team

3.3.5 Modification Due to Higher Growth Rate in 2009

The result of total container cargo is revised by taking account of the fact that the higher growth rate predicted for the year 2009 is about 1.5 times that of the year 2008. This high increase in container cargo predicted in 2009 is incorporated in the estimate as shown in Table 3.3.10. It is assumed that the growth trend before 2009 will resume from 2010 onwards on the basis of the predicted cargo in 2009. The result of revised total container cargo is shown in the following table:

Table 3.3.10 Forecast of Total Container of the Port of Walvis Bay (Incorporating High Growth Rate of 2009)

(Unit : TEU)

Year	Inbound											
	DSL			SADCL			CRBL			Subtotal		
	Low	Medium	High	Low	Medium	High	Low	Medium	High	Low	Medium	High
2008	19,457			5,618			17,098			42,173		
2009	23,306	23,348	23,802	5,723	5,734	5,845	42,292	42,369	43,192	71,321	71,451	72,839
2010	23,613	23,691	24,553	5,830	5,851	6,081	42,421	42,528	43,702	71,864	72,070	74,335
2014	26,227	28,418	34,310	6,301	6,908	8,525	45,881	47,931	53,763	78,409	83,257	96,598
2015	26,932	29,764	37,391	6,424	7,200	9,276	46,848	49,526	57,054	80,205	86,490	103,721
2020	30,394	37,554	47,341	6,682	8,462	10,881	50,773	57,668	67,461	87,849	103,685	125,683
2025	32,370	44,610	60,488	7,149	10,184	14,105	54,855	67,544	84,371	94,374	122,337	158,964
Year	Outbound											
	DSS			SADCS			CRBS			Subtotal		
	Low	Medium	High	Low	Medium	High	Low	Medium	High	Low	Medium	High
2008	32,230			9,161			167			41,558		
2009	38,670	38,676	39,692	9,387	9,435	9,682	412	414	425	48,469	48,524	49,799
2010	38,736	38,746	40,637	9,619	9,716	10,234	429	432	449	48,784	48,895	51,319
2014	43,730	47,862	54,345	11,024	12,306	14,180	507	541	594	55,261	60,708	69,119
2015	45,094	50,516	58,559	11,407	13,055	15,385	531	576	644	57,032	64,147	74,588
2020	50,844	62,909	78,459	12,735	16,590	21,104	584	693	825	64,162	80,191	100,387
2025	53,924	74,364	99,725	14,693	21,252	29,127	681	883	1,131	69,298	96,500	129,984

Note: 1.Outbound is Export and Transit outbound consists of, Inbound in Import and Transit inbound consisting.
2.The figures do not include the empty containers.
3. DSL : Landed cargoes from deepsea; SADCL:Landed cargoes from the South Africn Development Community (SADC);
CBRL: Landed cargoes to cross border.
DSS : Shipped cargoes to deepsea; SADCS:Shippeded cargoes to SADC; CBRS: Shipped cargoes from cross border.

Source : JICA Study Team

Table 3.3.11 Summary of Container Cargo Demand Forecast (Without-the-Project)

(Unit : TEU)

Year	Imports (Exc. CRBL)			Expports (Exc. CRBS)			Transit(CRBL+CRBS)		
	Low	Medium	High	Low	Medium	High	Low	Medium	High
2008	25,075			41,391			17,265		
2009	29,029	29,082	29,647	48,057	48,111	49,374	42,703	42,783	43,617
2010	29,443	29,542	30,634	48,355	48,463	50,870	42,850	42,960	44,151
2014	32,528	35,326	42,835	54,754	60,168	68,525	46,388	48,472	54,357
2015	33,356	36,964	46,667	56,501	63,571	73,944	47,380	50,102	57,697
2020	37,076	46,017	58,222	63,578	79,499	99,562	51,357	58,361	68,286
2025	39,519	54,793	74,593	68,617	95,616	128,852	55,535	68,427	85,503

Note: The transit container cargo is composed of CRBL and CRBS which are cross border container carges.
Source : JICA Study Team

Table 3.3.12 Average Annual Growth Rate of Container Cargo Demand (Without-the-Project)

(Unit :%)

Year	Imports (Exc. CRBL)			Exports (Exc. CRBS)			Transit(CRBL+CRBS)		
	Low	Medium	High	Low	Medium	High	Low	Medium	High
2008/2009	15.8	16.0	18.2	16.1	16.2	19.3	147.3	147.8	152.6
2009/2010	1.4	1.6	3.3	0.6	0.7	3.0	0.3	0.4	1.2
2010/2014	2.5	4.6	8.7	3.2	5.6	7.7	2.0	3.1	5.3
2014/2015	2.5	4.6	8.9	3.2	5.7	7.9	2.1	3.4	6.1
2015/2020	2.1	4.5	4.5	2.4	4.6	6.1	1.6	3.1	3.4
2020/2025	1.3	3.6	5.1	1.5	3.8	5.3	1.6	3.2	4.6

Note: The transit container cargo is composed of CRBL and CRBS which are cross border container carges.
Source : JICA Study Team

The drastic increase in the year 2009 reflects the recent upsurge in container demand. In particular, transit containers are expected to increase the most, by 147.8% in the medium scenario. The low growth rate in 2010 reflects the impact of the worldwide financial crisis but is expected to recover to a higher growth rate after 2010. The relatively higher growth rate in the year of 2014 is caused by the higher growth of reactionary economic indicators such as the GDP of related countries.

3.4 Forecast of Transshipment

To improve the accuracy of analyses, transshipment forecasts, in addition to Macro-demand Forecasts, were determined by including the following points on Micro-demand forecast.

1) Macro Demand Forecasts
2) Micro Demand Forecasts (forecasting based on presently-captured demand + newly-captured demand after 2015 by the Project)

3.4.1 Macro Demand Forecast

This is a forecasting method that utilizes the regression formula obtained from past trends of transshipment cargo volume at Walvis Bay Port. The estimation is based on all available data from 1996 to 2008.

The forecast model for transhipment is built up by regression model analysis. The transhipment (TRSH) as the dependent variable is explained by the GDP of major countries of origin and destination of cargo (GODMC) as the independent variable on the basis of OD statistics of Namport. The transhipment model is estimated by the following regression equation:

$$TRSH= 2,310,932.2 \times Ln(GODMC) – 20,933,660.4 \ (R=0.9203)$$

This model is a semi-logarithmic model and the GODMC is converted into the natural logarithmic value. “Ln” stands for natural logarithmic. TRSH shows a highly correlated relationship to the GOMDC because “R” is very close to 1.000 at 0.9023. Thus this model is a suitable one for transhipment.

The data for model building is shown in the following table.

Table 3.4.1 Data for Model Building of the Transhipment

Year	GDP of Major Countries for Transhipped Cargo (Billion US$)	Transhipped Cargo (Freight Ton)
1996	8,216	35,270
1997	8,442	26,537
1998	8,459	56,947
1999	8,609	35,681
2000	8,969	41,951
2001	9,154	61,175
2002	9,351	50,008
2003	9,650	72,420
2004	10,044	299,197
2005	10,443	354,656
2006	10,878	749,844
2007	11,377	711,657
2008	11,750	769,157

Source: a) Statistics by Country for the economic indicators;
b) Namport for Imported Cargo

As this formula is considered to entail both presently-captured demand and newly-captured demand as a result of the Project by 2015, therefore, newly-captured demand is not added to avoid the double-counting.

The following is the result of Macro Demand forecast under the condition of medium-growth scenario.

Table 3.4.2 Results of Forecast for Transshipment Containers (Macro)

Year	Total Cargo Volume (FT)	Cargo Volume of Laden Contaner (FT)	Laden Container (TEU)	Total Container (TEU)
2008	769,157	754,857	93,770	116,988
2010	1,136,778	1,116,316	138,671	173,007
2015	1,688,506	1,663,179	206,604	257,760
2020	2,175,032	2,153,281	267,485	333,716
2025	2,596,005	2,583,025	320,869	400,318

Source : JICA Study Team
Note: Laden conatiner (TEU) is two times of the laden container (TEU) which is initially converted from cargp volume of laden container (FT).

3.4.2 Micro Demand Forecasts

(1) Presently-Captured Forecast

Forecast methodology and prerequisites are in accordance with the DFR. In this method, future cargo volumes are estimated that transshipment volume to Angola will be projected with the assumption that the Angolan economy stabilizes after its initial economic booms, and the Walvis Bay Port will continues to operate under the current facilities. The focus will be on the most recent trends, as it has been concluded that tendencies between the late 1990s to early 2000s and late 2000s are under different economic environments.
More specifically, the following forecast formula was obtained through a regression analysis of performance and GDP data of major countries from a recent three-year period (2006 to 2008).

$$TRSH = -572{,}778 + 16.7137 \cdot IMGDP \quad (R = 0.2499)$$

Here, TRSH is the total tonnage including containers, and IMGDP is the GDP of major inland countries.
(Note: The low correlation co-efficient (R = 0.2499) can be attributed to limited data available from a period of only three years.)

From the total volume obtained from this forecast model, the containerization ratio is estimated using the 2008 actual figure (gradual increase from container cargo ratio, 0.981, of total volume). From that, container cargo volume is ascertained and again, from the 2008 actual figures, the total tonnage of containers (TEU) is derived by determining tons per TEU (fixed at 16.1) and the ratio of empty containers (fixed at 19.847%). This volume is further doubled to set the forecast values, for the reason that transshipment cargo is counted twice, as it enters (In) and departs (Out) the Port of Walvis Bay. The forecast results are as follows.

Table 3.4.3 Result of Forecast of Transshipment Containers (Micro)

Year	Total Cargo Volume (FT)	Cargo Volume of Laden Contaner (FT)	Laden Container (TEU)	Total Container (TEU)
2008	769,157	754,857	93,770	116,988
2010	1,126,366	1,106,091	137,401	171,423
2015	1,180,742	1,163,031	144,474	180,248
2020	1,240,350	1,227,946	152,538	190,309
2025	1,303,323	1,296,806	161,092	200,981

Source : JICA Study Team
Note: Laden conatiner (TEU) is two times of the laden container (TEU) which is initially converted from cargp volume of laden container (FT).

(2) Newly Captured Demand Forecast

The following is the newly-captured demand forecast as a result of constructing the new Walvis Bay Port Container Terminal. Special attention is given to the development at ports in Angola and South Africa. Each is individually analyzed and tallied before forecasting the captured demand.

1) Direct export/import cargo of other ports at present (diverted from Luanda Port, Angola)

The Port of Luanda is the most likely candidate for this diversion and thus it would be ideal to use the actual container cargo handling data in determining the target divertible (i.e., excluding the other transshipment cargos other than Walvis Bay) volume. However, due to insufficient valid statistics, the assumption is made, through Walvis Bay transshipment OD statistics, that the volume of transshipment cargo newly captured in 2015 would be double that of the transshipment cargo volume with Angola (one-way) captured in 2008 (approx. 36,790TEU). It is predicted that efficiency will improve over the present facilities, with the construction of the new container terminal.

In other words, the forecast for newly generated transshipment volume in 2015 is 36,790 x 2 x 2 (double with entry and departure at Port of Walvis Bay) = 147,160TEU. Following 2015, this figure is calculated to increase at the rate ascertained for forecast values based on presently-captured demand forecast, as discussed in 3.4.2 (1).

2) Present transshipment cargo from other ports (cargo diversion bound for Angola via Durban and Cape Town, South Africa)

After the selection of competing ports for winning the cargo diversion for transshipment containers handled at the Walvis Bay Port, such diversion volume is estimated by multiplying the “diversion rate” (capture rate) to the total transshipment volume of those ports. The diversion rate is determined after the assessment of cargo routes. For this project, container cargo bound for Angola via Durban and Cape Town shall be forecasted.

A comparison of container vessel loading capacity at ports-of-call in Namibia and South Africa shows that in 2008, TEU totals were 618,880 and 2,394,960 respectively, or 1:4. Based on this figure, it is assumed that the diversion rate for transshipment cargo to Walvis Bay can be roughly the same. Thus the ratio is set at 20%.

The forecast for such diverted captured demand is projected, pursuant to 2015, at the rate established in 3.4.1(1).

3) Correction of captured demand in consideration of development projects in neighboring ports (Luanda, Angora – Durban and Cape Town, South Africa)

In this section, figures obtained in 1) and 2) above shall be reconsidered and amended, based on development projects underway in neighboring ports.

<u>Port of Luanda, Angola</u>

Presently in Angola, there is a plan to build a new port near Luanda in order to alleviate congestion at the existing port. The proposed construction site is in the Barra do Dande vicinity, roughly 50 km north of Luanda.

A modest estimation of 6% increase in container cargo volume for Luanda since 2008 would set the increased amount in 2017 at roughly 390,000TEU. If today’s rapid increase rate is sustained at the level of 10%, the amount would be at 770,000TEU. The demand for container cargo in Angola largely depends on the level of the country’s rapid growth rate. If Angola’s economy continues to inflate at a steady pace, then the transshipment containers in Walvis Bay bound for Luanda will sustain at a significant level regardless of the construction of a new port in Barra do Dande.

Therefore, as long as Angola’s economic development sustains, the effects of building a new container terminal in the Barra do Dande vicinity (for this report, the predicted completion is 2017) is presumably small. In this forecast, the assumption is made that a 10% decrease in volume at the completion of the new port, with a continued estimated 10% decrease at every five-year interval.

Based on the above, the volume of transshipment cargo for Luanda is revised as follows:

1) 2017: 10% decrease in presently-captured demand forecast (1.1%/annum). (150,392TEUX0.9 =135,353TEU)

2) 2022: 10% decrease in the demand forecast based on the 1) above (142,922TEUX0.9 = 128,630TEU)

3) After 2023: Forecast at the increase rate (1.1%/annum) based on the 2) above.

Port of Durban, and South Africa

The Port of Durban also has plans for expansion. For this reason, there is a possibility that the volume of Walvis Bay Port transshipment cargo from Durban evaluated above would at some point level off, or decline. However, the effects of Durban's expansion on Walvis Bay would be minimal, as routes that have once been secured at Walvis Bay will be likely maintained even after the expansion of the Port of Durban. Therefore, for this evaluation, the capture demand for 2015 shall be considered definite.

(3) Results of Micro-Demand Forecast

The following table shows the evaluation results of micro demand forecasting based on the above methodology. Only the Port of Cape Town shows an increase in transshipment capture demand forecast value after 2015.

Table 3.4.4 Results of Captured Demand Forecast for Transshipment Containers at Diversion Target Ports

(Unit : TEU)

Year	Durban	Cape Town	Luanda	Total
2015	118,130	16,118	147,160	281,408
2016	118,130	16,294	148,767	283,191
2017	118,130	16,472	135,353	269,955
2018	118,130	16,652	136,831	271,613
2019	118,130	16,834	138,326	273,289
2020	118,130	17,017	139,836	274,984
2021	118,130	17,204	141,371	276,705
2022	118,130	17,393	128,630	264,153
2023	118,130	17,584	130,041	265,755
2024	118,130	17,777	131,468	267,375
2025	118,130	17,972	132,910	269,012

Souce : JICA Study Team

3.5 Forecast of Transit Container Cargoes

Transit cargo forecasts were calculated in two categories; 1) Namibia–Angola cargo, and 2) cargo bound for other inland countries (Zambia, Zimbabwe, Botswana and the Democratic Republic of Congo).

3.5.1 Forecast of Transit Container Cargoes for Southern Angola

Increase in demand is estimated by a regression formula obtained from past trends. Most of the cargo is transported from Namibia to Angola (imported) and containers are 100% laden, while the return to Walvis Bay (export) is almost empty (2005: 6TEU, 2006–2007: 0TEU, 2008: 1TEU). For this reason, transit cargo for Angola has been forecasted using the following regression formula.

$$ATRS = -6,911,686 + 3,448.5 \cdot Y \quad (R = 0.9569)$$

Here, ATRS is the total tonnage of transit cargo including containers bound for Angola, Y is year, and R is correlation co-efficient.

What is significant is that presently, containers from Angola have almost no volume, and especially, there is no returning empty containers shipped back. One of the main reasons is possibly theft or use for storage or disposal. However, with southern Angora's economic development resulting in increasing average income, it can be expected that the number of containers returning to Namibia from Angola will increase and thus in this report, they will not be ignored.

More specifically, the ratio of empty containers being returned is proportionate to containers bound for Angola and with this, it can be assumed that by 2020, close to 50% of 2008 Luanda Port throughput will be empty containers. Forecast results are as listed in Table 3.5.1.

Table 3.5.1 Results of Forecast of Southern Angola Transit Containers

(Unit : TEU)

Year	Imports	Exports	Total	Empty Ratio (%)
2005	3,457	6	3,463	0
2006	5,485	0	5,485	0
2007	7,795	0	7,795	0
2008	14,182	1	14,183	0.00
2010	19,800	1,980	21,779	10.00
2015	37,042	9,261	46,303	25.00
2020	54,285	27,142	81,427	50.00
2025	71,527	35,764	107,291	50.00

Source: 1. Namport , Data for 2005~2008
2. JICA Study Team for forecast after 2015

Note: 1. Container for imports to Angora is 100% of laden container.
2. Container for exports during from 2005 to 2008 are laden containers.
3. Container cargoes for exports after 2015 are empty containers.

3.5.2 Transit Cargo Forecast for Inland Countries

The following forecast is to determine export/import cargo and transit cargo between Walvis Bay and inland countries.

(1) Estimated Transit Cargo Volume at Competition Ports

Estimates were based on four inland countries with active flow between their countries and Namibia: Zambia, Zimbabwe, Botswana and the Democratic Republic of Congo. Inland transit cargo volume is calculated with the assumption that these countries might also choose to use the Ports of Cape Town and Durban, in addition to Walvis Bay, considering the port competition environment in Southern Africa.

To begin with, according to port statistics of the two competition ports in South Africa, container cargo are divided into three sections, transshipment, deepsea, and coastwise cargo (please see Table 3.5.2). Transit cargo shall be included in the latter two. Next, assuming that the container cargo is proportionate to the GDP of South Africa and inland countries, and that South African export/import is proportionate to that (transit) of inland countries, transit cargo for the two ports is estimated according to the export and import by the inland countries. (Please see Tables 3.5.2–3.5.5 for estimates.)

Table 3.5.2 Container Throughputs for the Ports of Cape Town and Durban (2008)

(Unit : TEU)

Name of Port	Form of Transport	Landed			Shipped		
		Full	Empty	Total	Full	Empty	Total
Cape Town	Deepsea	187,380	105,445	292,825	74,618	97,241	171,859
	Coastwise	8,472	19,901	28,373	188	2,038	2,226
	Trannshipment	41,592	15,044	56,636	20,900	3,053	23,953
	Total	237,444	140,390	377,834	95,706	102,332	198,038
Durban	Deepsea	839,755	140,686	980,441	668,689	358,524	1,027,213
	Coastwise	5,998	6,443	12,441	13,345	18,074	31,419
	Trannshipment	223,533	70,135	293,668	225,600	71,383	296,983
	Total	1,069,286	217,264	1,286,550	907,634	447,981	1,355,615

Source: Transnet, National Port Authority of South Africa

Table 3.5.3 GDP Comparisons between Major Inland Countries and South Africa (2008)

	Major Inland Countries					South Africa	Total
	Botswana	Zimbabue	Zambia	Congo(DRC)	Subtotal		
GDP (Million US$)	9,338	5,024	5,010	4,944	24,316	184,248	208,564
Share (%)	4.5	2.4	2.4	2.4	11.7	88.3	100.00

Source : IMF, "World Economic Outlook Database", 2009

Table 3.5.4 Transit Cargo (Landed) Estimates for the Ports of Cape Town and Durban (2008)

(Unit : TEU)

Name of Port	Transit	Imports	Total
Walvis Bay	2,916	25,075	27,991
Cape Town	37,448	283,750	321,198
Duran	115,757	877,125	992,882
Total	156,121	1,185,950	1,342,071

Source: Transnet, National Port Authority of South Africa

Note: Subtotal of the Port of Cpe Town and Durban is the total of Landed Deepsea and Coastwise.

Table 3.5.5 Transit Cargo (Shipped) Estimates for the Ports of Cape Town and Durban (2008)

(Unit :TEU)

Name of Port	Transit	Exports	Total
Walvis Bay	166	41,391	41,557
Cape Town	20,296	153,789	174,085
Durban	123,423	935,209	1,058,632
Total	143,885	1,130,389	1,274,274

Source: Transnet, National Port Authority of South Africa

Note : Subtotal of the Ports of Cape Town and Durba is the total of Landed Deepsea and Coastwise.

(2) Forecast of Amounts of Export/Import in Inland Countries

Statistics on exports and imports volume are not available for the inland countries. As an alternative, in light of the connection between import/export value and transit cargo, the transit cargo forecast between Walvis Bay and inland countries is estimated.

According to the amounts of export/import value (2002–2006), there was a dramatic increase of a yearly average of 13% to 56%, excluding Zimbabwe. The average increase among the four countries was also high, at 18%. Forecasting based on the past trend would result in an overestimation (please see Table 3.5.6), thus forecasting was based on the assumption of a gradual loss in momentum, after taking into consideration average rates of increase in both amounts of exports and import.

Table 3.5.6 Historical Performance of Amounts of Export/Import for Major Inland Countries

(Unit : Million US$)

Year	Exports					Imports					Total
	Botswana	Congo (DRC)	Zambia	Zimbabwe	Subtotal	Botswana	Congo (DRC)	Zambia	Zimbabwe	Subtotal	
2002	2,425	1,076	643	2,371	6,515	1,845	1,031	1,151	1,238	5,265	11,780
2003	3,024	1,340	1,090	2,286	7,740	2,448	1,223	1,573	1,235	6,479	14,219
2004	3,696	1,813	1,847	1,778	9,134	3,364	1,753	2,150	1,425	8,692	17,826
2005	4,429	2,071	2,210	1,700	10,410	3,247	2,473	2,577	1,331	9,628	20,038
2006	4,587	2,319	3,819	1,886	12,611	3,043	2,740	3,022	1,441	10,246	22,857
2008	4,961	2,909	6,454	2,324	16,648	3,817	3,946	3,997	1,555	13,314	29,962
2010	5,263	3,584	8,536	2,710	20,094	4,370	5,494	4,836	1,649	16,349	36,443
2015	6,404	5,266	13,747	3,801	29,218	5,578	11,050	7,105	1,959	25,692	54,910
2020	8,173	7,047	20,198	4,852	40,271	6,466	17,796	9,069	2,271	35,602	75,872
2025	10,431	9,431	27,030	6,192	53,084	7,496	26,149	11,574	2,507	47,726	100,810
Avearge Annual Growth Rate (%)											
2002/2006	17.3	21.2	56.1	-5.6	18.0	13.3	27.7	27.3	3.9	18.1	18.0

Table 3.5.7 Forecast of Amounts of Import/Export for the Five Major Inland Countries

(Unit : Million US$)

Year	Exports	Imports
2002	6,515	5,265
2003	7,740	6,479
2004	9,134	8,692
2005	10,410	9,628
2006	12,611	10,246
2008	16,648	13,314
2010	20,094	16,349
2015	29,218	25,629
2020	40,271	35,602
2025	53,084	47,726
Average Annnual Growth Rate (%)		
2002/2006	18.0	18.1
2006/2008	16.0	15.0
2008/2010	10.3	11.4
2010/2015	9.1	11.4
2015/2020	7.6	7.8
2020/2025	6.4	6.8

Source: EIU, "Country Profile 2008"

(3) Forecast of Transit Cargo Volume at the Three Major Ports for Inland Countries

This section discusses the Namibian Ports of Walvis Bay and the South African Ports of Cape Town and Durban, three ports that handle transit cargo bound for four inland countries, and calculates the forecast for transit cargo volume.

To begin with, it is assumed that transit cargo throughput of the three competition ports increases proportionately with amounts of export and import in major inland countries, based on data from 3.5.7 above.)

Notwithstanding, two possibilities were considered as follows, where the share handled by each port 1) remain unchanged, or 2) Walvis Bay gains shares with the expansion of Walvis Bay Port.

1) In the case where shares remain unchanged

The forecast is based on the assumption that Walvis Bay's future share of transport cargo among the three ports remains unchanged.

2) In the case where the shares change (including the newly-captured demand)

The forecast for imported containers is based on the assumption that with the joint use of the new container terminal commencing in 2015, the share at Walvis Bay Port will double that of 2008 and gradually increase thereafter. Regarding containers for export, the forecast is based on facts from 2008 showing performance with laden containers only and no empty containers. As in the case of returning transshipment cargo from Angola, the proportion of exported empty containers for import would increase as the countries' economic and social stabilities increases. In this case, it is estimated that by 2020 the proportion will reach a figure of 50%. Further increase in containers for exports will likely push the proportion over 50% of imports.

The following table is forecast results based on the afore-mentioned viewpoints.

Table 3.5.8 Results of Forecast for Sustained Transition Transit Cargo (Inland Country Exports)

Year	TEU				Share (%)				Exports Major Inland Countries	
	Walvis Bay	Cape Town	Durban	Total	Walvis Bay	Cape Town	Durban	Total	(Million US$)	Growth Rate (2008=100)
2008	166	20,296	123,423	143,885	0.12	14.11	85.78	100.00	16,678	100
2010	197	24,114	146,639	170,950	0.12	14.11	85.78	100.0	19,815	119
2015	290	35,431	215,460	251,181	0.12	14.11	85.78	100.0	29,115	175
2020	388	47,415	288,335	336,137	0.12	14.11	85.78	100.0	38,962	234
2025	495	60,515	367,996	429,006	0.12	14.11	85.78	100.0	49,727	298

Source : JICA Study Team

Table 3.5.9 Results of Forecast for Sustained Transition Transit Cargo (Inland Country Imports)

Year	TEU				Share (%)				Imports of Major Inland Countries	
	Walvis Bay	Cape Town	Durban	Total	Walvis Bay	Cape Town	Durban	Total	(Million US$)	Growth Rate (2008=100)
2008	2,916	37,448	115,757	156,121	1.87	23.99	74.15	100.00	13,314	100
2010	3,528	45,312	140,066	188,906	1.87	23.99	74.15	100.0	16,110	121
2015	5,429	69,717	215,509	290,656	1.87	23.99	74.15	100.0	24,787	186
2020	7,614	97,782	302,263	407,660	1.87	23.99	74.15	100.0	34,765	261
2025	10,207	131,082	405,197	546,486	1.87	23.99	74.15	100.0	46,604	350

Source : JICA Study Team

Table 3.5.10 Results of Forecast for Share Change in Transit Cargo Affected by Captured Demand (Inland Country Exports)

Year	TEU				Share (%)				Exports of Major Inland Countries	
	Walvis Bay	Cape Town	Durban	Total	Walvis Bay	Cape Town	Durban	Total	(Million US$)	Growth Rate (2008=100)
2008	166	20,296	123,423	143,885	0.12	14.11	85.78	100.00	16,678	100
2010	197	24,114	146,639	170,950	0.12	14.11	85.78	100.00	19,815	119
2015	5,024	34,763	211,395	251,181	2.00	13.84	84.16	100.00	29,115	175
2020	16,807	45,096	274,234	336,137	5.00	13.42	81.58	100.00	38,962	234
2025	30,030	56,344	342,632	429,006	7.00	13.13	79.87	100.00	49,727	298

Source : JICA Study Team

Table 3.5.11 Results of Forecast for Share Change in Transit Cargo Affected by Captured Demand (Inland Country Imports)

Year	TEU				Share (%)				Imports of Major Inland Countries	
	Walvis Bay	Cape Town	Durban	Total	Walvis Bay	Cape Town	Durban	Total	(Million US$)	Growth Rate (2008=100)
2008	2,916	37,448	115,757	156,121	1.9	24.0	74.1	100.0	13,314	100
2010	3,528	45,312	140,066	188,906	1.9	24.0	74.1	100.0	16,110	121
2015	11,626	68,203	210,827	290,656	4.0	23.5	72.5	100.0	24,787	186
2020	24,460	93,665	289,535	407,660	6.0	23.0	71.0	100.0	34,765	261
2025	43,719	122,890	379,877	546,486	8.0	22.5	69.5	100.0	46,604	350

Source : JICA Study Team

3.6 Demand Forecast for Container Cargo

This section is a summary of each type of demand forecast ascertained under the medium-growth scenario.

3.6.1 Macro Forecast for Container Cargo

The volume of exports and imports is equivalent to the figures in section 3.3. For transshipment volume, Macro Demand Forecasting results were utilized (section 3.4.2(1)). Forecast results for southern Angola and inland countries were used for transit cargo volume.

Table 3.6.1 Results of Micro Forecast for Port of Walvis Bay Container Cargo (Medium-Growth Scenario)

(Unit : TEU)

Year	Imports	Exports	Tanshippment	Transit	Total
2008	25,075	41,391	116,988	17,265	200,719
2010	29,542	48,463	173,007	25,505	276,517
2015	36,964	63,571	257,760	52,021	410,316
2020	46,017	79,499	333,716	89,429	548,660
2025	54,793	95,616	400,318	117,993	668,720

Source : JICA Study Team

Note : 1. Imports, Exports, and Transshipment are the same as of DFR.

2. Transit is revised and total of Southern Angora and inland countries.

3.6.2 Container Cargo Micro-Forecast

This section is a summary based on Micro Demand Forecast. The volume of exports and imports is equivalent to the figures in DRF (Chapter 1). For transshipment volume, results of the presently-captured demand of Micro Demand Forecast was utilized (Section 3.4.2(1)) Transit cargo value was obtained through calculations using Section 3.5.1 (Table 3.5.1) and section 3.5.2 (3) (Tables 3.5.8 and 3.5.9).

Table 3.6.2 Results of Micro Forecast for Walvis Bay Port Container Cargo Excluding Captured Demand (Medium-Growth Scenario)

(Unit : TEU)

Year	Imports (Namibia)	Exports (Namibia)	Trannsshipmnet	Transit							Grand Total
				Imports			Exports			Total	
				Southern Angora	Inland	Subtotal	Southern Angora	Inland	Subtotal		
2008	25,075	41,391	116,988	14,182	2,916	17,098	1	166	167	17,265	200,719
2010	29,542	48,463	171,423	19,800	3,528	23,328	1,980	197	2,177	25,505	274,933
2015	36,964	63,571	180,248	37,042	5,429	42,471	9,261	290	9,550	52,021	332,805
2020	46,017	79,499	190,309	54,285	7,614	61,899	27,142	388	27,530	89,429	405,253
2025	54,793	95,616	200,981	71,527	10,207	81,734	35,764	495	36,258	117,993	469,383

Source : JICA Study Team

Taking the results of Sections 3.4.2 (2) and 3.5.2 (3) of this report, captured demand can be summarized as follows (figures are capture mean).

Table 3.6.3 Results of Forecast for Captured Demand

(Unit : TEU)

Year	Trannsshipmnet	Transit			Total
		Imports	Exports	Subtotal	
		Inland	Inland		
2015	281,408	6,197	4,734	10,931	292,339
2020	274,984	16,845	16,419	33,264	308,248
2025	269,012	33,512	29,535	63,047	332,059

Source : JICA Study Team

The following table is a summary of the micro-forecast results of container cargo, including captured demand as taken from Tables 3.6.2 and 3.6.3.

Table 3.6.4 Results of Micro-Forecast for Container Cargo, including Captured Demand (Medium-Growth Scenario)

(Unit : TEU)

Year	Imports (Namibia)	Exports (Namibia)	Trannsshipmnet	Transit							Grand Total
				Imports			Exports			Total	
				Southern Angora	Inland	Subtotal	Southern Angora	Inland	Subtotal		
2008	25,075	41,391	116,988	14,182	2,916	17,098	1	166	167	17,265	200,719
2010	29,542	48,463	171,423	19,800	3,528	23,328	1,980	197	2,177	25,505	274,933
2015	36,964	63,571	461,656	37,042	11,626	48,668	9,261	5,024	14,284	62,952	625,144
2020	46,017	79,499	465,293	54,285	24,460	78,744	27,142	16,807	43,949	122,693	713,501
2025	54,793	95,616	469,993	71,527	43,719	115,246	35,764	30,030	65,794	181,040	801,442

Source : JICA Study Team

3.7 Comprehensive Review of Demand Forecast

The demand forecast was reviewed by utilizing Micro- and Macro-forecasting methods. As a result, the demand forecast for 2025 based on the medium-growth scenario was 668,720 TEU using micro forecasting, and 801,442 TEU with macro forecasting.

Although there is a difference between the two, through the micro forecasting of demand by analyzing trends at each element, this survey has provided a basis for the promotion of further analyses regarding project planning and profitability.

3.8 Demand Forecast of Inland Container Cargoes by Transport Mode

3.8.1 Modal Split in Base Case

(1) Basic Assumptions

1) Railway

The railway conditions are as follows: The frequency of trains for Tsumeb and for Windhoek is the same at 1–2 per day.

- There is only a single track with very few passing stations.
- The condition of the track is not good. The rails are mostly of 30 kg/m between Kranzberg and Tsumeb, whereas other rails including those of the newly built rail truck are of 48 kg/m. The 30 kg/m rails are very old and partly fatigued so trains cannot be operated at more than 10 km/hr on them between Kranzberg and Tsumeb.
- Track rehabilitation, which will replace the 30 kg/g rails with 48 kg/m rails, is now ongoing although very slowly. After rehabilitation, trains can be operated at 60 km/hr.
- A radio system is used for signalling and telecommunication. When a train leaves a station, the station master contacts the next station master by radio. He orders the train driver to start the train after confirming there are no trains between the current station and the next station.
- The largest fleet for a train is 35 wagons.
- The composition of wagon per train is split between break bulk, bulk and containers. Passenger cars are coupled onto some trains.

- Most trains stop at intermediate stations in order to shunt wagons.
- The construction of a railway between Oshicango and Ondangawa on the Trans-Cunene Corridor will be completed between 2010 and 2011. But railway construction plans on the Tran-Caprivi Corridor and the Trans-Kalahari Corridor are yet to be consolidated.

2) Highway

Most highways of Namibia and neighbouring and land-locked countries are well maintained and are partly under rehabilitation. The average speed on these highways is 60 km/hr.

(2) Total Container Cargo Demand

Total container cargo is composed of landed cargo and shipped cargo, and is further classified into road and rail. The shipped container cargo comprises deep sea (DSS) for the Southern African Development Community (SADCS), which are exports and cross-border transit. The landed container cargo also comprises deep sea (DSL) and SADCL, which are imports and cross-border transit.

(3) Modal Split of Total Container Cargo

The modal split of railway and road for shipped container cargo for the year of 2009 is estimated on the basis of the growth rate of shipped container cargo for the period between 2007 and 2008 because a high, sharp growth is predicted in comparison to the growth rate for the period between 2005 and 2007. After 2010, it is assumed that the railway demand of the shipped container cargo will increase by the growth rate of total demand for shipped container cargo and that of the landed container cargo will increase by the growth rate of total demand for landed container cargo respectively.

The result of the modal split between rail and road of total container cargo is shown in Tables 3.8.1 and 3.8.2.

Table 3.8.1 Modal Split of Total Container Cargo

(Unit : TEU)

Year	Shipped			Landed			Total		
	Road	Rail	Subtotal	Road	Rail	Subtotal	Road	Rail	Total
2006	21,161	1,921	23,082	20,153	4,083	24,236	41,314	6,004	47,318
2007	26,194	1,701	27,895	24,393	5,839	30,232	50,587	7,540	58,127
2008	39,979	1,579	41,558	36,775	5,398	42,173	76,754	6,977	83,731
2010	48,716	1,924	50,640	46,102	6,767	52,870	94,818	8,692	103,510
2015	74,897	2,959	77,855	74,671	10,961	85,632	149,568	13,919	163,488
2020	118,757	4,691	123,448	108,791	15,969	124,761	227,548	20,660	248,209
2025	155,277	6,134	161,410	148,274	21,765	170,039	303,551	27,899	331,449

Source : Data from 2006 to 2008 is based on Statistics Division of Namport.

Table 3.8.2 Modal Share of Total Container Cargo

(Unit : TEU)

Year	Shipped			Landed			Total		
	Road	Rail	Subtotal	Road	Rail	Subtotal	Road	Rail	Total
2006	91.7	8.3	100.0	83.2	16.8	100.0	87.3	12.7	100.0
2007	93.9	6.1	100.0	80.7	19.3	100.0	87.0	13.0	100.0
2008	96.2	3.8	100.0	87.2	12.8	100.0	91.7	8.3	100.0
2010	96.2	3.8	100.0	87.2	12.8	100.0	91.6	8.4	100.0
2015	96.2	3.8	100.0	87.2	12.8	100.0	91.5	8.5	100.0
2020	96.2	3.8	100.0	87.2	12.8	100.0	91.7	8.3	100.0
2025	96.2	3.8	100.0	87.2	12.8	100.0	91.6	8.4	100.0

Source : JICA Study Team

Total container cargo demand is broken down into transit and imports and exports.

(4) Transit Container Cargo Demand

Transit container cargos are cross border containers and composed of landed cargo and shipped cargo and are further classified into road and rail.

(5) Modal Split of Transit Container Cargo

It is assumed that the railway demand of the shipped container cargo will increase by the growth rate of total demand for shipped transit container cargo, and that of the landed container cargo will increase by the growth rate of total demand for landed transit container cargo.

The result of the modal split between rail and road of total container cargo is shown in Tables 3.8.3 and 3.8.4.

Table 3.8.3 Modal Split of Transit Container Cargo

(Unit : TEU)

Year	Shipped			Landed			Total		
	Road	Rail	Subtotal	Road	Rail	Subtotal	Road	Rail	Total
2008	161	6	167	14,909	2,189	17,098	15,070	2,195	17,265
2010	2,094	83	2,177	20,342	2,986	23,328	22,436	3,069	25,505
2015	13,741	543	14,284	42,439	6,230	48,668	56,180	6,772	62,952
2020	42,279	1,670	43,949	68,665	10,079	78,744	110,944	11,749	122,693
2025	63,294	2,500	65,794	100,494	14,751	115,246	163,788	17,252	181,040

Source : JICA Study Team

Table 3.8.4 Modal Share of Transit Container Cargo

(Unit : TEU)

Year	Shipped			Landed			Total		
	Road	Rail	Subtotal	Road	Rail	Subtotal	Road	Rail	Total
2008	96.2	3.8	100.0	87.2	12.8	100.0	87.3	12.7	100.0
2010	96.2	3.8	100.0	87.2	12.8	100.0	88.0	12.0	100.0
2015	96.2	3.8	100.0	87.2	12.8	100.0	89.2	10.8	100.0
2020	96.2	3.8	100.0	87.2	12.8	100.0	90.4	9.6	100.0
2025	96.2	3.8	100.0	87.2	12.8	100.0	90.5	9.5	100.0

Source : JICA Study Team

(6) Imports and Exports Container Cargo Demand

Import and export container cargo are further classified into road and rail respectively. The export (shipped) container cargo comprises of that for DSS and for SADCS. The import (landed) container cargo also comprises of that for DSL, SADCL and cross-border.

(7) Modal Split of Import and Exports Container Cargo

It is assumed that the railway demand of the exports container cargo will increase by the growth rate of total demand for the exports container cargo and that of the imports container cargo is assumed to increase by the growth rate of total demand for imports container cargo respectively. The result of the modal split between rail and road of total container cargo is shown in Tables 3.8.5 and 3.8.6.

Table 3.8.5 Modal Split of Import and Export Container Cargo

(Unit : TEU)

Year	Shipped(Exports)			Landed(Imports)			Total		
	Road	Rail	Subtotal	Road	Rail	Subtotal	Road	Rail	Total
2008	39,818	1,573	41,391	21,865	3,210	25,075	61,684	4,782	66,466
2010	46,621	1,842	48,463	25,760	3,781	29,542	72,382	5,623	78,005
2015	61,156	2,416	63,571	32,233	4,731	36,964	93,388	7,147	100,535
2020	76,478	3,021	79,499	40,126	5,890	46,017	116,604	8,911	125,515
2025	91,983	3,633	95,616	47,780	7,014	54,793	139,763	10,647	150,410

Source : JICA Study Team

Table 3.8.6 Modal Share of Imports and Exports Container Cargo

(Unit : TEU)

Year	Shipped			Landed			Total		
	Road	Rail	Subtotal	Road	Rail	Subtotal	Road	Rail	Total
2008	96.2	3.8	100.0	87.2	12.8	100.0	92.8	7.2	100.0
2010	96.2	3.8	100.0	87.2	12.8	100.0	92.8	7.2	100.0
2015	96.2	3.8	100.0	87.2	12.8	100.0	92.9	7.1	100.0
2020	96.2	3.8	100.0	87.2	12.8	100.0	92.9	7.1	100.0
2025	96.2	3.8	100.0	87.2	12.8	100.0	92.9	7.1	100.0

Source : JICA Study Team

(8) Demand Forecast by Corridor

The trans-corridors of the Port of Walvis Bay are essential routes for the development of the Port of Walvis Bay. In this study, a modal split analysis for the main three trans-corridors, which are Trans-Cunene Corridor, Trans-Caprivi Corridor and Trans-Kalahari Corridor, is performed.

1) Setting Up of Share of Container Cargo Demand by Corridor

The share of container cargo demand by corridor is estimated on the basis of an OD matrix of cross border container cargoes landed in 2008 while that of cross border container cargoes shipped is negligible at 164 TEU. The share by corridor after 2008 is set up on the basis of the share of GDP of countries influenced by each corridor as shown in the following table:

Table 3.8.7 Share of Container Cargo Volume by Corridor

(Unit : %)

Names of Corridor	2008 (TEU)	2008	2015	2020	2025
Trans-Cunene Corridors	29,728	82.0	82.5	83.0	83.5
Trans-Caprivi Corridor	6,163	17.0	16.6	16.2	15.8
Tarns-Kalahari Corridor	363	1.0	0.8	0.8	0.7
Total	36,254	100.0	100.0	100.0	100.0

Source : TEU and share is based on the Statistics Division of Namport

2) Setting Up of Railway Share of by Corridor

The railway share by corridor is set up on the basis of time series data of TransNamib during the period from 2004 to 2008 as shown in Table 3.8.8. The share of the Trans-Cunene Corridor is predicted to increase from 80.9% in 2008 to 83.9% in 2025.

Table 3.8.8 Projection of Railway Share by Corridor

(Unit : %)

Year	Trans-Cunene Corridor	Trans-Caprivi Corridor	Trans-Kalahari Corridor	Total
2004	77.3	22.7	-	100.0
2005	81.0	19.0	-	100.0
2006	86.0	14.0	-	100.0
2007	86.0	14.0	-	100.0
2008	80.9	19.1	0.1	100.0
2010	81.9	19.0	0.1	100.0
2013	81.5	18.4	0.1	100.0
2015	81.9	18.0	0.1	100.0
2020	82.9	18.0	0.1	100.0
2025	83.9	16.0	0.1	100.0

Source : 1.Ttansnamib, 2004-2008
2. The JICA Study Team projected for 2009-2025

3) Demand Forecast by Corridor and by Mode

On the basis of assumptions for (i) the share of container cargo demand by corridor and (ii) the railway share by corridor mentioned, the modal split of transit container cargo and that of imports and exports container cargo are forecasted.

The summary of the forecast is shown in Tables 3.8.9 and 3.8.10.

Table 3.8.9 Demand Forecast of Inland Container Cargoes by Mode and by Corridor (Base Case)

(Unit :TEU)

Corridor/Section	Directions	Category	Modes	2008	2015	2020	2025
Trans-Cunene Corridors	PWB to Inland	Transit	Railway	1,770	5,102	8,356	12,376
			Truck	12,251	31,940	45,929	59,151
			Subtotal	14,020	37,042	54,285	71,527
		Imports	Railway	1,542	2,302	2,900	3,495
			Truck	10,671	15,811	19,785	23,680
			Subtotal	12,213	18,113	22,686	27,175
		Total	Railway	3,311	7,404	11,256	15,872
			Truck	22,922	47,751	65,714	82,831
			Subtotal	26,233	55,155	76,970	98,702
	Iland to PWB	Transit	Railway	5	445	1,384	2,098
			Truck	132	8,816	25,758	33,666
			Subtotal	137	9,261	27,142	35,764
		Exports	Railway	126	196	248	302
			Truck	3,232	4,993	6,281	7,598
			Subtotal	3,358	5,189	6,528	7,899
		Total	Railway	131	640	1,632	2,399
			Truck	3,364	13,809	32,038	41,263
			Subtotal	3,495	14,449	33,671	43,663
Trans-Caprivi Corridors	PWB to Inland	Transit	Railway	417	1,121	1,713	2,360
			Truck	2,490	10,022	20,335	35,671
			Subtotal	2,907	11,143	22,048	38,031
		Imports	Railway	363	506	595	667
			Truck	2,169	3,139	3,833	4,476
			Subtotal	2,532	3,645	4,428	5,142
		Total	Railway	779	1,627	2,308	3,027
			Truck	4,659	13,161	24,168	40,146
			Subtotal	5,439	14,788	26,476	43,173
	Iland to PWB	Transit	Railway	1	98	284	400
			Truck	27	4,672	15,715	28,329
			Subtotal	28	4,769	15,999	28,729
		Exports	Railway	30	43	51	58
			Truck	667	1,001	1,223	1,437
			Subtotal	696	1,044	1,274	1,495
		Total	Railway	31	141	335	458
			Truck	694	5,673	16,938	29,766
			Subtotal	725	5,814	17,273	30,224
Tarns-Kalahari Corridor	PWB to Inland	Transit	Railway	2	6	10	15
			Truck	169	477	2,401	5,673
			Subtotal	171	483	2,411	5,688
		Imports	Railway	2	3	3	4
			Truck	147	195	215	224
			Subtotal	149	198	219	228
		Total	Railway	4	9	14	19
			Truck	316	671	2,616	5,897
			Subtotal	320	680	2,630	5,916
	Iland to PWB	Transit	Railway	0	1	2	3
			Truck	2	254	807	1,299
			Subtotal	2	254	808	1,301
		Exports	Railway	0	0	0	0
			Truck	41	56	63	66
			Subtotal	41	57	63	66
		Total	Railway	0	1	2	3
			Truck	42	310	869	1,365
			Subtotal	43	311	871	1,367
The Port of Walvis Bay - Windhoek	PWB to Windhoek	Transit	Railway	2,189	6,230	10,079	14,751
			Truck	14,909	42,439	68,665	100,494
			Subtotal	17,098	48,668	78,744	115,246
		Imports	Railway	3,210	4,731	5,890	7,014
			Truck	21,865	32,233	40,126	47,780
			Subtotal	25,075	36,964	46,017	54,793
		Total	Railway	5,398	10,961	15,969	21,765
			Truck	36,775	74,671	108,791	148,274
			Subtotal	42,173	85,632	124,761	170,039
	Windhoek to PWB	Transit	Railway	6	543	1,670	2,500
			Truck	161	13,741	42,279	63,294
			Subtotal	167	14,284	43,949	65,794
		Exports	Railway	1,573	2,416	3,021	3,633
			Truck	39,818	61,156	76,478	91,983
			Subtotal	41,391	63,571	79,499	95,616
		Total	Railway	1,579	2,959	4,691	6,134
			Truck	39,979	74,897	118,757	155,277
			Subtotal	41,558	77,855	123,448	161,410
	From/To PWB		Railway	6,977	13,919	20,660	27,899
			Truck	76,754	149,568	227,548	303,551
			Subtotal	83,731	163,488	248,209	331,449

Source : JICA Study Team

Table 3.8.10 Modal Share of Inland Container Cargoes by Mode and by Corridor (Base Case)

U it : %)

Corridor/Section	Directions	Category	Modes	2008	2015	2020	2025
Trans-Cunene Corridors	PWB to Inland	Transit	Railway	12.6	13.8	15.4	17.3
			Truck	87.4	86.2	84.6	82.7
			Subtotal	100.0	100.0	100.0	100.0
		Imports	Railway	12.6	12.7	12.8	12.9
			Truck	87.4	87.3	87.2	87.1
			Subtotal	100.0	100.0	100.0	100.0
		Total	Railway	12.6	13.4	14.6	16.1
			Truck	87.4	86.6	85.4	83.9
			Subtotal	100.0	100.0	100.0	100.0
	Iland to PWB	Transit	Railway	3.7	4.8	5.1	5.9
			Truck	96.3	95.2	94.9	94.1
			Subtotal	100.0	100.0	100.0	100.0
		Exports	Railway	3.7	3.8	3.8	3.8
			Truck	96.3	96.2	96.2	96.2
			Subtotal	100.0	100.0	100.0	100.0
		Total	Railway	3.7	4.4	4.8	5.5
			Truck	96.3	95.6	95.2	94.5
			Subtotal	100.0	100.0	100.0	100.0
Trans-Caprivi Corridors	PWB to Inland	Transit	Railway	14.3	10.1	7.8	6.2
			Truck	85.7	89.9	92.2	93.8
			Subtotal	100.0	100.0	100.0	100.0
		Imports	Railway	14.3	13.9	13.4	13.0
			Truck	85.7	86.1	86.6	87.0
			Subtotal	100.0	100.0	100.0	100.0
		Total	Railway	14.3	11.0	8.7	7.0
			Truck	85.7	89.0	91.3	93.0
			Subtotal	100.0	100.0	100.0	100.0
	Iland to PWB	Transit	Railway	4.3	2.0	1.8	1.4
			Truck	95.7	98.0	98.2	98.6
			Subtotal	100.0	100.0	100.0	100.0
		Exports	Railway	4.3	4.1	4.0	3.8
			Truck	95.7	95.9	96.0	96.2
			Subtotal	100.0	100.0	100.0	100.0
		Total	Railway	4.3	2.4	1.9	1.5
			Truck	95.7	97.6	98.1	98.5
			Subtotal	100.0	100.0	100.0	100.0
Tarns-Kalahari Corridor	PWB to Inland	Transit	Railway	1.3	1.3	0.4	0.3
			Truck	98.7	98.7	99.6	99.7
			Subtotal	100.0	100.0	100.0	100.0
		Imports	Railway	1.3	1.4	1.6	1.8
			Truck	98.7	98.6	98.4	98.2
			Subtotal	100.0	100.0	100.0	100.0
		Total	Railway	1.3	1.3	0.5	0.3
			Truck	98.7	98.7	99.5	99.7
			Subtotal	100.0	100.0	100.0	100.0
	Iland to PWB	Transit	Railway	0.4	0.5	1.7	2.5
			Truck	99.6	99.8	99.8	99.8
			Subtotal	100.0	100.0	100.0	100.0
		Exports	Railway	0.4	0.4	0.5	0.5
			Truck	99.6	99.6	99.5	99.5
			Subtotal	100.0	100.0	100.0	100.0
		Total	Railway	0.4	0.3	0.2	0.2
			Truck	99.6	99.7	99.8	99.8
			Subtotal	100.0	100.0	100.0	100.0
The Port of Walvis Bay - Windhoek	PWB to Windhoek	Transit	Railway	12.8	12.8	12.8	12.8
			Truck	87.2	87.2	87.2	87.2
			Subtotal	100.0	100.0	100.0	100.0
		Imports	Railway	12.8	12.8	12.8	12.8
			Truck	87.2	87.2	87.2	87.2
			Subtotal	100.0	100.0	100.0	100.0
		Total	Railway	12.8	12.8	12.8	12.8
			Truck	87.2	87.2	87.2	87.2
			Subtotal	100.0	100.0	100.0	100.0
	Windhoek to PWB	Transit	Railway	3.8	3.8	3.8	3.8
			Truck	96.2	96.2	96.2	96.2
			Subtotal	100.0	100.0	100.0	100.0
		Exports	Railway	3.8	3.8	3.8	3.8
			Truck	96.2	96.2	96.2	96.2
			Subtotal	100.0	100.0	100.0	100.0
		Total	Railway	3.8	3.8	3.8	3.8
			Truck	96.2	96.2	96.2	96.2
			Subtotal	100.0	100.0	100.0	100.0
	From/To PWB		Railway	8.3	8.5	8.3	8.4
			Truck	91.7	91.5	91.7	91.6
			Subtotal	100.0	100.0	100.0	100.0

Source : JICA Study Team

3.8.2 High Growth Case Promoted by Railway Transport

The high growth case is considered through a combination of measures for increasing the number of trains (transport capacity) as shown in the following table.

Table 3.8.11 Measures for Increasing the Number of Trains (Transport Capacity)

Measures		Increase of Number of Train (Frequncy)
1. Track Rehabilitation		
	1-1 Restore to the level of some years ago（Ave 30km/h）	2
	1-2 Speed up（Ave 60km/h）	3
2. Addition of passing stations		
	2-1 Additional passing stations	2
	2-2 Restore to the level of some years ago + Addition of passing stations	3
	2-2 Speed up +Addition of passing stations	4
3. Improvement of signalling system		
	3-1 Introduce of automatic block system	5
	3-2 Introduce of CTC	6
4. Improvement of alignment		
	4-1 Improvement of small radius curve and steep slope	1.5

Source: The JICA Study Team
Note: 5 or 6 tarin per difrection per day in the busiest section.

In this study, the high growth case is set up using the following measures:

- Additional passing stations (2-1) are built by 2013. The capacity of trains will increase by two times.
- Track rehabilitation to restore to levels of some years ago (Average speed 30 km/h) (1-1) will be completed by 2020. The capacity of trains will increase by three times.

The result of the forecast is summarized shown in the following tables.

