Table 4.26 Estimated Domestic Fleet

Type	Vessel Size	DWT	Units	Remarks
Container	1,000 - 2,000	703	1	
	2,000 - 4,000	46,404	15	
	4,000 - 8,000	320,611	53	
	8,000 - 12,000	112,495	11	
	over 12,000	253,114	17	
	Total	**733,327**	**98**	
Conventional	0 - 1,000	318,351	637	
	1,000 - 2,000	296,347	198	
	2,000 - 4,000	471,909	157	
	4,000 - 8,000	809,923	162	
	over 8,000	543,070	54	
	Total	**2,439,600**	**1208**	
Bulker	1,000 - 4,000	12,790	5	
	4,000 - 8,000	73,673	12	
	8,000 - 15,000	101,300	9	
	over 15,000	399,059	13	
	Total	**586,822**	**40**	
Barge	2,500 - 5,000	391,215	104	Barges of sizes below 2,500 DWT are assumed to operate in rivers and are not included
	5,000 - 10,000	307,383	41	
	10,000 - 15,000	18,629	1	
	Total	**717,227**	**147**	
Tanker	0 - 1,000	50,638	101	
	1,000 - 4,000	531,700	213	
	4,000 - 8,000	371,346	62	
	8,000 - 15,000	247,564	23	
	15,000 - 25,000	360,093	18	
	25,000 - 35,000	405,105	14	
	over 35,000	180,047	5	
	Total	**2,146,493**	**434**	
Passenger	0 - 1,500	72,000	162	Not including Ferries considered to be operating beyond the scope of the Study
	1,500 - 4,000	42,000	17	
	4,000 - 6,000	136,000	25	
	over 6,000	118,000	10	
	Total	**368,000**	**214**	
Passenger/RoRo	0 - 4,000	15,000	5	Not including RoRo Ferries considered to be operating beyond the scope of the Study
	4,000 - 6,000	29,000	6	
	over 6,000	8,000	1	
	Total	**52,000**	**12**	
RoRo	0 - 2,000	5,806	4	Not including small RoRo vessels considered to be operating beyond the scope of the Study
	2,000 - 4,000	9,282	3	
	over 4,000	14879	3	
	Total	**29,967**	**10**	

4.6. Required Fleet Expansion

4.6.1. Methodology and Key Parameters