Table 3.8.12 Demand Forecast of Inland Container Cargoes by Mode and by Corridor (High Growth Case of Railway)

(Unit : TEU)

Corridor/Section	Directions	Category	Modes	2008	2015	2020	2025
Trans-Cunene Corridors	PWB to Inland	Transit	Railway	1,770	10,204	25,067	37,129
			Truck	12,251	29,947	40,291	59,101
			Subtotal	14,020	40,151	65,358	96,230
		Imports	Railway	1,542	4,603	8,701	10,485
			Truck	10,671	13,510	13,985	16,690
			Subtotal	12,213	18,113	22,686	27,175
		Total	Railway	3,311	14,807	33,768	47,615
			Truck	22,922	43,457	54,275	75,791
			Subtotal	26,233	58,264	88,043	123,405
	Iland to PWB	Transit	Railway	5	889	4,153	6,293
			Truck	132	10,895	32,324	48,645
			Subtotal	137	11,784	36,478	54,938
		Exports	Railway	126	391	743	905
			Truck	3,232	4,797	5,785	6,994
			Subtotal	3,358	5,189	6,528	7,899
		Total	Railway	131	1,281	4,897	7,198
			Truck	3,364	15,693	38,109	55,639
			Subtotal	3,495	16,973	43,006	62,837
Trans-Caprivi Corridors	PWB to Inland	Transit	Railway	417	2,243	5,140	7,081
			Truck	2,490	5,836	7,616	11,128
			Subtotal	2,907	8,079	12,757	18,209
		Imports	Railway	363	1,012	1,784	2,000
			Truck	2,169	2,633	2,644	3,143
			Subtotal	2,532	3,645	4,428	5,142
		Total	Railway	779	3,254	6,925	9,080
			Truck	4,659	8,469	10,260	14,271
			Subtotal	5,439	11,723	17,184	23,351
	Iland to PWB	Transit	Railway	1	195	852	1,200
			Truck	27	2,176	6,268	9,195
			Subtotal	28	2,371	7,120	10,395
		Exports	Railway	30	86	152	173
			Truck	667	958	1,122	1,322
			Subtotal	696	1,044	1,274	1,495
		Total	Railway	31	281	1,004	1,373
			Truck	694	3,134	7,390	10,518
			Subtotal	725	3,415	8,394	11,890
Tarns-Kalahari Corridor	PWB to Inland	Transit	Railway	2	12	30	44
			Truck	169	426	600	762
			Subtotal	171	438	630	807
		Imports	Railway	2	6	10	12
			Truck	147	192	208	215
			Subtotal	149	198	219	228
		Total	Railway	4	18	41	57
			Truck	316	618	808	978
			Subtotal	320	636	849	1,035
	Iland to PWB	Transit	Railway	0	1	5	8
			Truck	2	127	347	453
			Subtotal	2	129	352	461
		Exports	Railway	0	0	1	1
			Truck	41	56	62	65
			Subtotal	41	57	63	66
		Total	Railway	0	2	6	9
			Truck	42	184	409	518
			Subtotal	43	185	415	527
The Port of Walvis Bay - Windhoek	PWB to Windhoek	Transit	Railway	2,189	12,459	30,238	44,254
			Truck	14,909	36,209	48,506	70,991
			Subtotal	17,098	48,668	78,744	115,246
		Imports	Railway	3,210	9,463	17,670	21,041
			Truck	21,865	27,501	28,346	33,753
			Subtotal	25,075	36,964	46,017	54,793
		Total	Railway	5,398	21,922	47,908	65,295
			Truck	36,775	63,710	76,853	104,744
			Subtotal	42,173	85,632	124,761	170,039
	Windhoek to PWB	Transit	Railway	6	1,086	5,010	7,501
			Truck	161	13,199	38,939	58,293
			Subtotal	167	14,284	43,949	65,794
		Exports	Railway	1,573	4,831	9,063	10,900
			Truck	39,818	58,740	70,436	84,716
			Subtotal	41,391	63,571	79,499	95,616
		Total	Railway	1,579	5,917	14,073	18,401
			Truck	39,979	71,938	109,375	143,009
			Subtotal	41,558	77,855	123,448	161,410
	From/To PWB		Railway	6,977	27,839	61,981	83,696
			Truck	76,754	135,649	186,227	247,754
			Subtotal	83,731	163,488	248,209	331,449

Source : JICA Study Team

Table 3.8.13 Modal Share of Inland Container Cargoes by Mode and by Corridor (High Growth Case of Railway)

(Unit %)

Corridor/Section	Directions	Category	Modes	2008	2015	2020	2025
Trans-Cunene Corridors	PWB to Inland	Transit	Railway	12.6	25.4	38.4	38.6
			Truck	87.4	74.6	61.6	61.4
			Subtotal	100.0	100.0	100.0	100.0
		Imports	Railway	12.6	25.4	38.4	38.6
			Truck	87.4	74.6	61.6	61.4
			Subtotal	100.0	100.0	100.0	100.0
		Total	Railway	12.6	25.4	38.4	38.6
			Truck	87.4	74.6	61.6	61.4
			Subtotal	100.0	100.0	100.0	100.0
	Iland to PWB	Transit	Railway	3.7	7.5	11.4	11.5
			Truck	96.3	92.5	88.6	88.5
			Subtotal	100.0	100.0	100.0	100.0
		Exports	Railway	3.7	7.5	11.4	11.5
			Truck	96.3	92.5	88.6	88.5
			Subtotal	100.0	100.0	100.0	100.0
		Total	Railway	3.7	7.5	11.4	11.5
			Truck	96.3	92.5	88.6	88.5
			Subtotal	100.0	100.0	100.0	100.0
Trans-Caprivi Corridors	PWB to Inland	Transit	Railway	14.3	27.8	40.3	38.9
			Truck	85.7	72.2	59.7	61.1
			Subtotal	100.0	100.0	100.0	100.0
		Imports	Railway	14.3	27.8	40.3	38.9
			Truck	85.7	72.2	59.7	61.1
			Subtotal	100.0	100.0	100.0	100.0
		Total	Railway	14.3	27.8	40.3	38.9
			Truck	85.7	72.2	59.7	61.1
			Subtotal	100.0	100.0	100.0	100.0
	Iland to PWB	Transit	Railway	4.3	8.2	12.0	11.5
			Truck	95.7	91.8	88.0	88.5
			Subtotal	100.0	100.0	100.0	100.0
		Exports	Railway	4.3	8.2	12.0	11.5
			Truck	95.7	91.8	88.0	88.5
			Subtotal	100.0	100.0	100.0	100.0
		Total	Railway	4.3	8.2	12.0	11.5
			Truck	95.7	91.8	88.0	88.5
			Subtotal	100.0	100.0	100.0	100.0
Tarns-Kalahari Corridor	PWB to Inland	Transit	Railway	1.3	2.8	4.8	5.5
			Truck	98.7	97.2	95.2	94.5
			Subtotal	100.0	100.0	100.0	100.0
		Imports	Railway	1.3	2.8	4.8	5.5
			Truck	98.7	97.2	95.2	94.5
			Subtotal	100.0	100.0	100.0	100.0
		Total	Railway	1.3	2.8	4.8	5.5
			Truck	98.7	97.2	95.2	94.5
			Subtotal	100.0	100.0	100.0	100.0
	Iland to PWB	Transit	Railway	0.4	0.8	1.4	1.6
			Truck	99.6	99.2	98.6	98.4
			Subtotal	100.0	100.0	100.0	100.0
		Exports	Railway	0.4	0.8	1.4	1.6
			Truck	99.6	99.2	98.6	98.4
			Subtotal	100.0	100.0	100.0	100.0
		Total	Railway	0.4	0.8	1.4	1.6
			Truck	99.6	99.2	98.6	98.4
			Subtotal	100.0	100.0	100.0	100.0
The Port of Walvis Bay - Windhoek	PWB to Windhoek	Transit	Railway	12.8	25.6	38.4	38.4
			Truck	87.2	74.4	61.6	61.6
			Subtotal	100.0	100.0	100.0	100.0
		Imports	Railway	12.8	25.6	38.4	38.4
			Truck	87.2	74.4	61.6	61.6
			Subtotal	100.0	100.0	100.0	100.0
		Total	Railway	12.8	25.6	38.4	38.4
			Truck	87.2	74.4	61.6	61.6
			Subtotal	100.0	100.0	100.0	100.0
	Windhoek to PWB	Transit	Railway	3.8	7.6	11.4	11.4
			Truck	96.2	92.4	88.6	88.6
			Subtotal	100.0	100.0	100.0	100.0
		Exports	Railway	3.8	7.6	11.4	11.4
			Truck	96.2	92.4	88.6	88.6
			Subtotal	100.0	100.0	100.0	100.0
		Total	Railway	3.8	7.6	11.4	11.4
			Truck	96.2	92.4	88.6	88.6
			Subtotal	100.0	100.0	100.0	100.0
	From/To PWB		Railway	8.3	17.0	25.0	25.3
			Truck	91.7	83.0	75.0	74.7
			Subtotal	100.0	100.0	100.0	100.0

Source : JICA Study Team

3.8.3 Train Operation Plan

Based on the foregoing section, the frequency of the freight trains of each corridor in the high growth case is calculated in this section.

The trains for containers should be dedicated trains only for containers that go to the assigned destinations directly in order to reduce the time required as much as possible.

(1) Trans-Cunene Corridor

The railway demand forecast of the Trans-Cunene Corridor is shown in the following table.

Table 3.8.14 Demand Forecast of Container Cargoes of Trans-Cunene Corridor by Railway

(Unit: TEU)

		2008	2015	2020	2025
PWB to Inland	Transit	1,770	10,204	25,067	37,129
	Import	1,542	4,603	8,701	10,485
	Subtotal	3,311	14,807	33,768	47,615
Inland to PWB	Transit	5	889	4,153	6,293
	Export	126	391	743	905
	Subtotal	131	1,281	4,897	7,198
Total		3,442	16,088	38,665	54,812

Source: JICA Study Team

The frequency of the freight train is determined by inbound traffic since there is more inbound cargo than outbound cargo in the Port of Walvis Bay.

From the above table, the average daily frequency of the dedicated train for containers along the Trans-Cunene Corridor each year is as follows[3]:

2015: 14,807 TEU ÷ 300 days ÷ 70 TEU/train = 0.7 trains a day
2020: 33,768 TEU ÷ 300 days ÷ 70 TEU/train = 1.6 trains a day
2025: 47,615 TEU ÷ 330 days ÷ 70 TEU/train = 2.3 trains a day

(2) Trans-Caprivi Corridor

The railway demand forecast of the Trans-Caprivi Corridor is shown in the following table.

Table 3.8.15 Demand Forecast of Container Cargos of Trans-Caprivi Corridor by Railway

(Unit: TEU)

		2008	2015	2020	2025
PWB to Inland	Transit	417	2,243	5,140	7,081
	Import	363	1,012	1,784	2,000
	Subtotal	779	3,254	6,925	9,080
Inland to PWB	Transit	1	195	852	1,200
	Export	30	86	152	173
	Subtotal	31	281	1,004	1,373
Total		810	3,536	7,929	10,453

Source: JICA Study Team

[3] The maximum number of TEU per train is assumed to be as follows:

The maximum numbers of wagons a train:	35 cars
The maximum length of a train:	525 m (35 cars×15 m)
The maximum TEU of containers a train:	70 TEU (2 TEU/car)

From the above table, the average daily frequency of the dedicated train for containers for the Trans-Caprivi Corridor each year is as follows:

2015: 3,254 TEU ÷ 300 days ÷ 70 TEU/train = 0.2 trains a day
2020: 6,925 TEU ÷ 300 days ÷ 70 TEU/train = 0.3 trains a day
2025: 9,080 TEU ÷ 300 days ÷ 70 TEU/train = 0.4 trains a day

There is little container traffic so that it may not be necessary to operate a dedicated train for containers every day. If a freight train does not depart until sufficient containers for one mono-destination train gather, many forwarders will use trucks instead and the share of railway transportation will not increase since the arrival time is unclear. Therefore, containers may be carried to Tsumeb with other cargo every day and trans-loaded to trucks there. The distance between Grootfontein and Tsumeb is just 50 km and it takes an hour by truck.

(3) Trans-Kalahari Corridor

The railway demand forecast of the Trans-Kalahari Corridor is shown in the following table.

Table 3.8.16 Demand Forecast of Container Cargos of Trans-Kalahari Corridor by Railway

(Unit: TEU)

		2008	2015	2020	2025
PWB to Inland	Transit	2	12	30	44
	Import	2	6	10	12
	To Windhoek	1,303	3,842	7,175	8,543
	Subtotal	1,307	3,860	7,216	8,600
Inland to PWB	Transit	0	1	5	8
	Export	0	0	1	1
	From Windhoek	1,138	4,371	8,199	9,861
	Subtotal	1,138	4,372	8,250	9,870
Total		2,446	8,233	15,420	18,470

Source: JICA Study Team

From the above table, the average daily frequency of the dedicated train for containers for the Trans-Kalahari Corridor each year is as follows:

2015: 3,860 TEU ÷ 300 days ÷ 70 TEU/train = 0.2 trains a day
2020: 7,216 TEU ÷ 300 days ÷ 70 TEU/train = 0.3 trains a day
2025: 8,600 TEU ÷ 300 days ÷ 70 TEU/train = 0.4 trains a day

The traffic volume is 8,543 TEU including traffic up to Windhoek in 2025. It is low enough that container-dedicated trains are unnecessary. Although the railhead of the Trans-Kalahari Corridor is Gobabis, containers are transported together with other domestic cargos up to Windhoek and trans-loaded to trucks there.

(4) Required Capacity of the New Railway Container Terminal

The average frequency of the freight train each day is as follows:

Table 3.8.17 Average Frequency of Freight Trains per Day by Corridor

(Unit: # of trains)

	2015	**2020**	**2025**
Trans-Cunene Corridor	0.7	1.6	2.3
Trans-Caprivi Corridor	0.2	0.3	0.4
Trans-Kalahari Corridor	0.2	0.3	0.4
Total	1.1	2.2	3.1

Source: JICA Study Team

The required handling capacity of the new railway container terminal is 1 to 2 trains a day in 2015 and 3 to 4 trains a day in 2025. Details of the capacity of the railway container terminal are described in Chapter 4.

4 Review of Feasibility of Container Terminal Development Plan 2008

4.1 Principles in Developing a Container Terminal

4.1.1 Pros and Cons of Walvis Bay as Container Hub Port

In addition to a favourable cultural/educational background, and political and social stability, the advantages of the Port of Walvis Bay are the following:

Efficient port operation: Waiting time for calling ships to berth is virtually zero. Loading and unloading are very efficient with the use of travelling shore cranes run by skilled operators. Gate control is also effective, as no significant queuing is observed. Efficiency might be affected by the shortage of stacking yards if the container throughput continues to increase. No additional documentation is required for custom clearance.

Good infrastructure for land transport: Roads are well maintained to and from the hinterlands including the land-locked neighbouring countries. Railways are also functioning even though their speed is partly limited to 10 km/hr. A modal shift from rail to truck and vice-versa is exercised at each railway terminal.

Favourable natural conditions: The weather is very moderate; despite the frequent foggy conditions, rainfall is minimal and storms are unrecorded. Oceanographically, there are no high waves to hamper ship berthing and cargo handling. The port is usable almost throughout the year. The maintenance of the navigational channel is easy because no siltation occurs except of diatomaceous sediments, which are very soft and cause no harm to ship manoeuvring. Geo-technically, dredging is easy and economical because dredged materials are sandy and usable for reclamation.

Geographical location: The Walvis Bay is located between two very economically active countries, namely South Africa and Angola, both of which are short of port facilities at present. Walvis Bay is also the nearest port to the Port of Santos in Brazil, the largest port in the southern hemisphere.

The disadvantages of the Port of Walvis Bay are as follows:

Small domestic market: The population of Namibia is about 2 million and its GDP per capita is US$ 4,100 in 2008. The domestic market is rather small and export and import container throughput of Namibia is not sizable enough to attract major shipping lines. Without providing incentives to shipping lines, the Port of Walvis Bay is likely to lose transhipment cargo.

Port Development of Neighbouring Countries: South Africa and Angola have a huge domestic market in comparison with Namibia and they are planning to develop their ports to cope with their own economic growth. Their ports are potentially strong competitors to the Port of Walvis Bay.

4.1.2 Strategic Points and Physical Principles

As discussed in “Ports in Neighbouring Countries,” several ports in the neighbouring countries are extraordinarily congested because of rapid economic growth in recent years and poor port facilities. However, some ports are planning to deepen their navigational channels and increase the number of container terminals. In South Africa, a new container port is ready for operation.

Under the current situation, taking into account the pros and cons, the following goals must be achieved in developing the new container terminals.

Strategic points in development: Capture transhipment cargo from Cape Town; the most active and successful container hub port along the coast of southern Africa is the Port of Cape Town, which is the nearest port to Walvis Bay. The Port of Cape Town is therefore the biggest rival port in the long term. The Port of Walvis Bay would be required to provide all its port customers, including shipping lines, with better services than the Port of Cape Town.

Exploit the time lag until Angola commences her infrastructure developments: As the congestion in the Port of Luanda in Angola is extraordinarily heavy and its port development has not yet been blueprinted, the Port of Walvis Bay should exploit this situation as much as possible in order to consolidate its position over the southern and south-eastern market of Angola. To this end, Cunene and Caprivi Corridors have to be activated.

Upgrade railway transport for land-locked countries: In order to consolidate the vantage position in transporting cargo to and from land-locked countries and, as a consequence, to capture the transhipment cargo, the railway has to be upgraded. Economical and scheduled railway transportation to and from the land-locked countries is mandatory. Angola, even though not land-locked, is developing her railway for exporting minerals from the east coast of Africa. The extension of the railways of Namibia into Angola will capture the container cargo to and from the southern part of this neighbouring west coast country.

Ensure the shortest berthing time of container mother ships: As the domestic cargo of Namibia are not sufficient for shipping lines to provide services using container mother ships, it is necessary for the Port of Walvis Bay to ensure the least waiting time for berthing of container mother ships.

Ensure minimal custom clearance: Particularly for transit cargoes to and from land-locked countries, speedy custom clearance is necessary to consolidate the position of the Port of Walvis Bay as a container hub port on the west coast of Africa.

From the discussions above, derived are the following goals for the physical development of the new container terminal:

Deepen the port for larger ships: This is necessary for attracting Panamax container vessels for Phase 1. These vessels will be the most popular type of container mother ships on the southern African Coast. In the later future, it is very probable that an 8000 TEU post-Panamax container vessel will call at the Port of Walvis Bay. Further deepening of the channel and basin should be envisaged in planning the port expansion.

Provide a longer berth to minimize waiting time for berthing: One larger container mother vessel will need more feeder container vessels which cannot call at the many ports that only have shallow drafts of channels or quays. The new container terminal needs a longer berth which can simultaneously accommodate one mother and one feeder container vessel.

Provide a railway terminal near to the “maritime” container terminal: In order to consolidate the position of the Port of Walvis Bay as the gateway to land-locked countries, an economical means of transportation has to be established. Railway transportation can provide low cost services for land transport. The railway terminal must be built neighbouring the new “maritime” container terminal.

Provide a rubber-tyred gantry (RTG) crane system: Efficient services are mandatory for transhipment cargo handling. An RTG system should be employed.

4.2 Layout of Facilities

4.2.1 Layout of Port Expansion

The layout of the expansion being envisaged is as follows:

Approach Channel: The alignment of the existing approach channel should be maintained, as no ship manoeuvring issues for the Port of Walvis Bay have been reported. Economically too, the existing approach channel should be used and deepened from CD −12.8 m [1] to −14.1 m on average in order to minimize the dredging quantity. As the width of the existing channel is 134 m and is sufficient for Panamax vessels, no widening of the approach channel is required for Phase 1. According to Permanent International Association of Navigation Congresses (PIANC) Standards, the width should be more than 4 times that of the beam of the design vessel, i.e. 4 x 32.2 m = 128.8 m, which is less than the current channel width. The ship manoeuvring simulation conducted by EIA Consultants has reportedly concluded the approach channel should be slightly deepened toward the channel entrance as CD – 14.0 m from Buoy 9 and Buoy 10 and CD – 14.5 m from Buoy 1 and Buoy 2 to offshore. No significant increase of the dredging volume takes place in this concern.

Turning Basin: The new turning basin should be positioned in front of the new container terminal. A calling container vessel will turn at this new turning basin and be berthed portside to the new container terminal. From the long-term perspective, the water area between the new container terminal and the existing berths has to be wide enough to turn an 8,000 TEU container vessel. The diameter and depth of the turning basin for Phase 1 are determined to be 450 m and CD −13.5 m, respectively. These dimensions are considered sufficient for Panamax container vessels. The turning basin for 8,000 TEU container vessels will be located according to future development by enlarging that of Phase 1 to 525 m in diameter and CD −15.5 m in depth. The deepening of the front of the exiting berths up to CD −13.5 m is also recommended in Phase 1 development. The ship manoeuvring simulation conducted by EIA consultants has reportedly confirmed the turning basin of these dimensions can provide safe stopping, turning and berthing of a calling ship. It is confirmed also that the CD – 13.5 m deep channel in front of the existing berths is safe.

Alignment of Berths: The berth of the container terminals should be aligned straight, even in future developments, to maximize the usage of the quay so that more vessels simultaneously can unload/load their cargo and consequently reduce the waiting time for berthing. Determination of the orientation of the berth alignment needs consideration of the future expansion of the port as well as the volume balance between dredging and reclamation. The current alignment Namport has envisaged is technically reasonable in consideration of the prevailing wind direction, which is mostly south. The ship manoeuvring simulation has reportedly confirmed the safe berthing of a calling ship.

Area required for Reclamation: The area of the container terminal is determined to be 370 m in width and 408 m in depth at the rectangular part with a triangular annex of about 56,000 m^2 as discussed in “Planning and Layout of Container Terminal.” The road in front of the container terminal requires a 3 lane carriage and a pedestrian strip in each direction to accommodate trucks queuing for gate control of the container terminal when the further expansion adjacent to

[1] Namport’s survey reveals that the seabed elevation is CD −13.5 m on average, while the chart indicates CD −12.8 m as the channel depth. The dredging quantity is computed according to the survey results.

Phase 1 is taken into account. Each carriage lane is 4.0 m wide and each pedestrian strip is 2.0 m wide. On the both sides a space of 2.0 m width is provided for services like power supply, water pipeline, and sewerage. As a result, the overall right of way is 32.0 m wide (2 x 3 x 4.0 m (carriage way) + 2 x 2.0 m (pedestrian strips) + 2 x 2.0 m (space for services)) The railway terminal, as discussed in "Layout of Railway Terminal", requires 45.0 m width for the 3 rail trucks (15.0 m) and yard for stacking and loading/unloading (30.0 m) of containers. As Namport envisages a potential future expansion of the reclamation not only for additional container terminals but also bulk cargo terminals, a 3.0 m strip should be reserved to this end. In addition, in order to mitigate potential impacts to tourism caused by operation of a modernized container terminal, a green belt having a width of 7.0 m should be provided. Slope protection will then require a 5.0 m width for maintenance purposes.

As a result, the depth of the reclamation is estimated as shown below:

Maritime container terminal:	408.0 m
Right of way	32.0 m
Railway terminal:	45.0 m
Reservation for future use:	3.0 m
Green belt:	7.0 m
Slope protection:	5.0 m
Total:	**500.0 m**

The master plan layout is shown in Figure 4.2.1.

Causeway to Container Terminal: The causeway is located at the south of Berth No. 8. This is the only location to minimize interference with the port operation.

As the causeway is located near to the entrance of the lagoon, the EIA Consultants have carried out hydrodynamic and water-quality modelling. The modelling concludes that:

> *The new container terminal reduces the water exchange rates in the Lagoon due to the artificial extension of the Lagoon neck. This occurs independent of the development phase and is most distinct during spring tides and near the lagoon entrance. The water refreshment rate in the Lagoon can not be positively influenced by incorporation of open piled causeway or by dredging the Lagoon entrance. Whether this is acceptable or not needs to be studied in the EIA.*

Therefore, neither a bridge nor culverts will be incorporated in the causeway.

Right of way consisting of a 2 lane carriage way in each direction, a sideway along the slope protection at the harbour side, pedestrian strips, and space for services will be 28.0 m wide (2 x 2 x 4.0 m (carriage way) + 4.0 m (sideway) + 2 x 2.0 m (pedestrian strip) + 2 x 2.0 m (space for services). For the railway, a 15.0 m wide strip will be kept for 3 rail tracks, one each for the passing train, for waiting and for locomotive movement.

As a result, the width of the causeway is estimated as shown below:

Slope protection harbour side:	5.0 m
Right of way:	28.0 m
Railway:	15.0 m
Reservation for future use:	3.0 m
Green belt:	9.0 m
Slope protection lagoon side:	5.0 m
Total:	65.0 m

Source: Namport

Figure 4.2.1 Layout of Port Expansion Based on Master Plan of Namport

4.2.2 Planning and Layout of Container Terminal

The layout for the container terminal was conceived while bearing in mind the efficiency and safety of terminal operations in order to achieve maximum terminal output at reasonable cost.

(1) Quay and Apron

Quay: Road traffic in Namibia is anchored to the "keep left lane rule" and for this reason all vessels, in principle, will be docking portside along the berths. This mode of approach is simple, efficient and safe as far as the layout of the terminal is concerned. Trailers from outside will operate in a clockwise direction while yard trailers will operate in a counter clockwise direction in order to maintain traffic orderliness and safety. As such, yard trailers will operate on the apron from the stern towards the head of the vessel.

The quay length is estimated based on the anticipated size of container vessels to be accommodated. The list of vessels passing off the coast of Namibia and expected to call at Walvis Bay is described here as follows. These vessels are currently deployed in the east coast of the South America/South Africa, Asia/West Africa and Europe/South Africa routes now.

Table 4.2.1 Expected Size of Container Vessels to Call at Walvis Bay

Shipping Line	Route	Size of Vessels	No. of Vessels Deployed
CMA/CGM/Delmas	E.Asia/W. Africa	1,895/2,506 TEU	9
	Asia/W.Af. Express	2,061/2,169 TEU	6
	S.Asia/Africa	1,641/2,262 TEU	11
	Med./ECSA/W.Af.	1,700/2,824 TEU	4
CSCL/Hapag/NMC	Asia/W. Africa	2,109/2,546 TEU	5
Gold Star	SE. Asia/W. Africa	1,512/1,793 TEU	7
Maersk	Asia/W.Africa 1	2,226/2,574 TEU	8
	Asia/W.Africa 2	2,824/3,854 TEU	9
	ECSA/W＆S.Africa	1,678/1,768 TEU	4
	W.Med./S.&W.Africa	1,369/1550 TEU	4
	N.Eur./W.& S.Africa	3,700/4,035 TEU	6
MOL	Asia/W.Africa	2,011/2,526 TEU	9
	N.Eur./S.&W.Africa	1,831/4,922 TEU	8
PIL	S.&W.Africa	1,304/1,810 TEU	9
MACS	Eur./W.Africa	854/1,908 TEU	8
Maruba	NE Asia/W.Africa	2,113 TEU	4
Ocean Africa C.L.	S./W.Africa	754/1,156 TEU	-
SAF Marine	N.Eur./W.&S.Africa	1,853/4,035 TEU	-
	W.Med./W.&S.Africa	1,700/2,474 TEU	-
DAL Deutsche	Eur./W.Africa	1,853 TEU	-
Nile Dutch	ECSA/W.&S.Africa	885/1,831 TEU	-
MSC	N.Eur./S.W.Africa	4,751/5,762 TEU	"MSC Oriane" (at: 5,762 TEU is the largest)
	ECNA/S.Africa	2,480/3,389 TEU	-
	S./W.Africa	949/1,597 TEU	-

Source: Compiled from a) Containerization International Year Book 2009; and b) International Transportation Handbook 2009

Based on this list, the largest container vessel passing along the coast of Namibia appears to be the Panamax type of container vessels and is expected to remain so for several years to come.

The development of a container terminal in Port of Walvis Bay is expected to attract shipping lines to use the port, which is anticipated to generate a significant increase in containerized cargo. The development is also anticipated to motivate many shipping lines to deploy larger capacity vessels in lieu of the small ones for economical operating reasons, and this is expected to generate active competition among shipping lines along the west coast of Africa that would bring about a considerable increase in vessel traffic along Walvis Bay.

A 550 m long berth is adopted to accommodate the simultaneous mooring of Panamax type and 2000 TEU class container vessels. The berthing length at 550 m is exclusive of the mooring bit structures to be provided at both ends of the berthing facility. Only 200 m out of the 550 m long quay will be provided with a 60 m wide apron at the northern section of the berthing structure.

To estimate the berth occupancy of the berth of the new container terminal, the distribution of the ship call of each size is assumed in comparison with the actual calls in 2008 as shown below:

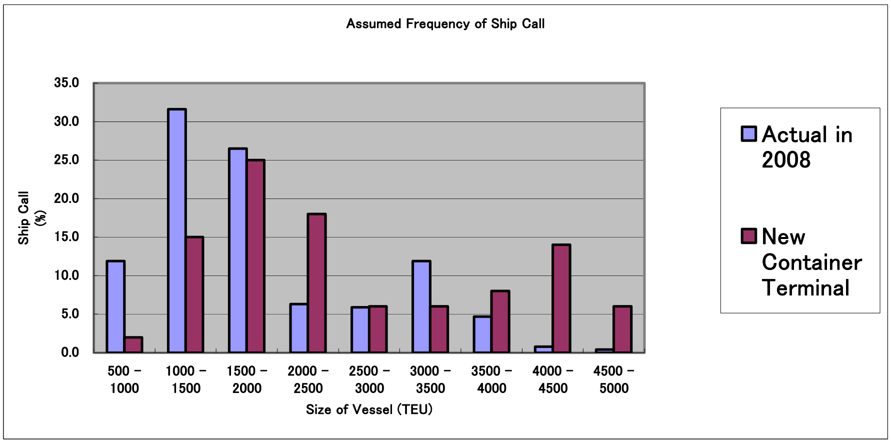


Figure 4.2.2 Assumed Frequency of Ship Calls

The assumptions for TEUs of each ship of varying sizes shipping and loading at the quay and the time required for entering, berthing, de-berthing and departing are tabulated below:

Table 4.2.2 Required Time for Ship to Call New Container Terminal

Berthing at New Container Terminal (Hours)										
	Through –put on Average		16km, 5knot		30 box per hour				16km, 8knot	
Vessel	TEU	Box	Approaching	Berthing	Land / Ship	Crane Number	Land / Ship Total	De-berthing	Departure	Time Each
500 – 1000	300	194	1.8	0.5	6.5	2	3.2	0.3	1.0	6.8
1000 – 1500	450	290	1.8	0.5	9.7	2	4.8	0.3	1.0	8.4
1500 – 2000	500	323	1.8	0.5	10.8	2	5.4	0.3	1.0	9.0
2000 – 2500	650	419	1.8	0.5	14.0	2	7.0	0.3	1.0	10.6
2500 – 3000	750	484	1.8	0.5	16.1	2	8.1	0.3	1.0	11.7
3000 – 3500	850	548	1.8	0.5	18.3	3	6.1	0.3	1.0	9.7
3500 – 4000	1000	645	1.8	0.5	21.5	3	7.2	0.3	1.0	10.8
4000 – 4500	1200	774	1.8	0.5	25.8	3	8.6	0.3	1.0	12.2
4500 – 5000	1400	903	1.8	0.5	30.1	3	10.0	0.3	1.0	13.6

When the above assumptions are applied for the annual container throughput, the berth occupancy (time needed from entering to departing the new container terminal divided by 365 days) is estimated as shown below:

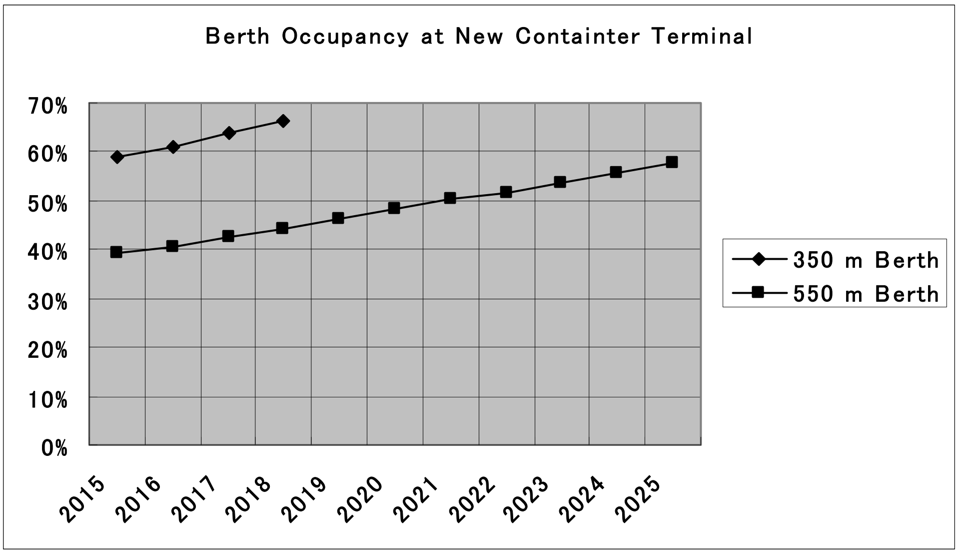


Figure 4.2.3 Berth Occupancy at New Container Terminal

From the above graph, it is recommended that the full length of 550 m quay wall be built from the beginning. Also concluded, ships will not significantly wait for berth until 2025, as the berth occupancy rate in this year is estimated to be less than 60%.

Apron width: Three passing lanes for container trailers will be provided under the gantry cranes. The lanes will be provided with pavement markings to ensure safety of cargo handling operations. Multiple truck lanes are needed to serve as a lashers' waiting area and temporary stowage space during container handling operations.

All vehicles operating inside the terminal will be limited to a maximum speed of 20km/hr. Systematic and properly regulated traffic routes will be implemented to provide expeditious, efficient and safe terminal operations as shown in the schematic drawings hereafter.

The apron is 60 m wide and is to be provided with crane rails 30 m in gauge for the installation of quayside gantry cranes to cater to container handling operations of Panamax type vessels. Sufficient space will be provided at the back of gantry cranes for the placing of the vessel's hatch covers, and for turning around 40 foot container trailers, particularly for reefer containers.

(2) Operation System

It is recommended that the new container terminal will adopt the RTG/yard trailer operation system.

High operational efficiency in a limited yard is the primary merit of this system. Containers can be stacked to 4 tiers high for simple and rapid operation with less container shifting operation required. (The most popular RTG is of one-over-four type.)

The area for reclamation would be smaller with the use of RTG equipment as described hereafter. An RTG yard will require some 36 sqm. per TEU while a straddle carrier system will require an average space of some 40 sqm. per TEU in ground slot.

The disadvantage of the RTG system is in container shifting operation. RTG must remove overriding containers several times if the lowest stowed containers are to be taken out.
In the RTG system yard, the following should be remarked:

- Heavy duty pavement is required only for RTG passage. Trailers will only require lighter pavement for operation in the yard.
- Maintenance and operation of RTG are simpler as compared with those of the straddle carrier. The RTG also provides a higher efficiency rate of operation than the straddle carrier.
- RTG will operate on dedicated runways, so that traffic accidents due to collision will be minimized, particularly when the yard layout planning is well-conceived.
- A runway can accommodate more than two RTG units simultaneously thereby increasing cargo handling efficiency.

(3) Size of Yard

Container Yard: The whole yard will be divided into a north, centre and south block. The north and centre blocks will be provided with 10 lanes including reefer container slots in lane F/J of the centre block. The south block will be provided with 5 lanes including 1 reefer container slot in lane E.

Three RTG traversing passages will be provided at the end of every container lane excluding the extreme head of the south block. The north and centre container blocks will be provided with 6 slots and 22 bays, and the south container lane 6 slots and 24 bays in the lane A/D for dry containers to be stacked with 5 tier-high containers. At the sixth tier, 4 units of slack space will be provided to allow the shifting of the other containers in the same bay. The stowage will be capable of swapping two 20 footers, whose locations can be shown in odd numbers, with one 40 foot container, whose location can be shown in even numbers on the ground.

At the extreme end of each north lane in the north block, an extra 5 foot space is provided for the 45 foot container stowage. It appears that the number of 45 foot containers will continue to increase on the European trading side since they are capable of accommodating 33 Euro standard pallets, giving them a capacity of up to 25% more than ISO 40 foot containers.

All dry containers will be stored with the door facing the rear side of the chassis. It might be worthwhile mentioning that, since the reefer units of reefer containers face the stern of the vessel during navigation to avoid the intrusion of sea water, it is crucial that the reefer containers should be turned around on the apron.

A passing lane between every two lanes will be provided in the yard, as shown in the drawings for overtaking, so as not to impede container delivery by RTG.

Ground Slots and Stowage Capacity: Stowage capacity is estimated as follows:

Ground Slots in the basic RTG yard adjacent to 350m quay (north &centre block) are equal to 2,460 TEU and are calculated as follows:

	Lane No.	x	Slot No.	x	Bay No.		
Dry Container	15	x	6	x	22	=	1,980 TEU
Reefer Container	5	x	6	x	8 (40 ft.)	=	480 TEU (240 FEU)
					Total		2,460 TEU

As the effectiveness of 85% of the ground slots is taken into account, the effective ground slots are 2091 TEU.

Ground Slots in additional RTG yard adjacent to extended 200m quay (south block) is 672 TEU and is calculated as follows:

	Lane No.	x	Slot No.	x	Bay No.		
Dry Container	4	x	6	x	24	=	576 TEU
Reefer Container	1	x	6	x	8 (40 ft.)	=	96 TEU (48 FEU)
					Total		672 TEU

Total Ground Slots = 3132 TEU Similarly, the effective ground slots are estimated as 2662 TEU.

The relation among the ground slots, RTG type used in the terminal, and the annual throughput of containers in TEU is shown in the table below:

Table 4.2.3 Required Ground Slots vs. Type of RTG vs. Container Throughput

		TEU – Days per annum											Required Ground Slots		
		Import		Export		Transit inbound		Transit outbound		Transshipment		Total	1 over 4 tiers	1 over 5 tiers	I over 6 tiers
		Dwell Time	5	Dwell Time	2	Dwell Time	5	Dwell Time	2	Dwell Time	15		3.5	4.5	5.5
Year	Throughpu	TEU	TEU – days	TEU	TEU – days	TEU	TEU – days	TEU	TEU – days	TEU	TEU – days	TEU–days			
2015	375,144	9,197	45,985	15,817	31,634	18,457	92,285	5,417	10,834	326,255	2,446,913	2,627,651	2,057	1,600	1,309
	386,900	10,560	52,799	18,211	36,422	22,894	114,470	8,382	16,763	326,852	2,451,390	2,671,844	2,091		
2016	389,420	10,852	54,260	18,724	37,448	23,845	119,225	9,017	18,034	326,980	2,452,350	2,681,317	2,099	1,632	1,336
2017	405,187	12,582	62,910	21,764	43,528	29,609	148,045	13,525	27,050	327,706	2,457,795	2,739,328	2,144	1,668	1,365
2018	422,638	14,389	71,945	24,943	49,886	35,703	178,515	19,169	38,338	328,434	2,463,255	2,801,939	2,193	1,706	1,396
2019	441,993	16,277	81,385	28,268	56,536	42,051	210,255	26,235	52,470	329,162	2,468,715	2,869,361	2,246	1,747	1,429
2020	463,501	18,249	91,245	31,745	63,490	48,533	242,665	35,082	70,164	329,892	2,474,190	2,941,754	2,303	1,791	1,465
2021	478,990	19,884	99,420	34,735	69,470	54,767	273,835	38,776	77,552	330,828	2,481,210	3,001,487	2,350	1,827	1,495
2022	495,454	21,577	107,885	37,837	75,674	61,494	307,470	42,780	85,560	331,766	2,488,245	3,064,834	2,399	1,866	1,527
2023	512,966	23,331	116,655	41,056	82,112	68,752	343,760	47,121	94,242	332,706	2,495,295	3,132,064	2,452	1,907	1,560
2024	531,601	25,146	125,730	44,396	88,792	76,584	382,920	51,826	103,652	333,648	2,502,360	3,203,454	2,508	1,950	1,596
2025	551,442	27,026	135,130	47,862	95,724	85,035	425,175	56,927	113,854	334,592	2,509,440	3,279,323	2,567	1,997	1,634
	583,300	30,045	150,223	53,427	106,854	98,604	493,022	65,117	130,235	336,108	2,520,808	3,401,143	2,662		

In computing the relationship among them, the dwell time of various containers are assumed in reference to the current actual dwell time as follows:

Import Containers:	5 days
Export Containers:	2 days
Transit Containers inbound:	5 days (equal to import containers)
Transit Containers outbound:	2 days (equal to export containers)
Transhipment Containers:	15 days per 2 TEU (as they will stay within the terminal)

From the table above, it is estimated that an RTG of the 1-over-four type will be able to handle containers up to about 583,300 TEU, which is almost the same capacity of the berth to handle, as the berth occupancy rate to handle this amount of containers is estimated as 61%. On the other hand, RTG of a 1-over-5 type and 1-over-6 type will be able to handle containers to about 837,300 TEU and 1,091,500 TEU respectively. Therefore a RTG of the 1-over-four type is recommendable. In this case, the capacity of the terminal is limited by the yard capacity up to 583,300 TEU. The demand is considered to reach to the yard capacity in 2026 from the above table. Also from the table above, the south block has to be completed by the end of 2015 at latest.

When Phase 2 is completed, the whole length of the berth will be 1,100 m. Then, the berth can handle more throughput, as more ships can be accommodated due to its continuity to the neighbouring quay. To this end, RTG of 1-over-5 type may gradually replace the 1-over-4 type in future.
As a result, the throughput capacity of the container terminal is estimated to be 583,300 TEU per annum. For estimated throughput exceeding terminal capacity from 2027 onwards, additional facilities like a quay and stacking yard should be constructed as Phase 2.

Among the estimated 583,300 TEU, it is estimated that 57.6% comprises foreign transhipment containers and 42.4% transit and local containers. 77.9% of containers (transhipment, transit outbound and export containers) will be stacked in the space proximate to the apron.

Additionally, the following space will be provided outside of the RTG covering yard zone.

Provisional space for reefer containers:	4 Slots x 20 Bays (40FT) = 80 FEU	160 TEU
Empty container (In the south triangle area):		178 TEU

The terminal operation will be carried out as follows:

- Transhipment containers will be stored in seaside lanes, while local/transit containers will be stored on the terminal gate side. Imported transit containers will be hauled directly from a vessel docked alongside the railway sidings, and containers to be exported will be transported from the railway wagon to the nominated location in the stacking yard, taking into consideration the vessel's stowage plan.
- External trailers will turn around from/to the Container Checking Gate for the delivery of local containers. There is no need for them to enter the seaside lane, and this prevents any hindrances to yard trailers.
- The Empty Container Depot (ECD) will be located in the vicinity of the terminal office. They will be stacked by size, kind, and according to shipping line. Reach stackers and/or forklifts with side-spreaders will be used for delivery of empty containers.
- The Reefer container lane will be secured in F/J lane in the centre block and in E lane in the south block, in proximity to the maintenance shop, in order to facilitate the monitoring and repair of reefer containers by mechanics and electricians when needed. The numbers of reefer receptacles and scaffolds will be determined.
- The quantity of the receptacles will be determined based on the movement of frozen containerized goods in 2008. (The two systems commonly adopted worldwide for temperature measuring are the Pre-Recorder and Digital Recording systems.)
- The procedure to be adopted for temperature monitoring will be the individual system.

(4) Yard Equipment

Quay Gantry Crane (QGC): Initially 3 units will be installed to cater to Panamax size vessels at the beginning of operations. The QGC will have an outreach capable of handling 13 rows of containers on the ship's deck and a gauge of 30m.

The numbers of gantry cranes to be installed is estimated with the following assumptions:

Annual maintenance of the equipment: 14 days @ Working ratio of 60%.
Productivity: one round @ 3 minutes, 20 units per hour.
Annual productivity rate per crane: (365 days–14 days) x 60% x 24hrs x 20 u. = 101,080

On this calculation, one quay gantry crane would be installed after exceeding 100,000 units in container operations.

Currently, there is no market in the West coast of Africa to justify the provisions of a QGC for post-Panamax vessels. However, in the event that it will be needed in the future, appropriate QGC could be provided on the crane rails that were previously installed for Panamax vessels.

Rubber Tired Gantry Crane (RTG): 8 units of 1-over-4 are to be installed. The most popular and desirable type is the 77 feet span with 16 wheels.

Two RTGs will be allocated for one quay gantry crane. A total of 6 RTGs will be allocated for 3 QGCs. The other 2 RTGs will be allocated for local and rail transit container delivery. Additional RTGs would be provided as additional gantry cranes are introduced.

Yard Trailer: 17 head units and 20 chassis units shall be provided or a total of 17 trailers and 3 spare chassis.

4 trailers will be allocated for one quay gantry crane or a total of 12 trailers for 3 quay gantry cranes.

3 trailers will be allocated for railway terminal haulage.

2 trailers and 3 additional chassis will be allocated for over-wide or over-high containers, animal/plant inspection, and spares.

These tractor heads should have more powerful engines than usual ones as well as simple couplers for the chassis due to rapid acceleration, deceleration, and frequent coupling/decoupling during operations.

The chassis should have strong steel beams applicable for both 40FT and 20FT and convertible container flippers on six corners and centres without twist locks.

Reach Stacker: Two of the reach stackers currently in use will be relocated to the railway yard and Empty Container Depot (ECD). At the end of their service life, it is desirable to replace some of them with high-mast side lifting type forklifts in ECD. This type of equipment can handle up to 6 to 10 stacked containers. Reach stackers will also be used at the reefer container stowage site close to the maintenance shop.

Multipurpose fork lift: Three units of 3–5 tonne capacity forklifts will be provided in the maintenance shop. These will be used for maintenance and repair work for heavy vehicles and various other uses.

(5) Buildings and Other Facilities

Terminal Operations Office: This building, which will be located directly opposite the terminal main gate, will house terminal operation personnel except for those involved with maintenance and stevedores as they have their own separate offices. The terminal operations office will be provided with compartments for members of the managing unit, documentations department, operations department, and computer facilities among other amenities to facilitate 24 hour continuous operation of the terminal.

The office will be provided with parking spaces for customers including shippers, consignees, customs brokers, forwarders and truckers.

Yard Control Room: The yard control room will be surrounded by transparent glass and will be located on the top floor of the terminal operations office. The yard controllers should be able to observe the stacking yard and berthing areas, and give instructions to all the yard workers and crane operators/truck drivers by monitoring information from the container checking gate and the working procedure plan.

Container Checking Gate: The checking gate is the dividing line of responsibility between the terminal side and the cargo side. Container inspectors are tasked to examine outlook conditions of the containers and to check whether the container seals are intact on the container doors.

Only one terminal gate in one location will be provided to facilitate inspection of container vehicles and other cars used by customers coming to the terminal office so as to ensure that security is maintained at all times. Yard trailers hauling containers to and from the railway sidings will pass through this gate.

The checkers together with the truck drivers will verify the condition of the container and seals for any damage, and whether the Equipment Interchange Receipt (EIR) is duly signed, whereas for reefer containers, the inside temperatures will be confirmed by checkers and drivers.

Each gate lane will be provided with a processing booth to be installed on the elevated platform alongside the checking lanes. Weighing scales will be installed in certain selected in-lanes for the checking the cargo payload of containers for compliance with safety requirements and the formulation of the stowage plan on board the vessel to be prepared by the GM and individual discharging ports. The checking gate will be provided with overhead catwalks to facilitate the inspection of container roofs by checkers.

Three gate lanes for entrance and three gate lanes for exit for a total of six lanes will be provided for flexible use when preparing for a rush of container deliveries. Wide passages will also be provided to the checking gate to cater to oversized cargo and heavy equipment and machinery that cannot pass through the checking gate.

The number of gate lanes needed is estimated as follows:

Anticipated number of local containers for import/export: 83,472 TEU

Ratio of 40FT : 20FT = 1.53
Gate operating hours: 8 hrs/day
83,472 TEU / 1.53 = 54,557 boxes
54,557 Boxes / 52 weeks / 7 days / 8 hours / 3 lanes = 6.25 boxes (trailers)

As it takes an average of four minutes for an external trailer to pass through the gate, each lane will be occupied for 25 minutes (4 minutes x 6.25 trailers) in an hour for documentation processing, and container inspection to be cleared in 8 hours during daytime operations.

Transit containers will be transported on land as Overland Transportation (OLT). Their documentation and inspection are made at the terminal station in case of railway or at the Inland Container Depot (ICD) in case of trucks, where the carriers' responsibility of containers terminates. Transit containers will not take time at the container checking gate of the (marine) container terminal.

Therefore, the six truck lanes are sufficient to control all the outgoing and incoming containers through the checking gate during the daytime operations.

Maintenance Shop: The container terminal will be provided with a "maintenance shop" for repair and maintenance of all yard equipment and facilities including vehicles used in the terminal. The shop will be equipped with an overhead crane for lifting heavy objects and a trench-pit for the inspection of the under-panelling of vehicles.

Similarly, the RTGs will be maintained in a depot adjacent to the maintenance shop.
Electricians will monitor the required temperature of reefer containers that are stacked in the reefer container lanes G and H and in the provisional stowage area close to the maintenance shop. They will also perform the Pre Trip Inspection (PTI) just before delivering empty reefer

containers for export. In accordance with requests from customers, repairs of reefer container units will be carried out.

Offices, spare parts storage, and other amenities for persons in charge of maintenance will be established in the shop.

RTG Traversing Passage: Three traversing passages for the RTGs will be provided at the end and centre of each block excluding the south head of the south block. The extended F lane passage to the south will reach the side of the maintenance shop up to the maintenance depot of the RTGs.

RTG Depot: A depot will be provided adjacent to the maintenance shop to cater to the maintenance of 2 units of RTGs simultaneously. In the depot, other equipment and vehicles can be repaired and washed in addition to the RTGs. The perimeter of the depot will be provided with a trench as a measure against oil spillage. Bilge that has accumulated will be deposited into a purifier installed in the maintenance shop.

Fuel Oil Station: A fuel oil station will be provided with underground storage tanks for gasoline and diesel, the capacity of which will be decided by the numbers and kinds of equipment and vehicles engines. Fire fighting appliances will be provided adjacent to this station in accordance with Namibian Fire Regulations, to ensure safety of operations.

Marine House (Stevedores Amenity): A building will be provided on the extreme south head of lane A, where stevedores can stay to wait for vessels berthing and/or break for coffee or meals.

Reefer Receptacles: The reefer lanes F/J in the centre block and lane E in the south block will be provided with steel scaffolds and electrical receptacles to provide power supply for six tier stacked reefer containers. All spaces are for 40 foot reefer containers, and will be secured with door-opening spaces for contents inspection. 20 foot reefer containers will be stored here too, with another 20 feet of vacant space. Additional spaces for reefer containers for long term storage will be provided by the fence in the west of the centre block, where electricity for them will be supplied from manholes on the ground by cables. A covering substation will be installed adjacent to the maintenance shop.

Terminal Main Gate: Security gate access will be provided for the terminal prior to entrance to the checking gate. Vehicles will be checked to maintain security inside the terminal premises at all times. Security guards will check vehicles and persons that go into the terminal, and also indicate lane numbers to the queuing external trailers towards to the container checking bridge. A 40 m long waiting lane will be provided between the terminal main gate and the container checking gate.

Dangerous Cargo Depot: Containers with hazardous and flammable cargo should be stored in the restricted area at the far north end of the terminal—north of lane A. This area will be marked with paint or red cones to distinguish it from other areas. The depot should be provided with safety features such as fire extinguishers, sand bags or other fire-prevention means pursuant to Namibian government rules and regulations.

Empty Container Depot: An empty container depot will be provided as a separate area close to the terminal operations office. The containers returned from consignees for delivery to shippers will be stored in sound condition for delivery upon request. A container washing site may be provided on request by container owners.

Railway Yard: The yard trailers connecting the railway yard for the transfer of imported containers onto wagons will return to the container yard. Exporting containers have been mounted onto trailers in order to avoid redundant handling operations.

In loading containers onto vessels, the container doors should be facing the ship's stern. As such, care should be taken during the mounting of containers onto the chassis.

Figure 4.2.4 on the following page shows the whole figure of the proposed layout of the container terminal.

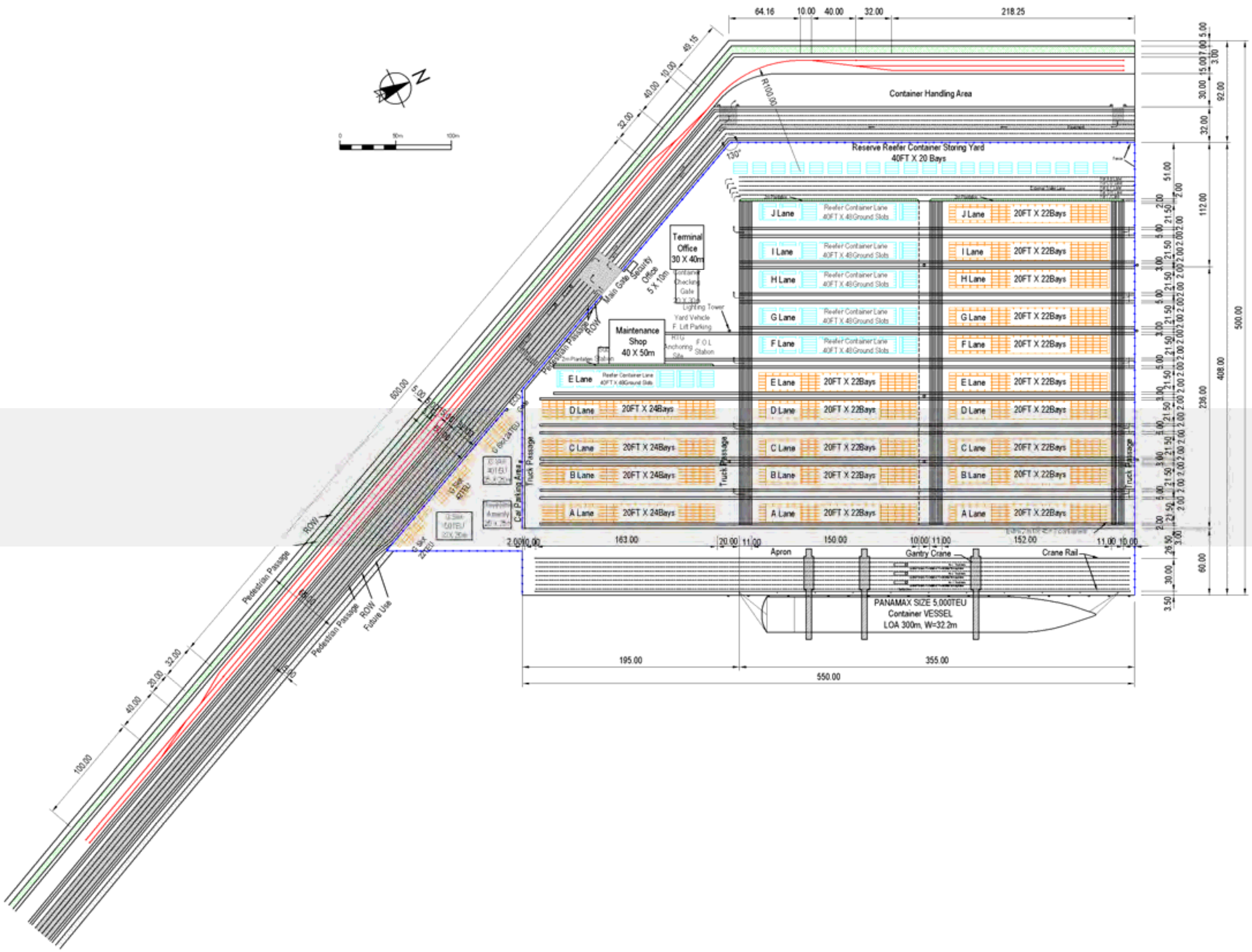


Figure 4.2.4 Proposed Layout of Container Terminal

4.2.3 Layout of Access Road

The right of way to the container terminal will be 28m, sufficient for two traffic lanes for both incoming and outgoing traffic at the causeway, and 32m wide, sufficient for three traffic lanes near the terminal gate. Parking spaces for trailers can be provided on both sides of the road near the terminal gate. As per Namport's rules, the traffic lane is 4 m wide without a median strip.

Outside trailers queuing for entrance will be provided with waiting space located at the adjacent side of the road in order to prevent obstructing traffic.

Trailers loaded with containers from the stacking yard for railway siding will have to exit and return in a counter clockwise direction.

It is probable the current port gate will be used for traffic to and from the new container terminal.

4.2.4 Layout of Railway Terminal

(1) Existing Railway Yard

The existing railway yard of Walvis Bay station is located on the east side of the port. The station has a large shunting yard in the middle, a locomotive maintenance depot in the south part, and a wagon maintenance depot in the north part. There is a platform in the station building for passengers in the east side of the shunting yard.

A fence divides the premises of the port and the railway, and the gate is set on the siding track connecting the station with the port.

Most freight is handled in the port and the oil terminal and private container terminal on the north side of the station. The main items of the freight are fuel, coal, cement, copper concentrate, salt, sugar, maize and grain and chemical materials. The freight volume to Walvis Bay is 24 thousand tonnes as compared to 551 thousand tonnes from Walvis Bay in 2007.

A passenger train runs once every day except on Saturday. One or two passenger coaches are coupled to the freight train and there are very few passengers.

(a) Existing Shunting Yard

(b) Passenger Platform

(c) Existing Railway Container Terminal

(d) Gate for port area

Source: JICA Study Team

Figure 4.2.5 Photos of Existing Railway Yard in Walvis Bay

(2) New Railway Container Terminal

1) Layout of Railway Container Terminal

The Railway Container Terminal has two loading/unloading tracks and a stabling track because the land for it is about 350 m long, which cannot accommodate trains over 200 m long. A stabling track will be used for the future main track extension.

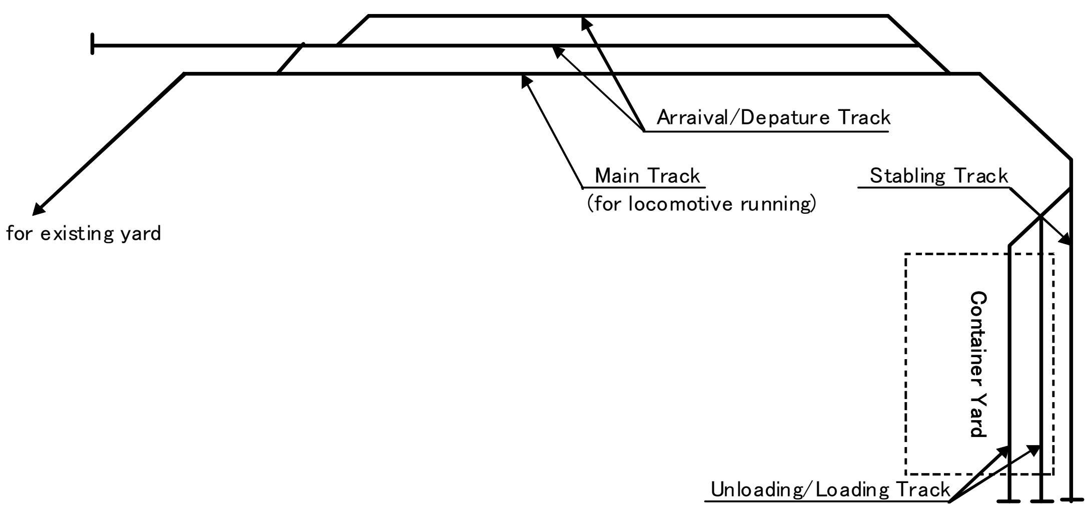
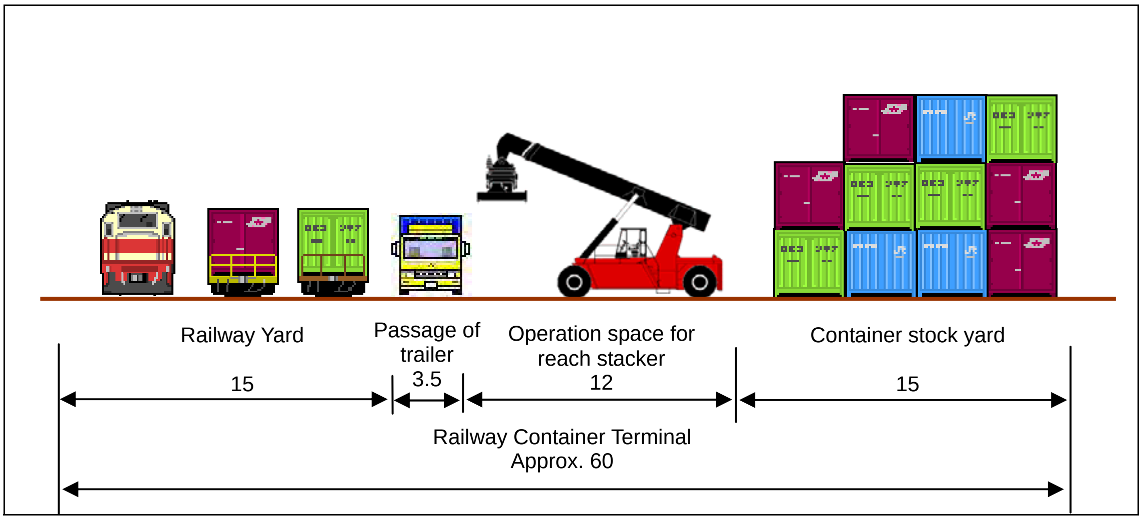


Figure 4.2.6 Track Layout of Railway Container Terminal

Excepting tracks, the railway container yard consists of the following:

- Passage of trailer (w=3.5 m)
- Operation space for reach stacker (w=12 m)
- Container stock yard (w=15 m)



Source: JICA Study Team

Figure 4.2.7 Section of Railway Container Terminal

The arrival/departure tracks are located on the causeway. Those consist of a main track and two loops. The arrival/departure and composition of trains is carried out here.

2) Connection with Existing Railway Yard

The approach track to the container terminal diverges from an existing siding track near the coal yard.

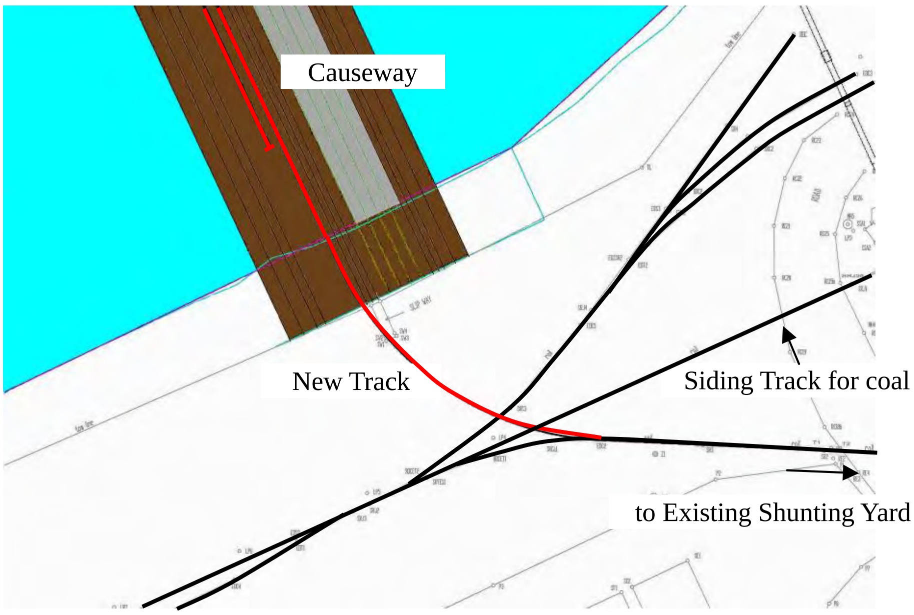


Figure 4.2.8 Plan of Connection with Existing Shunting Yard

Although the approach track crosses existing siding tracks for coal after divergence, these sidings are used only a few times a day. So, a train terminating/arriving at the container terminal seems to hardly disturb the shunting of existing siding tracks.

3) Operation Procedure in the Railway Container Terminal

The operation procedure of a train in the railway container terminal is as follows:

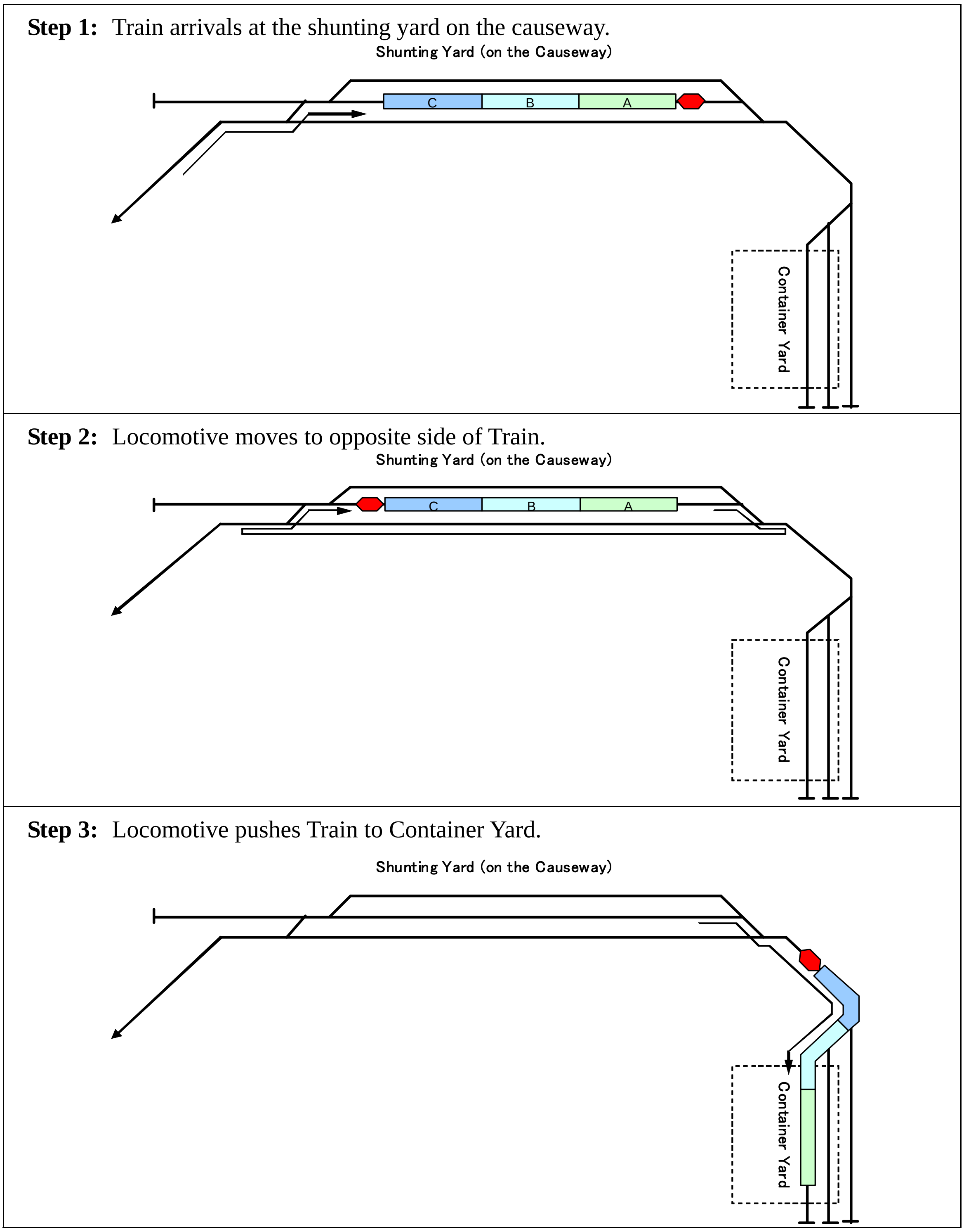
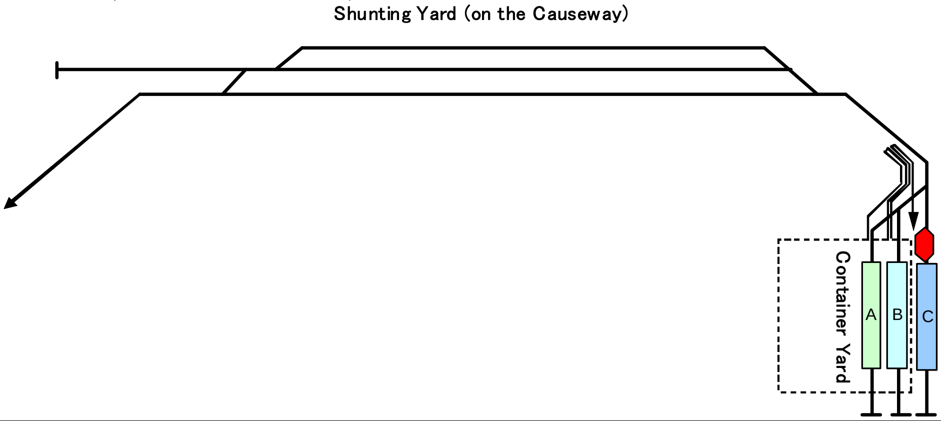
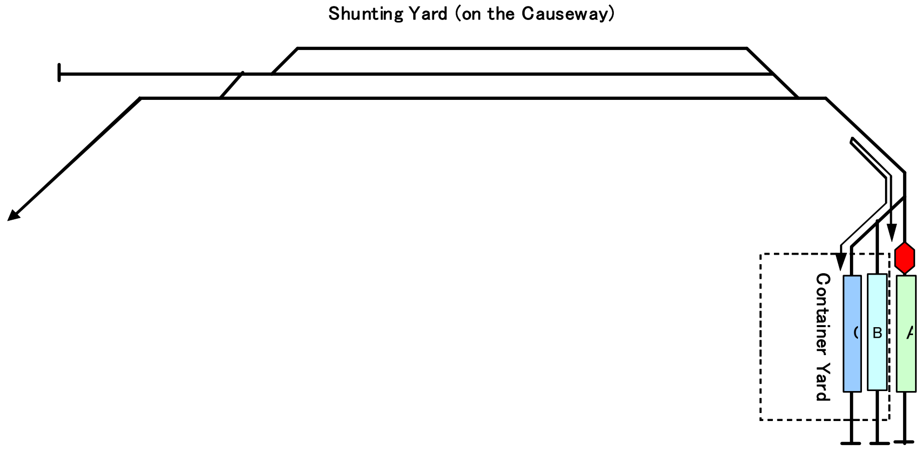


Figure 4.2.9 Operation Procedure in the Railway Container Terminal

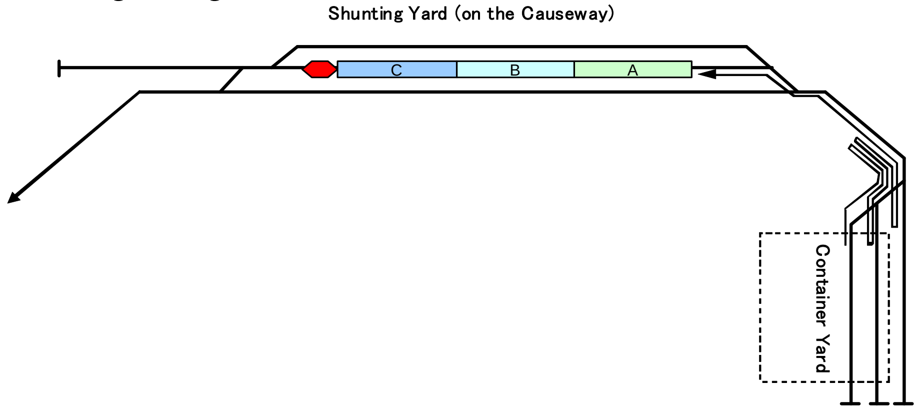
Step 4: Train is divided into two or three if train is longer than unloading/loading tracks. Two parts of Train (hereafter "A" and "B") is set at the unloading/loading tracks and the rest (hereafter A and "C") is set at the stable track.



Step 5: "A" and "C" is switched after A finishes unloading/loading.



Step 6: New train is composed on the arrival/departure track after all cars finish unloading/loading.



Step 7: Train departs from the shunting yard.

Figure 4.2.9 Operation Procedure in the Railway Container Terminal (continued)

In addition, recomposition of freight cars is carried out in the existing yard or the arrival/ departure track in the container yard.

4) Facilities of Railway Container Terminal

Rail used will be 48 kg/m rail taking availability for procurement into consideration. Sleeper used will be pre-stressed concrete.

Refuelling of locomotives and repairing of freight cars will use the existing railway facilities in the existing yard.

5) Capacity of Railway Container Terminal

Capacity of Railway Container Terminal, which is the number of containers and trains it can handle, is assumed as follows:

The maximum numbers of wagons a train:	35 cars
The maximum length of a train:	525 m (35 cars×15 m)
The maximum TEU of containers a train:	70 TEU (2 TEU/car)
The Ratio of 20ft container and 40ft container:	1.4
Number of Box loading a train	50 (20 ft is 30 and 40 ft is 20)

Handling Time

- Unloading containers from wagons and storing those at the stock yard 2 minutes
- Picking containers up from tractors and loading those into wagons 3 minutes
- Loading containers of the stock yard into tractors 3 minutes
- Total handling time for unloading and loading 8 minutes

The time required for loading and unloading of a container of a train is:

50 boxes × 8 minutes ÷ 2 reach stackers = 200 minutes ＝ 3 hour 20 minutes

The total handling time including that used in shunting wagons is about 4 hours a train. Therefore, the railway container terminal can handle 5 trains a day, if the operation time is 20 hours (ex 4:00 AM~12:00 PM). The capacity of train operation is 350 TEU per direction. The annual capacity is 210,000 TEU for 300 operation days.

4.3 Preliminary Design of Port Facilities

4.3.1 Reclamation and Slope Protection

(1) Reclamation

Subsoil data on the BH9 located at the turning basin indicates that the subsurface sediments to be dredged up to CD −13.5 m by capital dredging are non-plastic, granular with particle distribution mostly in the range of 0.8 mm to 0.1 mm and unconsolidated. It is suitable for the use of reclamation and therefore the materials for reclamation of the New Terminal area is sourced from the capital dredging of the new turning basin in front of the Quay Wall structure.

Because of the granular fill materials, which are placed through the hydraulic method, the settlement is normally rapid or instant once the surcharge load is applied. Any soil improvement techniques to accelerate the process of consolidation of the fill materials will not be required.

The underlying sandy silt deposits from around CD −25 m below to a depth of CD −45 m are stiff or medium dense with an N-value of 10 to 15. These soils are of a very fine granular, non-plastic and non cohesive kind. The deposits are of a relatively low strength and may exhibit moderate compressibility once the overburden pressure is applied by reclamation fill and surcharges are loaded onto the reclamation fill for its intended use. The settlement is estimated to be more or less 1 m but will be rapid or instant because of its unconsolidated properties.

(2) Revetment Work for Reclamation Area

1) Design Conditions

Natural Conditions: Chapter 2 of this report summarizes data and information on natural conditions at the site that are derived from the previous study report collected or supplementarily obtained through the site survey and investigation during the JICA Field Survey. Based on these data and information, and study on such design codes of practice such as the British & Japanese Standards, meteorological and oceanographic conditions are interpreted to produce key parameters in common use for the purpose of designing port facility components of the project.

Tides: HAT (Highest Astronomical Tide): +1.97 m LAT
MHWS (Mean High Water Spring Tide): +1.69 m LAT
ML Mean Level (Land Levelling Datum): +0.98 m LAT
MLWS (Mean Low Water Spring Tide): +0.27 m LAT
LAT (Lowest Astronomical Tide):±0.00 m
Chart Datum (CD) referred and equals to LAT.

Design Wave at the Project Site: Apply the following waves predicted at Locations 7 (at Offshore of Berth 8) by the report on “Design, Feasibility and Tender Berth 0/1, Concept and Feasibility for Ship Repair Hub & Dedicated Fish Terminal”: Inros Lacker Ag, June 2008.

Table 4.3.1 Wave Height H1/3 (m)

Location Nr	Location	Return Period				
		1 Yrs	5 Yrs	10 Yrs	50 Yrs	100 Yrs
8	Offshore Tanker Berth	1.7	2.5	2.7	3.0	3.2
7	Offshore Berth 8	1.5	2.4	2.6	2.8	3.0

Source: Report on “Design, Feasibility and Tender Berth 0/1, Concept and Feasibility for Ship Repair Hub & Dedicated Fish Terminal: Inros Lacker Ag, June 2008

Wave Height H1/3=2.8 m (50 yrs return period)
Wave Period T1/3 = 13.0 sec
Wave Direction NNW direction

Design Seismic Coefficient for Revetment: Not Considered

Soil Conditions: A series of offshore boring works at BH-1 to 9 was carried out as presented in Chapter 2. The design properties of the existing subsoil for each proposed work are determined based on the subsoil data collected from BH-3 to 8 positioned at the reclamation area and along the proposed revetment.

Table 4.3.2 Proposed Design Soil Parameter for Subsoil along Northwest Revetment: BH-6 & 7

Layer	Depth CD (m)	Soil Status	Soil Properties		
			N value	Unit Weight γ (kN/m^3)	Strength
Ooze	−4 to −5	Very Soft	N=0		C= 0
Silty Sand	−5 to −7.5	Loose to Medium Dense	5–26, Nav=10	10	ϕ = 25°
Sandy Silt	−7.5 to −10	Loose to Medium Dense	N=6–26	10	ϕ = 25°
Lower Sand	Deeper than −10	Medium to Dense	N>41	10	ϕ = 40°

Source: JICA Study Team

Table 4.3.3 Proposed Design Soil Parameter for Subsoil along Northeast Revetment (Temporary Revetment for Future Expansion): BH-3

Layer	Depth CD (m)	Soil Status	Soil Properties		
			N value	Unit Weight γ (kN/m^3)	Strength
Silt	−3.5 to −5	Loose	N=5		ϕ = 25°
Silt	Deeper than −5	Medium Dense	15–28, Nav=20	10	ϕ = 30°

Source: JICA Study Team

Table 4.3.4 Proposed Design Soil Parameter for Subsoil along Causeway Revetment: BH-8

Layer	Depth CD (m)	Soil Status	Soil Properties		
			N value	Unit Weight γ (kN/m^3)	Strength
Subsurface Layer	−2.3 to −8	Very Loose to Loose	N=2–10		ϕ = 25°
Silty Sand	−8 to –13.5	Medium Dense to Dense	21–50	10	ϕ = 30°
Sandy Silt	−13.5 to −21	Loose to Medium Dense	N=6–26	10	ϕ = 30°
Silty Sand	−21 to −27	Dense	N>38	10	ϕ = 35°
Sandy Silt	Deeper than −27	Medium to Dense	N=11–34 Nav=17	10	ϕ = 30°

Source: JICA Study Team

Analysis of SPT and laboratory test results has established the soil types and classification encountered in each boreholes. Since no strength test was carried out, the soil strength parameter of each major subsoil layer was experimentally derived based on its relationship with the N value in SPT.

The internal friction angle was obtained from the correlation with SPT values.

Internal Friction Angle of Sand: $\phi = \sqrt{(12xN)} + A$

where, ϕ : Internal friction angle (degree)

N: Blow counts in SPT

A: Empirical coefficients depending on characteristics of sandy soils:

15: Poorly graded sandy soils with rounded particles

20: Sandy soils of well graded with rounded particles or poorly graded with angular particles

25: Well graded sandy soils with angular particles

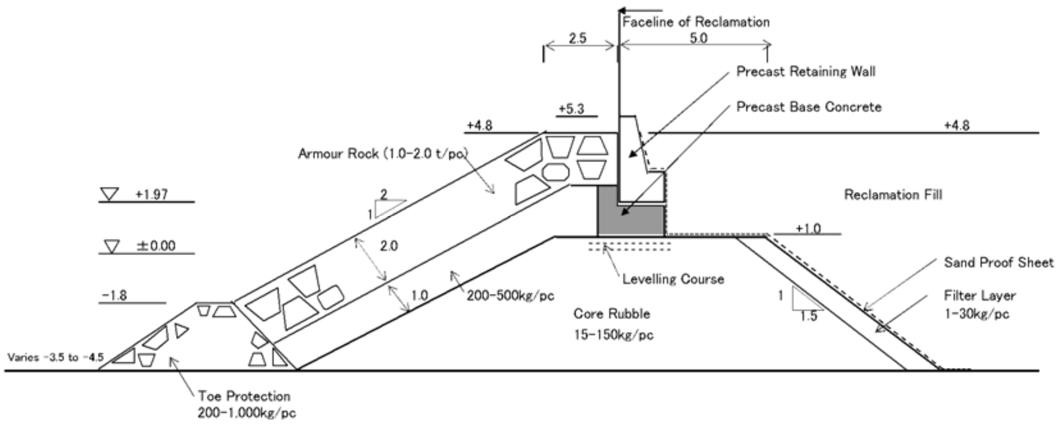
2) Design of Revetment

Northwest Revetment:

The Northwest Revetment (Seawall) is installed upon the seabed elevation of around CD −3.5 to −4.5 m. The revetment is designed in the form of sloped protection from the wave action covered by armour stones. The riprap mound between 15 kg and 150 kg per piece is placed in a seaside slope in 1 (V) to 2 (H) on which vertical precast concrete gravity walls are installed. The seaside front surface is protected by two layers of armour stones of 200 to 500 kg/pc and 1.0 to 2.0 ton/pc protected at toe by rock mound of 200 to 1,000 kg/pc. Thickness of the armour layer is 2.0 m. Due to vulnerability to erosion by waves at newly reclaimed areas for the container terminal, the armour stone layer protects the entire slope at this location.

The size (weight) of armour stone (Md) is calculated with Hudson's equation using a 50 year return period wave of H=2.8 m and stones of 1.0 to 2.0 ton/piece.

$$Md = \rho H^3/Ns^3(Sr-1)^3$$
$$= 2.65 \times 2.8^3/8(2.65/1.03 - 1)^3 = 1.87 \text{ t/pc}$$
where $Ns^3 = Kd \cot \alpha = 4 \times 2 = 8$



Source: JICA Study Team

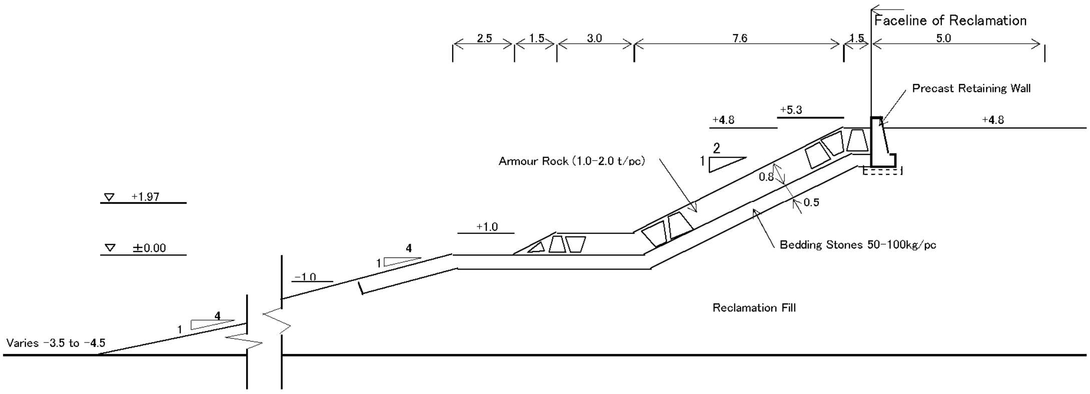
Figure 4.3.1 Northwest Revetment (Seawall)

Northeast Revetment:

Along the Northeast Revetment (Temporary Seawall for Future Expansion), reclamation fill may be placed in a gentle slope of 1 (V) to 4 (H) under water level. The surface of the under-water slope is protected by bedding stones layer to the depth of CD −1.0 m. Above CD±0.0m, the stone bedding of 50 kg to 100 kg per piece is placed on the reclamation fill as for scour protection. Above CD ±0.0 m, the revetment is designed in a form of sloped protection from the wave action covered by armour stones. The bedding stones are placed in a seaside slope in 1 (V) to 2 (H) on which one layer of armour stone of 1.0 to 2.0 ton per piece is installed.

The size (weight) of armour stone (Md) is calculated with Hudson's equation using 5 year return period wave of H = 2.4 m but the stones of the same size of 1.0 to 2.0 ton/piece as those for Northwest revetment are used in considering re-use for future expansion of new container terminal to offshore. At the edge of reclamation alignment, coping concrete is installed to retaining the reclamation fill. The coping concrete is precast member for possible replacement to new alignment of reclamation area for future offshore expansion of the terminal.

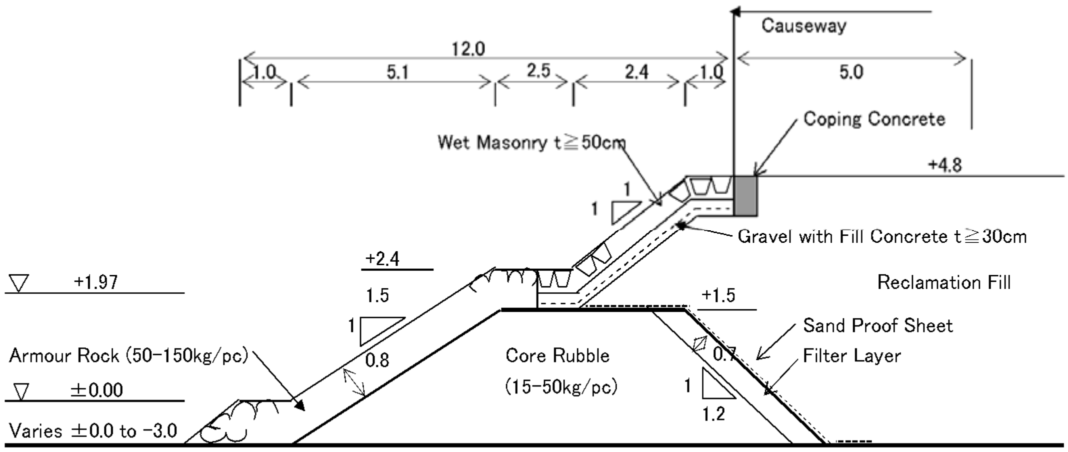
$Md = \rho H^3/Ns^3(Sr-1)^3$
$= 2.65 \times 2.4^3/8(2.65/1.03 - 1)^3 = 1.18$ t/pc
where $Ns^3 = Kd \cot \alpha = 4 \times 2 = 8$



Source: JICA Study Team

Figure 4.3.2 Northeast Revetment (Temporary Seawall)

Revetment Along Causeway:
Revetment along the Causeway is formed by a rubble mound base whose elevation is CD +1.5 m on which a slope facing wet masonry revetment in a slope of 1 (V) to 1 (H) is provided to the top level of causeway CD +4.8 m.



Source: JICA Study Team

Figure 4.3.3 Causeway Revetment

4.3.2 Quay Wall

(1) Preliminary Concept by Previous Study

According to previous studies on the New Container Terminal Project, the Primary Criteria of the New Container Berth (Berths 9–14) are summarized as follows.

- Objective Vessels: 2,500 TEU or 5,000 TEU or 8,000 TEU vessel
- Water Depth: CD −16.3 m (final)
- Berth Length: 530 m long to accommodate two (2) 2,500 Vessels or one (1) 5,000 TEU or 8,000 TEU
- Cope Line Height: CD +4.765 m (= +4.680 LWOST)
- Ship-to-Shore Crane: 30.48 m rail span for 6th generation 22 box wide container vessel
- Concept of Structure: 1) Open piled concrete quay
  About 34.5 wide concrete deck supported on cased reinforced concrete piles (3 pile rows 10.16 m apart and transverse spacing of 6 m)

  2) Retaining Wall
  A sheet pile cut-off wall, which will support the back crane rail and retain the backfill by double corrosion-protected steel anchors about 2 m apart drilled back into reclaimed fill at 30 degrees from the horizontal and secured to the top of the sheet pile wall
- Quay Fitting: Bollards and fender along the seaside edge
- Service Utilities: Services in a service duct along the seaside edge

(2) Proposed Design Criteria

1) Natural Conditions

Tide:

HAT (Highest Astronomical Tide): +1.97 m LAT
MHWS (Mean High Water Spring Tide): +1.69 m LAT
ML Mean Level (Land Levelling Datum): +0.98 m LAT
MLWS (Mean Low Water Spring Tide): +0.27 m LAT
LAT (Lowest Astronomical Tide):±0.00 m

(Chart Datum (CD) referred and equals to LAT)

Rainfall Intensity: Negligible

Wind Velocity:

Design Wind Velocity:	40 m/sec
Wind in Operation:	20 m/sec

Design Seismic Coefficient for Quay Wall Structure:

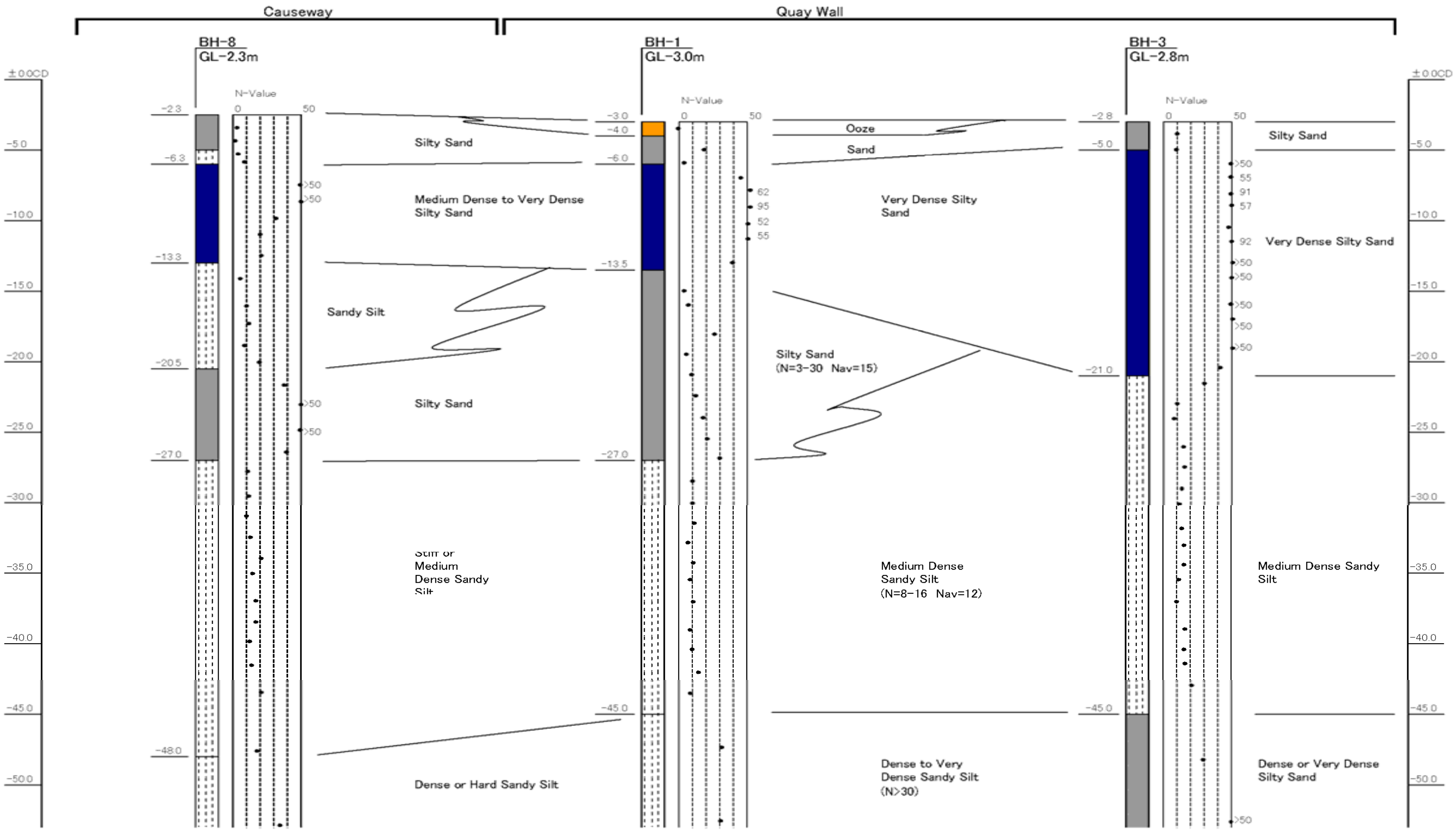
Horizontal Design Coefficient:	kh = 0.00 g
Vertical Design Coefficient:	kv = 0.00 g

Soil Conditions:
The design properties of the existing subsoil along the proposed quay wall are determined based on the subsoil data collected from BH-1 & 2 boring positioned along the proposed quay wall.

Table 4.3.5 Proposed Design Soil Parameter for Subsoil along Quay Wall

Layer	**Depth CD (m)**	**Soil Status**	**Soil Properties**			
			N value	**Unit Weight γ (kN/m^3)**	**Strength (kN/m^2)**	**Lateral Pile Resistance: Kh (N/cm^3)**
Ooze Deposit	−3 to −4	Very Soft	N=0		C= 0	
Upper Sand	−4 to −6	Loose	4–19, Nav=10	10	ϕ = 25°	
Upper Sand	−8 to −13.5	Very Dense	N> 50	10	ϕ = 40°	
Lower Sand	−13.5 to −27	Medium Dense	3–30, Nav=15	10	ϕ = 30°	25
Sandy Silt	−27 to −45	Medium Dense	8–16, Nav=12	10	ϕ = 30°	
Sandy Silt	> −45	Dense to Very Dense	N>30	10	ϕ >35°	

Source: JICA Study Team
Lateral soil resistance of pile (Kh) was obtained from the correlation with SPT values.
Lateral soil resistance of pile Kh= 1.5N (N/cm^3)
where N: Blow counts in SPT



Source: JICA Study Team

Figure 4.3.4 Subsoil Profile along Causeway to Quay Wall (BH8-1-2)

2) Design Conditions of Quay Wall

Objective Vessel: 8,000 TEU capacity container vessel

Geometry of Container Berth:

Top Elevation at Cope-line of Berth	CD +4.77 m
Planned Water Depth	CD −15.5 m (Future)
Ditto but for construction of Phase 1	CD −13.5 m

Loading Conditions:

Live Load on Apron: 4 tf/m^2

Quay Gantry Crane: For container vessel of 17 rows container on deck
- Weight: approx. 1,000 tf per Unit
- Rail Gauge: 30 m
- Wheel Number per Corner: 8 wheels at 1.3 m ctc
- Wheel Load:
  - (Seaside): approx 56 t/wheel (max. out reach)
  - (Landside): approx 52.5 t/wheel (max. back reach, boom up)

Harbour Mobile Crane: For container vessel of 17 rows container on deck
- Model: Liebherr –Werk Nenzing GmbH made Type LHM500
  - Weight: approx. 455 tf
- Number of tyres: 4 x 10 x 2 =80 tyres
- Max. load per tyre: 6.0 tf
- Supporting pad: 4 x 5.5 x 1.8 (=9.9 m^2/pad)
  - Lifting Capacity: 51 m outreach x 42.2 ton Hook Operation
- Max. Outrigger Load for Normal (static excluding wind): 293 tf/corner
- Ditto but for Normal (static including wind):321 tf/corner

Other Container Handling Equipment

Service Life:

BS 6349-1: 2000 stipulates that:

1) The design working life of a structure can be taken as the specified period for which a structure is to be used for its intended purpose with planned maintenance;
2) Normally a design working life of the order of 50 years or more is expected of maritime structures such as quay walls, jetties and docks but the design life is not necessarily the same as the return period of the design conditions;

Quay wall structure is designed for a service life of 35 years for the quay wall, including the pile and beam, as recommended by South African Harbour Manual.

3) Design Standards and Codes of Practice

1) Technical Standards and Commentaries for Ports and Harbour Facilities in Japan, 2007

2) British Standard Code of Practice for Maritime Structures (BS 6349)
   - Part 1: General Criteria 2000
   - Part 2: Design of quay walls, jetties and dolphins 1988
   - Part 4: Code of Practice for designing fendering and mooring systems 1994

3) Manual on Harbour Engineering, South African Transport Services (SATS) in 1986

(3) Selection of Docking Fender System

According to the established design method of fendering by Technical standards for port and harbour facilities in the Japan and BS 6349 codes of practice, the fender system was designed under the following conditions for berthing and the selection of type of fender system:

1) Conditions for Berthing

Objective Vessels to Berth: 8,000 TEU Container Vessel
Method of Berthing: Tug-assisted
Berthing Angle: 10 degrees at the quarter-point berthing of ship
Ship approach velocity: 0.10 m/sec perpendicular to dock face

2) Selection of Type of Fender System

Type of System: Rubber formed fender system (Elastomeric Unit Type)
Type of Rubber Fender: Hollow Cylindrical to absorb high berthing energy of ship at low fender reaction

Interval of Fender Unit: for 15 m, 20 m and 25 m respectively

The following is the summary of the selection of the fender system for critical cases of ship berthing:

Table 4.3.6 Selection of Fender Size

Size of Ship	Berthing Velocity (m/sec)	Fender Interval (m)	Berthing Energy of Ship (kN-m)	Fender Height (mm)	Energy Absorption (kN-m)	Fender Reaction (kN)
A. Japanese Standard						
8,000 TEU	0.10	25	719	1,150	767	1,200
		20	696			
		15	674			
B. BS Standard						
8,000 TEU	0.10	---	602 (Vasco Costa) 903 (with Safety Factor)	1,150	767	1,200

Source: JICA Study Team

The rubber type docking fenders with high energy absorption under low reaction force are installed at a space of around 18 m to accommodate objective vessels ranging from conventional vessels to 8,000 TEU's capacity vessels.

(4) Bollard Capacity

South African Transport Service (SATS) Harbour Manual recommends mooring bollards of 1,500 kN Hawser Pull force capacity per unit for vessels up to 200,000 Displacement at 20 m intervals. Therefore, bollards are provided at 18 m c/c spacing designed for 1,500 kN hawser pull.

(5) Selection of Type of Quay Wall Structure

1) Screening of Structural Type

Quay wall structures may be classified as either solid (gravity walls and sheet piled walls) or open-piled suspended deck. Typical type of marine quay wall structure has its own characteristics for suitability to the specific subsoil conditions or adaptability to the requirements of the proposed facility such as water depth, projected loading conditions, etc. A variety of different types of structures is first examined among the types of structures commonly used for the projected type of quay wall structure (deep water marginal wharf) on the following viewpoints:

- Structural Adaptability
- Suitability to Subsoil Condition at the Site
- Durability in Marine Environment
- Construction Method
- Overall Cost

2) Basic Considerations

The following considerations are important and should be reflected in the process of the preliminary design of the Quay Wall.

Water Depth of −15.5 m:
Proposed quay wall is dimensioned to have −15.5 m water depth (for future), so deep enough to accommodate Post Panamax type container vessels;

STS Crane Operation:
Container unloading/loading operation will be carried out by the use of heavy Ship-to-Shore Gantry Crane (approx. 900 tf to1,100 tf/unit) capable of handling 17 rows of containers on the ship deck. In addition, Namport also intends to use the existing Harbour Mobile Crane (Liebherr made type LHM 500 for handling 17 rows of containers on the ship deck of outrigger load 321 tf/leg) at the Quay wall apron.

Namport Preference:
Namport wishes to construct a quay wall structure of high durability and longer service time. Such major steel construction materials as steel pipe piles, steel sheet (pipe) piles need to be protected against corrosion. The steel corrosion protection work is not maintenance free and, without proper maintenance, the structure may deteriorate fairly quickly in a severe marine environment.

Subsoil Condition:
The upper sand layer exists below a very loose or loose subsurface layer with ooze (0.5 to 1.0 m thick) seabed sediment in places. This upper sand deposit is very dense (not less than 50 N-value in SPT) but, along the quay cope line, is changeable in thickness and disappears at a depth of around −14 m to −21 m CD. Below this layer, sandy silt layer exists in a loose to medium dense deposit (about 10 to 15 N-value) but, at about −45 m CD depth, becomes dense to very dense showing SPT N-value of more than 30. This silt deposit observed to be non-cohesive contains around 10 to 30 % of sandy soils;

Site Marine Condition:
Sea condition at the proposed site for construction is calm owing to the naturally developed sand bars (Pelican Peninsula). Therefore there is no difficulty in effective execution of offshore works such as pile driving (normally only workable at less than 0.3 to 0.4 m wave height conditions) or setting out concrete blocks or caisson boxes (workable only at less than 0.7 m wave height);

3) Selection of Type of Structure

Open Piled Deck structure is recommended for the new quay wall structure. A sloped mound is formed under deck structure to provide −15.5 m water depth. Cast-In-Situ Concrete Piles are used to sustain cast-in-situ concrete deck superstructure and surcharge or live load onto the deck structure.

The following are our commentaries on alternative types of structures other than the recommended open piled structure, which may be applicable to relatively deep water depth of structure, site conditions and/or Project requirements.

Alternative-1: Concrete Caisson Wall Type

Because of its mass structure, the gravity type of quay walls have to be bedded on a good subsoil foundation or on bearing soils replacing or improving unsuitable subsoil.

Concrete caissons are pre-fabricated at a floating dock with a temporary construction yard in the port area. Before placement of the concrete caisson, rubble stone mounds must be formed on its original seabed so as to obtain enough bearing capacity and to avoid settlement by the caissons' own weight. Then, concrete caissons are installed on the rubble mound base and in-situ coping concrete is provided at the top of the quay wall. A seaside crane rail is constructed directly on the coping concrete and the landside rail is supported by foundations such as piled structures.

Since the required water depth of the quay wall is planned to be 15.5 m, a large sized caisson box 19 m high is required. A dry dock or one or two sets of floating docks of about 5,000 ton capacity are needed to be mobilized to pre-fabricate concrete caisson boxes besides a temporary construction yard in the Walvis Bay port area. Mobilization of the floating dock from the country far from Namibia may be very costly.

Before placing pre-fabricated concrete caisson boxes, the original subsurface layer which comprises mostly soft or loose subsurface sediments and very dense upper sand deposit must be dredged to an elevation of around −23 to 25 m. Subsoil conditions along the proposed quay wall below this elevation is evaluated to be medium dense (N=10–15). This sediment seems to be compressible and not sufficient to sustain the vertical weight and load of gravity walls (at a level of about 45 t/m^2 pressure load on the existing subsoil surface). Therefore, this medium dense deposit will necessarily be subject to foundation improvement such as through replacement with better materials or through a cement deep mixing method. The nature of this subsoil does affect the stability and cost of the gravity types.

Well graded base rubble mound will next be placed so as to obtain the necessary bearing capacity for the vertical weight of the gravity wall (45 to 60 t/m^2 pressure load on the caisson bottom face) and to avoid any detrimental settlement to safely receive the loads of the gravity walls.

Once the base rubble mound is installed, prefabricated caisson boxes are towed to the site and neatly placed at the site. Caisson boxes at the site are filled with sand inside caisson boxes to provide the full weight of caisson mass and are backfilled by graded stones to moderate the earth pressures acting onto caisson gravity walls. In-situ coping concrete is provided at the top of caisson boxes to form a quay face elevated at CD+4.77 m.

The STS crane rail is founded upon different foundations for the seaside and landside rails. The seaside STS crane rail is constructed directly on the coping concrete but the landside crane rail is supported by pile foundation.

Alternative-2: Prefabricated and Pre-cast Concrete Block Walls Type
Concrete blocks are pre-fabricated at a temporary construction yard in the port area. Before placement of the concrete blocks, the original subsoil must be dredged to a depth of more or less CD−25 m on which a well-graded base rubble mound is placed so as to obtain bearing capacity and to avoid settlement by its own weight of blocks. Subsoil below CD −25 m is subject to foundation improvement such as through subsoil replacement or the cement deep mixing method to a certain depth so as to sufficiently sustain the vertical weight and load of gravity walls (in a level of 45 t/m^2 pressure load on the existing subsoil surface).

A layer of prefabricated pre-cast concrete blocks is installed on the rubble mound base which must sustain the vertical weight of the gravity wall (about 50 to 65 t/m^2 pressure load on the caisson bottom face) and in-situ coping concrete is provided at the top of the concrete blocks. STS Crane rail is founded upon different foundations for seaside and landside rails, as in the case of the concrete caisson boxes.

(6) Outline of Open Type Quay Wall Structure

Designed typical section of open type quay wall is shown in the figure below. The quay structure has an overall width of 36 m to fully support STS gantry crane and consists of:

- RC longitudinal front beam installed to support seaside crane rail. This beam accommodates service outlets for utility supply pipelines and box-outs for electrical and communication cables. An RC side apron along the cope line is extended down to around +1.5 m CD with a provision of rubber fenders on the seaside face and bollards on top of the cope line.
- An RC longitudinal rear beam to support landside crane rail. An RC curtain wall at the rear edge side of the deck extends down to around +1.5 m CD to retain the backfill behind the deck structure.
- The RC deck superstructure is divided into parts each of width approximately 34 m. A thick RC deck slab of about 0.80 cm is cast and supported in the longitudinal direction by 1.5 x 2.4 m RC transverse beams every 6.0 m. At the top surface of RC deck, 10cm paving concrete is provided. The transverse beams are connected to the longitudinal front beam, the front side apron, and the longitudinal rear beam and rear curtain wall.
- The transverse beam is supported every 7.5 m by bored cast-in-situ concrete piles of diameter 1.4 m and having a toe level at −47.0 m CD. At the expansion joints the pile spacing is reduced to 4.0 m.

Under the deck, a slope of 1 (V) to 1.5 (H) with the provision of a slope protection stone layer is provided to the depth of −16.0 m CD at the cope line of the quay wall. A rubble mound retaining wall is installed on top of the sloped surface with a RC deck curtain wall extension from the deck for retaining the back fill soils. The structural outline of the Quay Wall is as follows.

Levels refer to: Chart Datum (LAT) = CD 0.00 m
Top Level of Structure: CD +4.77 m
Width of Structure: 36 m
Designed Dredging Level: CD −15.5 m
Concrete Cube Strength at 28 days: 40 MPa
Spacing of Expansion Joints: 34 m
Spacing of Pile Rows: 6.0 m but 4.0 m at expansion joint
Type of Piles: Bored Cast-In-Situ Concrete Piles 1.4 m dia. Vertical
Pile Tip Elevation: CD −47.0 m embedded into dense or very dense subsoil layer

Working Vertical Load on a Pile:

Loaded by Harbour Mobile Crane: Pv= 4,600 kilonewton (kN)/pile
Loaded by STS Seaside Crane Wheels: Pv= 4,070 kN/pile
Loaded by STS Landside Crane Wheels: Pv= 3,900 kN/pile

Bending Moment on a Top of Pile: 390 to1,020 kN-m under ship's docking condition
Ultimate Load of a Pile: 13,860kN/pile

Ru=Qd x Ap + Fi x As

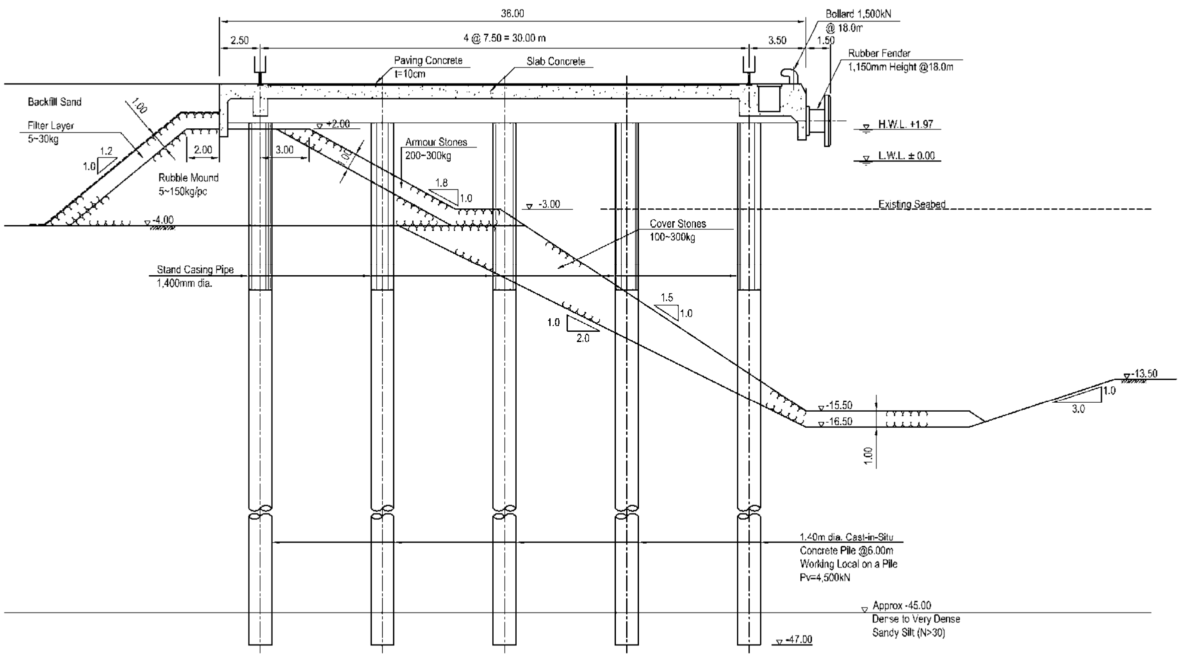
where

Ru: ultimate bearing capacity of a pile (kN)
Qd: bearing capacity of ground at the pile toe (kN/m^2)
Ap: tip area of a pile (m^2)
Fi: friction between the pile face and pile embedded ground (kN/m^2)
As: total peripheral area of a pile (m^2)

For 1.4 m dia. cast-in-situ pile,
Qd=3,000 kN/m^2 for cast-in situ pile onto cohesion-less ground
Fi= 5N kN/m^2 for cast-in-situ pile into cohesion-less ground

Lateral Resistance of Pile:

Coefficient of Lateral soil resistance of pile Kh= 1.5N (N/cm^3)
where N: Blow counts in SPT



Source: JICA Study Team

Figure 4.3.5 Typical Section Quay Wall

4.3.3 Pavement of Yards

Containers are stacked at maximum of 5 layers high at the container stacking yard according to the following:

Laden Container: 2–5 layers
Empty Container: 5 layers

The following basic container loads are used for the design, considering ISO standards for container boxes.

Table 4.3.7 Container Loads

Nominal Length (ft)	Designation	Length (L)	Width (W)	Height (H)	Maximum Weight
		ft (mm)	ft (mm)	ft (mm)	Lbs (kg)
40	1AAA	40’0” (12,192)	8’0” (2,438)	9’6” (2,896)	67,200 (30,480)
	1AA			8’6” (2,591)	
	1A			8’0” (2,438)	
20	1CC	19’10-1/2” (6,058)	8’0” (2,438)	8’6” (2,591)	52,900 (24,000)
	1C			8’0” (2,438)	

Source: ISO

The following table provides equivalent uniform distributed load for container stacking according to BS6349-1:

Table 4.3.8 Equivalent Uniform Distributed Load for Container Stacking

Type of container stacking	Equivalent Uniformly Distributed Load (kN/m^2)
Empty stacked 4-high	15
Full load by 1 load	20
Full load stacked 2-high	35
Full load stacked 4-high	55

Source: BS6349-1

Live Load on Yard is estimated as 5.5 tf/ms for full loaded stack with 4.5 layers of average 5.5 tf/m^2.

Design vehicles/equipment and their wheel load are shown in the table below. The different zones of Container Terminal will be used by different types of vehicles and equipment.

Table 4.3.9 Design Vehicles and Equipment for Container Terminal

Zone	Name of Area	Design Vehicle/ Equipment	Frequency
1	Berth Apron	Container, Hutch Cover	
		Harbour Mobile Crane	
		Top Lifter, Reach Stacker, Forklift	Occasional
		Tractor Trailer	
2	Stacking Yard	Container (2 to 5 high)	
		Top Lifter	Occasional
		Reach Stacker	Occasional
3	Yard Circulation Road	Harbour Mobile Crane	Occasional
		RTG	
		Tractor Trailer	
		Top Lifter, Reach Stacker, Forklift	Occasional
4	Van Pool Maintenance Area	Tractor Trailer	Occasional
		Forklift	Occasional
		Top Lifter, Reach Stacker, RTG (not loaded)	Occasional
		Empty Container (5 high)	
		Regular Vehicle	
5	Office Area	Regular Vehicle	
6	Terminal Gate Container Terminal Access Road Container related Building Area	Tractor Trailer	
		Top Lifter, Reach Stacker, Forklift	Occasional
		Regular Vehicle	

Source: JICA Study Team

Heavy duty pavement made up of Interlocking Concrete Blocks (ICB) will be constructed. The paving surface is covered by 80 mm thick heavy duty Interlocking Concrete Blocks above 20 mm of bedding sand layer. The ICB pavement structure currently used by Namport is applied.

The RTG crane foundation is used together with the interlocking concrete block yard pavement in the same area in order to support higher loads of crane wheels. The RTG crane foundation will be of cast-in-place type, pre-stressed with a post-tensioning system or RC slab structure. No specific container stacking foundation is provided at the edge corner of the containers for stacking containers in layers at the yard.

4.3.4 Access Road

The asphalt surfacing pavement is applied on the same base, sub-base and sub-grade course as for the ICB pavement currently used by Namport.

4.4 Construction Planning

4.4.1 Reclamation and Dredging Method

(1) Scope of Works

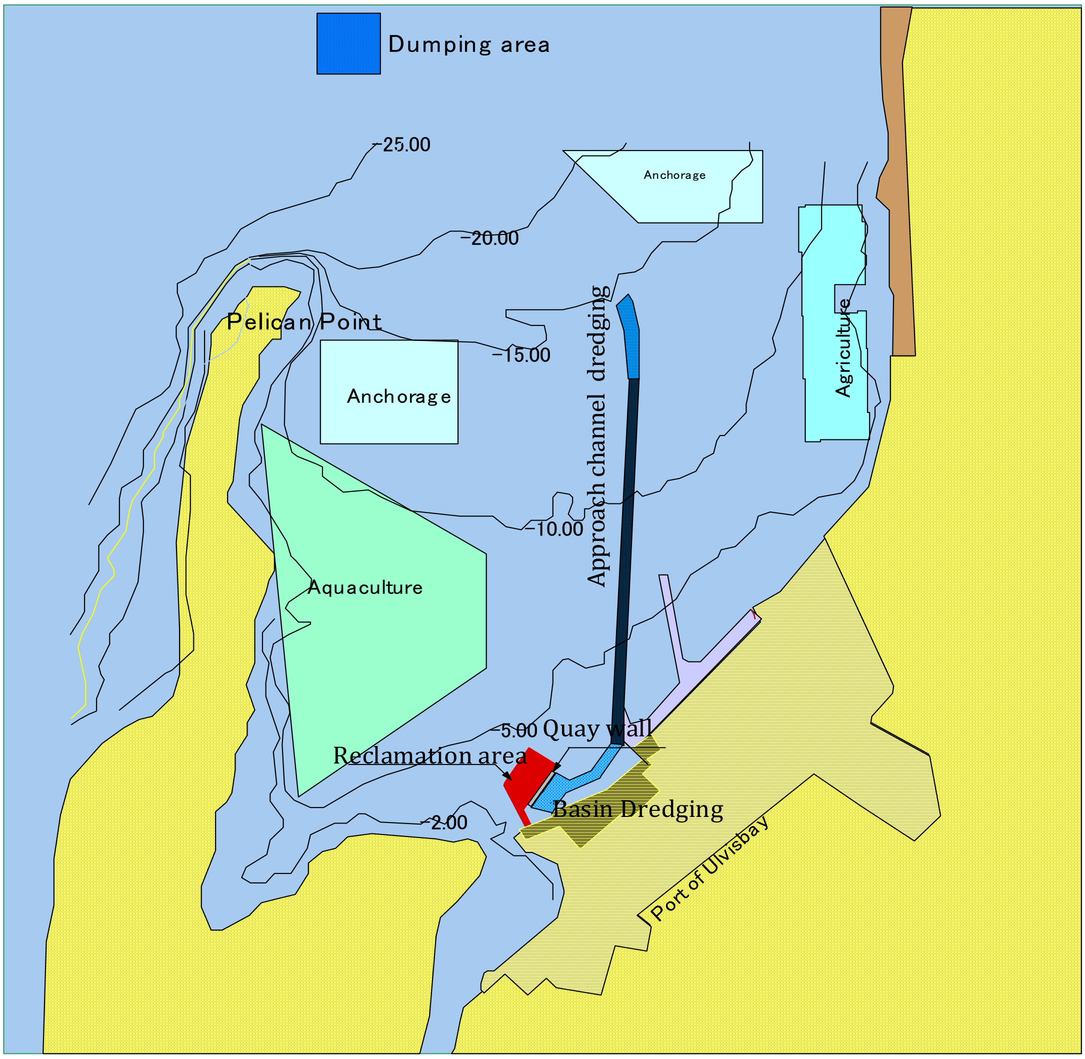
Scope of works of the dredging and reclamation are classified as follows.

1) Dredging

- Deepening of approach channel
- Basin dredging between new container terminal and existing berth.
- Dredging at quay wall of new container terminal

2) Reclamation

- Reclamation of the new container yard



Source: JICA Study Team

Figure 4.4.1 Target Area of Dredging and Reclamation

(2) Approach Channel Deepening

The existing approach channel is to be deepened to a depth of CE −14.1 m from CD −13.1 on average, with a length of about 7km and a width of 134 m. The estimated dredging volume is 1.06 million m^3. In consideration of the sandy soils to be dredged, the 13 km distance to the designated disposal area, and the navigation of vessels calling at the port, the approach channel dredging has to be carried out by a Trailing Suction Hopper Dredger (TSHD).

The basic dredging sequences used by TSHD are planned as follows.

i) Dredging
Moving at 2–4 knots, TSHD excavates the seabed and pumps the dredged materials into its hopper while water containing finer particles of the soils overflows back into the sea. The excavation continues until the hopper becomes filled with sand. This takes about one hour.

ii) Moving to Disposal Area
TSHD full of excavated sand in the hopper moves to the designated disposal area located about 13km north from the channel deepening site at 10 knots, which takes about 1 hour.

iii) Dumping
At the disposal area, dredged sand is dumped to the seabed by opening the bottom of the hopper of TSHD. An area of 1km square is designated as the disposal site.

iv) Return to the Dredging Site
TSHD returns to the dredging site in order to restart excavation of the channel seabed.

The production rate of the dredging is estimated at 12,000 m^3 per day based on the following assumptions.

- Work time of TSHD: **24 hours/ day**
- One cycle from the start of excavation–moving–dumping–returning–restart: **3 hours** (1 hour for the excavation and 2 hours for the round trip between the dredging area and the disposal area)
- The capacity of the hopper: **3,000 m^3**
- The efficiency coefficient: **0.5**

$$\textbf{8cycle/ day} \times \textbf{3,000 m}^3 \times \textbf{0.5 = 12,000 m}^3\textbf{/ day}$$

Though most of the sands excavated at the approach channel will be disposed of at the disposal area, 0.34 million m^3 will be used for reclamation. The time spent for the reclamation is assumed to be the same as that for the round trip to the disposal area because the distance between the dredging area and reclamation area is far less even though discharging takes a longer time.

(3) Reclamation of Container Yard and Basin Dredging

The sequences of reclamation of the container yard and of basin dredging are scheduled as follows.

i) Installation of silt-protectors
In order to protect seawater from contamination, silt-protectors will be installed near the hydraulic discharging point of dredged materials by crane and deck barges.

ii) Construction of revetment (Rubble mound)
Construction of revetment is carried out in parallel with reclamation works and construction of the quay wall. Basically, the rubble mound perimeter is extended using bulldozers and dump trucks from the landward side. Rubble is carried by dump trucks from the quarry located 15 km away from the construction site and is placed at the revetment area directly by the dump trucks. Slopes of the rubble mound are formed by backhoes.

The maximum daily delivery of the rubble to the revetment site per day is estimated to be 2,100 m^3 based on the following assumptions.

- The maximum supply capacity at the quarry: **200 ton/ hour**
- Working hours: **24 hours/ day**
- Bulk specific gravity of the rubble: **1.6 ton/ m^3**

- The maximum delivery to the revetment area is equivalent to **70%** of the maximum supply capacity at the quarry.

$$\mathbf{4{,}800\ ton/\ day\ /\ (1.6\ ton/\ m^3)\ \times\ 70\%\ =\ 2{,}100\ m^3/\ day}$$

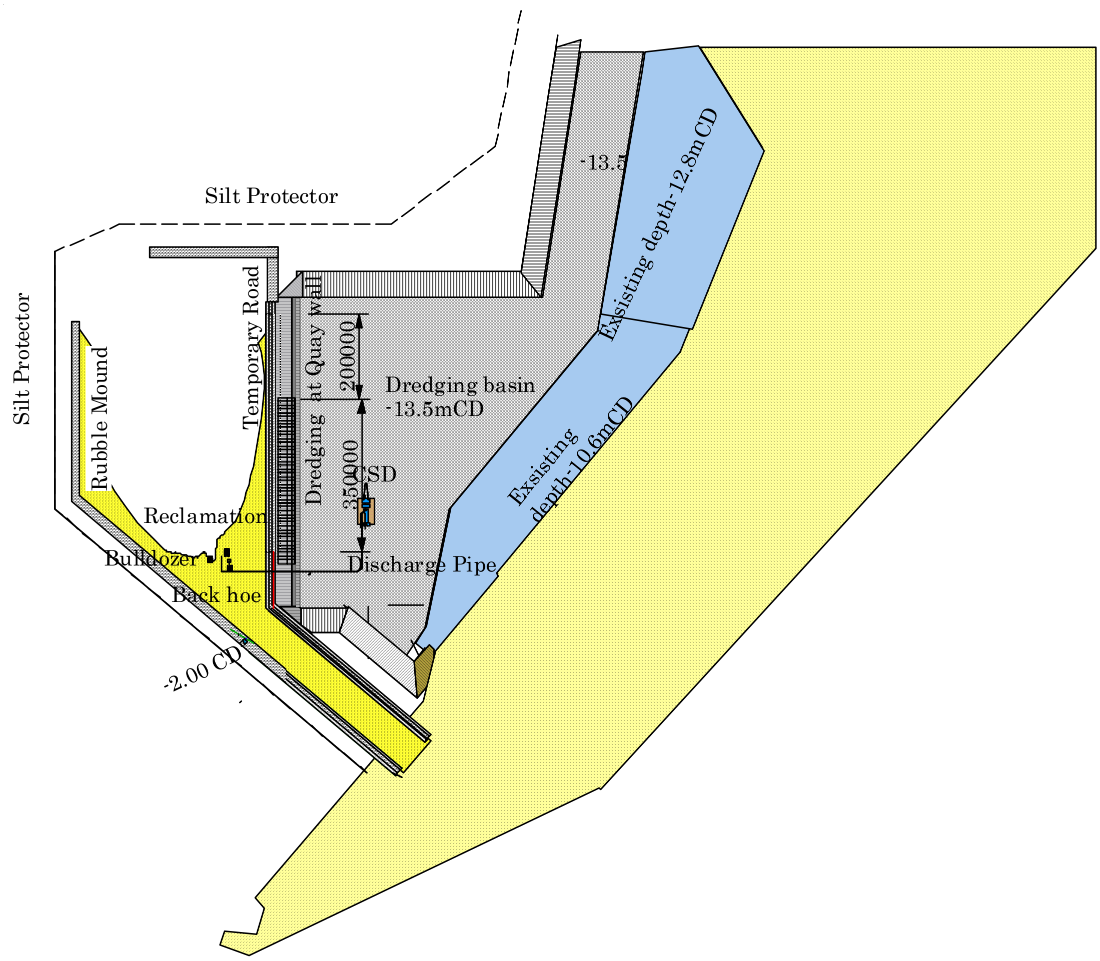
On the other hand, the placement of rubble and armour stones at the slope of the revetment is carried out by crane and deck barges from the seaside. Backhoes are used for armour stones at the causeway, which can be formed from the landward side.

iii) Basin Dredging and Reclamation

Among the total volume of basin dredging of 2.96 million m^3, 0.88 million m^3 will be carried out by the TSHD while 2.08 million m^3 will be dredged by a Cutter Suction Dredger (CSD). The whole sands dredged at the basin are discharged to the reclamation area by a pipeline (maximum 1.5 km) and used for reclamation, for which sands of total 3.53 million m^3 is needed. To obtain this volume, 0.34 million m^3 of sands dredged at the approach channel and 0.23 million m^3 of quay wall are also used. The reclamation is started from the causeway area and move to the east by controlling hydraulic filling with the assistance of bulldozers. Then, a spillway is installed at the closing point of the perimeter dike in order to protect seawater from contamination.

In estimating the reclamation volume, one (1) meter extra height is added to the surface elevation to compensate the settlement which will be due to the deep diatomaceous silt layer and will take place during the construction.

The production rate of the dredging by CSD is estimated at about 8,000 m^3 per day in consideration of a 1.5 km discharging distance of sands by pipeline.



Source: JICA Study Team

Figure 4.4.2 Dredging and Reclamation

4.4.2 Construction Sequence of Quay Wall

The construction of a quay wall of length 550 m is targeted in planning the construction schedule even though it is recommendable that the quay wall be continuously extended to 550 m in total. The proposed procedure of the construction of the quay wall and the incidental works in the container yard is described below.

(1) Construction of Temporary Road

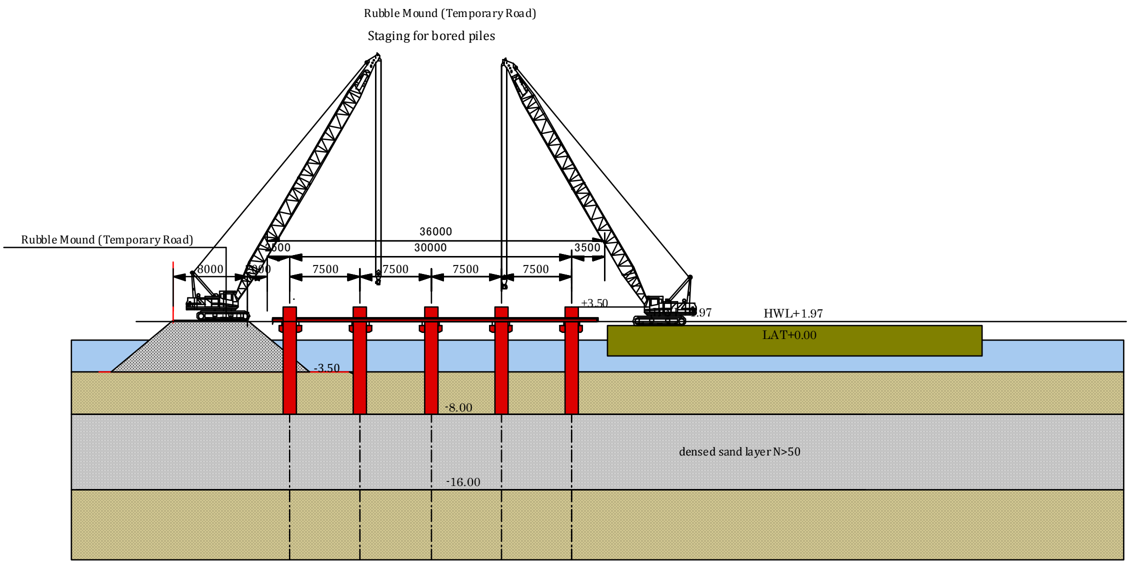
In order to carry out the construction of the quay wall smoothly, an access road will be temporarily made on the rubble mound of the causeway and quay wall. The purposes of the temporary road are as follows.

- To deliver materials and equipment for the construction
- To expand working area
- To use equipment from the landward side
- To work free from marine conditions

The time necessary to construct the temporary road is calculated as about 100 days based on the following assumptions.

- The total volume of rubble used for the temporary road: **75,000 m^3**
- Production rate of rubble dumping per day: **960 m^3**
- The operation rate: **0.8**

$$\mathbf{75{,}000\ m^3 / (960\ m^3/\ day \times 0.8) = 97\ days}$$



Source: JICA Study Team

Figure 4.4.3 Temporary Road, Scaffold and Stand Pipe

(2) Placement of Bored Piles

480 bored piles for the quay wall are placed in the sea by the Reversed Circulation Drilling (RCD) Method. Each of the bored piles is 1,400 mm in diameter and 50 m in length. As it is found that a very dense layer (N>50) of 5 to 10 m lies about 3 m below the seabed (See Figure 4.4.3), the detailed method to excavate this layer should be studied in due course. RCD Method is assumed to be technically applicable without any auxiliary equipment being considered at this stage.

The time necessary for placement of the bored piles is estimated to be about 405 days based on the following assumptions.

- One cycle for the placement of a bored pile is 4 days including 2 days for drilling, 1 day for reinforcement placing, and 1 day for slime treatment and for casting concrete.
- For each cycle, an excavator is necessary for **2 days** for only the drilling procedure.
- **3 sets** of excavators are used.
- The operation rate: **0.8**

$$\mathbf{(2\ days/pile \times 480\ piles/\ 3\ excavators + 3\ days)/\ 0.8 = 404\ days}$$

The procedures for placement of bored piles are described as follows.

i) Driving stand pipe

At the local dockyard, steel plates (12 mm thick) are processed into 480 stand pipes (1,400 mm in diameter × 12 m length). Stand pipes are carried to the site by deck barges and are driven into the seabed by a vibro-hammer installed on the crane barge. All stand pipes have to work as formwork after concrete placement and they cannot be recovered.

The time necessary for driving the stand pipes is estimated to be about 75 days based on the following assumptions.

- Capacity of driving per day: 8 pipes
- The operation rate: 0.8

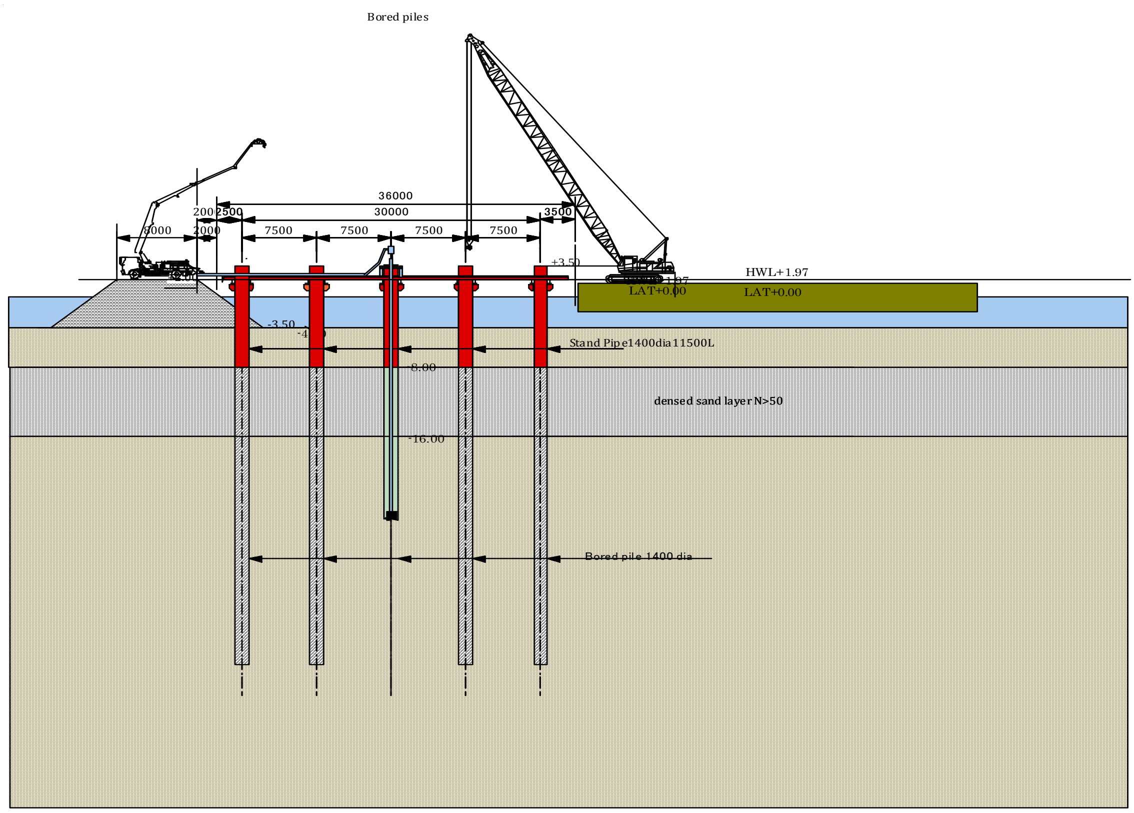
480 pipes/ (8 pipes/ day)/ 0.8 = 75 days (about 75 days)

ii) Scaffold

After driving stand pipes, the scaffold for placement of bored piles including concrete works is set up. To support the weight of scaffolding, formworks, rebards, fresh concrete and other temporary loads, H-shaped steel beams are set on the brackets welded to the stand pipes. H-shaped steel beams also improve safety of the construction by connecting stand pipes to each other.

iii) Excavation

The drilling is carried out by use of 3 RCD excavators. The slurry plants are placed on the temporary road. The bentonite slurry is used for drilling in order to prevent collapse of the bored hole since homogeneous sand layers are expected. Because of the bentonite slurry, disposal of circulated muddy water and removal of residual soil from slurry plants should be dealt with carefully in order to protect seawater from contamination.



Source: JICA Study Team

Figure 4.4.4 Bored Pile

iv) Installation of reinforcement cage

4 reinforcement cages are placed into the hole by welding and connecting them each other at the site.

v) Slime Treatment

Slime deposited at the bottom of the bored hole is removed by a sand pump before placing concrete.

vi) Placing concrete

Concrete is placed into the bored hole from the bottom by use of a tremy pipe. A concrete pump is used.

vii) Pile head treatment

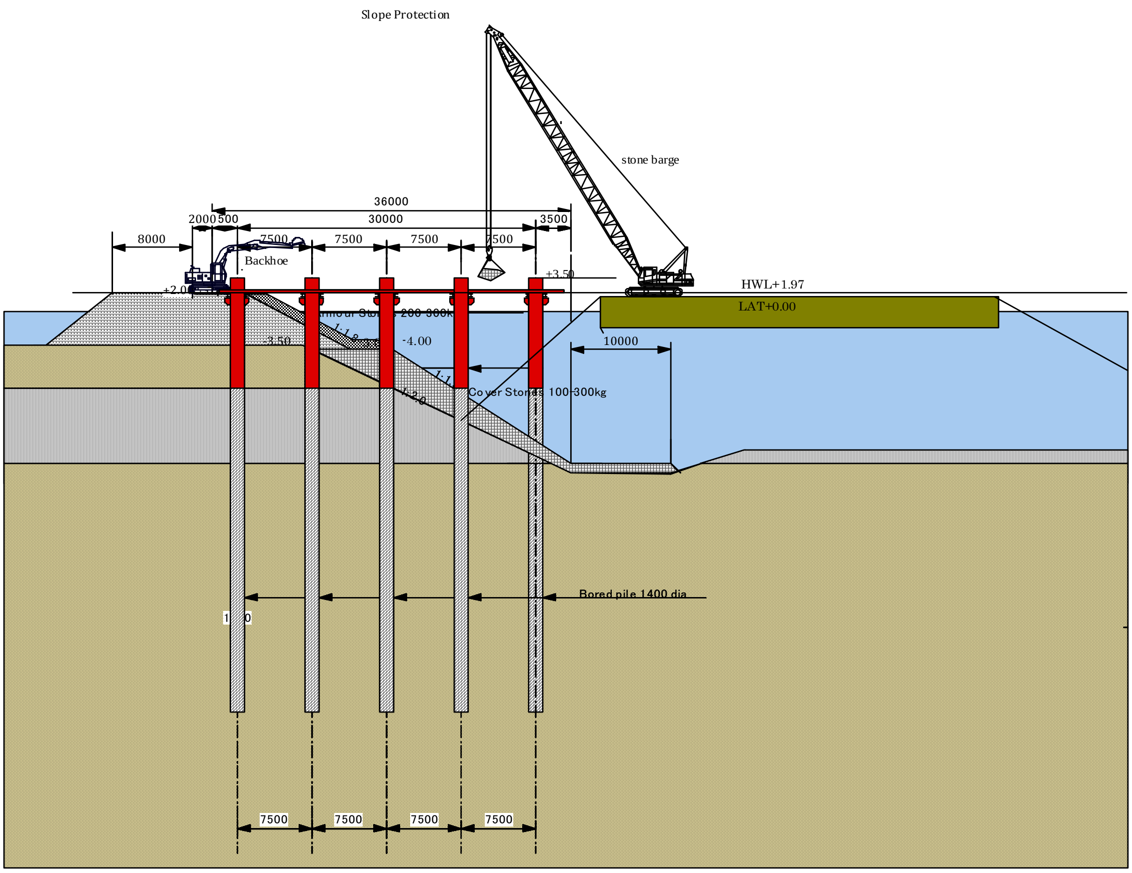
Upper part of each bored pile of 50 cm is removed in order to ensure the quality of the concrete.

(3) Dredging

Basically, dredging at the quay wall is carried out by 2 Grab Bucket Dredgers (GD) in advance.

(4) Revetment

Armour stones for the revetment are placed by a crane barge and a deck barge. Rubble mounds and slope protections above water of depth 4.0 m are put in position from the landward side by backhoes and crawler cranes.



Source: JICA Study Team

Figure 4.4.5 Slope Protection

(5) Formation of Concrete Deck

The total volume of concrete used for the concrete deck is estimated to be about 34,000 m^3, 17,000 m^3 of which is for its beam and 17,000 m^3 for its floor slab (550 m×36 m×0.85 m). Though the quay wall of 550 m is structurally composed of 16 blocks, each block requires about 1,000 m^3 of concrete, which exceeds the capacity of the concrete plants. Therefore, each of 16 blocks is planned to be divided into 2 blocks.

The procedure to construct the concrete deck is described as follows.

i) Scaffold support
The scaffold for the formwork of the concrete deck is placed by use of truck cranes utilizing H-beams used for the placement of the bored piles as scaffold supports.

ii) Formworks
Formworks are assembled by use of truck cranes.

iii) Reinforcements
Reinforcements are also placed by use of truck cranes. The time necessary for this work is estimated to be about 480 days based on the following assumptions:

- The team for reinforcement, made up of 20 members, takes **6 days** for placing each block of reinforcement with a processing capacity of 10 ton/day.
- The number of reinforcement blocks: **44 blocks**
- The operation rate: **0.8**

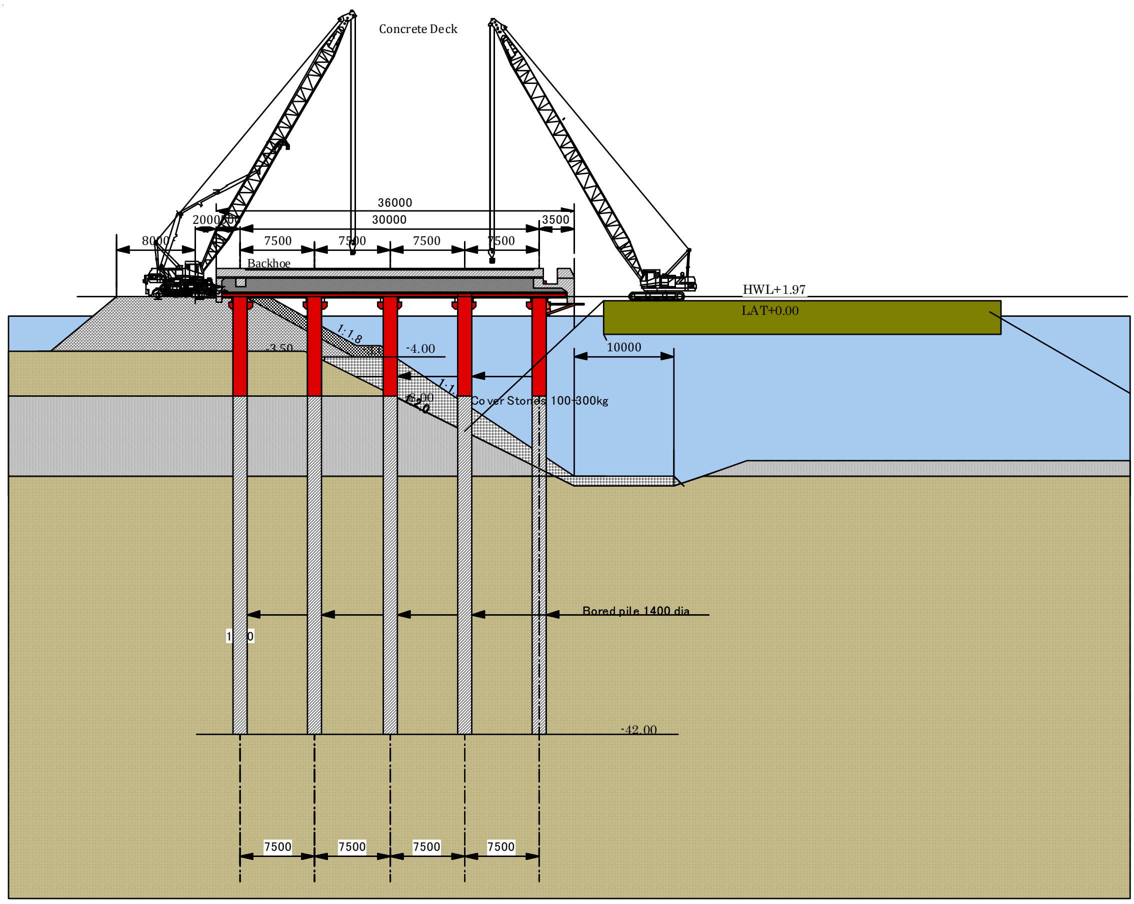
64 blocks × 6 days / 0.8 = 480 days

iv) Casting Concrete
Concrete is casted by a concrete pump vehicle deployed on the rubble mound. The maximum supply volume of concrete is assumed to be 500 m^3 per time.

v) Rubber Fenders
After anchor bolts for the rubber fenders are embedded on the concrete of the concrete deck, 20 rubber fenders are placed by a truck crane and a small working boat.

vi) Bollards
As well as the step for rubber fenders, anchor bolts for the bollard are embedded on the concrete of the concrete deck. Then, 20 bollards are placed by a truck crane.

vii) Rails for gantry crane
After anchor bolts are set on the concrete slab, rails for gantry crane are placed on the deck slab.



Source: JICA Study Team

Figure 4.4.6 Concrete Deck, Rubber Fender, Bollard and Crane Rail

(6) Placement of Gantry Crane

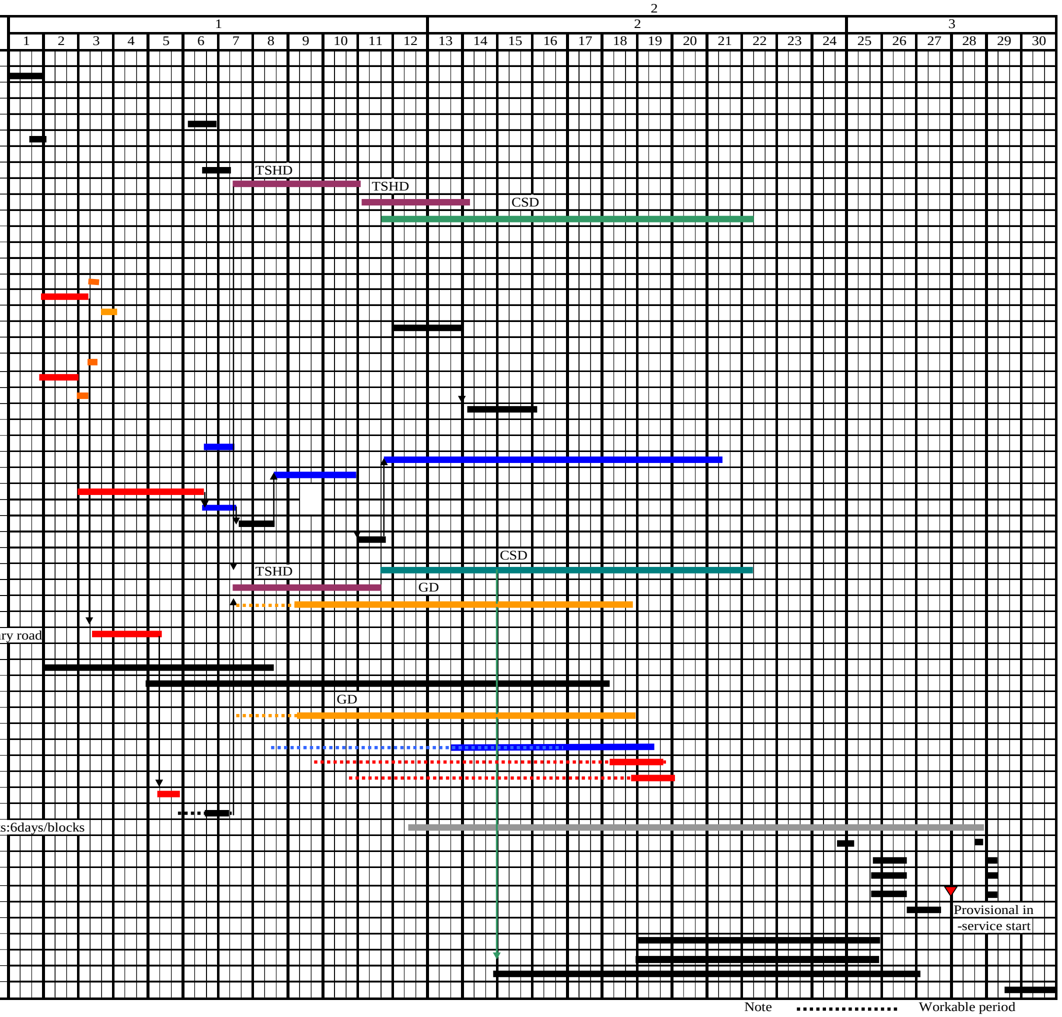
Gantry cranes are transported by a self propelled deck barge from the country of production to the Port of Walvis Bay. After arriving at the port, the barge stops beside the quay wall and gantry cranes are shifted to the quay and moved onto the crane rails by carriage.

4.4.3 Construction Schedule

The construction schedule is shown on Table 4.4.1.

Table 4.4.1 Construction Schedule

No	location	work items	quantities	unit	capacity /day	no	working day	calenda day	remark
1	Preparatory works								
		Temporary house							
2	Siltprotector								
	2.1	Deposit Area	4,000	m	200	1	20	25	
	2.2	Reclamation area	2,000	m	200	1	10	13	
3	Dredging								
	3.1	Cruising							
	3.2	Approach channel	1,060,000	m3	12,000	1	88	110	TSHD
	3.3	Basin	880,000	m3	12,000	1	73	92	TSHD
	3.4	Basin	2,080,000	m3	8,000	1	260	325	CSD
4	Revetment								
	4.1	Cause way(east side)							
		Cover stone(5-20kg)	2400	m3	360	1	7	8	
		Rubble mmound(10-50kg)	30800	m3	960	1	32	40	
		Slope protection(100-200Kg)	2400	m3	360	1	7	8	
		Stone revetment	2350	m2	25	2	47	59	
	4.2	Cause way(west side)							
		Cover stone(5-20kg)	2300	m3	360	1	6	8	
		Rubble mmound(10-50kg)	20300	m3	960	1	21	26	
		Slope protection(100-200Kg)	2300	m3	360	1	6	8	
		Stone revetment	2350	m2	25	2	47	59	
	4.3	Revetment(outer sea side)							
		Rubble mmound(10-50kg)	19000	m3	960	1	20	25	
		Aromour stone(1.5-3.5t)	41000	m3	180	1	228	285	
		Slope protection(200-500Kg)	19000	m3	360	1	53	66	
		Rubble mmound(10-50kg)	83000	m3	960	1	86	108	
		Cover stone(5-20kg)	9000	m3	480	1	19	23	
	4.4	Concrete block	750	no	10	3	25	31	
	4.5	L-shaped concrete blocks	750	no	10	3	25	31	
5		Reclamation	2,080,000	m3	8,000	1	260	325	CSD
		Reclamation	1,220,000	m3	12,000	1	102	127	TSHD
		Reclamation	230,000	m3	1,000	1	230	287.5	GD
6	Quaywall								
	6.1	Rubble mound(15-150kg)	44,000	m3	960	1	46	57	temporary road
	6.2	Bored pile							
		Stand Pipe(fabrcation)	480	No.	3	1	160	200	
		Bored pile	480	No.	0.5	3	320	400	
	6.3	Temporary staging							
	6.4	Dredging	230,000	m3	1,000	1	230	288	GD
	6.5	Slope Protection							
		Covered stone(100-300kg)	39,200	m3	270	1	145	181	
		Rubble mound(15-150kg)	19,000	m3	480	1	40	49	
		Armour stones(200-300kg)	7,800	m3	270	1	29	36	
		Filter layer(5-30kg)	6,700	m3	480	1	14	17	
	6.6	Sandproof sheet	8,000	m2	500	1	16	20	
	6.7	Concrete Deck	34,000	m3	85	1	400	500	64blocks:6days/blocks
	6.8	Concrete Pavement	15,400	m2	980	1	16	20	
	6.9	Bollard		No.				40	
	6.9	Rubber Fender		No.				40	
		Crane Rail	1,100	m	40	1	28	34	
	6.10	Gatry Crane		No.					
7	Road								
9	Drainage								
9	Building								
10	Cleaning								



Source: JICA Study Team

4.5 Preliminary Cost Estimate

4.5.1 Civil Works and Equipment Cost

(1) Estimate Conditions

1) Objective of Cost Estimate

The purpose of Civil Works and Equipment cost estimates are to establish the basis for economic and financial analysis.

2) Targeted Scope of Works

The Civil Works Cost is estimated for the Phase-1 Project (2012–2015) and the terminal yard expansion project to be carried out in 2015. The Equipment Cost is estimated for procurement and maintenance for 30 years commencing in 2014.

The estimated cost of Civil Works and Equipment is based on the following scope of works:

- Dredging and Land Reclamation
- Construction of Causeway, Container Terminal Yard and Quay Wall
- Procurement of Container Handling Equipment
- Construction of building facilities inside Container Terminal Yard
- Procurement of Container Terminal Operation System
- Construction of Access Roads
- Construction of Railway
- Utilities works and Power Supply System
- Mobilization, Demobilization and other Indirect Cost

3) Basis of Cost Estimate

The basis of the cost estimate is described as follows:

- The cost estimate is based on the information collected at Walvis Bay in June and July, 2009. Quotations submitted by contractors to Namport are also used.
- The unit costs are in general based on locally available materials, labour and construction equipment.
- The unit costs are essentially based on data and information from Namport for projects similar in nature, such as cost of interlocking block pavement, road construction and railway construction.
- The unit costs for container handling equipment are based on quotations obtained from suppliers. 4% of equipment cost is estimated for the maintenance cost of each piece of equipment including procurement of spare parts.
- The unit costs per m^2 for each building facility is based on the size, structure, number of floors and function as indicated on the container terminal layout plan.
- The price for power supply facilities is taken from the report submitted by a specialist firm to Namport in planning the power supply to the port after its expansion including the new container terminal.
- Unit costs of the Quay Wall work are established based on quotations obtained from several contractors.
- The unit costs of dredging and reclamation are based on data and information from Namport and a quotation from one contractor.
- All costs are estimated in Namibian Dollars (N$) and divided into foreign and local currency portions based on the experience in projects of similar nature.

(2) Civil Works and Equipment Costs

Civil works and equipment costs are estimated based on the scope, specifications and basis of cost estimate as described in sub-section (1). Tables 4.5.1 and 4.5.2 below summarize the breakdown of construction costs for the Phase-1 Project and the Yard Expansion project in 2015. Table 4.5.3 summarises the breakdown of equipment procurement and maintenance costs for 30 years.

In estimating the reclamation volume, one (1) meter extra height is added to the surface elevation to compensate the settlement which will be due to the deep diatomaceous silt layer and will take place during the construction.

Table 4.5.1 Breakdown of Civil Works Cost (Phase-1)

Description of Works	Quantity	Unit	Unit Price					Amount		
			Local Portion		Foreign Portion		Total	Local Portion	Foreign Portion	Total
			(N$)	%	(N$)	%	(N$)	(N$)	(N$)	(N$)
CIVIL WORKS COST										
1.General: (including mobilization, demobilization, temporary works, benchmarks, preparation works, testing laboratory and submittals)	5	%	9,336,590	70%	4,001,396	30%	13,337,985	46,682,948	20,006,978	66,689,925
Subtotal 1:								46,682,948	20,006,978	66,689,925
2. Dredging, Reclamation & Revetment										
(1) Mobilization & Demobilization of dredging and reclamation equipment including installation and dismantling of equipment	1	LS	13,390,000	10%	120,510,000	90%	133,900,000	13,390,000	120,510,000	133,900,000
(2) Dredging and reclamation by CSD	2,081,000	m3	7	10%	66	90%	73	15,191,300	136,721,700	151,913,000
(3) Dredging and reclamation by	1,218,000	m3	8	10%	68	90%	76	9,256,800	83,311,200	92,568,000
(4) Dredging and disposal by TSHD	720,000	m3	5	10%	46	90%	51	3,672,000	33,048,000	36,720,000
(5) Revetment	349,000	m3	600	100%	0	0%	600	209,400,000	0	209,400,000
Subtotal 2:								250,910,100	373,590,900	624,501,000
3. Quay Wall (550m long)										
(1) Piling (cast-insitu bored pile, 1400mm dia, 50m long)	480	No.	89,100	20%	356,400	80%	445,500	42,768,000	171,072,000	213,840,000
(2) Deck concrete including re-bars, foremworks and scaffoldings and all associated works.	34,000	m3	3,518	70%	1,508	30%	5,025	119,595,000	51,255,000	170,850,000
(3) Paving concrete including re-bars and formworks and all associated works	1,650	m3	2,100	70%	900	30%	3,000	3,465,000	1,485,000	4,950,000
(4) Dredging under Quay Wall	231,000	m3	30	20%	122	80%	152	7,022,400	28,089,600	35,112,000
(5) Quay Wall Fittings (Crane rail, fenders, bollards, etc)	1	LS	4,313,600	20%	17,254,400	80%	21,568,000	4,313,600	17,254,400	21,568,000
Subtotal 3:								177,164,000	269,156,000	446,320,000
4. Terminal Yard										
(1) Interlocking paving including drainage and preparation	140,500	m2	565	100%	0	0%	565	79,382,500	0	79,382,500
(2) Concrete slabs for RTG lanes	5,300	m3	4,000	100%	0	0%	4,000	21,200,000	0	21,200,000
(3) Yard lighting	8	No.	100,000	20%	400,000	80%	500,000	800,000	3,200,000	4,000,000
(4) Fencing with gates	1,250	m	1,400	100%	0	0%	1,400	1,750,000	0	1,750,000
(5) Utility facilities, excluding power supply facilities	1	LS	3,626,400	80%	906,600	20%	4,533,000	3,626,400	906,600	4,533,000
Subtotal 4:								106,758,900	4,106,600	110,865,500
5. Access Causeway										
(1) Road and footpath	43,000	m2	360	90%	40	10%	400	15,480,000	1,720,000	17,200,000
(2) Railway	3,500	m	3,150	90%	350	10%	3,500	11,025,000	1,225,000	12,250,000
(3) Landscaping and Irrigation	7,500	m2	297	90%	33	10%	330	2,227,500	247,500	2,475,000
Subtotal 5:								28,732,500	3,192,500	31,925,000
6. Building Works (9,245㎡)										
(1) Security Office (RC/1F)	15	m2	18,360	90%	2,040	10%	20,400	275,400	30,600	306,000
(2) Terminal Office (RC/5F+PH)	5,100	m2	6,660	90%	740	10%	7,400	33,966,000	3,774,000	37,740,000
(3) Maintenance Shop (S/partly 2F)	2,500	m2	6,390	90%	710	10%	7,100	15,975,000	1,775,000	17,750,000
(4) Checking Gate (1F w/catwalk)	580	m2	9,180	90%	1,020	10%	10,200	5,324,400	591,600	5,916,000
(5) Amenity Building (RC/2F)	1,250	m2	6,030	90%	670	10%	6,700	7,537,500	837,500	8,375,000
(6) Car Shed	20	No.	4,500	90%	500	10%	5,000	90,000	10,000	100,000
Subtotal 6:								63,168,300	7,018,700	70,187,000
7. Power Supply facilities, including substations	1	LS	40,000,000	80%	10,000,000	20%	50,000,000	40,000,000	10,000,000	50,000,000
Subtotal 7:								40,000,000	10,000,000	50,000,000
Total (1～7)								713,416,748	687,071,678	1,400,488,425
Engineering and Head Office Expenses (15% of Total): (including Administration Cost and Engineering Fee)										210,073,264
Grand Total for Civil Works Cost including O/H and Profit										**1,610,561,689**

Source: JICA Study Team

Table 4.5.2 Breakdown of Civil Works Cost for Yard Expansion in 2015

Description of Works	Quantity	Unit	Unit Price					Amount		
			Local Portion		Foreign Portion		Total	Local Portion	Foreign Portion	Total
			(N$)	%	(N$)	%	(N$)	(N$)	(N$)	(N$)
CIVIL WORKS COST										
1.Mobilization, Demobilization, Temporary Works, etc.	5	%	287,375	70%	123,161	30%	410,535	1,436,873	615,803	2,052,675
Subtotal 1:								1,436,873	615,803	2,052,675
2. Terminal Yard										
(1) Interlocking paving including drainage and preparation	32,500	m2	565	100%	0	0%	565	18,362,500	0	18,362,500
(2) Concrete slabs for RTG lanes	2,200	m3	4,000	100%	0	0%	4,000	8,800,000	0	8,800,000
(3) Yard lighting	1	No.	100,000	20%	400,000	80%	500,000	100,000	400,000	500,000
(4) Fencing with gates	250	m	1,400	100%	0	0%	1,400	350,000	0	350,000
(5) Utility facilities, excluding power supply facilities	1	LS	832,800	80%	208,200	20%	1,041,000	832,800	208,200	1,041,000
Subtotal 2:								28,445,300	608,200	29,053,500
3. Power Supply facilities, including substations	1	LS	9,600,000	80%	2400000	20%	12,000,000	9,600,000	2,400,000	12,000,000
Subtotal 3:								9,600,000	2,400,000	12,000,000
Total (1～3)								39,482,173	3,624,003	43,106,175
Engineering and Head Office Expenses (15% of Total)										6,465,926
Grand Total for Civil Works Cost including O/H and Profit										**49,572,101**

Source: JICA Study Team

Table 4.5.3 Breakdown of Equipment Procurement and Maintenance Costs

(for Year 1 – 15) (N$)

Project Year			1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
Calendar Year			2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028
	Usage																
	(year)																
QGC	**18**	**To procure**	**3**			**1**		**1**									
NAD 80,000,000		To replace															
		Required	3	3	3	4	4	5	5	5	5	5	5	5	5	5	5
Procurement Cost			240,000,000	0	0	80,000,000		80,000,000									
Maintenance Cost			9,600,000	9,600,000	9,600,000	12,800,000	12,800,000	16,000,000	16,000,000	16,000,000	16,000,000	16,000,000	16,000,000	16,000,000	16,000,000	16,000,000	16,000,000
RTG	**15**	**To procure**	**8**	**2**		**1**	**1**	**3**	**1**								
NAD 17,500,000		To replace															
		Required	8	10	10	11	12	15	16	16	16	16	16	16	16	16	16
Procurement Cost			140,000,000	35,000,000	0	17,500,000	17,500,000	52,500,000	17,500,000	0		0		0	0		
Maintenance Cost			5,600,000	7,000,000	7,000,000	7,700,000	8,400,000	10,500,000	11,200,000	11,200,000	11,200,000	11,200,000	11,200,000	11,200,000	11,200,000	11,200,000	11,200,000
Tractor Head	**7**	**To procure**	**17**	**6**	**2**	**2**	**3**	**2**	**2**	**17**	**8**	**2**	**2**	**3**	**2**	**2**	**17**
NAD 1,000,000		To replace								17	6	2	2	3	2	2	17
		Required	17	23	25	27	30	32	34	34	36	36	36	36	36	36	36
Procurement Cost			17,000,000	6,000,000	2,000,000	2,000,000	3,000,000	2,000,000	2,000,000	17,000,000	8,000,000	2,000,000	2,000,000	3,000,000	2,000,000	2,000,000	17,000,000
Maintenance Cost			680,000	920,000	1,000,000	1,080,000	1,200,000	1,280,000	1,360,000	1,360,000	1,440,000	1,440,000	1,440,000	1,440,000	1,440,000	1,440,000	1,440,000
Trailer Chassis	**8**	**To procure**	**20**	**7**	**2**	**2**	**4**	**2**	**2**		**22**	**2**	**2**	**4**	**2**	**2**	
NAD 550,000		To replace									20	2	2	4	2	2	
		Required	20	27	29	31	35	37	39	39	41	41	41	41	41	41	41
Procurement Cost			11,000,000	3,850,000	1,100,000	1,100,000	2,200,000	1,100,000	1,100,000	0	12,100,000	1,100,000	1,100,000	2,200,000	1,100,000	1,100,000	0
Maintenance Cost			440,000	594,000	638,000	682,000	770,000	814,000	858,000	858,000	902,000	902,000	902,000	902,000	902,000	902,000	902,000
Reach Stacker	**10**	**To procure**	**3**										**3**				
NAD 6,600,000		To replace											3				
		Required	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3
Procurement Cost			19,800,000										19,800,000				
Maintenance Cost			792,000	792,000	792,000	792,000	792,000	792,000	792,000	792,000	792,000	792,000	792,000	792,000	792,000	792,000	792,000
Folk Lift with Side Spreader	**10**	**To procure**	**2**	**1**			**1**		**1**			**1**	**2**	**1**			**1**
NAD 3,500,000		To replace											2	1			1
		Required	2	3	3	3	4	4	5	5	5	6	6	6	6	6	6
Procurement Cost			7,000,000	3,500,000			3,500,000		3,500,000			3,500,000	7,000,000	3,500,000			3,500,000
Maintenance Cost			280,000	420,000	420,000	420,000	560,000	560,000	700,000	700,000	700,000	840,000	840,000	840,000	840,000	840,000	840,000
Folk Lift Multi-purposed	**15**	**To procure**	**3**			**1**											
NAD 400,000		To replace															
		Required	3	3	3	4	4	4	4	4	4	4	4	4	4	4	4
Procurement Cost			1,200,000			400,000											
Maintenance Cost			48,000	48,000	48,000	64,000	64,000	64,000	64,000	64,000	64,000	64,000	64,000	64,000	64,000	64,000	64,000
Terminal Operation System	**1**	**To procure**	**1**														
NAD 15,000,000		To replace															
		Required	1														
Procurement Cost			15,000,000														
Maintenance Cost			600,000														
Procurement Cost Total			451,000,000	48,350,000	3,100,000	101,000,000	26,200,000	135,600,000	24,100,000	17,000,000	20,100,000	6,600,000	29,900,000	8,700,000	3,100,000	3,100,000	20,500,000
Maintenance Cost Total			18,040,000	19,374,000	19,498,000	23,538,000	24,586,000	30,010,000	30,974,000	30,974,000	31,098,000	31,238,000	31,238,000	31,238,000	31,238,000	31,238,000	31,238,000
Procurement & Maintenance Cost Total			469,040,000	67,724,000	22,598,000	124,538,000	50,786,000	165,610,000	55,074,000	47,974,000	51,198,000	37,838,000	61,138,000	39,938,000	34,338,000	34,338,000	51,738,000

(for Year 16 – 30) (N$)

Project Year			16	17	18	19	20	21	22	23	24	25	26	27	28	29	30
Calendar Year			2029	2030	2031	2032	2033	2034	2035	2036	2037	2038	2039	2040	2041	2042	2043
	Usage																
	(year)																
QGC	**18**	**To procure**				**3**			**1**		**1**						
NAD 80,000,000		To replace				3			1		1						
		Required	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5
Procurement Cost			0		0	240,000,000		0	80,000,000		80,000,000						
Maintenance Cost			16,000,000	16,000,000	16,000,000	16,000,000	16,000,000	16,000,000	16,000,000	16,000,000	16,000,000	16,000,000	16,000,000	16,000,000	16,000,000	16,000,000	16,000,000
RTG	**15**	**To procure**	**8**	**2**		**1**	**1**	**3**	**1**								
NAD 17,500,000		To replace	8	2		1	1	3	1								
		Required	16	16	16	16	16	16	16	16	16	16	16	16	16	16	16
Procurement Cost			140,000,000	35,000,000	0	17,500,000	17,500,000	52,500,000	17,500,000	0		0		0	0		
Maintenance Cost			11,200,000	11,200,000	11,200,000	11,200,000	11,200,000	11,200,000	11,200,000	11,200,000	11,200,000	11,200,000	11,200,000	11,200,000	11,200,000	11,200,000	11,200,000
Tractor Head	**7**	**To procure**	**8**	**2**	**2**	**3**	**2**	**2**	**17**	**8**	**2**	**2**	**3**	**2**	**2**	**17**	**8**
NAD 1,000,000		To replace	8	2	2	3	2	2	17	8	2	2	3	2	2	17	8
		Required	36	36	36	36	36	36	36	36	36	36	36	36	36	36	36
Procurement Cost			8,000,000	2,000,000	2,000,000	3,000,000	2,000,000	2,000,000	17,000,000	8,000,000	2,000,000	2,000,000	3,000,000	2,000,000	2,000,000	17,000,000	8,000,000
Maintenance Cost			1,440,000	1,440,000	1,440,000	1,440,000	1,440,000	1,440,000	1,440,000	1,440,000	1,440,000	1,440,000	1,440,000	1,440,000	1,440,000	1,440,000	1,440,000
Trailer Chassis	**8**	**To procure**	**2**	**22**	**2**	**2**	**4**	**2**	**2**		**2**	**22**	**2**	**2**	**4**	**2**	**2**
NAD 550,000		To replace	2	22	2	2	4	2	2		2	22	2	2	4	2	2
		Required	41	41	41	41	41	41	41	41	41	41	41	41	41	41	41
Procurement Cost			1,100,000	12,100,000	1,100,000	1,100,000	2,200,000	1,100,000	1,100,000	0	1,100,000	12,100,000	1,100,000	1,100,000	2,200,000	1,100,000	1,100,000
Maintenance Cost			902,000	902,000	902,000	902,000	902,000	902,000	902,000	902,000	902,000	902,000	902,000	902,000	902,000	902,000	902,000
Reach Stacker	**10**	**To procure**						**3**									
NAD 6,600,000		To replace						3									
		Required	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3
Procurement Cost								19,800,000									
Maintenance Cost			792,000	792,000	792,000	792,000	792,000	792,000	792,000	792,000	792,000	792,000	792,000	792,000	792,000	792,000	792,000
Folk Lift with Side Spreader	**10**	**To procure**		**1**			**1**	**2**	**1**			**1**		**1**			**1**
NAD 3,500,000		To replace		1			1	2	1			1		1			1
		Required	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6
Procurement Cost				3,500,000			3,500,000	7,000,000	3,500,000			3,500,000		3,500,000			3,500,000
Maintenance Cost			840,000	840,000	840,000	840,000	840,000	840,000	840,000	840,000	840,000	840,000	840,000	840,000	840,000	840,000	840,000
Folk Lift Multi-purposed	**15**	**To procure**	**3**			**1**											
NAD 400,000		To replace	3			1											
		Required	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4
Procurement Cost			1,200,000			400,000											
Maintenance Cost			64,000	64,000	64,000	64,000	64,000	64,000	64,000	64,000	64,000	64,000	64,000	64,000	64,000	64,000	64,000
Terminal Operation System	**1**	**To procure**															
NAD 15,000,000		To replace															
		Required															
Procurement Cost																	
Maintenance Cost																	
Procurement Cost Total			150,300,000	52,600,000	3,100,000	262,000,000	25,200,000	82,400,000	119,100,000	8,000,000	83,100,000	17,600,000	4,100,000	6,600,000	4,200,000	18,100,000	12,600,000
Maintenance Cost Total			31,238,000	31,238,000	31,238,000	31,238,000	31,238,000	31,238,000	31,238,000	31,238,000	31,238,000	31,238,000	31,238,000	31,238,000	31,238,000	31,238,000	31,238,000
Procurement & Maintenance Cost Total			181,538,000	83,838,000	34,338,000	293,238,000	56,438,000	113,638,000	150,338,000	39,238,000	114,338,000	48,838,000	35,338,000	37,838,000	35,438,000	49,338,000	43,838,000

(Total) (N$)

Procurement & Maintenance Cost	30 Years
Procurement Cost Total	1,747,350,000
Maintenance Cost Total	884,090,000
Procurement & Maintenance Cost Total	2,631,440,000

Source: JICA Study Team

4.5.2 Cost for Procurement of Consulting Services

(1) Objectives of the Consulting Services

The objectives of the procurement of the consulting services are for Namport to implement the construction of the Walvis Bay Container Terminal in an effective and timely manner as scheduled and in compliance with the Guidelines for Procurement under JICA ODA Loans (the JICA Guidelines) set out by Japan International Cooperation Agency (JICA).

(2) Scope of Services of Consultants

The Consultants shall assist the Namport in the following two phases:

- Pre-construction stage
- Construction stage

During the construction stage, the Consultants will assist Namport in selecting the supplier for procurement of the cargo handling equipment and each contractor for procurement of the buildings of the container terminal and for procurement of the electrical power supply works.

1) Pre-construction Stage

The Consultants shall prepare the tender documents in accordance with "Conditions of Contract for EPC/Turnkey Projects First Edition 1999" published by International Federation of Consulting Engineers (FIDIC) and assist Namport in selection of the Contractor for the civil works except for the buildings of the container terminal and electrical power supply works. At the construction stage, the Consultant shall carry out the following tasks:

- To review all the previous studies and investigations relevant to the implementation of the project which are available with Namport
- To formulate the Environmental Management Plan (EMP) prepared by Namport as the obligations of the contractor for which the tenderers can enter the price
- To collect all the necessary information from the above mentioned studies and investigations
- To incorporate all the necessary information mentioned above into the Drawings and Technical Specifications which shall be the parts of the tender documents for Namport to select the Contractor for the construction of the new container terminal (the Works) in accordance with the Engineer-Procure-Construct (EPC) contract
- To assist Namport in preparing the tender documents in accordance with the JICA Guidelines for the procurement of Civil Works
- To assist Namport in selecting the Contractor
- To assist Namport in negotiating and concluding the EPC contract with the Contractor
- To estimate overall project cost relating to the master implementation schedule
- To assess the financial position and project long-term financial statements

Assistance in preparing the tender documents for the procurement of the cargo handling equipment, the buildings of the container terminal and electrical power supply works will be carried out during the Construction Stage of the services.

2) Construction Stage

A. Civil Works

- To assist Namport in supervising the construction of the Works as "Other Employer's Personnel" in accordance with the EPC contract, particularly in carrying out the following assistance:
  - i) To monitor and examine all the technical, financial and contractual documents the Contractor shall submit in accordance with the contract and advise the Namport, if necessary, of the actions to be undertaken
  - ii) To examine whether the variations of design, materials and work methods proposed by the Contractor are technically reasonable and recommend the actions to be undertaken by the Namport for the variations
  - iii) To monitor the activities for the Contractor to conduct defined in the EMP and report necessary measures to be undertaken
  - iv) To examine whether the workmanship are acceptable and recommend the actions to be undertaken by the Namport
  - v) To examine whether the Contractor has fulfilled all the obligations under the EPC contract for the Namport to release the progress and final payments
  - vi) To assist the Namport in settling the claims which the Contractor may make during the execution of the contract
  - vii) To assist the Namport in concluding the final payment by evaluating the claims the Contractor has made

B. Cargo Handling Equipment

- To assist Namport in preparing the tender documents and concluding the contract with the Supplier in accordance with the JICA Guidelines for the procurement of the cargo handling equipment as follows:
  - i) To prepare the technical specifications of each item of cargo handling equipment to be procured
  - ii) To advise Namport of the JICA guidelines in concluding the tender documents
  - iii) To assist Namport in evaluating the tenders submitted by the tenderers
  - iv) To assist Namport in negotiating and concluding the contract with the Supplier
- To assist Namport in approving the design and/or specifications of the equipment
- To assist Namport in accepting the equipment by evaluating the tests and commissioning of the equipment

C. Buildings and Electrical Power Supply Works

- To assist Namport in preparing the tender documents and concluding the contracts with Contractors in accordance with the JICA Guidelines each for the procurement of the buildings and electrical power supply works as follows:
  - i) To prepare the technical specifications and drawings to be incorporated in the tender documents
  - ii) To advise Namport of the JICA guidelines in concluding the tender documents
  - iii) To assist Namport in evaluating the tenders submitted by the tenderers
  - iv) To assist Namport in negotiating and concluding the contracts with each Contractor
- To assist Namport in conducting the similar tasks i) through vi) described for Civil Works

(3) Tasks of Personnel

The Consultants will comprise of the following key personnel to conduct the services described in the Scope of the Services above:

- Team Leader/Resident Civil Engineer
- Contracts Engineer
- Port Engineer
- Dredging and Reclamation Engineer
- Architect
- Electrical Engineer
- Mechanical Engineer
- Environmental Expert
- Civil Engineer
- Project Financing and Accounting Expert
- Environmental Monitoring Staff (local)

The tasks to be undertaken by each key personnel are as follows:

A. Team Leader/Resident Civil Engineer

<u>Pre-construction Stage</u>

i) To liaise with Namport on behalf of the Consultants in assisting the preparation of the tender documents for procurement of Civil Works

ii) To collect all the information from the previous studies and investigations, except for those the other key personnel of the Consultants shall collect, which in his opinion are to be provided for the tenderers to make their tenders technically and financially reasonable and incorporate them into the tender documents

iii) To assist Namport in issuing the tender documents to the tenderers and clarifying them to the tenderers in response to the queries raised by the tenderers

iv) To evaluate the tenders and advise Namport of the ranking of the tenders

v) To assist Namport in negotiating the contract with the first ranked tenderer and, in case of the failure of the negotiation, with the second ranked tenderer and so forth

vi) To assist Namport in concluding the contract with the successful tenderer

vii) To submit the report covering the tender evaluation and contract negotiation including the main points agreed upon between Namport and the Contractor

<u>Construction Stage</u>

i) To liaise with Namport in conducting construction supervision of the civil works and consulting services for procurement of cargo handling equipment on behalf of the Consultants team and manage the activities of all the personnel of the Consultants

ii) To finalize all the correspondence, reports, etc the Consultants will submit to Namport

iii) To advise Namport of the actions to be undertaken in response to variations of the contract the Contractor may propose and the claims he may make

iv) To examine all the documents the Contractor will submit to the Namport except for those the other key personnel of the Consultants will be in charge of and advise Namport of the actions to be undertaken

v) Except for those the other key personnel of the Consultants are in charge of, to examine whether the variations of design, materials and work methods proposed by the Contractor are technically reasonable

vi) Except for those the other key personnel of the Consultants are in charge of, to examine whether the workmanship is acceptable

vii) To report to the Contracts Engineer whether all the civil works except for the other key personnel are in charge of have been completed in accordance with the contract for making the progress and final payments

B. Contracts Engineer

Pre-construction Stage

i) To advise the other key personnel of the Consultants of the contractual considerations in preparing the technical specifications and drawings which are to be incorporated in the tender documents for Civil Works

ii) To assist Namport in issuing the tender documents to the tenderers and clarifying them to the tenderers in response to the queries raised by the tenderers from contractual view point

iii) To check the tenders and advise Namport of the contractual issues to be clarified before tender close and/or terms to be negotiated during the contract negotiation

iv) To assist Namport in concluding the contract with due consideration on the contractual matters

Construction Stage

i) To advise Namport of the contractually appropriate response to variations of the contract the Contractor may propose as well as the claims he may make

ii) To examine all the documents the Contractor will submit to the Namport which requires contractual consideration and advise Namport of the actions to be undertaken

iii) To advise Namport of due contractual consideration in making progress and final payments

iv) To advise the Mechanical Engineer of the Consultants of the contractual considerations in preparing the technical specifications and drawings which are to be incorporated in the tender documents for procurement of the cargo handling equipment

v) To assist Namport in issuing the tender documents to the tenderers for procurement of the cargo handling equipment and clarifying them to the tenderers in response to the queries raised by the tenderers from contractual view point

vi) To check the tenders for the procurement of the cargo handling equipment and advise Namport of the contractual issues to be clarified before tender close and/or terms to be negotiated during the contract negotiation

vii) To assist Namport in concluding the contract with the Supplier of the cargo handling equipment with due consideration on the contractual matters

viii) To advise Namport of the settlement or other actions with respect to the claims the Contractor of the Civil Works and/or the Supplier of the cargo handling equipment may make

ix) To do the similar advice and assistance to Namport or Architect as described from iv) through ix) for the procurement of both the buildings of the container terminal and electrical power supply works

C. Port Engineer

Pre-construction Stage

i) To collect all the information from the previous studies and investigations with respect to the design of the quay wall and revetment which in his opinion are to be provided for the tenderers to make their tenders technically and financially reasonable

ii) To prepare technical specifications and drawings sufficient for the tenderers to conduct basic design of the quay wall and revetment and estimate their construction costs

iii) To prepare the technical specifications and drawings of other maritime civil works if necessary

<u>Construction Stage</u>

i) To examine all the documents the Contractor will submit to the Namport with respect to the quay wall, revetment and other maritime civil works and advise Namport of the actions to be undertaken

ii) To examine whether the variations of design, materials and work methods proposed by the Contractor with respect to the quay wall, revetment and other maritime civil works are technically reasonable

iii) To examine whether the workmanship are acceptable with respect to the quay wall, revetment and other maritime civil works

iv) To report to the Contracts Engineer whether the quay wall, revetment and other maritime civil works have been completed in accordance with the contract for making the progress payments

D. Dredging and Reclamation Engineer

<u>Pre-construction Stage</u>

i) To collect all the information from the previous studies and investigations with respect to the method and planning of the dredging and reclamation which in his opinion are to be provided for the tenderers to make their tenders technically and financially reasonable

ii) To prepare technical specifications and drawings sufficient for the tenderers to conduct planning their construction methods and equipment and estimate their construction costs

<u>Construction Stage</u>

i) To examine all the documents the Contractor will submit to the Namport with respect to the dredging and reclamation and advise Namport of the actions to be undertaken

ii) To examine whether the change of the method and equipment proposed by the Contractor with respect to the dredging and reclamation are technically reasonable

iii) To examine whether the workmanship of the excavation of the approach channel, port basin and turning basin as well as the reclamation are acceptable

iv) To report to the Contracts Engineer whether the dredging and reclamation have been completed in accordance with the contract for making the progress payments

E. Architect

<u>Pre-construction Stage</u>

Architect will be employed only at the construction stage.

<u>Construction Stage</u>

i) To collect all the information from the previous studies and investigations with respect to the buildings of the container terminal which in his opinion are to be provided for the tenderers to make their tenders technically and financially reasonable

ii) To prepare technical specifications and drawings sufficient for the tenderers to conduct basic design of the buildings of the container terminal and estimate their construction costs

iii) To assist Namport in issuing the tender documents to the tenderers and clarifying them to the tenderers in response to the queries raised by the tenderers

iv) To evaluate the tenders and advise Team Leader of the Consultants of the ranking of the tenders

v) To assist Namport in negotiating the contract with the first ranked tenderer and, in case of the failure of the negotiation, with the second ranked tenderer and so forth

vi) To examine all the documents the Contractor will submit to the Namport with respect to the buildings of the container terminal and advise Namport of the actions to be undertaken

vii) To examine whether the variations of design, materials and work methods proposed by the Contractor with respect to the buildings of the container terminal are technically reasonable
viii) To examine whether the workmanship are acceptable with respect to the buildings of the container terminal
ix) To report to the Contracts Engineer whether buildings of the container terminal have been completed in accordance with the contract for making the progress payments

F. Electrical Engineer

Pre-construction Stage

i) To collect all the information from the previous studies and investigations with respect to the electrical works which in his opinion are to be provided for the tenderers to make their tenders technically and financially reasonable
ii) To prepare technical specifications and drawings sufficient for the tenderers to conduct basic design of those structures to be embedded in the ground for the electrical power supply works which will be carried out by other contractor and estimate their construction costs

Construction Stage

As the electrical power supply works are carried out by the contractor the power supply company nominates and there is no competitive bidding, it is assumed that after receiving the tender Namport will negotiate the contract with the nominated contractor.

i) To prepare technical specifications and drawings sufficient for the nominated tenderer to conduct basic design of the electrical power supply works and estimate their construction costs
iii) To assist Namport in issuing the tender documents to the nominated tenderer and clarifying them to the tenderer in response to the queries raised by the tenderer
ii) To assist Namport in negotiating the contract with the tenderer
iii) To examine all the documents the Contractor of electrical power supply works will submit to the Namport and advise Namport of the actions to be undertaken
iv) To examine whether the variations of design, materials and work methods proposed by the Contractor of the electrical power supply works are technically reasonable
v) To examine whether the workmanship are acceptable
vi) To report to the Contracts Engineer whether the electrical power supply works have been completed in accordance with the contract for making the progress and final payments

G. Mechanical Engineer

Pre-construction Stage

i) To determine all the working loads of the equipment to be installed for the project and incorporate them into the technical specifications for the tender documents for the Civil Works

Construction Stage

i) To collect all the information from the previous studies and investigations with respect to the cargo handling equipment to be procured for the new container terminal which in his opinion are to be provided for the tenderers to make their tenders technically and financially reasonable
ii) To prepare technical specifications and drawings sufficient for the tenderers to prepare their tenders
iii) To assist Namport in issuing the tender documents to the tenderers and clarifying them to the tenderers in response to the queries raised by the tenderers

iv) To evaluate the tenders and advise Team Leader of the Consultants of the ranking of the tenders
v) To assist Namport in negotiating the contract with the first ranked tenderer and, in case of the failure of the negotiation, with the second ranked tenderer and so forth
vi) To assist Namport in concluding the contract with the successful tenderer
vii) To submit the report covering the tender evaluation and contract negotiation including the main points agreed upon between Namport and the Supplier of the cargo handling equipment
viii) To examine all the documents the Supplier will submit to the Namport and advise Namport of the actions to be undertaken
ix) To examine whether the variations of makes and/or manufactures of the cargo handling equipment proposed by the Supplier are technically reasonable
x) To report to the Contracts Engineer whether the cargo handling equipment have been delivered and successfully commissioned in accordance with the contract for making the progress and final payments

H. Environmental Expert

Pre-construction Stage

i) To finalize the monitoring of the environmental observations and other activities to be conducted by the Civil Works Contractor in accordance with the Construction Environmental Management Plan (CEMP) and to incorporate them into the tender documents for the tenderers to enter the relevant costs into their tenders

Construction Stage

i) To monitor with his assistance the environmental observations and other activities the Contractor shall undertake in accordance with CEMP and, if necessary, make recommendations to Namport that the Contractor undertake the additional environmental monitoring, mitigation measures and other activities
ii) To advise Namport of appropriate actions to settle any environmental issues which may be arisen during the construction works
iii) To periodically submit with his assistance the environmental monitoring reports to Namport covering all the monitoring results, activities and other actions the Contractor has undertaken during the respective periods and the issues to be settled by Namport if any

I. Civil Engineer

Pre-construction Stage

i) To collect all the information from the previous studies and investigations with respect to the design of road, railway, pavement, drainage, landscaping, utility works other than electrical works which in his opinion are to be provided for the tenderers to make their tenders technically and financially reasonable
ii) To prepare technical specifications and drawings sufficient for the tenderers to conduct basic design of the civil works mentioned above and estimate their construction costs

Construction Stage

i) To examine all the documents the Contractor will submit to the Namport with respect to t road, railway, pavement, drainage, landscaping, utility works other than electrical works and advise Namport of the actions to be undertaken
ii) To examine whether the variations of design, materials and work methods proposed by the Contractor with respect to the road, railway, pavement, drainage, landscaping, utility works other than electrical works are technically reasonable

iii) To examine whether the workmanship are acceptable with respect to the road, railway, pavement, drainage, landscaping, utility works other than electrical works
iv) To report to the Contracts Engineer whether the road, railway, pavement, drainage, landscaping, utility works other than electrical works have been completed in accordance with the contract for making the progress payments

J. Project Financing and Accounting Expert

Pre-construction Stage

i) To obtain the monthly financial progress of the civil works from the successful tenderer as well as to prepare, being assisted by other key personnel, the financial progress of the other works to be carried out in parallel with the civil works
ii) To estimate overall project cost relating to the master implementation schedule
iii) To collect required information regarding the financial planning of Namport and assess the financial position and project long-term financial statements of Namport

Construction Stage

Project Financing and Accounting Expert will be employed only at the pre-construction stage.

K. Environmental Monitoring Staff (local)

An environmental monitoring staff will be employed to monitor all the activities to be conducted by the Contractor as required according to the CEMP. His/her tasks are as follows:

Pre-construction Stage

Environmental Monitoring Staff will be employed only at the construction stage.

Construction Stage

i) To monitor all the environmental observations and activities to be carried out by the Contractor according to the CEMP
ii) To report the results of the monitoring to Namport
iii) To recommend actions to be undertaken by Namport to mitigate adverse environmental impacts caused by or in executing the project, if necessary

(4) Staffing Schedule

Based on the tasks, the staffing of the key personnel of the Consultants is scheduled according to the project implementation schedule and construction schedule. The staffing schedule is shown in Table 4.5.4.

(5) Reporting

It is assumed that each tender document will be compiled and issued by Namport. The Consultants will prepare and submit the following reports besides submission of reports regarding the technical and contractual matters from time to time:

1) Pre-construction Stage

- Technical Specifications for all the civil works
- Tender Drawings for the bathymetry, topography, layout of the civil works and typical cross sections of principal structures
- Particular Conditions for each tender
- Attachments to the Tender Documents like results of sub-soil investigation, oceanographic investigation, meteorological observation, etc
- Evaluation Report on each tender

2) Construction Stage

- Technical Specifications for cargo handling equipment, electrical power supply works and buildings for the container terminal
- Tender Drawings like layout and schematic drawings for electrical power supply works, conceptual drawings of the buildings for the container terminal
- Particular Conditions for each tender
- Evaluation Report on each tender
- Contract Completion Reports on each contract

(6) Cost Estimate

The office for all the consulting staff including power and water supply, furniture, office equipment, consumables, etc are assumed to be provided by Namport during both the Pre-construction Stage and Construction Stage. Remuneration and out-of-pocket expenses are estimated according to the staffing schedule and shown in Table 4.5.5.

Table 4.5.4 Staffing Schedule (In Case of Use of Japanese ODA)

Month (August 2010 = 0)	8	9	10	11	12	13	14	15	16
Year	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Calendar Month	2011								

Month (August 2010 = 0)	17	18	19	20	21	22	23	24	25	26	27	28
Year	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Calendar Month	2012											

Month (August 2010 = 0)	29	30	31	32	33	34	35	36	37	38	39	40
Year	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Calendar Month	2013											

Month (August 2010 = 0)	41	42	43	44	45	46	47	48	49	50	51	52
Year	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Calendar Month	2014											

Month (August 2010 = 0)	53	54	55	56	57	58	59	60	61
Year	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
Calendar Month	2015								

	Activities			M/M
Staffing Schedule				
	Pre-construction Stage			M/M
A	Team Leader/Resident Civil Engineer			10
B	Contracts Engineer			10
C	Port Engineer			5
D	Dredging and Reclamation Engineer			3
E	Architect			0
F	Electrical Engineer			3
G	Mechanical Engineer			1
H	Civil Engineer			5
I	Environmental Expert			2
J	Project Financing and Accounting			2
K	Envrionmental Monitoring Staff (Local)			0
L	CAD Operators each for 2 key personnel			21
I	Secretary/Accountant			10
	Construction Stage			M/M
A	Team Leader/Resident Civil Engineer		Plus 2	33
B	Contracts Engineer		Plus 2	33
C	Port Engineer			20
D	Dredging and Reclamation Engineer			16
E	Architect			15
F	Electrical Engineer			7
G	Mechanical Engineer			7
H	Civil Engineer			7
I	Environmental Expert			0
J	Project Financing and Accounting			0
K	Envrionmental Monitoring Staff (Local)			9.3
L	CAD Operators each for 2 key personnel		Plus 2	69
I	Secretary/Accountant		Plus 2	33
1	Preparation of Bid Documents and JICA's Concurrence			
	Procurement of Construction Works			
2	Bidding			
3	Bid Evaluation			
4	Concurrence to Bid Evaluation by JICA			
5	Contract Negotiation			
6	Concurrence to the Contract by JICA			
7	Opening of L/C, Issuance of L/Com			
8	Construction Works			
	Procurement of Buildings			
9	Preparation of Bid Documents	Design Build Contract		
10	Bidding	International Contractor		
11	Selection of Contractor			
12	Construction Works			
	Electrical Power Supply Works			
13	Preparation and Issuance of Contract Documents			
14	Contract Negotiation			
15	Construction Works			
	Procurement of Equipment			
16	Preparation of Bid Documents for Equipment			
17	Bidding			
18	Selection of Supplier			
19	Manufacturing and Delivery, Commissioning			
	Procurement of Terminal Operation System	Navis		
20	Preparation of Bidding Documents	Requirements to specify		
21	Bidding			
22	Design, delivery, Installation, Commissioning			
23	Training	In case Namport to operate		
	Procurement of Terminal Operator			
24	Preparation of Bid Documents	Concession for Terminal Operation		
25	Bidding			
26	Selection of Terminal Operator			
27	Handover of Terminal to Operator			

Source: JICA Study Team

Table 4.5.5 Breakdown of Consulting Services Cost

		Unit	Rate ¥	Quantity	Amount ¥	Rate N$	Quantity	Amount N$
Pre-construction Stage								
Remuneration								
A	Team Leader/Resident Civil Engineer	M/M	2,830,000	10	28,300,000			
B	Contracts Engineer	M/M	2,360,000	10	23,600,000			
C	Port Engineer	M/M	2,360,000	5	11,800,000			
D	Dredging and Reclamation Engineer	M/M	2,360,000	3	7,080,000			
E	Architect	M/M	2,360,000	0	0			
F	Electrical Engineer	M/M	2,360,000	3	7,080,000			
G	Mechanical Engineer	M/M	2,360,000	1	2,360,000			
H	Civil Engineer	M/M	2,360,000	5	11,800,000			
I	Environmental Expert	M/M	2,360,000	2	4,720,000			
J	Project Financing and Accounting	M/M	2,830,000	2	5,660,000			
K	Environmental Monitoring Staff	M/M				22,000	0	0
L	CAD Operators each for 2 key personnel	M/M				12,000	21	252,000
I	Secretary/Accountant	M/M				9,000	10	90,000
Out-of-pocket Expenses								
	International Travel							
	Air ticket Tokyo - Walvis Bay - Tokyo	R.T	1,200,000	17	20,400,000			
	Miscellaneous Travel Expenses	R.T	25,000	17	425,000			
	Rent-a-car each for 3 key personnel incl. driver & fuel	Month				20,000	18	360,000
	Communication Cost	Month				5,000	10	50,000
	Subsistence Allowance	M/M				30,000	41	1,230,000
	Pre-construction Stage Sub-total				123,225,000			1,982,000
Construction Stage								
Remuneration								
A	Team Leader/Resident Civil Engineer	M/M	2,830,000	33	93,390,000			
B	Contracts Engineer	M/M	2,360,000	33	77,880,000			
C	Port Engineer	M/M	2,360,000	20	47,200,000			
D	Dredging and Reclamation Engineer	M/M	2,360,000	16	37,760,000			
E	Architect	M/M	2,360,000	15	35,400,000			
F	Electrical Engineer	M/M	2,360,000	7	16,520,000			
G	Mechanical Engineer	M/M	2,360,000	7	16,520,000			
H	Civil Engineer	M/M	2,360,000	7	16,520,000			
I	Environmental Expert	M/M	2,360,000	0	0			
J	Project Financing and Accounting	M/M	2,830,000	0	0			
K	Environmental Monitoring Staff	M/M				22,000	10	220,000
L	CAD Operators each for 2 key personnel	M/M				12,000	69	828,000
I	Secretary/Accountant	M/M				9,000	33	297,000
Out-of-pocket Expenses								
	International Travel							
	Air ticket Tokyo - Walvis Bay - Tokyo	R.T	1,200,000	27	32,400,000			
	Miscellaneous Travel Expenses	R.T	25,000	27	675,000			
	Rent-a-car each for 3 key personnel incl. driver & fuel	Month				20,000	54	1,080,000
	4WD Rent-a-car each at site incl. driver & fuel	Month				24,000	31	744,000
	Communication Cost	Month				5,000	33	165,000
	Subsistence Allowance	M/M				30,000	138	4,140,000
	Construction Stage Sub-total				374,265,000			7,474,000
	Total				497,490,000			9,456,000
	Total in Namibian $	Exchange rate (N$/¥) = 11.4						53,095,474

Source: JICA Study Team

4.5.3 Operation and Maintenance Cost

In June 2008, Namport conducted a study, "Design, Feasibility and Tender Berth 0/1 Concepts and Feasibility for Ship Repair for Ship Repair Hub & Dedicated Fish Terminal, Inros Lackner Study." (hereafter "Berth 0/1 Study"). In the study, the operating cost of a container terminal was estimated.

(1) Cost for Workers

Reviewing the facilities, equipment and services of the new container terminal, the number of staff necessary for the new container terminal's operation were estimated. The facilities and equipment for this container terminal will develop as the number of handled containers at the terminal increases. Therefore, the number of workers will increase as the facilities and equipment develop. The result is summarized in the following table:

Table 4.5.6 Number of Staff Necessary for the Container Terminal Operation

Stages / Department	1 2015	2 16	3 1 7	4 18	5 19	6- 20-
Management	8	8	8	8	8	8
Administration	134	134	134	134	134	134
Operation	224	239	254	254	254	254
Total	366	381	396	396	396	396

Source: JICA Study Team

Annual costs for workers of Namport by class in 2008 are summarized in the following table. These costs include salary & wages, payment for overtime, training.

Table 4.5.7 Average Annual Salary of Staffs of Namport

Class	Average Annual Cost (N$)
Management	1,606,013
Administration	264,346
Operation (Cargo Services)	184,715

Source: Namport

Cost for workers is estimated based on information shown above.

(2) Cost of Energy

Based on the actual operation cost of Namport in 2007/08, the unit cost of energy is established under the assumption that the cost of energy is in proportion to the weight of cargo. The results are as follows.

Table 4.5.8 Energy Consumption

Item	Amount	Unit
Electricity	1.70	N$/ton
Fuel and Lubrication	2.23	N$/ton

Source: JICA Study Team

According to this unit cost, the operating cost of energy is estimated to be in proportion to the weight of handled cargo.

(3) Cost of Maintenance and Repair

Cost for maintenance and repair is estimated based on the following assumptions:

- Annual cost of maintenance and repair of cargo handling equipment is 4% of original purchase price. This cost includes the cost of necessary IT support.
- Annual cost of maintenance and repair of civil works, infrastructure, and buildings is 1.5% of their original cost.

(4) Cost of General Administration

The cost of general administration will increase as the handled containers increase. Therefore, the administration cost is estimated based on the following assumptions:

- General office cost: 2.1N$/TEU
- Telecommunication expenses: 0.8 N$/TEU
- Bank charge and legal expenses: 0.8 N$/TEU
- Insurance cost: 4.0 N$/TEU

Marketing cost = 1 million N$ for the first year of operation and 0.5 million N$ for the other years.

4.5.4 Preliminary Cost

Preliminary costs results are summarized in the following table. These costs do not include taxes.

Table 4.5.9 Preliminary Cost

Description of Works	Quantity	Unit	Unit Price(N$)	Amount(N$)	Remarks
1.CIVIL WORKS COST				**1,610,561,689**	(Subtotal 1)
1) Mobi. / Demobilization, etc	1	LS	66,689,925	66,689,925	5%
2) Dredging, Reclamation & Revetment	1	LS	624,501,000	624,501,000	
3) Quay Wall (550m long)	1	LS	446,320,000	446,320,000	
4) Terminal Yard (140,500m2)	1	LS	110,865,500	110,865,500	
5) Access Causeway	1	LS	31,925,000	31,925,000	
6) Building Works (9,245㎡)	1	LS	70,187,000	70,187,000	
7) Power Supply facilities, etc.	1	LS	50,000,000	50,000,000	
8) Engineering and Head Office Expences	1	LS	210,073,264	210,073,264	(15% of Σ 1)~7))
2.EQUIPMENT PROCUREMWNT COST				**436,000,000**	(Subtotal 2)
1) Quay Gantry Crane (QGC)	3	Nos	80,000,000	240,000,000	
2) Rubber Tired Gantry Crane (RTG)	8	Nos	17,500,000	140,000,000	
3) Tractor Head	17	Nos	1,000,000	17,000,000	
4) Yard Type Chassis	20	Nos	550,000	11,000,000	
5) Reach Stacker	3	Nos	6,600,000	19,800,000	
6) Forklift whith Side Spreader	2	Nos	3,500,000	7,000,000	
7) Forklift Multipurposed	3	Nos	400,000	1,200,000	
3.TERMIINAL OPERATION SYSTEM				**15,000,000**	(Subtotal 3)
1) Navis	1	LS	15,000,000	15,000,000	
4.CONSULTING SERVICES COST				**53,095,474**	(Subtotal 4)
1) Pre-Construction Stage			(	12,791,211	)
-1 Pre-Construction Stage (JP￥)	1	LS	123,225,000	10,809,211	(￥/11.4=N＄)
-2 Pre-Construction Stage (N＄)	1	LS	1,982,000	1,982,000	
2) Construction Stage			(	40,304,263	)
-1 Construction Stage (JP￥)	1	LS	374,265,000	32,830,263	(￥/11.4=N＄)
-2 Construction Stage (N＄)	1	LS	7,474,000	7,474,000	
・Grand Total				**2,114,657,163**	(not include tax)

Source: JICA Study Team

4.5.5 Project Cost

Project cost is estimated by adding up following items.

(i) Base Cost + Tax
(ii) Price Escalation: (i) x Price Escalation Rate
(iii) Physical Contingency: ((i)+(ii)) x Phisical Contingency Rate

Base cost consists of costs for consulting service, civil work, equipment, administration, and expansion. Details of them are shown in the other sections. Cost for equipment includes the necessary cost before the operation starts. As cost of equipment after operation starts will be financed by the profit of the operation, this cost is not included in the project cost.

As for Tax, as administration will be provided by the implementation agent, only cost for administration does not include tax. Tax is assumed 15% of values.

Annual price escalation rate for local portion is 0.0%, and that for foreign portion is 3.1%. Price escalation is estimated by year and base year is 2010.

Physical contingency is 10% of values. But the cost for administration does not include physical contingency, because administration is served by the implementation agency.

Project cost of this project by year is summarized in the following table.

Table 4.5.10 Project Cost by Year

(in million N$)

Year	2010	2011	2012	2013	2014	2015	Total
Price Escalation Rate (Local)	0.00	0.00	0.00	0.00	0.00	0.00	
Price Escalation Rate (Foreign)	0.00	0.03	0.06	0.10	0.13	0.16	
Consulting Service							
Base Cost (Local Portion)	0.00	1.10	1.56	3.13	3.04	0.61	9.46
Base Cost (Foreign Portion)	0.00	5.83	7.95	13.68	13.48	2.71	43.64
Base Cost (Total)	0.00	6.93	9.52	16.81	16.52	3.32	53.10
Tax	0.00	1.04	1.43	2.52	2.48	0.50	7.96
Price Escalation	0.00	0.21	0.58	1.51	2.01	0.51	4.82
Contingency	0.00	0.82	1.15	2.08	2.10	0.43	6.59
Sub-Total	0.00	9.00	12.67	22.92	23.11	4.76	72.47
Civil Work							
Base Cost (Local Portion)	0.00	0.00	51.63	265.21	447.64	55.95	820.43
Base Cost (Foreign Portion)	0.00	0.00	69.92	359.95	333.81	26.45	790.13
Base Cost (Total)	0.00	0.00	121.55	625.16	781.45	82.40	1,610.56
Tax	0.00	0.00	18.23	93.77	117.22	12.36	241.58
Price Escalation	0.00	0.00	5.06	39.70	49.86	5.02	99.64
Contingency	0.00	0.00	14.48	75.86	94.85	9.98	195.18
Sub-Total	0.00	0.00	159.33	834.50	1,043.37	109.75	2,146.97
Equipment							
Base Cost (Local Portion)	0.00	0.00	0.00	0.00	431.25	0.00	431.25
Base Cost (Foreign Portion)	0.00	0.00	0.00	0.00	19.75	0.00	19.75
Base Cost (Total)	0.00	0.00	0.00	0.00	451.00	0.00	451.00
Tax	0.00	0.00	0.00	0.00	67.65	0.00	67.65
Price Escalation	0.00	0.00	0.00	0.00	2.95	0.00	2.95
Contingency	0.00	0.00	0.00	0.00	52.16	0.00	52.16
Sub-Total	0.00	0.00	0.00	0.00	573.76	0.00	573.76
Expansion							
Base Cost (Local Portion)	0.00	0.00	0.00	0.00	0.00	30.68	30.68
Base Cost (Foreign Portion)	0.00	0.00	0.00	0.00	0.00	18.89	18.89
Base Cost (Total)	0.00	0.00	0.00	0.00	0.00	49.57	49.57
Tax	0.00	0.00	0.00	0.00	0.00	7.44	7.44
Price Escalation	0.00	0.00	0.00	0.00	0.00	3.58	3.58
Contingency	0.00	0.00	0.00	0.00	0.00	6.06	6.06
Sub-Total	0.00	0.00	0.00	0.00	0.00	66.65	66.65
Administration							
Base Cost (Local Portion)	0.00	0.00	1.47	4.40	4.40	0.73	11.00
Base Cost (Foreign Portion)	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Base Cost (Total)	0.00	0.00	1.47	4.40	4.40	0.73	11.00
Tax	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Price Escalation	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Contingency	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Sub-Total	0.00	0.00	1.47	4.40	4.40	0.73	11.00
Total							
Base Cost	0.00	6.93	132.54	646.37	1,253.36	136.02	2,175.23
Tax	0.00	1.04	19.66	96.30	187.34	20.29	324.63
Price Escalation	0.00	0.21	5.64	41.21	54.82	9.11	110.99
Contingency	0.00	0.82	15.64	77.95	149.11	16.47	259.99
Total	0.00	9.00	173.47	861.83	1,644.64	181.90	2,870.84

Source: JICA Study Team

4.6 Project Implementation

4.6.1 Project Implementation Schedule

(1) Selection of Financier

Several financial institutions with potential to finance the loan for the project requested the detailed marketing survey be conducted, especially for the captured demand from competitive ports like Port of Cape Town. Namport is determined to conduct such surveys by employing experts. The financial institutions also demand studies on the economic benefits not only for Namibia but also for other SADC countries. As Namport estimates that these surveys need about 3 to 4 months, the financier to provide the loan for the project will be selected in July 2010.

Below, the discussion will follow the assumption that the Namibian Government will request in July 2010 that the Japanese Government provide a Japan Official Development Assistance (ODA) loan to Namibia.

(2) Financial Arrangement by JICA

Most probable procedures for an ODA loan are programmed as follows:

- 1st Japanese Government to pledge the loan in October 2010.
- 2nd JICA to open EIA for public review for 120 days
- 3rd Japanese Government to approve the loan
- 4th Exchange of notes to be signed between Namibian Government and Japanese Government
- 5th Loan agreement to be signed between Namibian Government/Namport and JICA.
- 6th JICA to approve the bidding documents for procurement of the consultants

The official request for the ODA loan from Namibian Government is assumed in March 2009. After the ledge by the Japanese Government, it may take around eight months to conclude the selection of the consultants, i.e. in May 2011.

(3) Commencement of Works

According to the guidelines for disbursing an ODA loan, the bidding documents have to be approved by JICA in advance of the announcement of the bidding. The consultants may need about five months including the concurrence to be made by JICA to finalize the bidding documents to select the contractor. The procedures from bidding, bid evaluation, contract negotiation, and conclusion of contract to concurrence to be made by JICA will take about 15 months. As a result, the construction works will commence in Sep. 2012.

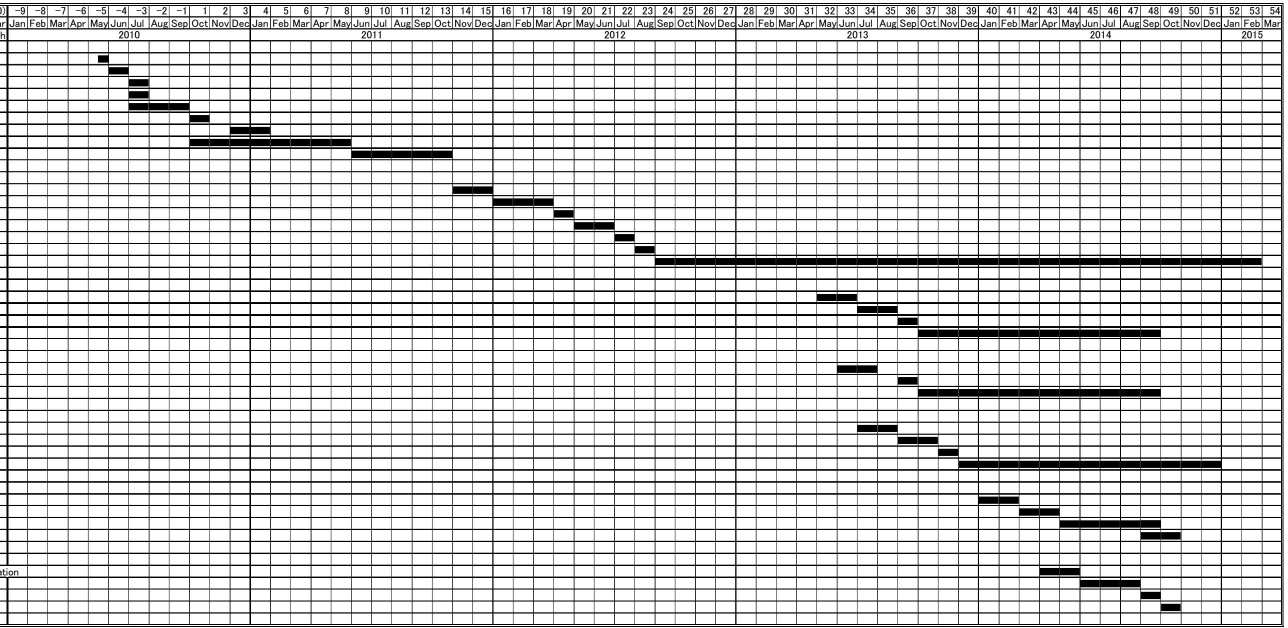
(4) Procurement of Equipment and Terminal Operator

Namport has an ample period of time to select the supplier of cargo handling equipment and terminal operator. In parallel with civil works construction, bidding documents can be prepared by the consultants to supervise the construction. For selection of the terminal operator, it is advisable that a specialist firm be employed to prepare the bidding documents probably as a form of concession contract.

An overall time schedule for implementation of the project as discussed above is shown in the bar chart below.

Table 4.6.1 Project Implementation Schedule (Use of Japanese ODA)

No.	Activities	Remarks
1	Approval on Economic and Financial Analyses	Namport to make decision.
2	Negotiation with Financiers	JICA as a potential financier.
3	Selection of Financier	JICA to be selected.
4	Request for Financial Assistance	
5	Appraisal of the project by JICA	
6	Pledge for Assistance by Japanese Government	
7	Singing of E/N and L/A	
8	Selection of Consultants	
9	Preparation of Bid Documents and JICA's Concurrence	
	Procurement of Construction Works	
10	Bidding	
11	Bid Evaluation	
12	Concurrence to Bid Evaluation by JICA	
13	Contract Negotiation	
14	Concurrence to the Contract by JICA	
15	Opening of L/C, Issuance of L/Com	
16	Construction Works	
	Procurement of Buildings	
17	Preparation of Bid Documents	Design Build Contract
18	Bidding	International Contractor
19	Selection of Contractor	
20	Construction Works	
	Electrical Power Supply Works	
21	Preparation and Issuance of Contract Documents	
22	Contract Negotiation	
23	Construction Works	
	Procurement of Equipment	
24	Preparation of Bid Documents for Equipment	
25	Bidding	
26	Selection of Supplier	
27	Manufacturing and Delivery, Commissioning	
	Procurement of Terminal Operation System	Navis
28	Preparation of Bidding Documents	Requirements to specify
29	Bidding	
30	Design, delivery, Installation, Commissioning	
31	Training	In case Namport to operate
	Procurement of Terminal Operator	
32	Preparation of Bid Documents	Concession for Terminal Operation
33	Bidding	
34	Selection of Terminal Operator	
35	Handover of Terminal to Operator	



Notes:
1. Namport will make an official approval on the project viability after marketing study.
2. In case JICA is selected as the financier, the procedures to extend the loan will be made as follows;
 a) Japanese Government to pledge the loan. The timing is set forth with October 2010.
 b) JICA to open EIA for public review for 120 days
 c) Japanese Government to approve the loan
 d) Exchange of notes to be signed between Namibian Government and Japanese Government.
 e) Loan agreement to be signed between Namibian Government/Namport and JICA.
 f) JICA to approve the bidding documents for procurement of the consultants.
3. Finance for procurement of Civil Works and Equipment is assumed to use the proceeds of Yen Loan from JICA.
4. In case of 3 above, selection of contractors and suppliers has to be made in accordance with JICA Guidelines for Procurement of Construction Works and Equipment.
5. Consequently, the bidding documents for selection of the contractor of Civil Works has to be approved by JICA.
6. To shorten the selection procedure, post-qualification of bidders has to be adopted.
7. For Design& Build or EPC contract, a longer bidding period as well as a longer contract negotiation are necessary.
8. As a consequence, the commencement of Civil Works Construction will be in January 2015

Abbreviations
ODA : Official Development Assistance
E/N: Exchange of Notes
L/A: Loan Agreement
L/C: Letter of Commitment
ODA : Official Development Assistance

Source: JICA Study Team

4.6.2 Procurement Packages

The project consists of the following services, construction works and equipment to be procured:

- Civil works of Phase 1 construction including electrical and mechanical works
- Supply and installation of cargo handling equipment
- Bidding documents preparation and supervision of civil works construction and procurement (engineering services)
- Provision and installation of Navis (Terminal Operating System)

(1) Time for Completion

In view of the forecast throughput of container cargoes, the existing container berths can only cope with the demand up to 2011, as their capacity in total is estimated at 250,000 TEU per year. Meanwhile, as discussed in the "Project Implementation Schedule," it will take until February to March 2010 to arrange the finances for the project. The design and build or EPC contract with a civil works contractor will conclude in September 2012. Therefore, the most probable date for completion of the civil works has to be 30 months after September 2012, i.e. February 2015. By use of the completed part of the construction, the new container terminal can be operated from the beginning of 2015.

The demand forecast requires a 550 m berth from the very beginning of the operation of the new container terminal. The completion of the whole length within 30 months is technically possible with use of three sets of the drilling machines for construction of cast-in-situ concrete piles even though the construction cost may be slightly higher than use of two sets of the machines.

(2) Package of Civil Works of Phase 1

Major civil works included in the Phase 1 construction works are dredging, reclamation, slope protection, quay wall, road/yard pavement, buildings, power supply, road/yard lighting, water supply and sewerage. These works can be grouped according to their characteristics as follows:

Group 1: Dredging, Reclamation, Slope Protection
Group 2: Quay Wall
Group 3: Road/Yard Pavement. Railway, Water Supply, Fire fighting Sewerage
Group 4: Buildings, Gate and Fence, Landscaping
Group 5: Electrical Works. Road/Yard Lighting

In view of the construction sequence discussed in the "Construction Schedule," the quay wall construction has to commence in parallel with reclamation works. Therefore, Group 1 and Group 2 works should be grouped together.

In order to avoid potential contractual disputes due to the responsibilities of reclamation and road/yard pavement, as well as to shorten the time for completion, it is recommended that Group 1, 2 and 3 should be grouped into one package. Group 5 should be treated as one package contract because of its specialized characteristics that are different from those of other works. However, the duct banks for power supply cables beneath the container terminal pavement, as well as those crossing the roads, should belong to the package consisting of Group 1, 2 and 3.

It is advisable for Namport to separate the building works from other civil works, i.e. one separate package for Group 4. As the bidding time is very limited considering the design and build or EPC contract, the bidders for the package of Group 1, 2, and 3 should be given sufficient time to estimate the cost of major civil works such as dredging and reclamation, quay wall construction and slope protection so that they can prepare more competitive bids.

(3) Package of Equipment Supply

Items of equipment to be procured for Phase 1 are tabulated below according to the increase in cargo throughput from 375,000 TEU in 2015 to 583,000 TEU or the full capacity of Phase 1 in 2026:

Table 4.6.2 Items of Equipment to be Required for Phase 1

Project Year				1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30
Item	Remarks	Usage	Year	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032	2033	2034	2035	2036	2037	2038	2039	2040	2041	2042	2043
QGC	To Procure			3			1		1													3			1		1						
With	To Replace	18																				3			1		1						
spreaders	Required			3	3	3	4	4	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5
RTG	To Procure			8	2		1	1	3	1									8	2		1	1	3	1								
Ditto	To Replace	15																	8	2		1	1	3	1								
	Required			8	10	10	11	12	15	16	16	16	16	16	16	16	16	16	16	16	16	16	16	16	16	16	16	16	16	16	16	16	16
Tractor Head	To Procure			17	6	2	2	3	2	2	17	8	2	2	3	2	2	17	8	2	2	3	2	2	17	8	2	2	3	2	2	17	8
Yard exclusive	To Replace	7									17	6	2	2	3	2	2	17	8	2	2	3	2	2	17	8	2	2	3	2	2	17	8
type	Required			17	23	25	27	30	32	34	34	36	36	36	36	36	36	36	36	36	36	36	36	36	36	36	36	36	36	36	36	36	36
Chassis	To Procure			20	7	2	2	2	4	2		22	2	2	2	4	2	2		20	2	2	2	4	2	2		20	2	2	2	4	2
Ditto	To Replace	8										20	2	2	2	4	2	2		20	2	2	2	4	2	2		20	2	2	2	4	2
	Required			20	27	29	31	33	37	39	39	41	41	41	41	41	41	41	41	41	41	41	41	41	41	41	41	41	41	41	41	41	41
Reach Stacker	To Procure			3										3										3									
	To Replace	10												3										3									
	Required			3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3
Fork Lift	To Procure			2	1			1		1			1	2	1			1		1			1	2	1			1		1			1
Side-lifter,	To Replace	10												2	1			1		1			1	2	1			1		1			1
7tiers	Required			2	3	3	3	4	4	5	5	5	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6
Fork Lift	To Procure			3			1												3			1											
5 ton	To Replace	15																	3			1											
	Required			3	3	3	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4

Note: the procurement should be made one year before the requirement.
Source: JICA Study Team

For the initial procurement of cargo handling equipment in 2014, only one package is advisable in order to attract more competitive bids. It is likely that a supplier will quote prices of each item of equipment from their manufactures and offer a discounted contract price for the whole package. For future procurement, each item of equipment may be purchased in separate contracts.

Should Namport desire that these be procured by a terminal operator, the cost should be included in the concession contract for the container terminal

(4) Engineering Services

Regardless of the type of procurement contract, Namport needs engineering services to approve, supervise and inspect the contractors' workmanship. To this end, Namport is recommended to procure the engineering services from the reputable consulting firms. TOR and tentative cost estimate can be referred to Section 4.5.2 of this report. To make the supervisory work simple, it is suggested that engineering services be procured as one package.

(5) Terminal Operating System

Along with the new container terminal, Namport is also planning to purchase a new terminal operating system called Navis replacing the existing one, because the current system developed in South Africa is not compatible with other systems. Navis is compatible with other operating systems and is thus essential for effective terminal operation.

4.6.3 Organization for Project Implementation

The civil works construction will be executed as a design & build contract or EPC (engineer, procure and construct) contract by an international contractor. Meanwhile, the building works will most probably be executed as a design & build contract by a local contractor. As in such a case there will be no detailed design in preparing bidding documents but basic design only and also there will be neither intensive inspection nor approval works on the client side during the construction period, the organization for project implementation will, therefore, be rather small. The organisation of the project implementation including higher government agencies which will be decision makers on the selection of contractor, supplier or concessionaire and the construction contractors, equipment supplier and terminal operator will be as shown in Figure 4.6.1.

(1) Tasks of Project Management Committee

The committee is the responsible body for proper and timely implementation of the project. The committee should have the right to make decisions to such extent that the appropriate progress of the project implementation is secured. Therefore, the members should be appointed from the managers of Namport. The members described in the Organization should be interpreted as the suggestion of JICA Study Team but should be officially appointed otherwise by Namport when it becomes necessary.

The committee should have the tasks as outlined below:

A) To prepare the bidding documents of:
- engineering services
- civil works contract
- building works contract
- procurement contract of cargo handling equipment and
- concession contract for terminal operation.

B) To select and conclude the various contracts with:
- engineering consultants
- civil works contractor
- building works contractor
- supplier of cargo handling equipment and
- terminal operator.

C) To monitor:
- quality
- progress

D) To approve design changes if necessary

E) To certify several payments like:
- advance payments
- progress payments
- final payments

F) To issue certificates for:
- completion of civil works
- completion of building works
- acceptance of cargo handling equipment

(2) Project Management Office

Project Management Office is the task-force of the Project Management Committee. The head of the office should be a member of the committee for smooth collaboration between these two organizations. The office should employ minimal engineering consultants to monitor the project implementation.

(3) Engineering Consultants

The contract engineer is necessary for the preparation of biding and contract documents including the basic or conceptual design drawings and contract administration like issuance of various certificates. In Section 4.5.2, the simplified TOR for employment of the consultants is described for reference.

Namport is recommended to start to employ the engineering consultants when preparation of the bidding documents for the civil works contract becomes necessary.

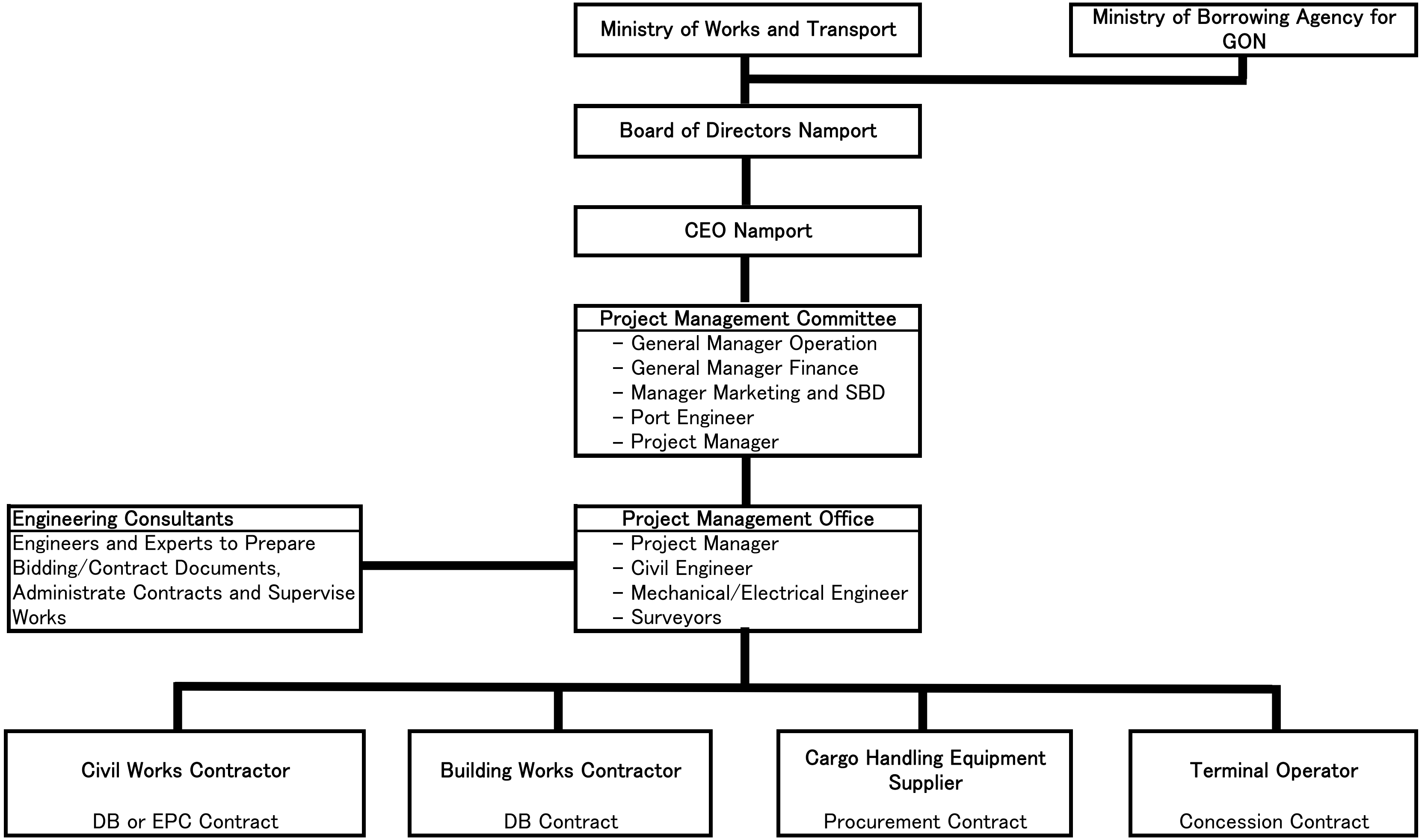


Figure 4.6.1 Organization of Project Implementation

4.7 Financial Analysis of Project

In this section, the financial feasibility of the new container terminal project is discussed and the financial statements for the project are concluded.

4.7.1 Scenario for Financial Analysis

For the analysis of the financial feasibility of the project, assumed are the following two scenarios:

Scenario A: Namport constructs the container terminal and operates the terminal by itself. Namport will gain income from the users.

Scenario B: Namport constructs the container terminal and entrusts the terminal operation to a private operator. Namport will gain income from the operator under a concession agreement. As there are many variations for the concession contract, the results presented in this report are preliminary and tentative. Therefore, they should not be interpreted as conclusive.

4.7.2 Operating Income

Income generated by the new container terminal consists basically of income chargeable on calling vessels and income from container handling. As the current capacity of this port is assumed 250,000TEU, surplus from 250,000 TEU in forecasted demand is accounted for operating income of this project.

The charges on calling ships, according to “Namibian Ports Authority Tariffs 2009” are simplified to the following items against all the container vessels using the new container terminal:

- Port dues: basic charge per 100 gross tonnage or part thereof per call N$ 88.60 PLUS per 100 GT (gross tonnage) or part thereof per 6 hour period or part there of N$ 6.90
- Light dues: per 100 GT per call N$16.50
- Dues against the following tariff items are levied per gross tonne of the calling vessels: Berthing Dues, Tugs/Craft Assistance and/or Attendance, Berthing Services, Pilot Services and Channel Levy.

On the assumptions that the ratio of calls of feeder vessels over those of mother container vessels is 3, the average capacities are 2,000 TEU and 4,250 TEU, respectively; the capacity and gross tonnage of the calling vessels are estimated at 2,562 TEU and 27,410 GT respectively. Thus, for computation purposes, the ship call is simplified that a hypothetical 27,400 GT container vessel will call to land and ship 800 TEU at each call to meet the annual throughput.

Dues for one call of a hypothetical 27,400 GT container vessels are tabulated below:

Table 4.7.1 Port Dues of Hypothetical 27,400 GT Container Vessel

Item	Unit	Rate (N$)	Quantity	Amount (N$)
Port Dues	100 GT	88.0	274	24,112.00
Light Dues	100 GT	16.5	274	4,521.00
Berthing Dues	6 hours 100 GT	28.1	11.1	14,243.89
Tugs/craft assistance and/or attendance	25,000 GT	18,535.0	2.0	38,318.00
	100 GT above 25,000 GT	26.0	24	
Berting Services	25,000 to 30,000 GT	3,779.0	2	7,558.00
Pilotage Services	25,000 to 30,000 GT	9,595.0	2	19,190.00
Channel Levy	m of ship length	8.0	250	2,000.00
Total for one hypothetical container vessel				109,942.89

Source: Estimated based on “Namibian Ports Authority Tariffs 2009” by JICA Study Team

Cargo handling charges levied on the containers to be handled to, from and at the new container terminal, also according to “Namibian Ports Authority Tariffs 2009” are simplified as tabulated below:

Table 4.7.2 Simplified Tariffs on Container Handling

(in N$)

Type of Containers		Land/Ship	Extra Storage Per Day	Reefer Storage Per Day	Base Tariff
Import/Export	20ft	715	66	32	2,563
	40ft	927	132	65	3,429
Transhipment	20ft	1,362	66	32	0
	40ft	2,145	132	65	0
Transit Inbound/Outbound	20ft	1,745	66	32	0
	40ft	3,203	132	65	0

Source: Namibian Ports Authority Tariffs 2009

The estimate is based on the following assumptions:

- Dwell time is assumed at 2 days for export/transit outbound containers, 5 days for import/transit inbound containers and 15 days for transship containers.
- Storage is free of charge for 3 days for import containers, 4 days for export containers and 10 days for transshipment.
- Land/Ship charge of inbound and outbound transit containers include both dry and reefer storage.
- Land/Ship charge of transshipment containers includes both landing and shipping.
- Base Tariff is computed on the assumption that all the import/export containers to/ from ports within the SACU Region is negligible.
- Empty container ratios for import/export containers are assumed at 14.6% and 66.1% respectively.
- Following surcharges are assumed negligible: IMDG and abnormal containers, transport within the harbour/terminal and outside the boundaries, reefer movement, late arrivals, etc.
- Chargeable storage of import containers is assumed at 2 days on average.
- Chargeable storage of export containers is assumed to be zero days on average. (Storage on average is 2 days.)
- Chargeable storage of transhipment containers is assumed to be 5 days on average. (Storage on average is 15 days).
- Storage surcharges of transhipment containers are taken to be those of the 11th to 14th days.

Details of operating income by year are summarized in the following table. As the forecasted demand of containers reaches the capacity of this container terminal in 2026, operating income after 2026 is same as that in 2026.

Table 4.7.3 Details of Operating Income

(in million N$)

	2015	16	17	18	19	20	21	22	23	24	25	26-
Base Tariff	26.1	30.8	35.8	41.0	46.4	52.0	56.8	61.7	66.8	72.1	77.6	86.5
Land/Ship	239.6	257.2	277.1	299.6	324.9	353.5	372.8	393.6	415.9	439.9	465.6	507.0
Extra Storage	57.5	58.5	59.6	60.8	62.0	63.2	64.4	65.7	67.1	68.5	70.0	72.4
Reefer	12.8	13.0	13.3	13.6	13.9	14.3	14.6	14.9	15.2	15.6	15.9	16.5
Port Dues	51.6	53.5	55.7	58.1	60.7	63.7	65.8	68.1	70.5	73.1	75.8	80.2
Total	387.5	413.2	441.6	473.0	508.0	546.7	574.5	604.0	635.5	669.1	705.0	762.5

Expected Income	Unit		2015	16	17	18	19	20
Base Tariff (Import 40)	3429	N$/box	9.33	11.01	12.76	14.60	16.51	18.51
Base Tariff (Import 20)	2563	N$/box	6.18	7.30	8.46	9.67	10.94	12.27
Base Tariff (Export 40)	3429	N$/box	6.37	7.54	8.76	10.04	11.38	12.78
Base Tariff (Export 20)	2563	N$/box	4.22	5.00	5.81	6.66	7.54	8.47
Land/Ship (Import 40)	927	N$/box	2.95	3.48	4.04	4.62	5.23	5.86
Land/Ship (Import 20)	715	N$/box	2.02	2.38	2.76	3.16	3.58	4.01
Land/Ship (Export 40)	927	N$/box	5.08	6.01	6.99	8.01	9.08	10.19
Land/Ship (Export 20)	715	N$/box	3.47	4.11	4.78	5.48	6.21	6.97
Land/Ship (Transit Inbound 40)	3203	N$/box	20.48	26.46	32.85	39.61	46.66	53.85
Land/Ship (Transit Inbound 20)	1745	N$/box	9.89	12.78	15.87	19.14	22.54	26.02
Land/Ship (Transit Outbound 40)	3203	N$/box	6.01	10.01	15.01	21.27	29.11	38.92
Land/Ship (Transit Outbound 20)	1745	N$/box	2.90	4.83	7.25	10.28	14.06	18.81
Land/Ship (Transhipment 40)	2145	N$/box	131.22	131.51	131.80	132.09	132.38	132.68
Land/Ship (Transhipment 20)	1362	N$/box	55.54	55.67	55.79	55.92	56.04	56.16
Extra Storage (Import 40)	132	N$/box	0.84	0.99	1.15	1.32	1.49	1.67
Extra Storage (Import 20)	66	N$/box	0.37	0.44	0.51	0.58	0.66	0.74
Extra Storage (Export 40)	132	N$/box	0.00	0.00	0.00	0.00	0.00	0.00
Extra Storage (Export 20)	66	N$/box	0.00	0.00	0.00	0.00	0.00	0.00
Extra Storage (Transit Inbound 40)	132	N$/box	1.69	2.18	2.71	3.27	3.85	4.44
Extra Storage (Transit Inbound 20)	66	N$/box	0.75	0.97	1.20	1.45	1.71	1.97
Extra Storage (Transit Outbound 40)	132	N$/box	0.00	0.00	0.00	0.00	0.00	0.00
Extra Storage (Transit Outbound 20)	66	N$/box	0.00	0.00	0.00	0.00	0.00	0.00
Extra Storage (Transhipment 40)	132	N$/box	40.37	40.46	40.55	40.64	40.73	40.82
Extra Storage (Transhipment 20)	66	N$/box	13.46	13.49	13.52	13.55	13.58	13.61
Reefer Ratio		15%						
Reefer (Import 40)	65	N$/box	0.16	0.18	0.21	0.24	0.27	0.31
Reefer (Import 20)	32	N$/box	0.07	0.08	0.09	0.11	0.12	0.13
Reefer (Export 40)	65	N$/box	0.11	0.13	0.15	0.17	0.19	0.21
Reefer (Export 20)	32	N$/box	0.05	0.06	0.06	0.07	0.08	0.09
Reefer (Transit Inbound 40)	65	N$/box	0.31	0.40	0.50	0.60	0.71	0.82
Reefer (Transit Inbound 20)	32	N$/box	0.14	0.18	0.22	0.26	0.31	0.36
Reefer (Transit Outbound 40)	65	N$/box	0.04	0.06	0.09	0.13	0.18	0.24
Reefer (Transit Outbound 20)	32	N$/box	0.02	0.03	0.04	0.06	0.08	0.10
Reefer (Transhipment 40)	65	N$/box	8.95	8.97	8.99	9.01	9.03	9.05
Reefer (Transhipment 20)	32	N$/box	2.94	2.94	2.95	2.96	2.96	2.97
Port Dues	109,943	N$/call	51.56	53.52	55.68	58.08	60.74	63.70

Expected Income	Unit		2021	22	23	24	25	26-
Base Tariff (Import 40)	3429	N$/box	20.17	21.89	23.67	25.51	27.42	30.48
Base Tariff (Import 20)	2563	N$/box	13.37	14.51	15.69	16.91	18.17	20.20
Base Tariff (Export 40)	3429	N$/box	13.99	15.24	16.53	17.88	19.27	21.51
Base Tariff (Export 20)	2563	N$/box	9.27	10.10	10.96	11.85	12.77	14.26
Land/Ship (Import 40)	927	N$/box	6.39	6.93	7.49	8.07	8.68	9.65
Land/Ship (Import 20)	715	N$/box	4.37	4.74	5.12	5.52	5.94	6.60
Land/Ship (Export 40)	927	N$/box	11.15	12.15	13.18	14.26	15.37	17.16
Land/Ship (Export 20)	715	N$/box	7.63	8.31	9.02	9.75	10.51	11.73
Land/Ship (Transit Inbound 40)	3203	N$/box	60.77	68.23	76.28	84.97	94.35	109.40
Land/Ship (Transit Inbound 20)	1745	N$/box	29.36	32.96	36.85	41.05	45.58	52.86
Land/Ship (Transit Outbound 40)	3203	N$/box	43.02	47.47	52.28	57.50	63.16	72.25
Land/Ship (Transit Outbound 20)	1745	N$/box	20.79	22.93	25.26	27.78	30.52	34.91
Land/Ship (Transhipment 40)	2145	N$/box	133.05	133.43	133.81	134.19	134.57	135.18
Land/Ship (Transhipment 20)	1362	N$/box	56.32	56.48	56.64	56.80	56.96	57.22
Extra Storage (Import 40)	132	N$/box	1.82	1.97	2.13	2.30	2.47	2.75
Extra Storage (Import 20)	66	N$/box	0.81	0.87	0.95	1.02	1.10	1.22
Extra Storage (Export 40)	132	N$/box	0.00	0.00	0.00	0.00	0.00	0.00
Extra Storage (Export 20)	66	N$/box	0.00	0.00	0.00	0.00	0.00	0.00
Extra Storage (Transit Inbound 40)	132	N$/box	5.01	5.62	6.29	7.00	7.78	9.02
Extra Storage (Transit Inbound 20)	66	N$/box	2.22	2.49	2.79	3.11	3.45	4.00
Extra Storage (Transit Outbound 40)	132	N$/box	0.00	0.00	0.00	0.00	0.00	0.00
Extra Storage (Transit Outbound 20)	66	N$/box	0.00	0.00	0.00	0.00	0.00	0.00
Extra Storage (Transhipment 40)	132	N$/box	40.94	41.06	41.17	41.29	41.41	41.59
Extra Storage (Transhipment 20)	66	N$/box	13.65	13.69	13.72	13.76	13.80	13.86
	Reefer Ratio	15%						
Reefer (Import 40)	65	N$/box	0.34	0.36	0.39	0.42	0.46	0.51
Reefer (Import 20)	32	N$/box	0.15	0.16	0.17	0.19	0.20	0.22
Reefer (Export 40)	65	N$/box	0.23	0.26	0.28	0.30	0.32	0.36
Reefer (Export 20)	32	N$/box	0.10	0.11	0.12	0.13	0.14	0.16
Reefer (Transit Inbound 40)	65	N$/box	0.92	1.04	1.16	1.29	1.44	1.67
Reefer (Transit Inbound 20)	32	N$/box	0.40	0.45	0.51	0.56	0.63	0.73
Reefer (Transit Outbound 40)	65	N$/box	0.26	0.29	0.32	0.35	0.38	0.44
Reefer (Transit Outbound 20)	32	N$/box	0.11	0.13	0.14	0.15	0.17	0.19
Reefer (Transhipment 40)	65	N$/box	9.07	9.10	9.12	9.15	9.18	9.22
Reefer (Transhipment 20)	32	N$/box	2.98	2.99	2.99	3.00	3.01	3.02
Port Dues	109,943	N$/call	65.83	68.09	70.50	73.06	75.78	80.16

Source: JICA Study Team

4.7.3 Results of Financial Analysis

(1) Opportunity Cost of Capital

The Namibia government issues several kinds of government bonds. One of them is the “GC24”. GC24 stands for “Government Internal Registered Stock Matured in 2024”. As the GC24 is currently the longest term bond among available government bonds in Namibia, it is assumed that the interest rate of GC24 is the best indicator of the opportunity cost of capital. The interest rate of GC24 is 10.5%.[2] Therefore, 10.5% is assumed as the opportunity cost of capital for this financial analysis.

(2) Results of FIRR Calculation (Scenario A)

By utilizing the construction cost mentioned in 4.5, and the operating income mentioned in 4.7.2, FIRR (Financial internal rate of return) can be estimated. Project evaluation period is 33 years, from 2010 to 2045. 35 years consist of 5 years for construction and 30 years for operation, the period of normal operation for port facilities.

10% of construction cost is added to the construction cost as a physical contingency, as with administration cost. The total amount is used as project cost in this financial analysis. Total project cost is N$ 2,748.75 million. This amount does not include inflation.

The FIRR in the case of Scenario A is **11.52%**.

Following table shows the cost and revenue of each year in the case of Scenario A.

In the case of Scenario A, the FIRR is larger than the opportunity cost of capital, 10.5%. Therefore, it is concluded that this new container terminal project is financially feasible.

[2] Source: Annual report 2008, Bank of Namibia, p. 206

Table 4.7.4 Cost and Revenue by year (FIRR of Scenario A)

Operaton Year						1	2	3	4	5	6	7	8	9	10	11	12
Calender Year	**2010**	**2011**	**2012**	**2013**	**2014**	**2015**	**2016**	**2017**	**2018**	**2019**	**2020**	**2021**	**2022**	**2023**	**2024**	**2025**	**2026**
Cost																	
Initial Investment, Expansion	0.00	8.77	167.27	816.50	1584.34	171.88	0.00	0.00	0.00								
O&M Expenses						160.26	165.65	169.86	175.36	178.04	185.29	187.53	188.89	190.46	192.15	193.81	196.47
Additional Investment						55.60	3.57	116.15	30.13	155.94	27.72	19.55	23.12	7.59	34.39	10.01	3.57
Total Cost	-	8.77	167.27	816.50	1,584.34	387.74	169.21	286.01	205.49	333.98	213.00	207.08	212.00	198.05	226.54	203.81	200.03
Revenue																	
Base Tariff						26.10	30.84	35.80	40.97	46.38	52.04	56.80	61.73	66.84	72.14	77.63	86.45
Land/Ship						239.57	257.25	277.15	299.57	324.88	353.47	372.85	393.63	415.95	439.91	465.64	506.95
Extra Storage						57.48	58.53	59.64	60.80	62.01	63.25	64.44	65.71	67.05	68.48	70.00	72.44
Reefer						12.76	13.02	13.30	13.61	13.93	14.28	14.57	14.88	15.21	15.55	15.92	16.51
Port Dues						51.56	53.52	55.68	58.08	60.74	63.70	65.83	68.09	70.50	73.06	75.78	80.16
Total Revenue	0.00	0.00	0.00	0.00	0.00	387.48	413.16	441.57	473.04	507.95	546.74	574.49	604.04	635.55	669.14	704.98	762.52
NET INCOME	-	(8.77)	(167.27)	(816.50)	(1,584.34)	(0.26)	243.95	155.56	267.55	173.97	333.74	367.41	392.04	437.49	442.60	501.16	562.49

Year	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30
	2027	**2028**	**2029**	**2030**	**2031**	**2032**	**2033**	**2034**	**2035**	**2036**	**2037**	**2038**	**2039**	**2040**	**2041**	**2042**	**2043**	**2044**
Cost																		
Initial Investment, Expansion																		
O&M Expenses	196.47	196.47	196.47	196.47	196.47	196.47	196.47	196.47	196.47	196.47	196.47	196.47	196.47	196.47	196.47	196.47	196.47	196.47
Additional Investment	3.57	23.58	172.85	60.49	3.57	301.30	28.98	94.76	136.97	9.20	95.57	20.24	4.72	7.59	4.83	20.82	14.49	0.00
Total Cost	200.03	220.04	369.31	256.96	200.03	497.77	225.45	291.23	333.43	205.67	292.03	216.71	201.18	204.06	201.30	217.28	210.96	196.47
Revenue																		
Base Tariff	86.45	86.45	86.45	86.45	86.45	86.45	86.45	86.45	86.45	86.45	86.45	86.45	86.45	86.45	86.45	86.45	86.45	86.45
Land/Ship	506.95	506.95	506.95	506.95	506.95	506.95	506.95	506.95	506.95	506.95	506.95	506.95	506.95	506.95	506.95	506.95	506.95	506.95
Extra Storage	72.44	72.44	72.44	72.44	72.44	72.44	72.44	72.44	72.44	72.44	72.44	72.44	72.44	72.44	72.44	72.44	72.44	72.44
Reefer	16.51	16.51	16.51	16.51	16.51	16.51	16.51	16.51	16.51	16.51	16.51	16.51	16.51	16.51	16.51	16.51	16.51	16.51
Port Dues	80.16	80.16	80.16	80.16	80.16	80.16	80.16	80.16	80.16	80.16	80.16	80.16	80.16	80.16	80.16	80.16	80.16	80.16
Total Revenue	762.52	762.52	762.52	762.52	762.52	762.52	762.52	762.52	762.52	762.52	762.52	762.52	762.52	762.52	762.52	762.52	762.52	762.52
NET INCOME	562.49	542.48	393.21	505.56	562.49	264.75	537.07	471.29	429.09	556.85	470.49	545.81	561.34	558.46	561.22	545.24	551.56	566.05
FIRR	**11.52%**																	

Source: JICA Study Team

(3) Result of FIRR Calculation (Scenario B)

In the case of scenario B, Namport will receive concessions from the private operator. The amount of concession can vary tremendously according to the contract between a private operator and Namport. In this analysis, results of 2 cases are shown for Scenario B.

First case is the case that Namport gains concessions from a private operator to cover only the necessary cost of this project. The amount of concession is assumed to be 287.68 million N$/year for 30 years, from 2015 to 2044. This amount is estimated based on the following assumptions.

- The amount of concession is set under the assumption that the amount covers the necessary items related to the operation of this project for Namport.
- The items are (i) payment from Namport during construction, (ii) additional investment, (iii) total debt payment (include principal payment and interest), and (iv) operation and maintenance cost. The total of these items are divided by 30 years to gain the amount of concession.
- Total debt payment is estimated assuming the case that all construction cost is procured by ODA-loan (general condition, normal, see 4.7.4 (1)).
- Additional investments are made as the equipment develops or is replaced during the operation. The amount is the same as conducted in Scenario A.
- Operation and maintenance cost in this scenario is different from the cost in Scenario A. The items included in operations and maintenance costs are staff cost (1 manager and 3 administration staffs), maintenance cost for cargo handling equipment (2% of initial purchase cost), maintenance cost for civil works, infrastructure, building (1.50% of initial purchase cost), and general administration cost (same as Scenario A).

In this case, it is assumed that Namport does not pursue profit from this project. Therefore, FIRR becomes **3.98%**, lower than the opportunity cost of capital.

That being said, it must be restated that the contractual stipulations of a concessionary contract are key to the financial viability of this case. If the contract is written in such a way as to bring the FIRR over the hurdle rate (opportunity cost of capital) of 10.5%, and assuming that there are no significant capital constraints and that Namport is trying to maximize return for its stakeholders, Scenario A and Scenario B should be compared using NPV analysis and not FIRR analysis since they are mutually exclusive to one another—i.e. depending on the financial structuring, Scenario A with a higher FIRR could actually have a lower overall profit than Scenario B with a lower FIRR.

The other case is the case that Namport gains concessions 27% of operating income, in addition to the necessary cost of this project. In this case FIRR becomes **10.66%**, higher than the opportunity cost of capital.

(4) Results of Other Financial Indicators (Scenario A)

The Study Team conduct further financial analysis by utilizing other indicators, NPV (Net Present Value) and B/C. In these calculation, opportunity cost of capital, 10.5%, is utilized as a discount rate.

The NPV in the case of Scenario A is **N$ 192.16 million** as of 2009.

In the case of Scenario A, the NPV is larger than 0. Therefore, it is concluded that this new container terminal project is financially feasible.

The B/C in the case of Scenario A is **1.06**.

In the case of Scenario A, the B/C is larger than 1. Therefore, it is concluded that this new container terminal project is financially feasible.

(5) Sensitivity Analysis

For the results of FIRR and other financial indicators in the case of Scenario A shown above, the Study Team conducted a sensitivity analysis. The results are shown in the following tables. In this analysis, the cost and revenue changed from 80% (a 20% decrease) to 120% (a 20% increase) by 5% respectively.

Table 4.7.5 Results of Sensitivity Analysis (FIRR of Scenario A)

		Cost								
		−20%	−15%	−10%	−5%	0%	5%	10%	15%	20%
Income	20%	18.97%	17.75%	16.63%	15.61%	14.67%	13.80%	12.99%	12.23%	11.52%
	15%	18.11%	16.91%	15.83%	14.83%	13.91%	13.06%	12.26%	11.52%	10.81%
	10%	17.23%	16.07%	15.01%	14.03%	13.13%	12.30%	11.52%	10.78%	10.09%
	5%	16.33%	15.20%	14.17%	13.22%	12.34%	11.52%	10.75%	10.02%	9.34%
	0%	15.42%	14.32%	13.31%	12.38%	11.52%	10.71%	9.95%	9.24%	8.57%
	−5%	14.49%	13.41%	12.43%	11.52%	10.67%	9.88%	9.13%	8.43%	7.76%
	−10%	13.53%	12.48%	11.52%	10.62%	9.79%	9.01%	8.28%	7.58%	6.92%
	−15%	12.54%	11.52%	10.57%	9.70%	8.88%	8.11%	7.39%	6.69%	6.04%
	−20%	11.52%	10.52%	9.59%	8.73%	7.93%	7.17%	6.44%	5.76%	5.10%

Source: JICA Study Team

Table 4.7.6 Results of Sensitivity Analysis (NPV of Scenario A)

(in million N$, as of 2009)

		Cost								
		−20%	−15%	−10%	−5%	0%	5%	10%	15%	20%
Income	20%	1,440	1,289	1,138	987	835	684	533	382	231
	15%	1,279	1,128	977	826	675	523	372	221	70
	10%	1,119	967	816	665	514	363	211	60	-91
	5%	958	807	655	504	353	202	51	-101	-252
	0%	797	646	495	343	192	41	-110	-261	-413
	−5%	636	485	334	183	31	-120	-271	-422	-573
	−10%	475	324	173	22	-129	-281	-432	-583	-734
	−15%	315	163	12	-139	-290	-441	-593	-744	-895
	−20%	154	3	-149	-300	-451	-602	-753	-905	-1,056

Source: JICA Study Team

Table 4.7.7 Results of Sensitivity Analysis (B/C of Scenario A)

		Cost								
		−20%	−15%	−10%	−5%	0%	5%	10%	15%	20%
Income	20%	1.60	1.50	1.42	1.34	1.28	1.22	1.16	1.11	1.06
	15%	1.53	1.44	1.36	1.29	1.22	1.16	1.11	1.06	1.02
	10%	1.46	1.38	1.30	1.23	1.17	1.11	1.06	1.02	0.97
	5%	1.40	1.31	1.24	1.18	1.12	1.06	1.02	0.97	0.93
	0%	1.33	1.25	1.18	1.12	1.06	1.01	0.97	0.92	0.89
	−5%	1.26	1.19	1.12	1.06	1.01	0.96	0.92	0.88	0.84
	−10%	1.20	1.13	1.06	1.01	0.96	0.91	0.87	0.83	0.80
	−15%	1.13	1.06	1.00	0.95	0.90	0.86	0.82	0.79	0.75
	−20%	1.06	1.00	0.95	0.90	0.85	0.81	0.77	0.74	0.71

Source: JICA Study Team

Cells in blue indicate feasible cases for the project.

4.7.4 Assumptions for Forecast Financial Statements

(1) ODA-Loan

The interest rates and repayment periods of ODA-loans are determined by the government of Japan, based on the income level of the borrower country. Namibia belongs to the "Upper Middle-Income Countries" category, and the conditions for Namibia are defined as follows as of June 2009.

Table 4.7.8 Conditions of ODA-loan for Namibia Walvis Bay Container Terminal Project

Type		Concessionary Interest Rate (%)	Repayment Period (years)	Grace Period (years)	Procurement Condition
General Condition	Normal	1.70	25	7	General Untide
	Option 1	0.60	20	6	
	Option 2	1.50	15	5	

Source: Website of JICA, http://www.jica.go.jp/activities/schemes/finance_co/about/standard/index.html
Note: Interest rate for consulting service portion is 0.01%. Conditions of repayment period and grace period are same as those for main portion.
STEP stands for "Special Terms for Economic Partnership".

The ODA-loan can cover every initial contraction cost except land expropriation cost and taxes. If the general condition is applied, maximum financing is less than 85% of total project cost. Therefore, in this analysis, it is assumed that taxes, interest during construction, and administration cost are covered by Namport.

Even if there are several options for each type of ODA-loan, it is assumed that the "Normal" case applies for each type of ODA-loan in this financial analysis

(2) Other Financing Sources

Currently, many donors are interested in investing in this project. They are International Finance Corporation (IFC), KfW, European Investment Bank, and so on. So far, Namport has not decided anything concerning the financing sources of this project.

Referring to the conditions of the donors other than JICA, it is assumed that conditions of other public financing sources than ODA-loan are as follows.

- Interest rate: 8.5%
- Repayment period: 15 years
- Grace period: 3 years
- Commitment charge: 0.1%

The government of Namibia will not invest in this project. The government will provide Namport with only a guarantee to assist in setting up financing sources.

(3) Cases for Forecast Financial Statements

As mentioned above, many donors have approached Namport for the investment of this project, and Namport is currently considering the best combination of financing sources for this project. Therefore, several cases can be assumed in this analysis. Two categories (civil work & facilities and equipment) are assumed for this project, and it is assumed that different donors can invest separately.

Civil work and facilities include costs of the following items.

- Mobilization, temporary facilities, etc
- Dredging and reclamation
- Quay wall
- Terminal Yard
- Access causeway

Equipment includes costs of following items.

- Building works
- Container handling equipment
- Terminal operation system
- Power supply facilities, including substations

It is assumed that cost for the consulting service be financed by ODA-loan in any cases.

The cases for this analysis are summarized in the following table.

Table 4.7.9 Cases for Forecasted Financial Statements

	Case 1	**Case 2**	**Case 3**
Civil work & facilities	ODA-loan	ODA-loan	Other Source
Equipment	ODA-loan	Other Source	ODA-loan

Source: JICA Study Team

(4) Assumptions about Financial Statements

- 35% of profit is collected as tax for the government[3].
- One-third of profit after tax is supplied as dividend[4].
- Depreciation is set on a straight-line basis, according to the current financial scheme of Namport.[5] Its period is assumed to be 30 years for the assets of this project. Salvage value is 0 for all assets.
- It is assumed that the price escalation for local portion is assumed to be 0% and that price escalation for foreign portion is assumed to be 3.1%. Revenues and costs will escalate as the inflation progresses. Base date of the price escalation is April, 2010.
- Average interest rate for cash balance is assumed to be 8%.
- 5% of payment for ODA-loan is earmarked for foreign exchange risk of payment.

4.7.5 Forecast Financial Statements of the Project

In the following analysis, financial statements are shown according to scenario A, the case that Namport operates the container terminal by itself.

[3] Source: Interview with Mr. Van der Merwe (Group Executive of Finance, Namport) and Mr. !Hanabeb (Manager of Finance, Namport) in May, 2009
[4] Source: Interview with Mr. Van der Merwe (Group Executive of Finance, Namport) and Mr. !Hanabeb (Manager of Finance, Namport) in May, 2009
[5] Annual report 2008, Namport, p38.

(1) Income Statement

The results in each case are shown in the following tables.

Table 4.7.10 Income Statement (Case 1)

(million N$)														
Financial Year Begins	**1-Sep-14**	**1-Sep-15**	**1-Sep-16**	**1-Sep-17**	**1-Sep-18**	**1-Sep-19**	**1-Sep-20**	**1-Sep-21**	**1-Sep-22**	**1-Sep-23**	**1-Sep-24**	**1-Sep-25**	**1-Sep-26**	**1-Sep-27**
Financial Year Ends	**31-Aug-15**	**31-Aug-16**	**31-Aug-17**	**31-Aug-18**	**31-Aug-19**	**31-Aug-20**	**31-Aug-21**	**31-Aug-22**	**31-Aug-23**	**31-Aug-24**	**31-Aug-25**	**31-Aug-26**	**31-Aug-27**	**31-Aug-28**
Year	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**13**	**14**
No. of Months	**12**	**12**	**12**	**12**	**12**	**12**	**12**	**12**	**12**	**12**	**12**	**12**	**12**	**12**
OPERATING REVENUE														
Base Tariff	20	35	42	50	59	68	77	87	97	108	120	136	145	149
Land/Ship	188	301	334	372	416	466	512	557	606	661	721	803	850	877
Extra Storage	45	70	73	77	81	85	89	94	99	104	110	117	121	125
Reefer	10	16	16	17	18	19	20	21	22	24	25	27	28	29
Port Dues	40	63	68	73	79	85	91	97	103	111	118	128	134	139
Total Revenue	**303**	**485**	**534**	**589**	**652**	**723**	**789**	**856**	**928**	**1,007**	**1,094**	**1,210**	**1,279**	**1,318**
OPERATING EXPENSES														
Staff Cost	60	91	94	95	95	95	95	95	95	95	95	95	95	95
Energy Cost	6	10	11	12	14	15	17	18	19	20	22	24	25	25
Maintenance Cost	45	71	74	80	85	93	99	103	106	109	113	116	120	124
General Administration Cost	3	4	4	4	4	4	4	4	4	5	5	5	5	5
Total Expenses	**114**	**176**	**183**	**191**	**197**	**207**	**215**	**220**	**224**	**229**	**235**	**240**	**245**	**249**
NET OPERATING INCOME	**190**	**309**	**352**	**399**	**455**	**516**	**574**	**636**	**703**	**778**	**859**	**969**	**1,034**	**1,070**
NON-OPERATING REVENUES														
Interest on Cash Balance -	0	3	2	2	-	-	-	2	5	8	13	18	24	30
Total Non-operating Revenues	**0**	**3**	**2**	**2**	**-**	**-**	**-**	**2**	**5**	**8**	**13**	**18**	**24**	**30**
NON-OPERATING EXPENSES														
Payment for principal and Interest Expenses on Debts	38	43	112	180	177	175	173	170	168	166	163	161	158	156
Forex Losses on Debt Servicing	2	2	6	9	9	9	9	9	8	8	8	8	8	8
Total Non-Operating Expenses	**40**	**45**	**118**	**189**	**186**	**184**	**181**	**179**	**176**	**174**	**171**	**169**	**166**	**164**
PROFIT BEFORE DEPRE & TAX	150	268	236	212	269	332	393	460	533	612	700	819	892	936
Depreciation	100	101	105	107	113	115	116	117	117	119	119	120	120	121
PROFIT BEFORE TAX	50	167	131	105	155	218	278	343	415	493	581	699	772	815
Corporate Tax	18	59	46	37	54	76	97	120	145	173	203	245	270	285
PROFIT AFTER TAX	33	109	85	68	101	141	181	223	270	321	378	454	502	530
APPROPRIATIONS														
Dividends Distributed	11	36	28	23	34	47	60	74	90	107	126	151	167	177
RETAINED EARNINGS														
Retained Earnings	22	72	57	46	67	94	120	149	180	214	252	303	335	353
Cumulative Retained Earnings	22	94	151	196	264	358	478	627	807	1,021	1,272	1,575	1,910	2,263

(million N$)														
Financial Year Begins	**1-Sep-28**	**1-Sep-29**	**1-Sep-30**	**1-Sep-31**	**1-Sep-32**	**1-Sep-33**	**1-Sep-34**	**1-Sep-35**	**1-Sep-36**	**1-Sep-37**	**1-Sep-38**	**1-Sep-39**	**1-Sep-40**	**1-Sep-41**
Financial Year Ends	**31-Aug-29**	**31-Aug-30**	**31-Aug-31**	**31-Aug-32**	**31-Aug-33**	**31-Aug-34**	**31-Aug-35**	**31-Aug-36**	**31-Aug-37**	**31-Aug-38**	**31-Aug-39**	**31-Aug-40**	**31-Aug-41**	**31-Aug-42**
Year	**15**	**16**	**17**	**18**	**19**	**20**	**21**	**22**	**23**	**24**	**25**	**26**	**27**	**28**
No. of Months	**12**	**12**	**12**	**12**	**12**	**12**	**12**	**12**	**12**	**12**	**12**	**12**	**12**	**12**
OPERATING REVENUE														
Base Tariff	154	159	164	169	174	180	185	191	197	203	209	216	222	229
Land/Ship	904	932	961	990	1,021	1,053	1,085	1,119	1,154	1,190	1,227	1,265	1,304	1,344
Extra Storage	129	133	137	142	146	150	155	160	165	170	175	181	186	192
Reefer	29	30	31	32	33	34	35	36	38	39	40	41	42	44
Port Dues	143	147	152	157	161	166	172	177	182	188	194	200	206	213
Total Revenue	**1,359**	**1,401**	**1,445**	**1,490**	**1,536**	**1,584**	**1,633**	**1,683**	**1,736**	**1,789**	**1,845**	**1,902**	**1,961**	**2,022**
OPERATING EXPENSES														
Staff Cost	95	95	95	95	95	95	95	95	95	95	95	95	95	95
Energy Cost	25	25	25	25	25	25	25	25	25	25	25	25	25	25
Maintenance Cost	128	131	136	140	144	149	153	158	163	168	173	178	184	190
General Administration Cost	5	5	5	5	5	5	5	5	5	5	5	5	5	5
Total Expenses	**252**	**256**	**260**	**265**	**269**	**273**	**278**	**283**	**288**	**293**	**298**	**303**	**309**	**315**
NET OPERATING INCOME	**1,107**	**1,145**	**1,184**	**1,225**	**1,267**	**1,310**	**1,355**	**1,401**	**1,448**	**1,497**	**1,547**	**1,599**	**1,652**	**1,707**
NON-OPERATING REVENUES														
Interest on Cash Balance	31	37	45	42	50	55	62	76	87	102	119	135	153	170
Total Non-operating Revenues	**31**	**37**	**45**	**42**	**50**	**55**	**62**	**76**	**87**	**102**	**119**	**135**	**153**	**170**
NON-OPERATING EXPENSES														
Payment for principal and Interest Expenses on Debts	154	151	149	147	144	142	70	0	0	0	0	0	0	0
Forex Losses on Debt Servicing	8	8	7	7	7	7	4	0	0	0	0	0	0	0
Total Non-Operating Expenses	**161**	**159**	**156**	**154**	**151**	**149**	**74**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
PROFIT BEFORE DEPRE & TAX	977	1,023	1,073	1,113	1,165	1,217	1,343	1,477	1,535	1,599	1,665	1,734	1,805	1,877
Depreciation	131	135	135	154	156	163	172	173	180	181	182	182	183	185
PROFIT BEFORE TAX	846	888	938	959	1,009	1,054	1,171	1,304	1,355	1,418	1,484	1,552	1,622	1,693
Corporate Tax	296	311	328	336	353	369	410	456	474	496	519	543	568	592
PROFIT AFTER TAX	550	577	609	623	656	685	761	848	881	921	964	1,009	1,054	1,100
APPROPRIATIONS														
Dividends Distributed	183	192	203	208	219	228	254	283	294	307	321	336	351	367
RETAINED EARNINGS														
Retained Earnings	366	385	406	415	437	457	507	565	587	614	643	672	703	734
Cumulative Retained Earnings	2,629	3,014	3,421	3,836	4,273	4,730	5,237	5,803	6,390	7,004	7,647	8,319	9,022	9,756

Source: JICA Study Team

Table 4.7.11 Income Statement (Case 2)

(million N$)																												
Financial Year Begins	**1-Sep-14**	**1-Sep-15**	**1-Sep-16**	**1-Sep-17**	**1-Sep-18**	**1-Sep-19**	**1-Sep-20**	**1-Sep-21**	**1-Sep-22**	**1-Sep-23**	**1-Sep-24**	**1-Sep-25**	**1-Sep-26**	**1-Sep-27**	**1-Sep-28**	**1-Sep-29**	**1-Sep-30**	**1-Sep-31**	**1-Sep-32**	**1-Sep-33**	**1-Sep-34**	**1-Sep-35**	**1-Sep-36**	**1-Sep-37**	**1-Sep-38**	**1-Sep-39**	**1-Sep-40**	**1-Sep-41**
Financial Year Ends	**31-Aug-15**	**31-Aug-16**	**31-Aug-17**	**31-Aug-18**	**31-Aug-19**	**31-Aug-20**	**31-Aug-21**	**31-Aug-22**	**31-Aug-23**	**31-Aug-24**	**31-Aug-25**	**31-Aug-26**	**31-Aug-27**	**31-Aug-28**	**31-Aug-29**	**31-Aug-30**	**31-Aug-31**	**31-Aug-32**	**31-Aug-33**	**31-Aug-34**	**31-Aug-35**	**31-Aug-36**	**31-Aug-37**	**31-Aug-38**	**31-Aug-39**	**31-Aug-40**	**31-Aug-41**	**31-Aug-42**
Year	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**13**	**14**	**15**	**16**	**17**	**18**	**19**	**20**	**21**	**22**	**23**	**24**	**25**	**26**	**27**	**28**
No. of Months	**12**	**12**	**12**	**12**	**12**	**12**	**12**	**12**	**12**	**12**	**12**	**12**	**12**	**12**	**12**	**12**	**12**	**12**	**12**	**12**	**12**	**12**	**12**	**12**	**12**	**12**	**12**	**12**
OPERATING REVENUE																												
Base Tariff	20	35	42	50	59	68	77	87	97	108	120	136	145	149	154	159	164	169	174	180	185	191	197	203	209	216	222	229
Land/Ship	188	301	334	372	416	466	512	557	606	661	721	803	850	877	904	932	961	990	1,021	1,053	1,085	1,119	1,154	1,190	1,227	1,265	1,304	1,344
Extra Storage	45	70	73	77	81	85	89	94	99	104	110	117	121	125	129	133	137	142	146	150	155	160	165	170	175	181	186	192
Reefer	10	16	16	17	18	19	20	21	22	24	25	27	28	29	29	30	31	32	33	34	35	36	38	39	40	41	42	44
Port Dues	40	63	68	73	79	85	91	97	103	111	118	128	134	139	143	147	152	157	161	166	172	177	182	188	194	200	206	213
Total Revenue	**303**	**485**	**534**	**589**	**652**	**723**	**789**	**856**	**928**	**1,007**	**1,094**	**1,210**	**1,279**	**1,318**	**1,359**	**1,401**	**1,445**	**1,490**	**1,536**	**1,584**	**1,633**	**1,683**	**1,736**	**1,789**	**1,845**	**1,902**	**1,961**	**2,022**
OPERATING EXPENSES																												
Staff Cost	60	91	94	95	95	95	95	95	95	95	95	95	95	95	95	95	95	95	95	95	95	95	95	95	95	95	95	95
Energy Cost	6	10	11	12	14	15	17	18	19	20	22	24	25	25	25	25	25	25	25	25	25	25	25	25	25	25	25	25
Maintenance Cost	45	71	74	80	85	93	99	103	106	109	113	116	120	124	128	131	136	140	144	149	153	158	163	168	173	178	184	190
General Administration Cost	3	4	4	4	4	4	4	4	4	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5
Total Expenses	**114**	**176**	**183**	**191**	**197**	**207**	**215**	**220**	**224**	**229**	**235**	**240**	**245**	**249**	**252**	**256**	**260**	**265**	**269**	**273**	**278**	**283**	**288**	**293**	**298**	**303**	**309**	**315**
NET OPERATING INCOME	**190**	**309**	**352**	**399**	**455**	**516**	**574**	**636**	**703**	**778**	**859**	**969**	**1,034**	**1,070**	**1,107**	**1,145**	**1,184**	**1,225**	**1,267**	**1,310**	**1,355**	**1,401**	**1,448**	**1,497**	**1,547**	**1,599**	**1,652**	**1,707**
NON-OPERATING REVENUES																												
Interest on Cash Balance -	-	-	-	-	-	-	-	-	-	-	4	9	15	21	22	27	36	35	44	51	58	72	83	98	114	131	148	165
Total Non-operating Revenues	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**4**	**9**	**15**	**21**	**22**	**27**	**36**	**35**	**44**	**51**	**58**	**72**	**83**	**98**	**114**	**131**	**148**	**165**
NON-OPERATING EXPENSES																												
Payment for principal and Interest Expenses on Debts	102	136	181	226	220	214	208	203	197	191	185	180	174	168	162	133	106	105	103	101	50	(0)	(0)	(0)	(0)	(0)	(0)	(0)
Forex Losses on Debt Servicing	5	7	9	11	11	11	10	10	10	10	9	9	9	8	8	7	5	5	5	5	2	(0)	(0)	(0)	(0)	(0)	(0)	(0)
Total Non-Operating Expenses	**107**	**143**	**191**	**237**	**231**	**225**	**219**	**213**	**207**	**201**	**195**	**189**	**183**	**177**	**171**	**139**	**111**	**110**	**108**	**106**	**52**	**(0)**	**(0)**	**(0)**	**(0)**	**(0)**	**(0)**	**(0)**
PROFIT BEFORE DEPRE & TAX	83	166	161	162	224	291	356	423	497	577	669	790	866	914	958	1,033	1,109	1,150	1,203	1,254	1,360	1,472	1,531	1,595	1,661	1,730	1,801	1,873
Depreciation	100	101	105	107	113	115	116	117	117	119	119	120	120	121	131	135	135	154	156	163	172	173	180	181	182	182	183	185
PROFIT BEFORE TAX	(17)	66	56	55	110	176	240	306	380	458	549	670	747	793	827	898	974	996	1,047	1,092	1,188	1,300	1,351	1,413	1,479	1,547	1,618	1,688
Corporate Tax	-	23	19	19	39	62	84	107	133	160	192	235	261	277	289	314	341	349	366	382	416	455	473	495	518	542	566	591
PROFIT AFTER TAX	(17)	43	36	36	72	115	156	199	247	298	357	436	485	515	537	584	633	647	680	710	772	845	878	918	961	1,006	1,051	1,097
APPROPRIATIONS																												
Dividends Distributed	-	14	12	12	24	38	52	66	82	99	119	145	162	172	179	195	211	216	227	237	257	282	293	306	320	335	350	366
RETAINED EARNINGS																												
Retained Earnings	(17)	28	24	24	48	76	104	133	164	198	238	291	324	344	358	389	422	431	454	473	515	563	585	612	641	670	701	732
Cumulative Retained Earnings	(17)	11	36	59	107	184	288	420	585	783	1,021	1,312	1,635	1,979	2,337	2,726	3,148	3,580	4,033	4,507	5,021	5,584	6,170	6,782	7,423	8,094	8,795	9,526

Source: JICA Study Team

Table 4.7.12 Income Statement (Case 3)

(million N$)																												
Financial Year Begins	**1-Sep-14**	**1-Sep-15**	**1-Sep-16**	**1-Sep-17**	**1-Sep-18**	**1-Sep-19**	**1-Sep-20**	**1-Sep-21**	**1-Sep-22**	**1-Sep-23**	**1-Sep-24**	**1-Sep-25**	**1-Sep-26**	**1-Sep-27**	**1-Sep-28**	**1-Sep-29**	**1-Sep-30**	**1-Sep-31**	**1-Sep-32**	**1-Sep-33**	**1-Sep-34**	**1-Sep-35**	**1-Sep-36**	**1-Sep-37**	**1-Sep-38**	**1-Sep-39**	**1-Sep-40**	**1-Sep-41**
Financial Year Ends	**31-Aug-15**	**31-Aug-16**	**31-Aug-17**	**31-Aug-18**	**31-Aug-19**	**31-Aug-20**	**31-Aug-21**	**31-Aug-22**	**31-Aug-23**	**31-Aug-24**	**31-Aug-25**	**31-Aug-26**	**31-Aug-27**	**31-Aug-28**	**31-Aug-29**	**31-Aug-30**	**31-Aug-31**	**31-Aug-32**	**31-Aug-33**	**31-Aug-34**	**31-Aug-35**	**31-Aug-36**	**31-Aug-37**	**31-Aug-38**	**31-Aug-39**	**31-Aug-40**	**31-Aug-41**	**31-Aug-42**
Year	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**13**	**14**	**15**	**16**	**17**	**18**	**19**	**20**	**21**	**22**	**23**	**24**	**25**	**26**	**27**	**28**
No. of Months	**12**	**12**	**12**	**12**	**12**	**12**	**12**	**12**	**12**	**12**	**12**	**12**	**12**	**12**	**12**	**12**	**12**	**12**	**12**	**12**	**12**	**12**	**12**	**12**	**12**	**12**	**12**	**12**
OPERATING REVENUE																												
Base Tariff	20	35	42	50	59	68	77	87	97	108	120	136	145	149	154	159	164	169	174	180	185	191	197	203	209	216	222	229
Land/Ship	188	301	334	372	416	466	512	557	606	661	721	803	850	877	904	932	961	990	1,021	1,053	1,085	1,119	1,154	1,190	1,227	1,265	1,304	1,344
Extra Storage	45	70	73	77	81	85	89	94	99	104	110	117	121	125	129	133	137	142	146	150	155	160	165	170	175	181	186	192
Reefer	10	16	16	17	18	19	20	21	22	24	25	27	28	29	29	30	31	32	33	34	35	36	38	39	40	41	42	44
Port Dues	40	63	68	73	79	85	91	97	103	111	118	128	134	139	143	147	152	157	161	166	172	177	182	188	194	200	206	213
Total Revenue	**303**	**485**	**534**	**589**	**652**	**723**	**789**	**856**	**928**	**1,007**	**1,094**	**1,210**	**1,279**	**1,318**	**1,359**	**1,401**	**1,445**	**1,490**	**1,536**	**1,584**	**1,633**	**1,683**	**1,736**	**1,789**	**1,845**	**1,902**	**1,961**	**2,022**
OPERATING EXPENSES																												
Staff Cost	60	91	94	95	95	95	95	95	95	95	95	95	95	95	95	95	95	95	95	95	95	95	95	95	95	95	95	95
Energy Cost	6	10	11	12	14	15	17	18	19	20	22	24	25	25	25	25	25	25	25	25	25	25	25	25	25	25	25	25
Maintenance Cost	45	71	74	80	85	93	99	103	106	109	113	116	120	124	128	131	136	140	144	149	153	158	163	168	173	178	184	190
General Administration Cost	3	4	4	4	4	4	4	4	4	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5
Total Expenses	**114**	**176**	**183**	**191**	**197**	**207**	**215**	**220**	**224**	**229**	**235**	**240**	**245**	**249**	**252**	**256**	**260**	**265**	**269**	**273**	**278**	**283**	**288**	**293**	**298**	**303**	**309**	**315**
NET OPERATING INCOME	**190**	**309**	**352**	**399**	**455**	**516**	**574**	**636**	**703**	**778**	**859**	**969**	**1,034**	**1,070**	**1,107**	**1,145**	**1,184**	**1,225**	**1,267**	**1,310**	**1,355**	**1,401**	**1,448**	**1,497**	**1,547**	**1,599**	**1,652**	**1,707**
NON-OPERATING REVENUES																												
Interest on Cash Balance -	-	-	-	-	-	-	-	-	-	-	-	-	-	5	6	12	23	22	33	41	49	63	74	89	105	122	139	157
Total Non-operating Revenues	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**5**	**6**	**12**	**23**	**22**	**33**	**41**	**49**	**63**	**74**	**89**	**105**	**122**	**139**	**157**
NON-OPERATING EXPENSES																												
Payment for principal and Interest Expenses on Debts	204	267	279	290	280	269	259	248	238	227	217	206	196	185	175	107	46	46	45	44	22	0	0	0	0	0	0	0
Forex Losses on Debt Servicing	10	13	14	15	14	13	13	12	12	11	11	10	10	9	9	5	2	2	2	2	1	0	0	0	0	0	0	0
Total Non-Operating Expenses	**214**	**280**	**293**	**305**	**294**	**283**	**272**	**261**	**250**	**239**	**227**	**216**	**205**	**195**	**183**	**112**	**49**	**48**	**47**	**46**	**23**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
PROFIT BEFORE DEPRE & TAX	(24)	29	59	94	161	233	303	375	454	539	632	753	828	881	929	1,045	1,158	1,199	1,253	1,305	1,381	1,464	1,522	1,586	1,652	1,721	1,792	1,864
Depreciation	100	101	105	107	113	115	116	117	117	119	119	120	120	121	131	135	135	154	156	163	172	173	180	181	182	182	183	185
PROFIT BEFORE TAX	(124)	(72)	(46)	(12)	48	118	187	259	337	420	512	633	709	759	798	910	1,023	1,045	1,097	1,142	1,209	1,291	1,342	1,404	1,470	1,538	1,609	1,679
Corporate Tax	-	-	-	-	17	41	66	91	118	147	179	222	248	266	279	318	358	366	384	400	423	452	470	492	515	538	563	588
PROFIT AFTER TAX	(124)	(72)	(46)	(12)	31	77	122	168	219	273	333	412	461	494	519	591	665	679	713	743	786	839	873	913	956	1,000	1,046	1,091
APPROPRIATIONS																												
Dividends Distributed	-	-	-	-	10	26	41	56	73	91	111	137	154	165	173	197	222	226	238	248	262	280	291	304	319	333	349	364
RETAINED EARNINGS																												
Retained Earnings	(124)	(72)	(46)	(12)	21	51	81	112	146	182	222	274	307	329	346	394	443	453	475	495	524	559	582	609	637	667	697	728
Cumulative Retained Earnings	(124)	(196)	(242)	(255)	(234)	(183)	(102)	10	156	338	560	835	1,142	1,471	1,817	2,211	2,654	3,107	3,582	4,077	4,601	5,161	5,742	6,351	6,988	7,655	8,352	9,080

Source: JICA Study Team

(2) Cash Flow

The results in each case are shown in the following tables.

Table 4.7.13 Cash Flow (Case 1)

(milion N$) Financial Year Begins	1-Sep-14	1-Sep-15	1-Sep-16	1-Sep-17	1-Sep-18	1-Sep-19	1-Sep-20	1-Sep-21	1-Sep-22	1-Sep-23	1-Sep-24	1-Sep-25	1-Sep-26	1-Sep-27
Financial Year Ends	31-Aug-15	31-Aug-16	31-Aug-17	31-Aug-18	31-Aug-19	31-Aug-20	31-Aug-21	31-Aug-22	31-Aug-23	31-Aug-24	31-Aug-25	31-Aug-26	31-Aug-27	31-Aug-28
Year	1	2	3	4	5	6	7	8	9	10	11	12	13	14
SOURCES OF FUNDS														
Net Profit After Tax	33	109	85	68	101	141	181	223	270	321	378	454	502	530
Depreciation	100	101	105	107	113	115	116	117	117	119	119	120	120	121
Transfer from Cash Surplus	0	13	159	110	85	0	0	27	120	267	409	625	903	1,212
Total Sources of Funds	**132**	**222**	**350**	**285**	**299**	**256**	**296**	**367**	**508**	**707**	**906**	**1,199**	**1,524**	**1,863**
USES OF FUNDS														
Debt Repayment	0	0	69	139	139	139	139	139	139	139	139	139	139	139
Increase in Working Capital	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Transfer to Debt Service Reserve														
Additonal investment during operation	109	27	142	38	202	37	27	33	11	53	16	6	6	41
Dividend Distributed	11	36	28	23	34	47	60	74	90	107	126	151	167	177
Total Uses of Funds	**120**	**63**	**240**	**200**	**375**	**223**	**226**	**246**	**240**	**298**	**281**	**296**	**312**	**356**
NET CHANGES IN CASH BALANCE	13	159	110	85	(75)	33	70	120	267	409	625	903	1,212	1,507
Opening Balance of Cash	0	0	0	0	0	(75)	(42)	0	0	0	0	0	0	0
Closing Balance of Cash	13	159	110	85	(75)	(42)	27	120	267	409	625	903	1,212	1,507

(milion N$) Financial Year Begins	1-Sep-28	1-Sep-29	1-Sep-30	1-Sep-31	1-Sep-32	1-Sep-33	1-Sep-34	1-Sep-35	1-Sep-36	1-Sep-37	1-Sep-38	1-Sep-39	1-Sep-40	1-Sep-41
Financial Year Ends	31-Aug-29	31-Aug-30	31-Aug-31	31-Aug-32	31-Aug-33	31-Aug-34	31-Aug-35	31-Aug-36	31-Aug-37	31-Aug-38	31-Aug-39	31-Aug-40	31-Aug-41	31-Aug-42
Year	15	16	17	18	19	20	21	22	23	24	25	26	27	28
SOURCES OF FUNDS														
Net Profit After Tax	550	577	609	623	656	685	761	848	881	921	964	1,009	1,054	1,100
Depreciation	131	135	135	154	156	163	172	173	180	181	182	182	183	185
Transfer from Cash Surplus	1,507	1,564	1,835	2,231	2,087	2,484	2,771	3,095	3,812	4,368	5,116	5,929	6,765	7,639
Total Sources of Funds	**2,188**	**2,276**	**2,580**	**3,008**	**2,899**	**3,332**	**3,705**	**4,115**	**4,873**	**5,471**	**6,262**	**7,120**	**8,003**	**8,924**
USES OF FUNDS														
Debt Repayment	139	139	139	139	139	139	69	0	0	0	0	0	0	0
Increase in Working Capital	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Transfer to Debt Service Reserve														
Additonal investment during operation	302	109	7	574	57	194	287	20	212	47	11	19	12	55
Dividend Distributed	183	192	203	208	219	228	254	283	294	307	321	336	351	367
Total Uses of Funds	**624**	**441**	**349**	**921**	**415**	**561**	**610**	**303**	**505**	**355**	**333**	**355**	**364**	**422**
NET CHANGES IN CASH BALANCE	1,564	1,835	2,231	2,087	2,484	2,771	3,095	3,812	4,368	5,116	5,929	6,765	7,639	8,502
Opening Balance of Cash	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Closing Balance of Cash	1,564	1,835	2,231	2,087	2,484	2,771	3,095	3,812	4,368	5,116	5,929	6,765	7,639	8,502

Source: JICA Study Team

Table 4.7.14 Cash Flow (Case 2)

(milion N$) Financial Year Begins	1-Sep-14	1-Sep-15	1-Sep-16	1-Sep-17	1-Sep-18	1-Sep-19	1-Sep-20	1-Sep-21	1-Sep-22	1-Sep-23	1-Sep-24	1-Sep-25	1-Sep-26	1-Sep-27
Financial Year Ends	31-Aug-15	31-Aug-16	31-Aug-17	31-Aug-18	31-Aug-19	31-Aug-20	31-Aug-21	31-Aug-22	31-Aug-23	31-Aug-24	31-Aug-25	31-Aug-26	31-Aug-27	31-Aug-28
Year	1	2	3	4	5	6	7	8	9	10	11	12	13	14
SOURCES OF FUNDS														
Net Profit After Tax	(17)	43	36	36	72	115	156	199	247	298	357	436	485	515
Depreciation	100	101	105	107	113	115	116	117	117	119	119	120	120	121
Transfer from Cash Surplus	0	0	5	0	0	0	0	0	0	0	16	211	468	758
Total Sources of Funds	**83**	**143**	**146**	**143**	**185**	**229**	**272**	**316**	**364**	**416**	**492**	**766**	**1,073**	**1,395**
USES OF FUNDS														
Debt Repayment	24	48	97	147	147	147	147	147	147	147	147	147	147	147
Increase in Working Capital	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Transfer to Debt Service Reserve														
Additonal investment during operation	109	27	142	38	202	37	27	33	11	53	16	6	6	41
Dividend Distributed	0	14	12	12	24	38	52	66	82	99	119	145	162	172
Total Uses of Funds	**133**	**89**	**252**	**197**	**373**	**222**	**226**	**246**	**240**	**299**	**282**	**298**	**315**	**359**
NET CHANGES IN CASH BALANCE	(50)	55	(105)	(54)	(188)	7	45	69	123	118	211	468	758	1,036
Opening Balance of Cash	0	(50)	0	(105)	(159)	(347)	(340)	(295)	(225)	(102)	0	0	0	0
Closing Balance of Cash	(50)	5	(105)	(159)	(347)	(340)	(295)	(225)	(102)	16	211	468	758	1,036

(milion N$) Financial Year Begins	1-Sep-28	1-Sep-29	1-Sep-30	1-Sep-31	1-Sep-32	1-Sep-33	1-Sep-34	1-Sep-35	1-Sep-36	1-Sep-37	1-Sep-38	1-Sep-39	1-Sep-40	1-Sep-41
Financial Year Ends	31-Aug-29	31-Aug-30	31-Aug-31	31-Aug-32	31-Aug-33	31-Aug-34	31-Aug-35	31-Aug-36	31-Aug-37	31-Aug-38	31-Aug-39	31-Aug-40	31-Aug-41	31-Aug-42
Year	15	16	17	18	19	20	21	22	23	24	25	26	27	28
SOURCES OF FUNDS														
Net Profit After Tax	537	584	633	647	680	710	772	845	878	918	961	1,006	1,051	1,097
Depreciation	131	135	135	154	156	163	172	173	180	181	182	182	183	185
Transfer from Cash Surplus	1,036	1,076	1,368	1,819	1,732	2,185	2,528	2,878	3,594	4,148	4,894	5,705	6,539	7,411
Total Sources of Funds	**1,704**	**1,795**	**2,136**	**2,621**	**2,568**	**3,057**	**3,472**	**3,896**	**4,652**	**5,248**	**6,037**	**6,894**	**7,774**	**8,693**
USES OF FUNDS														
Debt Repayment	147	123	99	99	99	99	50	0	0	0	0	0	0	0
Increase in Working Capital	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Transfer to Debt Service Reserve														
Additonal investment during operation	302	109	7	574	57	194	287	20	212	47	11	19	12	55
Dividend Distributed	179	195	211	216	227	237	257	282	293	306	320	335	350	366
Total Uses of Funds	**628**	**427**	**317**	**889**	**383**	**529**	**594**	**302**	**504**	**354**	**332**	**354**	**363**	**421**
NET CHANGES IN CASH BALANCE	1,076	1,368	1,819	1,732	2,185	2,528	2,878	3,594	4,148	4,894	5,705	6,539	7,411	8,272
Opening Balance of Cash	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Closing Balance of Cash	1,076	1,368	1,819	1,732	2,185	2,528	2,878	3,594	4,148	4,894	5,705	6,539	7,411	8,272

Source: JICA Study Team

Table 4.7.15 Cash Flow (Case 3)

(milion N$)														
Financial Year Begins	**1-Sep-14**	**1-Sep-15**	**1-Sep-16**	**1-Sep-17**	**1-Sep-18**	**1-Sep-19**	**1-Sep-20**	**1-Sep-21**	**1-Sep-22**	**1-Sep-23**	**1-Sep-24**	**1-Sep-25**	**1-Sep-26**	**1-Sep-27**
Financial Year Ends	**31-Aug-15**	**31-Aug-16**	**31-Aug-17**	**31-Aug-18**	**31-Aug-19**	**31-Aug-20**	**31-Aug-21**	**31-Aug-22**	**31-Aug-23**	**31-Aug-24**	**31-Aug-25**	**31-Aug-26**	**31-Aug-27**	**31-Aug-28**
Year	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**13**	**14**
SOURCES OF FUNDS														
Net Profit After Tax	(124)	(72)	(46)	(12)	31	77	122	168	219	273	333	412	461	494
Depreciation	100	101	105	107	113	115	116	117	117	119	119	120	120	121
Transfer from Cash Surplus	0	0	0	0	0	0	0	0	0	0	0	0	0	14
Total Sources of Funds	**(24)**	**29**	**59**	**94**	**145**	**192**	**237**	**285**	**336**	**392**	**452**	**531**	**580**	**629**
USES OF FUNDS														
Debt Repayment	57	115	136	158	158	158	158	158	158	158	158	158	158	158
Increase in Working Capital	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Transfer to Debt Service Reserve														
Additonal investment during operation	109	27	142	38	202	37	27	33	11	53	16	6	6	41
Dividend Distributed	0	0	0	0	10	26	41	56	73	91	111	137	154	165
Total Uses of Funds	**166**	**141**	**278**	**196**	**371**	**221**	**226**	**247**	**242**	**302**	**285**	**301**	**317**	**363**
NET CHANGES IN CASH BALANCE	(190)	(112)	(219)	(102)	(226)	(29)	12	38	94	90	168	230	263	266
Opening Balance of Cash	0	(190)	(303)	(522)	(624)	(850)	(879)	(868)	(830)	(737)	(646)	(479)	(248)	0
Closing Balance of Cash	(190)	(303)	(522)	(624)	(850)	(879)	(868)	(830)	(737)	(646)	(479)	(248)	14	266

(milion N$)														
Financial Year Begins	**1-Sep-28**	**1-Sep-29**	**1-Sep-30**	**1-Sep-31**	**1-Sep-32**	**1-Sep-33**	**1-Sep-34**	**1-Sep-35**	**1-Sep-36**	**1-Sep-37**	**1-Sep-38**	**1-Sep-39**	**1-Sep-40**	**1-Sep-41**
Financial Year Ends	**31-Aug-29**	**31-Aug-30**	**31-Aug-31**	**31-Aug-32**	**31-Aug-33**	**31-Aug-34**	**31-Aug-35**	**31-Aug-36**	**31-Aug-37**	**31-Aug-38**	**31-Aug-39**	**31-Aug-40**	**31-Aug-41**	**31-Aug-42**
Year	**15**	**16**	**17**	**18**	**19**	**20**	**21**	**22**	**23**	**24**	**25**	**26**	**27**	**28**
SOURCES OF FUNDS														
Net Profit After Tax	519	591	665	679	713	743	786	839	873	913	956	1,000	1,046	1,091
Depreciation	131	135	135	154	156	163	172	173	180	181	182	182	183	185
Transfer from Cash Surplus	266	283	602	1,130	1,120	1,650	2,071	2,458	3,170	3,720	4,463	5,270	6,101	6,968
Total Sources of Funds	**916**	**1,009**	**1,402**	**1,964**	**1,989**	**2,555**	**3,029**	**3,470**	**4,223**	**4,815**	**5,600**	**6,453**	**7,329**	**8,244**
USES OF FUNDS														
Debt Repayment	158	101	43	43	43	43	22	0	0	0	0	0	0	0
Increase in Working Capital	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Transfer to Debt Service Reserve														
Additonal investment during operation	302	109	7	574	57	194	287	20	212	47	11	19	12	55
Dividend Distributed	173	197	222	226	238	248	262	280	291	304	319	333	349	364
Total Uses of Funds	**633**	**407**	**272**	**844**	**338**	**484**	**570**	**300**	**502**	**352**	**330**	**352**	**361**	**419**
NET CHANGES IN CASH BALANCE	283	602	1,130	1,120	1,650	2,071	2,458	3,170	3,720	4,463	5,270	6,101	6,968	7,825
Opening Balance of Cash	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Closing Balance of Cash	283	602	1,130	1,120	1,650	2,071	2,458	3,170	3,720	4,463	5,270	6,101	6,968	7,825

Source: JICA Study Team

(3) Balance Sheet

The results in each case are shown in the following tables.

Table 4.7.16 Balance Sheet (Case 1)

(million N$)														
Financial Year Begins	**1-Sep-14**	**1-Sep-15**	**1-Sep-16**	**1-Sep-17**	**1-Sep-18**	**1-Sep-19**	**1-Sep-20**	**1-Sep-21**	**1-Sep-22**	**1-Sep-23**	**1-Sep-24**	**1-Sep-25**	**1-Sep-26**	**1-Sep-27**
Financial Year Ends	**31-Aug-15**	**31-Aug-16**	**31-Aug-17**	**31-Aug-18**	**31-Aug-19**	**31-Aug-20**	**31-Aug-21**	**31-Aug-22**	**31-Aug-23**	**31-Aug-24**	**31-Aug-25**	**31-Aug-26**	**31-Aug-27**	**31-Aug-28**
Year	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**13**	**14**
ASSETS														
Fixed Assets														
Gross Block	2,994	3,021	3,163	3,201	3,404	3,441	3,468	3,502	3,513	3,565	3,581	3,587	3,593	3,634
Less: Accumulated Depreciation	100	201	306	413	526	641	756	873	990	1,109	1,228	1,348	1,468	1,589
Net Fixed Assets	2,895	2,821	2,857	2,789	2,878	2,800	2,712	2,628	2,523	2,456	2,353	2,239	2,125	2,045
Current Assets														
Working Capital	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Balance in NAMPORT Feed														
Cash Balance	13	159	110	85	(75)	(42)	27	120	267	409	625	903	1,212	1,507
Total Assets	***2,907***	***2,980***	***2,967***	***2,874***	***2,802***	***2,758***	***2,739***	***2,749***	***2,790***	***2,865***	***2,978***	***3,142***	***3,337***	***3,552***
LIABILITIES														
Shareholders Fund														
Shareholders Equity	386	386	386	386	386	386	386	386	386	386	386	386	386	386
Reserves& Surplus	22	94	151	196	264	358	478	627	807	1,021	1,272	1,575	1,910	2,263
Total Shareholders Fund	408	480	537	582	650	744	864	1,013	1,193	1,407	1,658	1,961	2,296	2,649
Senior Term Liabilities - Debt	2,500	2,500	2,430	2,291	2,153	2,014	1,875	1,736	1,597	1,458	1,319	1,180	1,042	903
Total Liabilities & Owners Equity	***2,907***	***2,980***	***2,967***	***2,874***	***2,802***	***2,758***	***2,739***	***2,749***	***2,790***	***2,865***	***2,978***	***3,142***	***3,337***	***3,552***

(million N$)														
Financial Year Begins	**1-Sep-28**	**1-Sep-29**	**1-Sep-30**	**1-Sep-31**	**1-Sep-32**	**1-Sep-33**	**1-Sep-34**	**1-Sep-35**	**1-Sep-36**	**1-Sep-37**	**1-Sep-38**	**1-Sep-39**	**1-Sep-40**	**1-Sep-41**
Financial Year Ends	**31-Aug-29**	**31-Aug-30**	**31-Aug-31**	**31-Aug-32**	**31-Aug-33**	**31-Aug-34**	**31-Aug-35**	**31-Aug-36**	**31-Aug-37**	**31-Aug-38**	**31-Aug-39**	**31-Aug-40**	**31-Aug-41**	**31-Aug-42**
Year	**15**	**16**	**17**	**18**	**19**	**20**	**21**	**22**	**23**	**24**	**25**	**26**	**27**	**28**
ASSETS														
Fixed Assets														
Gross Block	3,935	4,045	4,052	4,626	4,684	4,877	5,164	5,184	5,396	5,443	5,455	5,474	5,486	5,541
Less: Accumulated Depreciation	1,720	1,855	1,990	2,144	2,300	2,463	2,635	2,808	2,988	3,169	3,351	3,533	3,716	3,901
Net Fixed Assets	2,215	2,190	2,062	2,482	2,383	2,414	2,529	2,376	2,408	2,274	2,104	1,940	1,770	1,640
Current Assets														
Working Capital	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Balance in NAMPORT Feed														
Cash Balance	1,564	1,835	2,231	2,087	2,484	2,771	3,095	3,812	4,368	5,116	5,929	6,765	7,639	8,502
Total Assets	***3,779***	***4,025***	***4,293***	***4,569***	***4,868***	***5,186***	***5,623***	***6,189***	***6,776***	***7,390***	***8,033***	***8,705***	***9,408***	***10,142***
LIABILITIES														
Shareholders Fund														
Shareholders Equity	386	386	386	386	386	386	386	386	386	386	386	386	386	386
Reserves& Surplus	2,629	3,014	3,421	3,836	4,273	4,730	5,237	5,803	6,390	7,004	7,647	8,319	9,022	9,756
Total Shareholders Fund	3,015	3,400	3,807	4,222	4,659	5,116	5,623	6,189	6,776	7,390	8,033	8,705	9,408	10,142
Senior Term Liabilities - Debt	764	625	486	347	208	69	0	0	0	0	0	0	0	0
Total Liabilities & Owners Equity	***3,779***	***4,025***	***4,293***	***4,569***	***4,868***	***5,186***	***5,623***	***6,189***	***6,776***	***7,390***	***8,033***	***8,705***	***9,408***	***10,142***

Source: JICA Study Team

Table 4.7.17 Balance Sheet (Case 2)

(million N$)														
Financial Year Begins	**1-Sep-14**	**1-Sep-15**	**1-Sep-16**	**1-Sep-17**	**1-Sep-18**	**1-Sep-19**	**1-Sep-20**	**1-Sep-21**	**1-Sep-22**	**1-Sep-23**	**1-Sep-24**	**1-Sep-25**	**1-Sep-26**	**1-Sep-27**
Financial Year Ends	**31-Aug-15**	**31-Aug-16**	**31-Aug-17**	**31-Aug-18**	**31-Aug-19**	**31-Aug-20**	**31-Aug-21**	**31-Aug-22**	**31-Aug-23**	**31-Aug-24**	**31-Aug-25**	**31-Aug-26**	**31-Aug-27**	**31-Aug-28**
Year	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**13**	**14**
ASSETS														
Fixed Assets														
Gross Block	2,994	3,021	3,163	3,201	3,404	3,441	3,468	3,502	3,513	3,565	3,581	3,587	3,593	3,634
Less: Accumulated Depreciation	100	201	306	413	526	641	756	873	990	1,109	1,228	1,348	1,468	1,589
Net Fixed Assets	2,895	2,821	2,857	2,789	2,878	2,800	2,712	2,628	2,523	2,456	2,353	2,239	2,125	2,045
Current Assets														
Working Capital	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Balance in NAMPORT Feed														
Cash Balance	(50)	5	(105)	(159)	(347)	(340)	(295)	(225)	(102)	16	211	468	758	1,036
Total Assets	***2,845***	***2,826***	***2,752***	***2,629***	***2,530***	***2,460***	***2,417***	***2,403***	***2,421***	***2,472***	***2,563***	***2,707***	***2,884***	***3,080***
LIABILITIES														
Shareholders Fund														
Shareholders Equity	386	386	386	386	386	386	386	386	386	386	386	386	386	386
Reserves& Surplus	(17)	11	36	59	107	184	288	420	585	783	1,021	1,312	1,635	1,979
Total Shareholders Fund	369	397	422	445	493	570	674	806	971	1,169	1,407	1,698	2,021	2,365
Senior Term Liabilities - Debt	2,476	2,428	2,331	2,184	2,037	1,890	1,743	1,597	1,450	1,303	1,156	1,009	862	715
Total Liabilities & Owners Equity	***2,845***	***2,826***	***2,752***	***2,629***	***2,530***	***2,460***	***2,417***	***2,403***	***2,421***	***2,472***	***2,563***	***2,707***	***2,884***	***3,080***

(million N$)														
Financial Year Begins	**1-Sep-28**	**1-Sep-29**	**1-Sep-30**	**1-Sep-31**	**1-Sep-32**	**1-Sep-33**	**1-Sep-34**	**1-Sep-35**	**1-Sep-36**	**1-Sep-37**	**1-Sep-38**	**1-Sep-39**	**1-Sep-40**	**1-Sep-41**
Financial Year Ends	**31-Aug-29**	**31-Aug-30**	**31-Aug-31**	**31-Aug-32**	**31-Aug-33**	**31-Aug-34**	**31-Aug-35**	**31-Aug-36**	**31-Aug-37**	**31-Aug-38**	**31-Aug-39**	**31-Aug-40**	**31-Aug-41**	**31-Aug-42**
Year	**15**	**16**	**17**	**18**	**19**	**20**	**21**	**22**	**23**	**24**	**25**	**26**	**27**	**28**
ASSETS														
Fixed Assets														
Gross Block	3,935	4,045	4,052	4,626	4,684	4,877	5,164	5,184	5,396	5,443	5,455	5,474	5,486	5,541
Less: Accumulated Depreciation	1,720	1,855	1,990	2,144	2,300	2,463	2,635	2,808	2,988	3,169	3,351	3,533	3,716	3,901
Net Fixed Assets	2,215	2,190	2,062	2,482	2,383	2,414	2,529	2,376	2,408	2,274	2,104	1,940	1,770	1,640
Current Assets														
Working Capital	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Balance in NAMPORT Feed														
Cash Balance	1,076	1,368	1,819	1,732	2,185	2,528	2,878	3,594	4,148	4,894	5,705	6,539	7,411	8,272
Total Assets	***3,292***	***3,558***	***3,881***	***4,214***	***4,568***	***4,942***	***5,407***	***5,970***	***6,556***	***7,168***	***7,809***	***8,480***	***9,181***	***9,912***
LIABILITIES														
Shareholders Fund														
Shareholders Equity	386	386	386	386	386	386	386	386	386	386	386	386	386	386
Reserves& Surplus	2,337	2,726	3,148	3,580	4,033	4,507	5,021	5,584	6,170	6,782	7,423	8,094	8,795	9,526
Total Shareholders Fund	2,723	3,112	3,534	3,966	4,419	4,893	5,407	5,970	6,556	7,168	7,809	8,480	9,181	9,912
Senior Term Liabilities - Debt	569	446	347	248	149	50	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(0)
Total Liabilities & Owners Equity	***3,292***	***3,558***	***3,881***	***4,214***	***4,568***	***4,942***	***5,407***	***5,970***	***6,556***	***7,168***	***7,809***	***8,480***	***9,181***	***9,912***

Source: JICA Study Team

Table 4.7.18 Balance Sheet (Case 3)

(million N$)														
Financial Year Begins	**1-Sep-14**	**1-Sep-15**	**1-Sep-16**	**1-Sep-17**	**1-Sep-18**	**1-Sep-19**	**1-Sep-20**	**1-Sep-21**	**1-Sep-22**	**1-Sep-23**	**1-Sep-24**	**1-Sep-25**	**1-Sep-26**	**1-Sep-27**
Financial Year Ends	**31-Aug-15**	**31-Aug-16**	**31-Aug-17**	**31-Aug-18**	**31-Aug-19**	**31-Aug-20**	**31-Aug-21**	**31-Aug-22**	**31-Aug-23**	**31-Aug-24**	**31-Aug-25**	**31-Aug-26**	**31-Aug-27**	**31-Aug-28**
Year	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**13**	**14**
ASSETS														
Fixed Assets														
Gross Block	2,994	3,021	3,163	3,201	3,404	3,441	3,468	3,502	3,513	3,565	3,581	3,587	3,593	3,634
Less: Accumulated Depreciation	100	201	306	413	526	641	756	873	990	1,109	1,228	1,348	1,468	1,589
Net Fixed Assets	2,895	2,821	2,857	2,789	2,878	2,800	2,712	2,628	2,523	2,456	2,353	2,239	2,125	2,045
Current Assets														
Working Capital	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Balance in NAMPORT Feed														
Cash Balance	(190)	(303)	(522)	(624)	(850)	(879)	(868)	(830)	(737)	(646)	(479)	(248)	14	266
Total Assets	***2,704***	***2,518***	***2,335***	***2,165***	***2,027***	***1,921***	***1,844***	***1,798***	***1,786***	***1,810***	***1,874***	***1,990***	***2,140***	***2,311***
LIABILITIES														
Shareholders Fund														
Shareholders Equity	386	386	386	386	386	386	386	386	386	386	386	386	386	386
Reserves& Surplus	(124)	(196)	(242)	(255)	(234)	(183)	(102)	10	156	338	560	835	1,142	1,471
Total Shareholders Fund	262	190	144	131	152	203	284	396	542	724	946	1,221	1,528	1,857
Senior Term Liabilities - Debt	2,442	2,328	2,192	2,034	1,876	1,718	1,560	1,402	1,244	1,086	928	770	612	454
Total Liabilities & Owners Equity	***2,704***	***2,518***	***2,335***	***2,165***	***2,027***	***1,921***	***1,844***	***1,798***	***1,786***	***1,810***	***1,874***	***1,990***	***2,140***	***2,311***

(million N$)														
Financial Year Begins	**1-Sep-28**	**1-Sep-29**	**1-Sep-30**	**1-Sep-31**	**1-Sep-32**	**1-Sep-33**	**1-Sep-34**	**1-Sep-35**	**1-Sep-36**	**1-Sep-37**	**1-Sep-38**	**1-Sep-39**	**1-Sep-40**	**1-Sep-41**
Financial Year Ends	**31-Aug-29**	**31-Aug-30**	**31-Aug-31**	**31-Aug-32**	**31-Aug-33**	**31-Aug-34**	**31-Aug-35**	**31-Aug-36**	**31-Aug-37**	**31-Aug-38**	**31-Aug-39**	**31-Aug-40**	**31-Aug-41**	**31-Aug-42**
Year	**15**	**16**	**17**	**18**	**19**	**20**	**21**	**22**	**23**	**24**	**25**	**26**	**27**	**28**
ASSETS														
Fixed Assets														
Gross Block	3,935	4,045	4,052	4,626	4,684	4,877	5,164	5,184	5,396	5,443	5,455	5,474	5,486	5,541
Less: Accumulated Depreciation	1,720	1,855	1,990	2,144	2,300	2,463	2,635	2,808	2,988	3,169	3,351	3,533	3,716	3,901
Net Fixed Assets	2,215	2,190	2,062	2,482	2,383	2,414	2,529	2,376	2,408	2,274	2,104	1,940	1,770	1,640
Current Assets														
Working Capital	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Balance in NAMPORT Feed														
Cash Balance	283	602	1,130	1,120	1,650	2,071	2,458	3,170	3,720	4,463	5,270	6,101	6,968	7,825
Total Assets	***2,498***	***2,792***	***3,192***	***3,602***	***4,033***	***4,485***	***4,987***	***5,547***	***6,128***	***6,737***	***7,374***	***8,041***	***8,738***	***9,466***
LIABILITIES														
Shareholders Fund														
Shareholders Equity	386	386	386	386	386	386	386	386	386	386	386	386	386	386
Reserves& Surplus	1,817	2,211	2,654	3,107	3,582	4,077	4,601	5,161	5,742	6,351	6,988	7,655	8,352	9,080
Total Shareholders Fund	2,203	2,597	3,040	3,493	3,968	4,463	4,987	5,547	6,128	6,737	7,374	8,041	8,738	9,466
Senior Term Liabilities - Debt	296	195	152	108	65	22	0	0	0	0	0	0	0	0
Total Liabilities & Owners Equity	***2,498***	***2,792***	***3,192***	***3,602***	***4,033***	***4,485***	***4,987***	***5,547***	***6,128***	***6,737***	***7,374***	***8,041***	***8,738***	***9,466***

Source: JICA Study Team

(4) Results of Financial Statements

The results of cash flow indicate that closing balance of cash becomes deficit for some years. Such period is 2 years in case 1 (2018 and 2019), 8 years in case 2 (2015, 2017-2023), and 12 years (2015-2026) in case 3. During these periods, it is necessary that Namport has to find financial supports to help out these deficits.

(5) Analysis of Debt Payment Ability

Based on the results of financial statements for this project shown above, debt payment ability of this project is evaluated by Debt Service Coverage Ratio (DSCR). DSCR is gained by the following formula.

DSCR = (Amount available for debt service) / (Debt service requirements)

Amount available for debt service includes profit after tax, depreciation and interest expenditure. Debt service requirements include interest payment and principal repayment. The more DSCR is, the more capability Namport has to cover its debt. Although there is a common standard value to evaluate this value, the Study Team assumes DSCR should be more than 1.50, which means that Namport can afford to cope with unexpected 33% decrease of amount available for debt service. The evaluation period is 30 years from Sep. 1, 2010 to Aug. 31, 2040. The results of DSCR in 3 cases are summarized in the following table.

Table 4.7.19 Results of DSCR

	Case 1	**Case 2**	**Case 3**
Minimum DSCR during evaluation period	2.02	1.68	0.93
Period of minimum DSCR	2017/18	2017/18	2014/15
Average DSCR during evaluation period	4.55	4.09	3.56
Loan Life DSCR[1]	3.65	3.29	2.87
Amount of ODA-loan (million N$)	2,499.76	1,782.68	780.50

Source: JICA Study Team

Note 1: Loan Life DSCR is calculated by dividing net present value of amount available for debt service during evaluation period by total debt service requirements during evaluation period. Discount rate for estimating net present value is 10.5%.

As the ODA-loan offers good conditions for as a financing source of this project, the numbers become better as the portion of the ODA-loan becomes larger. In case 1 and case 2, as all DSCR is larger than 1.5, it is concluded that this project will bring enough capability to cover debt in these cases. But, in case 3, DSCR is less than 1.50 for 4 years. Therefore, it can be said that case 3 includes some risks that this project cannot bring enough capability to cover its debt by itself.

4.8 Economic Analysis of Project

4.8.1 Basic Conditions for Economic Analysis

The economic analysis of this project is carried out based on the concept of “with-the-project” and “without-the-project. In this method, the project is evaluated from an economic viewpoint by comparing the costs and benefits in case that the project is implemented – “with-the-project” – and in case that the project is not implemented – “without-the-project”.

This economic analysis is calculated based on the following assumptions:

(1) Project Life and Project Evaluation Period

The project life is 30 years from 2015 to 2044 after the completion of the implementation of construction works for the three years from 2011 to 2015 including consulting service. The project evaluation period is 34 years including the period of implementation of construction works of 3 years and the project life of 30 years.

(2) Opportunity Cost of Capital (OCC)

The opportunity cost of capital (OCC) is the criteria or the cut-off ratio for judgment of economic feasibility of the project. The OCC is expressed by IRR (%) and is usually decided by the Government. The OCC of Namibia is not assumed to be authorized by the Government. The OCC for this project is assumed to be greater than 12% which is the standard OCC of similar projects.

4.8.2 Traffic Demand

Traffic demand, referring to hereinafter as estimated container throughputs, is the basis of the economic evaluation. However, the traffic demand is constrained by the capacity of the Port of Walvis Bay to handle the traffic volume.

(1) Container Traffic Demand Without-the-Project

In the case of without-the-project, the capacity of three container berths of the Port of Walvis Bay is to handle 250,000 TEU per annum and is assumed to reach to its limit in 2009. Based on this constraint, the container traffic demand after 2015 is assumed to remain steady at 250,000 TEU per annum.

(2) Container Traffic Demand With-the-Project

In the case of with-the-project, the capacity of five container berths of the Port of Walvis Bay is assumed to be 833,300 TEU of which 583,300 TEU will be attributed to the capacity of the new container terminal that will probably reach its limit in 2026.

4.8.3 Economic Benefits

The economic benefits are estimated from the viewpoint of the national economy of Namibia. The beneficiaries are considered to be the container ships and cargo for international trade of imports and exports of Namibia and also Namport as the supplier. The most direct beneficiaries are the users. The user’s benefits compose those for vessel (shipping company) and for loaded/unloaded cargos (consignors/consignees). Meanwhile, the supplier’s benefits could be generated by services to be provided by Namport. The supplier’s benefits are assumed to derive from more efficient operations that will lead to revenues for transits and transhipment.

(1) Cost Savings of Transport of Container Ship by Economies of Scale

The transport cost of container ships is expected to be saved due to economies of scale as the result of larger container ships calling.

1) Container Cargoes Demand for Cost Savings

The cost savings of transport by scale economy is considered from the viewpoint of the national economy of Namibia. One of the cost savings for the Namibian economy is computed according to the local cargos) between the Without-the-project and With-the-project cases as follows:

In the Without-the-project case, the capacity of container cargo handling of the Port of Walvis Bay is limited to 250,000 TEU per annum after 2009. As time passes, it is assumed that the import and export cargo will increase their share because no other options to transport them but through the Port of Walvis Bay are available.

In With-the-project case, therefore, the export and import cargos remain the same as those of the Without-the-project case. As a result, the benefits are generated not by the increase of the volume but by the lower transport cost due to larger container vessels.

2) Main Countries for Exports and the Imports of Container Cargoes

The main countries of the exports and imports of the container cargoes of the Port of Walvis Bay by shipping route in 2008 are shown in Table 4.8.1 and 4.8.2. The cost savings by scale economy are estimated for the container cargoes of these main countries.

3) Shipping Routes for Cost Savings by Scale Economy

The shipping routes for cost savings by scale economy are assumed to be expected to be scaled up of the container ship. These shipping routes are set up based on the main countries for exports and imports: (i) Asia and Europe for exports and (i) Asia, Europe and South America for imports.

Table 4.8.1 Main Destined Countries of Container Cargoes by Shipping Route for Exports of the Port of Walvis Bay

Shipping Route	Destinated Countries	Freight Tons	6m Container	12m Container	TEU	Share of TEU (%)
Asia	Malaysia	7,828	380	3,283	6,946	16.8
	China	16,746	751	7	765	1.8
	Hong Kong	2,798	273	233	739	1.8
	Singapore	12,733	234	232	698	1.7
	Indonesia	12,280	557	0	557	1.3
	Subtotal	52,385	2,195	3,755	9,705	23.4
Europe	United Kingdom	23,512	65	1,088	2,241	5.4
	Netherlands	16,812	213	308	829	2.0
	Germany	13,276	230	281	792	1.9
	Portugal	10,626	23	231	485	1.2
	Spain	79,861	850	6,516	13,882	33.5
	Subtotal	144,087	1,381	8,424	18,229	44.0
SADC	South Africa	40,238	5,210	1,495	8,200	19.8
Total		236,710	8,786	13,674	36,134	87.3
Total of Exports		324,638	11,599	14,896	41,391	100.0

Source : Pmaesa Query Calender Year 2008 (Namport)

Note : 1. The container cargoes of Ivory Coast is the empty containers.

2. TEU of Malasia is mostly empty containers as 6,750.

Table 4.8.2 Main Originated Countries of Container Cargoes by Shipping Route for Imports of the Port of Walvis Bay

Shipping Route	Originated Countries	Freight Tons	6m Container	12m Container	TEU	Share of TEU (%)
Asia	China	140,892	1679	2,405	6,489	25.9
	India	37,538	789	459	1,707	6.8
	Singapore	9,900	34	208	450	1.8
	Indonesia	5,566	78	88	254	1.0
	Japan	5,260	51	94	239	1.0
	Thailand	4,070	77	54	185	0.7
	Subtotal	203,226	2,708	3,308	9,324	37.2
Europe	Germany	47,476	1,479	391	2,261	9.0
	Switzerland	18,838	479	181	841	3.4
	Portugal	4,444	122	341	804	3.2
	Spain	11,946	139	198	535	2.1
	Netherlands	10,186	223	120	463	1.8
	United Kingdom	7,856	104	149	402	1.6
	Belguim	6,990	226	83	392	1.6
	France	6,578	265	17	299	1.2
	Subtotal	114,314	3,037	1,480	5,997	23.9
South America	Brazil	13,619	106	258	622	2.5
SADC	South Africa	62,167	3,045	191	3,427	13.7
Total		393,326	8,896	5,237	19,370	77.2
Total of Imports		468,284	10,411	7,332	25,075	100.0

Source : Pmaesa Query Calender Year 2008 (Namport)

4) Future Exports and Imports of Container Cargoes by Shipping Route

Cost savings due to scale economy is estimated only for those shipping routes in which the ship size can be expected to increase. The future exports and imports of container cargoes by shipping route are estimated on the assumption that the shares by shipping route would be the same in the future as 2008 as shown in Table 4.8.3.

Table 4.8.3 Future Exports and Imports of Container Cargoes of the Port of Walvis Bay Based on Scale Economy Cost Savings

(Unit : TEU)

Year	Exports				Imports				
	Asia	Europe	Subtotal	Total	Asia	Europe	South America	Subtotal	Total
2015	14,906	27,997	42,903	63,571	13,745	8,840	917	23,502	36,964
2016	15,587	29,278	44,865	66,478	14,360	9,236	958	24,555	38,620
2017	16,300	30,617	46,917	69,519	15,004	9,650	1,001	25,654	40,349
2018	17,046	32,017	49,062	72,698	15,676	10,082	1,046	26,803	42,156
2019	17,825	33,481	51,306	76,022	16,378	10,534	1,093	28,004	44,044
2020	18,640	35,012	53,652	79,499	17,111	11,005	1,141	29,258	46,017
2021	19,341	36,329	55,670	82,489	17,719	11,396	1,182	30,297	47,652
2022	20,069	37,695	57,764	85,591	18,349	11,801	1,224	31,374	49,345
2023	20,823	39,113	59,936	88,810	19,000	12,221	1,268	32,489	51,098
2024	21,607	40,584	62,191	92,151	19,676	12,655	1,313	33,643	52,913
2025	22,419	42,110	64,530	95,616	20,375	13,105	1,359	34,838	54,793
2026	23,262	43,694	66,957	99,213	21,099	13,570	1,407	36,076	56,740
2027	23,262	43,694	66,957	99,213	21,099	13,570	1,407	36,076	56,740
2028	23,262	43,694	66,957	99,213	21,099	13,570	1,407	36,076	56,740
2029	23,262	43,694	66,957	99,213	21,099	13,570	1,407	36,076	56,740
2030	23,262	43,694	66,957	99,213	21,099	13,570	1,407	36,076	56,740
2031	23,262	43,694	66,957	99,213	21,099	13,570	1,407	36,076	56,740
2032	23,262	43,694	66,957	99,213	21,099	13,570	1,407	36,076	56,740
2033	23,262	43,694	66,957	99,213	21,099	13,570	1,407	36,076	56,740
2034	23,262	43,694	66,957	99,213	21,099	13,570	1,407	36,076	56,740
2035	23,262	43,694	66,957	99,213	21,099	13,570	1,407	36,076	56,740
2036	23,262	43,694	66,957	99,213	21,099	13,570	1,407	36,076	56,740
2037	23,262	43,694	66,957	99,213	21,099	13,570	1,407	36,076	56,740
2038	23,262	43,694	66,957	99,213	21,099	13,570	1,407	36,076	56,740
2039	23,262	43,694	66,957	99,213	21,099	13,570	1,407	36,076	56,740
2040	23,262	43,694	66,957	99,213	21,099	13,570	1,407	36,076	56,740
2041	23,262	43,694	66,957	99,213	21,099	13,570	1,407	36,076	56,740
2042	23,262	43,694	66,957	99,213	21,099	13,570	1,407	36,076	56,740
2043	23,262	43,694	66,957	99,213	21,099	13,570	1,407	36,076	56,740
2044	23,262	43,694	66,957	99,213	21,099	13,570	1,407	36,076	56,740
Share (%)	23.4	44.0	67.5	100.0	37.2	23.9	2.5	63.6	100.0

Source : JICA Study Team.

5) The Transport Cost by Shipping Route

The transport cost by shipping route is composed of the lease cost (charter rate), container cost and fuel cost. The total transport cost by route is decided by transport cost per TEU, the number of TEUs, and the shipping time, which is decided by the distance and the average speed. These conditions are assumed by shipping route and by without-the-project and with-the-project cases as shown in Tables 4.8.4 through 4.8.6.

6) Cost Savings by Scale Economy

The cost savings by scale economy is derived from comparison between the transport cost of the without-the-project and the with-the-project by shipping route as shown in Tables 4.8.7 and 4.8.8.

Table 4.8.4 Fuel Cost by Scale of Ship

TEU	Fuel Consumption (ton/day/TEU)	Fuel Consumption (ton/day/ship)	Fuel Cost (US$/Day/Ship)	Fuel Cost (US$/Day/TEU)
2,200	0.0509	112	56,022	25.5
3,000	0.0397	119	59,594	19.9
4,000	0.0309	124	61,750	15.4
4,500	0.0281	126	63,211	14.0
6,000	0.0216	130	64,800	10.8

Source: Estimates by the JICA Study Team based on International Containerization and other various data.

Note : Fuel cost is based on the price of bunker oil (C type heavy oil) as 500US$/ton (2009.9).

Table 4.8.5 Transport Cost by Shipping Route

(Unit : US$)

Shipping Route		TEU	Lease Cost	Container Cost	Fuel Cost	Total Cost	Average Cost
			US$/day/ship	US$/day/ship	US$/day/ship	US$/day/ship	day/TEU
Asia	without	2,200	19,000	3,925	56,022	78,947	36
	with	3,000	24,000	5,352	59,594	88,946	30
Europe	without	3,000	24,000	5,352	59,594	88,946	30
	with	4,000	30,000	7,136	61,750	98,886	25
South America	without	4,500	32,000	8,028	63,211	103,239	23
	with	6,000	37,000	10,704	64,800	112,504	19

Source: JICA Study Team

Note: 1. Container cost is assumed to be 200 Yen(2.23US)/TEU and accounted for 80% of TEU by ship size.

2. The fuel cost is the price of bunker oil (C type heavy fuel) as 500US$/ton (2009.9).

Table 4.8.6 Transport Distance and Time by Shipping Route

Shippping Route	Approximate Distance (km)	Average Navigation Speed		Shipping Hours (days)
		knot/hour	km/hour	
Asia (Singapore - WVB)	13,000	20	37.04	14.6
Europe (Antwerp - WVB)	11,000	20	37.04	12.4
South America (Santos - WVB)	5,000	20	37.04	5.6

Source: World-Wide Distance Chart, 3rd edition, Japan Navigating Officers Association, KEIBUNDO, Tokyo JAPAN, 2009

Note: 1. 1knot=1.852km

2. The shipping route is set up for the averge shipping distance.

Table 4.8.7 Transport Cost by Shipping Route Without-the-Project

(Unit: 1,000N$)

Year	Exports			Imports				Total
	Asia	Europe	Subtotal	Asia	Europe	South America	Subtotal	
2015	62,968	82,686	145,654	58,065	26,109	952	85,126	230,780
2016	65,848	86,467	152,315	60,665	27,278	995	88,939	241,253
2017	68,859	90,421	159,280	63,382	28,500	1,040	92,922	252,202
2018	72,008	94,556	166,564	66,221	29,776	1,086	97,083	263,648
2019	75,301	98,880	174,182	69,186	31,110	1,135	101,431	275,613
2020	78,745	103,402	182,147	72,285	32,503	1,186	105,973	288,121
2021	81,706	107,291	188,998	74,853	33,658	1,228	109,739	298,736
2022	84,779	111,327	196,106	77,513	34,853	1,271	113,638	309,744
2023	87,968	115,514	203,482	80,267	36,092	1,317	117,675	321,157
2024	91,277	119,858	211,135	83,119	37,374	1,363	121,856	332,991
2025	94,710	124,366	219,076	86,072	38,702	1,412	126,186	345,261
2026	98,272	129,044	227,315	89,130	40,077	1,462	130,669	357,984

Source : JICA Study Team

Note : 1. The exchange rate of N$ to US$ is 8.05

2. All figures are the same after 2026.

Table 4.8.8 Transport Cost by Shipping Route of With-the-Project and the Cost Savings

(Unit: 1,000N$)

Year	Exports			Imports				Total	Cost Savings (without - with)
	Asia	Europe	Subtotal	Asia	Europe	South America	Subtotal		
2015	52,025	68,945	120,970	47,974	2,704	10,692	61,371	182,341	48,440
2016	54,404	72,098	126,502	50,122	2,825	11,181	64,129	190,631	50,622
2017	56,892	75,395	132,287	52,367	2,952	11,693	67,012	199,299	52,903
2018	59,494	78,843	138,337	54,712	3,084	12,227	70,024	208,361	55,287
2019	62,215	82,448	144,663	57,163	3,222	12,786	73,172	217,835	57,778
2020	65,060	86,219	151,279	59,723	3,367	13,371	76,461	227,739	60,381
2021	67,507	89,461	156,968	61,845	3,486	13,874	79,205	236,173	62,563
2022	70,046	92,826	162,872	64,042	3,610	14,396	82,048	244,920	64,824
2023	72,680	96,317	168,998	66,317	3,738	14,937	84,993	253,991	67,166
2024	75,414	99,940	175,354	68,674	3,871	15,499	88,044	263,398	69,593
2025	78,250	103,699	181,949	71,114	4,009	16,082	91,204	273,153	72,108
2026	81,193	107,599	188,792	73,640	4,151	16,687	94,478	283,271	74,714

Source : JICA Study Team

Note : 1. The exchange rate of N$ to US$ is 8.05

2. All figures are the same after 2026.

(2) Cost Savings for Container Ship due to Handling Improvements at Container Berth

The cost savings of container ship due to handling improvements at container berth as the benefits of ship is estimated by the difference of handling time at container berth between without-the-project and with-the-project on the basis of the following assumptions:

1) Without-the-Project

- Total length of space is 450m.
- Container handling capacity is 250,000 TEU per year.
- Container cargo to be handled per day per ship is 650 TEU
- Average Capacity of crane for transhipment is 30 TEU per hour and for non-transhipment 31 TEU per hour.
- Number of crane is four for two berths.
- Lease cost of ship per day is US$ 18,000 (N$ 137,646: US$ 1= N$ 7.647).

2) With-the-Project

- Total length of space of new container terminal is 550m equalling 1,000m in total including the total length of space as 450m.
- Container handling capacity is 250,000 plus 583,300 TEU (833,300 TEU in total) per annum.
- Container cargo per ship per day to be handled is 800 TEU
- Average capacity of crane for transhipment is 46 TEU per hour and for non-transhipment 48TEU per hour.
- Number of cranes is four for two berths.
- Lease cost of ship per day is US$ 18,000 (N$ 137,646: US$ 1= N$ 7.647).

The average handling capacity of a crane is shown in the following table.

Table 4.8.9 Average Handling Capacity of Crane

Items		No. of Berth (Without)			No. of Berth (With)				
		1	2	Average	1	2	New(1)	New(2)	Average
Tansshipment	Loading (Box/h)	24	24	24	24	24	30	30	30
	Unloading (Box/h)	15	15	15	15	15	30	30	30
	Loading (TEU/h)	37	37	37	37	37	46	46	46
	Unloading (TEU/h)	23	23	23	23	23	46	46	46
	Average (TEU/h)	30	30	30	30	30	46	46	46
Non-Transshipment	Loading (Box/h)	24	24	24	24	24	30	30	30
	Unloading (Box/h)	15	15	15	15	15	30	30	30
	Loading (TEU/h)	38	38	38	38	38	48	48	48
	Unloading (TEU/h)	24	24	24	24	24	48	48	48
	Average (TEU/h)	31	31	31	31	31	48	48	48

Source : JICA Study Team

Note : TEU per container box is 1.53 for transshipent and 1.60 for non-transshipment.

The handling time and cost at the berth for without-the-project and with-the-project and the time savings of container ship at the berth are shown in Table 4.8.10 and 4.8.11.

Table 4.8.10 Handling Time and Cost at the Berth (Without)

Year	Total Container	Vessel Calls	Average Crane Capacity	No. of Carne per Berth	Average Berth Capacity	Containder to be Handled at Berth	Handling Time at Berth	Handling Time at Berth	Handling Cost at Berth
	TEU/year	ship/year	TEU/hour /crane	crane/berth	TEU/hour/ berth	TEU/Ship	hour/ship/ berth	hour/year	year (Million N$)
2015	250,000	385	31	2	62	650	10	4,006	24.2
2016	250,000	385	31	2	62	650	10	4,006	24.2
2017	250,000	385	31	2	62	650	10	4,006	24.2
2018	250,000	385	31	2	62	650	10	4,006	24.2
2019	250,000	385	31	2	62	650	10	4,006	24.2
2020	250,000	385	31	2	62	650	10	4,006	24.2
2021	250,000	385	31	2	62	650	10	4,006	24.2
2022	250,000	385	31	2	62	650	10	4,006	24.2
2023	250,000	385	31	2	62	650	10	4,006	24.2
2024	250,000	385	31	2	62	650	10	4,006	24.2
2025	250,000	385	31	2	62	650	10	4,006	24.2
2026	250,000	385	31	2	62	650	10	4,006	24.2

Source : JICA Study Team
Note : All figures are the same after 2026.

Table 4.8.11 Handling Time and Cost at the Berth (With) and Cost Savings for Container Ship

Year	Total Container	Vessel Calls	Average Crane Capacity	No. of Carne per Berth	Average Berth Capacity	Containder to be Handled at Berth	Handling Time at Berth	Handling Time at Berth	Handling Cost at Berth	Without-With	
										Saved Time	Saved Cost
	TEU/year	ship/year	TEU/hour /crane	crane/ berth	TEU/hour /berth	TEU/Ship	hour/ship/ berth	hour/year	year (Million N$)	hour/year	Million N$
2015	250,000	313	48	2	96	800	8	2,604	15.7	1,402	8.47
2016	250,000	313	48	2	96	800	8	2,604	15.7	1,402	8.47
2017	250,000	313	48	2	96	800	8	2,604	15.7	1,402	8.47
2018	250,000	313	48	2	96	800	8	2,604	15.7	1,402	8.47
2019	250,000	313	48	2	96	800	8	2,604	15.7	1,402	8.47
2020	250,000	313	48	2	96	800	8	2,604	15.7	1,402	8.47
2021	250,000	313	48	2	96	800	8	2,604	15.7	1,402	8.47
2022	250,000	313	48	2	96	800	8	2,604	15.7	1,402	8.47
2023	250,000	313	48	2	96	800	8	2,604	15.7	1,402	8.47
2024	250,000	313	48	2	96	800	8	2,604	15.7	1,402	8.47
2025	250,000	313	48	2	96	800	8	2,604	15.7	1,402	8.47
2026	250,000	313	48	2	96	800	8	2,604	15.7	1,402	8.47

Source : JICA Study Team
Note : All figures are the same after 2026.

(3) Time Savings of Container Cargo in Respects to Handling at Container Berth

Benefits for container cargo are also assumed to be generated from saved handling time for consignors (shippers). The benefits of time savings for cargos are estimated on the basis of the same assumptions as of the cost savings of ship and the time value is estimated with the following assumptions:

- The unit value of TEU is estimated at N$ 1,016,082/TEU on the basis of the container cargo exports and imports and trade statistics for Namibia in 2007.

- The prime interest rate is set at 10% on the basis of data on fixed deposits of the First National Bank, Windhoek Bank and Nedbank Namibia. It is assumed that the same value of money for container cargo per TEU is mentioned above.
- The saved time for ships are counted in hours by taking account of loaded TEUs per ship on the basis of container cargo to be handled per day at 650 TEU per ship without-the-project and 800 TEU with-the-project.

The time savings for the container cargo due to handling improvements at the berth are estimated on the basis of the time savings already mentioned in section (2) above. The result of the estimates of time savings for container cargo is shown in Table 4.8.12.

Table 4.8.12 Time Savings of Container Cargoes by Handling at the Berth

Year	Cargo Value	Saved Time	Saved Cargo Time Value (Total Cargo))	Saved Cargo Time Value for Imports & Exports
	Million N$/ship	hour/year	Million N$	Million N$
2015	1,142	1,402	18.28	5.60
2016	1,142	1,402	18.28	5.85
2017	1,142	1,402	18.28	6.12
2018	1,142	1,402	18.28	6.39
2019	1,142	1,402	18.28	6.68
2020	1,142	1,402	18.28	6.99
2021	1,142	1,402	18.28	7.24
2022	1,142	1,402	18.28	7.51
2023	1,142	1,402	18.28	7.79
2024	1,142	1,402	18.28	8.07
2025	1,142	1,402	18.28	8.37
2026	1,142	1,402	18.28	8.68

Source : JICA Study Team
Note : All figures are the same after 2026.

(4) Time Savings of Container Cargoes for Turnaround of Trailer in the Container Yard

The existing container yard is narrow and the movement of container boxes is not effective. It is assumed that there is a difference of turnaround time for container trucks (outside trailer) between the existing yard and the new container yard. The average time for turnaround of outside trailers is estimated on the basis of the following assumptions:

1) Without-the-Project

- Passing through the gate for documentation processing and container inspection: 2 minutes
- Reaching the container ground slots: 2 minutes
- Picking up the container box: 30 minutes
- Passing through the gate: 2 minutes
- Total average time: 45 minutes

2) With-the-Project

- Passing through the gate for documentation processing and container inspection: 2 minutes
- Reaching to the container ground slots: 2 minutes
- Picking up the container box: 15 minutes
- Passing through the gate: 2 minutes
- Total average time: 21 minutes

The result of estimates of the container cargoes for turnaround of container trailers in the container yard is shown in Table 4.8.13.

Table 4.8.13 Time Savings of Container Cargoes for Turnaround of Trailer in the Container Yard

Year	Total Container (Imports)	With Project		Without		Saved Time	Saved Time Value
		Average Time to Search and Pick up in the Container Yard	Total Time to Search and Pick up in the Container Yard	Average Time to Search and Pick up in the Container Yard	Total Time to Search and Pick up in the Container Yard		
	TEU/year	hour/TEU	hour/year	hour/TEU	hour/year	hour/year	Million N$/year
2015	36,964	0.3	12,321	1.0	36,964	24,643	0.574
2016	38,620	0.3	12,873	1.0	38,620	25,746	0.599
2017	40,349	0.3	13,450	1.0	40,349	26,899	0.626
2018	42,156	0.3	14,052	1.0	42,156	28,104	0.654
2019	44,044	0.3	14,681	1.0	44,044	29,363	0.683
2020	46,017	0.3	15,339	1.0	46,017	30,678	0.714
2021	47,652	0.3	15,884	1.0	47,652	31,768	0.739
2022	49,345	0.3	16,448	1.0	49,345	32,896	0.766
2023	51,098	0.3	17,033	1.0	51,098	34,065	0.793
2024	52,913	0.3	17,638	1.0	52,913	35,276	0.821
2025	54,793	0.3	18,264	1.0	54,793	36,529	0.850
2026	56,740	0.3	18,913	1.0	56,740	37,827	0.880

Source : JICA Study Team
Note : All figures are the same after 2026.

(5) Time Savings of Container Cargoes by Handling in the Container Yard

The efficiency for movement of the handling machines after landing and for shipping are assumed to be considerably different between the existing container yard and the new container yard. Considerable time savings for handling machines is expected. The average time of handling machines are estimated with the following assumptions:

1) Without-the-Project

For landed containers:

- Waiting for picking up: 20 minutes.
- Picking up and laying on slots: 40 minutes

For shipping containers:

- Waiting for picking up: 20 minutes.
- Picking up from slots and laying on the quay: 20 minutes.

Total time: 110 minutes

2) With-the-Project

For landed containers:

- Waiting for picking up: 2~3 minutes.
- Picking up and laying on slots: 2~3 minutes

For shipping containers:

- Waiting for picking up: 5 minutes
- Picking up from slots and laying on the quay: 2~3 minutes.

Total time : 11~14 minutes

The result of estimates of cargo handling time without-the-project and with-the-project as well as time savings of container cargo for turnaround of container trailers in the container yard is shown in Tables 4.8.14 through 4.8.16.

Table 4.8.14 Cargo Handling Time in the Container Yard (Without)

Year	Container (Imports)	Container (Exports)	After Landing				For Shipping				Total Time
			Waiting for Picking Up	Picking Up and Laying on Slot	Sub-Total	Total	Waiting for Picking Up	Picking Up and Laying on Slot	Sub-Total	Total	
	TEU/Year	TEU/ Year	minute/ TEU	minute/ TEU	minute/ TEU	hours	minute/ TEU	minute/ TEU	minute/ TEU	hours	Hours
2015	36,964	63,571	20.0	30.0	50.0	30,803.4	20.0	20.0	40.0	42,380.8	73,184
2016	38,620	66,478	20.0	30.0	50.0	32,183.0	20.0	20.0	40.0	44,318.9	76,502
2017	40,349	69,519	20.0	30.0	50.0	33,624.3	20.0	20.0	40.0	46,345.7	79,970
2018	42,156	72,698	20.0	30.0	50.0	35,130.1	20.0	20.0	40.0	48,465.1	83,595
2019	44,044	76,022	20.0	30.0	50.0	36,703.4	20.0	20.0	40.0	50,681.5	87,385
2020	46,017	79,499	20.0	30.0	50.0	38,347.2	20.0	20.0	40.0	52,999.2	91,346
2021	47,652	82,489	20.0	30.0	50.0	39,709.7	20.0	20.0	40.0	54,992.5	94,702
2022	49,345	85,591	20.0	30.0	50.0	41,120.5	20.0	20.0	40.0	57,060.8	98,181
2023	51,098	88,810	20.0	30.0	50.0	42,581.5	20.0	20.0	40.0	59,206.9	101,788
2024	52,913	92,151	20.0	30.0	50.0	44,094.5	20.0	20.0	40.0	61,433.7	105,528
2025	54,793	95,616	20.0	30.0	50.0	45,661.1	20.0	20.0	40.0	63,744.2	109,405
2026	56,740	99,213	20.0	30.0	50.0	47,283.5	20.0	20.0	40.0	66,141.7	113,425

Source : JICA Study Team

Note : All figures are the same after 2026.

Table 4.8.15 Cargo Handling Time in the Container Yard (With)

Year	Container (Imports)	Container (Exports)	After Landing				For Shipping				Total Time
			Waiting for Picking Up	Picking Up and Laying on Slot	Sub-Total	Total	Waiting for Picking Up	Picking Up and Laying on Slot	Sub-Total	Total	
	TEU/ Year	TEU/ Year	minute/ TEU	minute/ TEU	minute/ TEU	hours	minute/ TEU	minute/ TEU	minute/ TEU	hours	hours
2015	36,964	63,571	2.0	2.0	4.0	2,464.3	5.0	5.0	10.0	10,595.2	13,059
2016	38,620	66,478	2.0	2.0	4.0	2,574.6	5.0	5.0	10.0	11,079.7	13,654
2017	40,349	69,519	2.0	2.0	4.0	2,689.9	5.0	5.0	10.0	11,586.4	14,276
2018	42,156	72,698	2.0	2.0	4.0	2,810.4	5.0	5.0	10.0	12,116.3	14,927
2019	44,044	76,022	2.0	2.0	4.0	2,936.3	5.0	5.0	10.0	12,670.4	15,607
2020	46,017	79,499	2.0	2.0	4.0	3,067.8	5.0	5.0	10.0	13,249.8	16,318
2021	47,652	82,489	2.0	2.0	4.0	3,176.8	5.0	5.0	10.0	13,748.1	16,925
2022	49,345	85,591	2.0	2.0	4.0	3,289.6	5.0	5.0	10.0	14,265.2	17,555
2023	51,098	88,810	2.0	2.0	4.0	3,406.5	5.0	5.0	10.0	14,801.7	18,208
2024	52,913	92,151	2.0	2.0	4.0	3,527.6	5.0	5.0	10.0	15,358.4	18,886
2025	54,793	95,616	2.0	2.0	4.0	3,652.9	5.0	5.0	10.0	15,936.1	19,589
2026	56,740	99,213	2.0	2.0	4.0	3,782.7	5.0	5.0	10.0	16,535.4	20,318

Source : JICA Study Team
Note : All figures are the same after 2026.

Table 4.8.16 Time Savings of Container Cargoes in the Container Yard

Year	Container (Imports)	Container (Exports)	After Landing		For Shipping		Total Saved Cost
			Saved Time	Saved Time Cost	Saved Time	Saved Cost	
	TEU/Year	TEU/Year	hours	million N$	hours	million N$	million N$
2015	36,964	63,571	28,339.2	0.660	31,785.6	0.740	1.40
2016	38,620	66,478	29,608.3	0.689	29,609.0	0.689	1.38
2017	40,349	69,519	30,934.3	0.720	30,935.1	0.720	1.44
2018	42,156	72,698	32,319.7	0.752	32,320.5	0.752	1.50
2019	44,044	76,022	33,767.2	0.786	33,767.9	0.786	1.57
2020	46,017	79,499	35,279.4	0.821	35,280.2	0.821	1.64
2021	47,652	82,489	36,532.9	0.850	36,533.7	0.850	1.70
2022	49,345	85,591	37,830.9	0.881	37,831.8	0.881	1.76
2023	51,098	88,810	39,175.0	0.912	39,175.9	0.912	1.82
2024	52,913	92,151	40,566.9	0.944	40,567.8	0.944	1.89
2025	54,793	95,616	42,008.2	0.978	42,009.2	0.978	1.96
2026	56,740	99,213	43,500.8	1.012	43,501.8	1.013	2.02

Source : JICA Study Team
Note : All figures are the same after 2026.

(6) Increase of Revenues from Captured Demand

The Port of Lüderitz does not have enough capacity to handle the container cargo in comparison with the Port of Walvis Bay and cannot be considered an alternative port for the Port of Walvis Bay. In such a situation, alternative or competitive ports are assumed to be the ports outside the country such as Luanda, Durban, Cape Town and others. In this project, the drastic increase of demand for container cargo for transit and transhipment is expected to increase as captured demand. This drastic increased demand which is included in the demand over the capacity of without-the-project (250,000 TEU) would be handled at other competitive ports outside Namibia. Then the revenues from handling container cargo for the with-the-project could be considered as benefits for service suppliers and operators. These benefits are estimated based on the following assumptions:

The result of the estimates of the increased revenues from the increased demand of transit and transhipment container cargoes is shown in Table 4.8.17.

Table 4.8.17 Increased Revenues from the Increased Demand of Transit and Transhipment

(Unit: Million N$)

Year	Land/Ship			Extra Storage			Reefer			Port Dues	Total
	Transit	Tranship-ment	Subtotal	Transit	Tranship-ment	Subtotal	Transit	Tranship-ment	Subtotal		
2015	39.3	186.8	226.0	2.4	53.8	56.3	0.5	11.9	12.4	51.6	346.3
2016	54.1	187.2	241.3	3.1	54.0	57.1	0.7	11.9	12.6	53.5	364.4
2017	71.0	187.6	258.6	3.9	54.1	58.0	0.8	11.9	12.8	55.7	385.0
2018	90.3	188.0	278.3	4.7	54.2	58.9	1.1	12.0	13.0	58.1	408.3
2019	112.4	188.4	300.8	5.6	54.3	59.9	1.3	12.0	13.3	60.7	434.7
2020	137.6	188.8	326.4	6.4	54.4	60.8	1.5	12.0	13.5	63.7	464.5
2021	137.6	188.8	326.4	6.4	54.4	60.8	1.5	12.0	13.5	65.8	466.6
2022	137.6	188.8	326.4	6.4	54.4	60.8	1.5	12.0	13.5	68.1	468.9
2023	137.6	188.8	326.4	6.4	54.4	60.8	1.5	12.0	13.5	70.5	471.3
2024	137.6	188.8	326.4	6.4	54.4	60.8	1.5	12.0	13.5	73.1	473.9
2025	137.6	188.8	326.4	6.4	54.4	60.8	1.5	12.0	13.5	75.8	476.6
2026	137.6	188.8	326.4	6.4	54.4	60.8	1.5	12.0	13.5	80.2	481.0

Source : JICA Study Team

Note: 1.The conditions for calculation for revenues such as tarif, ship calls are the same as of the Financial Analysis.

2. All figures are the same after 2026.

4.8.4 Socio-Economic Impacts

(1) Direct Impact

Direct socio-economic impacts are accounted for in the economic benefits of the economic evaluation of the project as outlined in the above section.

(2) Indirect Impact

This project is expected to influence not only Namibia but also the surrounding SADC countries including landlocked countries. While direct impacts are relatively easily quantified, it is also necessary to discuss in a qualitative way potential indirect impacts, insofar as possible. In this context, indirect impacts include difficult-to-quantify broad aspects of the socio-economy that are considered a common good.

The following comprises a very brief summary of some indirect impacts but should not be taken as a comprehensive list.

1) Impacts of Scale Economy on the Price of the Imported Goods and Private Sector Importers

The direct impact of the scale economy due to larger container sizes was already accounted in the economic benefits. However there will also be indirect impacts of scale economy including the reduction of container tariffs due to cost reduction of transport on container ships. For importers, this means a lower cost to import goods that can be reflected in higher profits (and presumably higher tax revenue for the government) in the short-term. For domestic consumers in the long run, as price competition between firms increases, transport cost savings will, *ceteris paribus*, result in lower prices for imported goods and goods that are produced with imported inputs (foodstuffs, non-durable goods, etc.[6]).

[6] Generally, long-term price decreases will be most observed in low value-added industries.

2) Impacts of Scale Economy on the Price of the Exported Goods and Private Sector Exporters

Decreased transport cost will also lead to higher profits for firms engaged in export-related industries that use containers for transporting of goods. As discussed in Chapter 2, in Namibia and other SADC countries, a very large share of the economy is based on agriculture, mining and manufacturing, which normally have a relatively low value to volume ratio and thus incur heavy transport unit costs. Even a small decrease in transport costs can have a very large impact on the bottom line of firms engaging in these industries. That being said, it is expected that the project will have a greater impact on export-facing manufacturing industries than on agriculture and mining as the latter is generally dominated by regional road transport and also not transported by container while the former has a large share transported by sea. Among the SADC countries, since the economies of Namibia, Botswana, DRC, and Zimbabwe have a greater share of their economy focused on the manufacturing industries, relative to, say, South Africa and Zambia, it is likely that export-oriented firms in these countries and industries will benefit most from a decrease in ocean transport costs. Since Angola already has a large port, the impact is less certain for such firms there (depending of course on the geographic and economic situation at the individual firm level).

3) Acceleration of Industry Related to Port Activities

The increase of revenues from increased transit and transhipment are counted for as economic benefits in the economic evaluation of this project. However, it must also be noted in this section that an increase in revenue for port and transport-facing private business will also create new opportunities for port services activities in container operations. It will be important to monitor the growth of transporters, forwarders, container repair companies, and other transport-related firms.

4) Increased Revenue for the Central and Local Government

As already mentioned above, income is expected to increase and will impact employment opportunities in industries related to the import of goods and in port services activities. All else being equal, this increased economic activity will lead to increased tax revenue for the central and local governments of Namibia and the surrounding countries. It is essential for the beneficiary governments to use this increase in tax revenue in a way that promotes further economic growth by channelling a portion of the funds to maintenance and improvement of transport infrastructure as well as education for training personnel to use and maintain the infrastructure.

5) Increase of Gross Domestic Product (GDP) of SADC Countries

The increase of employment and income of the industries mentioned above is closely related to the impact of other categories of industry and ultimately the GDP of Namibia and other SADC countries. As a rising tide generally lifts all boats, a rise in GDP will contribute to poverty alleviation in SADC countries. That being said, it is particularly difficult to disaggregate the impact of this project on the GDP growth of Namibia or the SADC countries.

4.8.5 Economic Cost

(1) Conversion from Financial Cost to Economic Cost

The financial cost of the project in the financial analysis is evaluated by the market price in Namibia. Then the financial cost is converted into the economic price (i) by excluding the transfer items from the view point whether the resources of the project is inherent to the project and (ii) by applying the standard conversion rate to the local currency portion of the project cost on the assumption that the financial cost reflects the distortion of the market price in Namibia.

The basic assumptions for conversion of the financial cost into the economic cost are as follows.

(2) Basic Assumptions

1) Composure of Project Cost

The project costs are divided into a foreign currency portion and a domestic currency portion. The domestic currency portion is divided into materials cost and labour cost, respectively. The labour cost is composed of skilled labour at 80% and unskilled labour at 20%. The materials cost and unskilled labour costs are converted into an economic price.

2) Exclusion of Transfer of Expenditure Items

The taxes, custom duties, loan interest, government subsidies, etc. are not inherent cost items incurred in the project. These transfer items should be excluded from the project cost.

3) Present-Value-Based Evaluation

The project cost would be evaluated at 2009 prices. Therefore, inflationary cost elements incurred during the construction period should be excluded because these are external factors for the project.

4) Standard Conversion Factor (SCF)

The local currency portion for the materials including and the machinery & equipment should be converted into economic prices by applying the standard conversion factor, because this portion is usually valuated within Namibia, and their prices are distorted due to the inefficient markets and information, and consequently, they do not reflect international market prices. As the result, the economic prices are evaluated by the international market prices. In this study, the SCF is adopted as 0.913.

5) Opportunity Cost of Unskilled Labour

The skilled labour cost is considered to reflect the market price and to be the economic price and the share of the skilled labour is 80% of the total cost of labour. However, the unskilled labour cost is not considered to reflect the market price because of the lack of liquidity of workers—i.e. the surplus of workers caused by a high rate of unemployment or potential unemployment in developing countries. The unskilled labour cost is necessary to be revised by the opportunity cost. Then the opportunity cost of the unskilled labour is assumed to be 0.80 of the financial price as the conversion factor by taking account the unemployment ratio of around 20% in Namibia 2004–2006.

(3) Economic Cost

The disbursement schedules of the initial investment and that of the additional investment in financial price and in economic price are shown in the following tables.

The project cost for the initial investment and the additional investment in the *financial terms* are N$ 2,748.8 million and N$ 1,490.8 million, respectively, and total project cost is N$ 4,239.6 million. On the other hand, the project cost for the initial investment and the additional investment in *economic terms* are N$ 2,317.4 million and N$ 1,294.4 million, respectively, and total project cost is N$ 3,611.8 million.

Table 4.8.18 Disbursement Schedule of Initial Investment (Financial Price)

(Unit : 1,000 N$)

Items of Cost	2011	2012	2013	2014	2015	Total
A. Consulting Service	6,931	9,518	16,810	16,519	3,318	53,095
B. Civil Works Cost						
1.Local Currency Portion						
(1).Material&Equipment		40,986	211,843	351,767	77,911	682,507
(2).Labour						
(Skilled)		8,515	42,693	76,699	18,754	146,661
(Unskilled)		2,129	10,673	19,175	4,689	36,665
subtotal		10,644	53,366	95,874	23,443	183,327
Total		51,630	265,209	447,640	101,354	865,834
2.Foreign Portion Portion						
(1) Material&Equipment		62,661	324,681	301,810	27,544	716,696
(2).Labour						
(Skilled)		7,262	35,273	31,995	3,074	77,604
(Unskilled)		0	0	0	0	0
subtotal		7,262	35,273	31,995	3,074	77,604
Total		69,923	359,954	333,805	30,618	794,300
Civil Works Total		121,553	625,164	781,445	131,972	1,660,134
C. Equipment Cost						
1.Local Currency Portion						
(1) Material		0	0	0	0	0
(2) Labour						
(Skilled)		0	0	15,800	0	15,800
(Unskilled)		0	0	3,950	0	3,950
subtotal		0	0	19,750	0	19,750
Total		0	0	19,750	0	19,750
2.Foreign Portion Portion						
(1) Material		0	0	431,250	0	431,250
(2) Labour						
(Skilled)		0	0	0	0	0
(Unskilled)		0	0	0	0	0
subtotal		0	0	0	0	0
Total		0	0	431,250	0	431,250
Equipment Total		0	0	451,000	0	451,000
Total (A+B+C)	6,931	131,070	641,974	1,248,964	135,290	2,164,229
Tax (15%)	1,040	19,661	96,296	187,345	20,294	324,634
Contingency (10%	797	15,073	73,827	143,631	15,558	248,886
Total	8,768	165,804	812,097	1,579,939	171,142	2,737,750
D. Administration Fee	0	1,467	4,400	4,400	733	11,000
Grand Total	8,768	167,271	816,497	1,584,339	171,875	2,748,750

Source : JICA Study Team

Note: The contingency is assumed to be 10% of total of civil works and equipment.

Table 4.8.19 Disbursement Schedule of Additional Investment (Financial Price)

(Unit : 1,000 N$)

Items of Cost	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024
1.Local Currency Portion										
(1).Material&Equipment	0	0	0	0	0	0	0	0	0	0
(2).Labour										
(Skilled)	1,400	0	3,900	700	5,300	700	0	0	0	0
(Unskilled)	350	0	975	175	1,325	175	0	0	0	0
subtotal	1,750	0	4,875	875	6,625	875	0	0	0	0
Total(A)	1,750	0	4,875	875	6,625	875	0	0	0	0
2.Foreign Portion Portion										
(1) Material&Equipment	46,600	3,100	96,125	25,325	128,975	23,225	17,000	20,100	6,600	29,900
(2).Labour	0	0	0	0	0	0	0	0	0	0
Total(B)	46,600	3,100	96,125	25,325	128,975	23,225	17,000	20,100	6,600	29,900
Tax::15%=(A+B)x0.15	7,253	465	15,150	3,930	20,340	3,615	2,550	3,015	990	4,485
Grand Total	55,603	3,565	116,150	30,130	155,940	27,715	19,550	23,115	7,590	34,385

Items of Cost	2025	2026	2027	2028	2029	2030	2031	2032	2033	2034
1.Local Currency Portion										
(1).Material&Equipment	0	0	0	0	0	0	0	0	0	0
(2).Labour										
(Skilled)	0	0	0	0	5,600	1,400	0	10,300	700	2,100
(Unskilled)	0	0	0	0	1,400	350	0	2,575	175	525
subtotal	0	0	0	0	7,000	1,750	0	12,875	875	2,625
Total(A)	0	0	0	0	7,000	1,750	0	12,875	875	2,625
2.Foreign Portion Portion										
(1) Material&Equipment	8,700	3,100	3,100	20,500	143,300	50,850	3,100	249,125	24,325	79,775
(2).Labour	0	0	0	0	0	0	0	0	0	0
Total(B)	8,700	3,100	3,100	20,500	143,300	50,850	3,100	249,125	24,325	79,775
Tax::15%=(A+B)x0.15	1,305	465	465	3,075	22,545	7,890	465	39,300	3,780	12,360
Grand Total	10,005	3,565	3,565	23,575	172,845	60,490	3,565	301,300	28,980	94,760

Items of Cost	2035	2036	2037	2038	2039	2040	2041	2042	2043	Total
1.Local Currency Portion										
(1).Material&Equipment	0	0	0	0	0	0	0	0	0	0
(2).Labour										
(Skilled)	3,900	0	3,200	0	0	0	0	0	0	39,200
(Unskilled)	975	0	800	0	0	0	0	0	0	9,800
subtotal	4,875	0	4,000	0	0	0	0	0	0	49,000
Total(A)	4,875	0	4,000	0	0	0	0	0	0	49,000
2.Foreign Portion Portion										
(1) Material&Equipment	114,225	8,000	79,100	17,600	4,100	6,600	4,200	18,100	12,600	1,247,350
(2).Labour	0	0	0	0	0	0	0	0	0	0
Total(B)	114,225	8,000	79,100	17,600	4,100	6,600	4,200	18,100	12,600	1,247,350
Tax::15%=(A+B)x0.15	17,865	1,200	12,465	2,640	615	990	630	2,715	1,890	194,453
Grand Total	136,965	9,200	95,565	20,240	4,715	7,590	4,830	20,815	14,490	1,490,803

Source : JICA Study Team

Table 4.8.20 Disbursement Schedule of Initial Investment (Economic Price)

(Unit : 1,000 N$)

Items of Cost	2011	2012	2013	2014	2015	Total
A. Consulting Service	6,931	9,518	16,810	16,519	3,318	53,095
B. Civil Works Cost						
1.Local Currency Portion						
(1).Material&Equipment		37,420	193,413	321,163	71,133	623,129
(2).Labour						
(Skilled)		8,515	42,693	76,699	18,754	146,661
(Unskilled)		1,703	8,539	15,340	3,751	29,332
subtotal		10,218	51,232	92,039	22,505	175,994
Total		47,639	244,644	413,202	93,638	799,123
2.Foreign Portion Portion						
(1) Material&Equipment		62,661	324,681	301,810	27,544	716,696
(2).Labour						
(Skilled)		7,262	35,273	31,995	3,074	77,604
(Unskilled)		0	0	0	0	0
subtotal		7,262	35,273	31,995	3,074	77,604
Total		69,923	359,954	333,805	30,618	794,300
Civil Works Total		117,561	604,599	747,006	124,256	1,593,423
C. Equipment Cost						
1.Local Currency Portion						
(1) Material		0	0	0	0	0
(2) Labour						
(Skilled)		0	0	15,800	0	15,800
(Unskilled)		0	0	3,160	0	3,160
subtotal		0	0	18,960	0	18,960
Total		0	0	18,960	0	18,960
2.Foreign Portion Portion						
(1) Material		0	0	431,250	0	431,250
(2) Labour						
(Skilled)		0	0	0	0	0
(Unskilled)		0	0	0	0	0
subtotal		0	0	0	0	0
Total		0	0	431,250	0	431,250
Equipment Total		0	0	450,210	0	450,210
Total (A+B+C)	6,931	127,079	621,409	1,213,735	127,574	2,096,728
Contingency	693	12,708	62,141	121,374	12,757	209,673
Total	7,624	139,787	683,549	1,335,109	140,332	2,306,401
C. NAMPORT Administration Fee	0	1,467	4,400	4,400	733	11,000
Grand Total	7,624	141,253	687,949	1,339,509	141,065	2,317,401

Source : JICA Study Team

Note: The contingency is assumed to be 10% of total of civil works and equipment.

Table 4.8.21 Disbursement Schedule of Additional Investment (Economic Price)

(Unit : 1,000 N$)

Items of Cost	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024
1.Local Currency Portion										
(1).Material&Equipment	0	0	0	0	0	0	0	0	0	0
(2).Labour	0	0	0	0	0	0	0	0	0	0
(Skilled)	1,400	0	3,900	700	5,300	700	0	0	0	0
(Unskilled)	280	0	780	140	1,060	140	0	0	0	0
subtotal	1,680	0	4,680	840	6,360	840	0	0	0	0
Total	1,680	0	4,680	840	6,360	840	0	0	0	0
2.Foreign Portion Portion										
(1) Material&Equipment	46,600	3,100	96,125	25,325	128,975	23,225	17,000	20,100	6,600	29,900
(2).Labour	0	0	0	0	0	0	0	0	0	0
Total	46,600	3,100	96,125	25,325	128,975	23,225	17,000	20,100	6,600	29,900
Grand Total	48,280	3,100	100,805	26,165	135,335	24,065	17,000	20,100	6,600	29,900

Items of Cost	2025	2026	2027	2028	2029	2030	2031	2032	2033	2034
1.Local Currency Portion										
(1).Material&Equipment	0	0	0	0	0	0	0	0	0	0
(2).Labour	0	0	0	0	0	0	0	0	0	0
(Skilled)	0	0	0	0	5,600	1,400	0	10,300	700	2,100
(Unskilled)	0	0	0	0	1,120	280	0	2,060	140	420
subtotal	0	0	0	0	6,720	1,680	0	12,360	840	2,520
Total	0	0	0	0	6,720	1,680	0	12,360	840	2,520
2.Foreign Portion Portion										
(1) Material&Equipment	8,700	3,100	3,100	20,500	143,300	50,850	3,100	249,125	24,325	79,775
(2).Labour	0	0	0	0	0	0	0	0	0	0
Total	8,700	3,100	3,100	20,500	143,300	50,850	3,100	249,125	24,325	79,775
Grand Total	8,700	3,100	3,100	20,500	150,020	52,530	3,100	261,485	25,165	82,295

Items of Cost	2035	2036	2037	2038	2039	2040	2041	2042	2043	Total
1.Local Currency Portion										
(1).Material&Equipment	0	0	0	0	0	0	0	0	0	0
(2).Labour	0	0	0	0	0	0	0	0	0	
(Skilled)	3,900	0	3,200	0	0	0	0	0	0	39,200
(Unskilled)	780	0	640	0	0	0	0	0	0	7,840
subtotal	4,680	0	3,840	0	0	0	0	0	0	47,040
Total	4,680	0	3,840	0	0	0	0	0	0	47,040
2.Foreign Portion Portion										
(1) Material&Equipment	114,225	8,000	79,100	17,600	4,100	6,600	4,200	18,100	12,600	1,247,350
(2).Labour	0	0	0	0	0	0	0	0	0	0
Total	114,225	8,000	79,100	17,600	4,100	6,600	4,200	18,100	12,600	1,247,350
Grand Total	118,905	8,000	82,940	17,600	4,100	6,600	4,200	18,100	12,600	1,294,390

Source : JICA Study Team

4.8.6 Economic Evaluation

(1) Indicators for Economic Evaluation

Based on economic benefits and the cost as mentioned above, the economic evaluation is conducted by the indicators of the economic internal rate of return (EIRR) and the net present values (NPV) which is the difference of the economic benefits and the economic cost and the economic benefits cost ratio (B/C).

(2) Result of Evaluation

The indicators for the economic evaluation are figured in the cash flow of the economic cost and benefits during the project evaluation period from 2015 to 2044 as shown in Table 4.8.22. The EIRR is 12.1% and the NPV and the B/C to be discounted by 12% indicate N$ 19.6 million and 1.01, respectively.

(3) Conclusion

The EIRR is higher than 12% to consider the project feasible. The NPV and the B/C show that the present values of the economic benefits are higher than the present values of the economic cost.

Table 4.8.22 Cash Flow of Economic Cost and Benefits for the Walvis Bay Container Terminal Development Project

(Unit : Million N$)

No.	Year	Economic Cost				Economic Bensefits							Net Benefits
		Capital Cost	Additional Investment Cost	O&M Cost	Total	Cost Savings for Conatiner Ship to Handle at Berth	Time Savings for Conatiner Cargo to Handle at Berth	Time Savings for Conatiner Cargo by Trailer in Container Yard	Time Savings for Conatiner Cargo to Handle in Container Yard	Scale Economy by Big Size Ship	Increase of Revenues from Captured Deamnd	Total	
1	2011	7.6			7.6							0.0	-7.6
2	2012	141.3			141.3							0.0	-141.3
3	2013	687.9			687.9							0.0	-687.9
4	2014	1,339.5			1,339.5							0.0	-1,339.5
5	2015	141.1	48.3	144.6	334.0	8.5	5.6	0.6	1.4	48.4	346.3	410.7	76.8
6	2016		3.1	149.5	152.6	8.5	5.8	0.6	1.4	50.6	364.4	431.4	278.8
7	2017		100.8	153.3	254.1	8.5	6.1	0.6	1.4	52.9	385.0	454.6	200.5
8	2018		26.2	158.2	184.4	8.5	6.4	0.7	1.5	55.3	408.3	480.6	296.2
9	2019		135.3	160.7	296.0	8.5	6.7	0.7	1.6	57.8	434.7	509.8	213.9
10	2020		24.1	167.2	191.3	8.5	7.0	0.7	1.6	60.4	464.5	542.7	351.4
11	2021		17.0	169.2	186.2	8.5	7.2	0.7	1.7	62.6	466.6	547.3	361.1
12	2022		20.1	170.4	190.5	8.5	7.5	0.8	1.8	64.8	468.9	552.2	361.7
13	2023		6.6	171.9	178.5	8.5	7.8	0.8	1.8	67.2	471.3	557.3	378.9
14	2024		29.9	173.4	203.3	8.5	8.1	0.8	1.9	69.6	473.9	562.7	359.4
15	2025		8.7	174.9	183.6	8.5	8.4	0.9	2.0	72.1	476.6	568.3	384.8
16	2026		3.1	177.3	180.4	8.5	8.7	0.9	2.0	74.7	481.0	575.7	395.3
17	2027		3.1	177.3	180.4	8.5	8.7	0.9	2.0	74.7	481.0	575.7	395.3
18	2028		20.5	177.3	197.8	8.5	8.7	0.9	2.0	74.7	481.0	575.7	377.9
19	2029		150.0	177.3	327.3	8.5	8.7	0.9	2.0	74.7	481.0	575.7	248.4
20	2030		52.5	177.3	229.8	8.5	8.7	0.9	2.0	74.7	481.0	575.7	345.9
21	2031		3.1	177.3	180.4	8.5	8.7	0.9	2.0	74.7	481.0	575.7	395.3
22	2032		261.5	177.3	438.8	8.5	8.7	0.9	2.0	74.7	481.0	575.7	137.0
23	2033		25.2	177.3	202.5	8.5	8.7	0.9	2.0	74.7	481.0	575.7	373.3
24	2034		82.3	177.3	259.6	8.5	8.7	0.9	2.0	74.7	481.0	575.7	316.2
25	2035		118.9	177.3	296.2	8.5	8.7	0.9	2.0	74.7	481.0	575.7	279.5
26	2036		8.0	177.3	185.3	8.5	8.7	0.9	2.0	74.7	481.0	575.7	390.4
27	2037		82.9	177.3	260.2	8.5	8.7	0.9	2.0	74.7	481.0	575.7	315.5
28	2038		17.6	177.3	194.9	8.5	8.7	0.9	2.0	74.7	481.0	575.7	380.8
29	2039		4.1	177.3	181.4	8.5	8.7	0.9	2.0	74.7	481.0	575.7	394.3
30	2040		6.6	177.3	183.9	8.5	8.7	0.9	2.0	74.7	481.0	575.7	391.8
31	2041		4.2	177.3	181.5	8.5	8.7	0.9	2.0	74.7	481.0	575.7	394.2
32	2042		18.1	177.3	195.4	8.5	8.7	0.9	2.0	74.7	481.0	575.7	380.3
33	2043		12.6	177.3	189.9	8.5	8.7	0.9	2.0	74.7	481.0	575.7	385.8
34	2044		0.0	177.3	177.3	8.5	8.7	0.9	2.0	74.7	481.0	575.7	398.4
Total		2,317.4	1,294.4	5,161.8	8,773.6	254.0	241.5	24.5	56.5	2,081.2	13,899.0	16,556.8	7,783.2

Source : JICA Study Team

EIRR= 12.1%
NPV= 19.6
B/C= 1.01
(Discount Rate : 12%

4.9 Indicative Targets of Project Effectiveness and Operational Efficiency

4.9.1 Strategy to Achieve the Objectives of the Project

The objectives of the Project are considered to be as follows:

1. **To make Port of Walvis Bay a world class hub-port/gateway in south-western Africa:** The first object is expected to accelerate transhipment and transit cargo to and from the hinterland and neighbouring countries. The following two points elaborate on this point.
2. **To increase throughput of transhipment containers:** The attainment of the first point would make it possible to increase throughput of transhipment containers with larger container ships as developed in the demand forecast.
3. **To increase the throughput of transit containers:** The attainment of the first point would make it possible to increase the throughput of transit containers with larger container ship as figured out from the demand forecast. As a result of the second and third points, the following two points elaborate.
4. **To reduce price of imported goods:** The transportation of transhipment and transit containers with larger ships will make it possible to save transportation costs of container ships and to reduce the container tariff which will lead to a reduction in the price of imported goods.
5. **To create an appropriate profit for Namport:** The increase of transhipment and transit containers through captured demand induced by the new container terminal with deepened water would create appropriate profits for Namport by a suitable and competitive level of tariffs vis-à-vis other competing ports.

Therefore, the strategies are considered to be:

1. To promote the transhipment of containers, particularly those transhipped to and from Angola
2. To increase provision of services to container mother vessels with services competitive with the Port of Cape Town
3. To provide economical and scheduled transportation to and from land-locked countries
4. To provide one-stop services for transit containers
5. To educate Namport employees for efficient operation and document processing
6. To introduce a terminal operation system that is standardized worldwide

4.9.2 Indicative Targets of Project Effectiveness

The indicative targets of project effectiveness are considered on the basis of the project objectives and the strategy mentioned above as follows.

(1) Annual Throughput of Transhipment Containers (Objective 2)

The target year of demand forecast of container cargoes is 2025. The throughput of transhipment containers is projected at 469,993 TEU which is 4.0 times growth by the year 2025. This upsurge of transhipment containers is composed of (i) the demand based on the relationship with socio-economic indicators such as GDP and per capita GDP of the major countries and (ii) the captured demand based on comparison between the existing and the future marine inland transport network of the hinterland and surrounding countries. As the result of the study, the considerable induced demand is expected to be captured from other competitive ports of southern Africa. After 2015, the captured demand will grow at the same growth rate of the demand based on the relationship with the socio-economic indicators. The main ports from which transhipment containers will be captured are assumed to be Luanda, Cape Town, and

Durban. Particularly, the Port of Luanda is very congested and has exceeded its capacity; this situation is expected to continue during the short and medium term. However, if a new container terminal were constructed, captured demand from the Port of Luanda would decrease.

It must be noted that the demand of transhipment in the target year is within the limit of capacity of the existing and the new container terminal of the Port of Walvis Bay—i.e. 250,000 TEU and 583,300 TEU, respectively with a total of 833,300TEU. Total demand for container cargo would reach to a new container terminal in 2026. In this case, the demand of transhipment cargo of the Port of Walvis Bay would be 469,993 TEU in the target year of 2025 by the growth rate of 4.0 times from 2008.

Table 4.9.1 Targets of Transhipment and Transit Container

Year	Transshipment		Transit						Total	
			PWB to Inland		Inland to PWB		Subtotal			
	TEU	Growth Rate	TEU	Growth Rate	TEU	Growth Rate	TEU	Growth Rate	TEU	Growth Rate
2008	116,988	1.0	17,098	1.0	167	1.0	17,265	1.0	134,253	1.0
2015	461,656	3.9	48,668	2.8	14,284	85.5	62,952	3.6	524,608	3.9
2020	465,293	4.0	78,744	4.6	43,949	263.2	122,693	7.1	587,986	4.4
2025	469,993	4.0	115,246	6.7	65,794	394.0	181,040	10.5	651,033	4.8

Source: JICA Study Team

Note: Transit includes the southern part of Angola

(2) Annual Throughput of Transit Containers (Objective 3)

The total throughput of transit containers is projected to be 181,040 TEU which is 10.5 times in the year of 2025. The demand of transit container cargoes composes of (i) the southern part of Angola and (ii) the major inland countries. The former demand (i) was forecasted based on (i) the trend and the latter demand (ii) was forecasted based on the share of transit container cargoes of three competitive ports such as Walvis Bay, Cape Town and Durban and (ii) the increase of the amounts of imports and exports of the major inland countries. The share was estimated by taking account of the amounts of imports and exports of major inland countries such as Botswana, Zambia, Zimbabwe and Congo (DRC). In case of with-the-project, the share of the Port of Walvis Bay might be increased considerably and then the increased transit by the increase of share of the Port of Walvis Bay is considered as the captured demand.

It must also be noted that transit demand is within the limit of capacity of the combined existing and the new container terminal of the Port of Walvis Bay as already mentioned. The total demand of transit cargoes of the Port of Walvis Bay would be 181,040 TEU in the target year of 2025 by the growth rate of 10.5 times from 2008. Especially, the transit from inland to PWB is expected to increase extremely to 65,794 in 2025. It is expected that the exports from the inland countries could upsurge by the economic development and the improvement of standard of living of the peoples of these countries.

(3) Reduction of Commodity Price Index Regarding Imported Goods (Objective 4)

Larger ships will call at the Port of Walvis Bay due to the deepened water port after the construction of the new container terminal. Due to this, transport cost per ship could be saved by scale economy and would be reflected in the tariff level of containers which would lead to the reduction of price of the imported goods. If imported goods are consumable, the consumer would benefit from cheaper goods and will likely accelerate their consumption. If the imported goods are materials for production, production of related industries would increase. The reduction of the price of the imported goods could influence the commodity price index and contribute to controlling inflation.

(4) Jobs Creation from Project (Objective 5)

The scale economy of larger container ships will have an enormous socio-economic impact not only in Namibia but also in the surrounding countries including the nearby landlocked countries and would contribute to socio-economic development of the SADC countries as a whole. Succeeding to the impact on the reduction of price of the imported goods and the increase of production of related industries, it is predicted that jobs in relevant industries would be created and that jobs of other indirectly affected industries could also be positively influenced. In addition, it is expected that jobs in industries related to port services would be positively influenced by captured demand through the new container terminal.

(5) Annual Profit from the New Container Terminal (Objective 6)

Port revenues were projected based on increased demand of container cargo in comparing the two scenarios of without-the-project and with-the-project and the tariffs of Namport. The tariffs are applied based on the type of container cargo such as imports, exports, transit, and transhipment. The revenues are predicted to increase from N$ 387.5 million in 2015 to N$ 705.0 million in 2025, 1.8 times of 2015.

On the other hand, the expenditures compose of additional investment in equipment, operation and maintenance. Expenditures would decrease from N$ 387.7 million to N$ 213.0 million in 2020 at a rate of 0.55 times and further decrease to N$ 203.8 million in 2025, mainly because of a gradually decrease in additional investment.

Profits are the difference between the revenues and the expenditures. They would increase from deficits of N$ 0.3 million in 2015 to N$ 333.7 million and further increase to N$ 501.2 million in 2025. It could be concluded that the financial situation of the project is fairly good and Namport could have an allowance of funds as internal reserves for investment in new equipment and facilities.

Table 4.9.2 Target of Annual Profits from the New Container Terminal

Year	Revenues		Expenditures		Profits	
	Million N$	Growth Rate	Million N$	Growth Rate	Million N$	Growth Rate
2015	387.5	1.00	387.7	1.00	-0.3	-
2020	546.7	1.41	213.0	0.55	333.7	1.00
2025	705.0	1.82	203.8	0.53	501.2	1.50

Source: JICA Study Team

(6) Tariff of Transhipment Containers (Strategy 1)

One of the most important factors of hub port is the possibility of availability of the Port of Walvis Bay for handling of the transhipment containers. In this context, the tariff level for the transhipment containers is a key factor for the availability and one of the major factors of transportation cost and also one of the important factors for the shipping companies to call the Port of Walvis Bay. Then if the level of tariff is relatively higher in comparison with the service level such as container handling than other competitive ports, the shipping companies would refrain from calling the Port of Walvis Bay. As the result, the role of the Port of Walvis Bay as the hub port would be eliminated. The competitive level of tariff is necessary to be low as much as possible by keeping the quality of service level. Then the discount of the tariff is one of the most effective measures to compete with other ports.

(7) Annual Number of Containers Transported by Train (Strategy 3)

The modal split analysis of the inland transport effects concluded that total containers by rail would increase from 6,977 TEU in 2008 to 13,919 TEU in 2015 at a rate of 2.0 times and further increase to 27,899TEU in 2025 at a rate of 4.0 times the base case. The share of railway would be mostly constant as 8% and that of truck is 92% respectively and still remain lower than that of truck-based transport. Transit container cargoes by rail may increase at a much higher growth rate of 7.9 times in comparison with those of the exports and imports mainly because of the extension of railway from Namibia to Angola along the Trans-Cunene Corridor .

Table 4.9.3 Target of Annual Number of Containers Transported by Train (Base Case)

Year	Transit						Exports		Imports		Total	
	PWB to Inland		Inland to PWB		Subtotal							
	TEU	Growth Rate	TEU	Growth Rate	TEU	Growth Rate	TEU	Growth Rate	TEU	Growth Rate	TEU	Growth Rate
2008	2,189	1.0	6	1.0	2,195	1.0	1,573	1.0	3,210	1.0	6,977	1.0
2015	6,230	2.8	543	85.5	6,772	3.1	2,416	1.5	4,731	1.5	13,919	2.0
2020	10,079	4.6	1,670	263.2	11,749	5.4	3,021	1.9	5,890	1.8	20,660	3.0
2025	14,751	6.7	2,500	394.0	17,252	7.9	3,633	2.3	7,014	2.2	27,899	4.0

Source : JICA Study Team

Note : Transit includes the southern part of Angola

Regarding the high growth case, the modal split analysis of the inland transport concludes that total containers by rail would increase from 6,977 TEU in 2008 to 27,839 TEU in 2015 at a rate of 4.0 times and would increase to 83,696 TEU in 2025 at a rate of 12.0 times. The share of railway would increase from 8% in 2008 to 17-25% after 2015 indicating that it would still have a smaller share than truck-based transit. It could be expected that transit container cargoes by rail would increase at an extremely higher growth rate of around 24 times in comparison with those of the exports and imports as in 2025. The main reasons for this drastic increase of railway are due to capacity expansion of train by construction of the additional passing stations and by track rehabilitation. However, it will take a long time before railway maximizes its advantages such as long haul, high speed, low cost, large capacity, and environmentally friendliness.

Table 4.9.4 Target of Annual Number of Containers Transported by Train (High Growth Case)

Year	Transit						Exports		Imports		Total	
	PWB to Inland		Inland to PWB		Subtotal							
	TEU	Growth Rate	TEU	Growth Rate	TEU	Growth Rate	TEU	Growth Rate	TEU	Growth Rate	TEU	Growth Rate
2008	2,189	1.0	6	1.0	2,195	1.0	1,573	1.0	3,210	1.0	6,977	1.0
2015	12,459	5.7	1,086	171.1	13,545	6.2	4,831	3.1	9,463	2.9	27,839	4.0
2020	30,238	13.8	5,010	789.5	35,248	16.1	9,063	5.8	17,670	5.5	61,981	8.9
2025	44,254	20.2	7,501	1,181.9	51,755	23.6	10,900	6.9	21,041	6.6	83,696	12.0

Source : JICA Study Team

Note : Transit includes the southern part of Angola

4.9.3 Indicative Targets of Operational Efficiency

Several major container operators are operating in the principal world container terminals as private operators and are becoming dominant due to their size. In addition, shipping industry mergers and acquisitions are rising in the sector and reinforcing the dominance of large companies.

The world operators are classified into two categories; shipping company subsidiaries ones and independent operators. Typical of the former type is A.P.M. Terminals under the Maersk line, and typical of the latter are Hatchson Port Holding, PSA International, DP World, among others.

In Angola, the country bordering Namibia to the North, A.P.M. Terminals is in charge of container terminal management as a private operator in the port of Luanda while to the South of Namibia in South Africa, DP World and SSA Marine operate the container terminals in Durban.

In the case of Walvis Bay, Namport should seek non-shipping company operators if they wish to induce a private operator from outside. The reason for this is described in Section 4.7.2 in this report and basically comes down to instilling a sense of fairness for all in the shipping company.

When Namport operates the Walvis Bay container terminal independently, the indicative target of operation efficiency is to achieve a handling rate of 25 boxes per gantry crane per hour to UNCTAD standards at the opening of a new terminal as a first step in developing countries. Later, the container productivity at quay side will rise in tandem with the progress of the terminal workers' skills and training. The target is 30 boxes per gantry crane per hour.

The following section describes items to be considered in practicing actual terminal operations.

(1) Principal Points for Operations

a) Container handling/working procedures to be completed and in hands of the relevant persons before a container vessel enters the port. Workers should board the vessel and the gantry should be stationed in the appropriate working position on the berth without delay.

b) Information should be obtained for each container upon delivery of the empty container from the Empty Container Depot (ECD) prior to transporting it to the container yard. The terminal should develop a yard stowage plan on these data. Data should include: destination, weight, inside stowage condition on Container Load Plan (CLP), kinds of 20FT/40FT, etc.

c) On inspection of containers passing the container checking gate towards the yard, the checkers should direct truck drivers hauling export containers to the stowage location in the stacking yard to appropriate location where the containers are piled in accordance with the loading sequence. The containers reached by the railway wagons should be stowed in the same blocks for loading on their vessel. Based on the stowage plan of a vessel on her departure from the previous port, the Walvis Bay stowage plan should be created on board.

d) The operation/working procedure for individual hatches of the vessel should be created, and the terminal operation department and gang boss should confirm with one another.

e) Gantry cranes and gangs should be allocated aside the covering hatches for discharging/loading Walvis Bay containers according to procedure. The target of operation time should be decided based on the hatch with the greatest number of containers; this will benchmark the vessel’s departure time. Gantry cranes and gangs allotted on the other hatches should be shifted to adjust working hours to time the completion in handling the most burdened hatch with the working time of other less-burdened hatches. For example if small numbers of containers are handled in some hatches, there may be a case where one gantry crane is enough for shifting use in order. The terminal can handle two vessels at the same time without waste with three gantry cranes.

f) It is normal practice to decide beforehand the stacking positions of the containers to be discharged from the ship as well as the positions on the deck or in the hold for the containers to be loaded on the ship. In order to do discharging and loading of containers in a shorter time, it is important to have complete information about the containers to be discharged and loaded, in case of loaded, those to be placed in the hold or on deck. Based on this information, the movement of each container from ship to stacking yard or vice versa has to be determined in advance.

g) On discharging/loading containers from/to a vessel by gantry crane, a vessel’s heel mount and reciprocal handling on the starboard/port side should be considered to prevent movement. An imbalance of container contents weight and inclination inside significantly influences the achievement of safe handling

h) Imported transit containers should be directly hauled from the apron to the railway wagon.

(2) Other Notes for Concerning Operation include

a) All the export containers should be carried into the terminal after completion of customs clearance almost without exception. If this is not done, the customs inspection in the yard disturbs container handling operations.

b) All the imported containers should be taken out in bond for customs inspection in warehouses/bonded area outside.

c) Warehouse spaces should be secured close to the port and workflows should be established where fumigation, consolidation, palletizing, packing, etc. can be performed in addition to customs documentation. Such achievements assist cargo flow smoothly and rapidly.

d) Terminal handling procedures are to be set in a manual and formalized in working patterns. Based on this, working quality and efficiency can be gradually improved.

e) Care must be always paid to evaluate the functioning condition of handling equipment. To these ends, it is essential that drivers and operators record and remark on the actual moving condition and report on the remaining oil in a daily report upon commencing and finishing the work.

f) For yard equipment, risk insurance/breakdown incident insurance should be employed for unexpected accidents. Otherwise the terminal may bear significant fiduciary damages.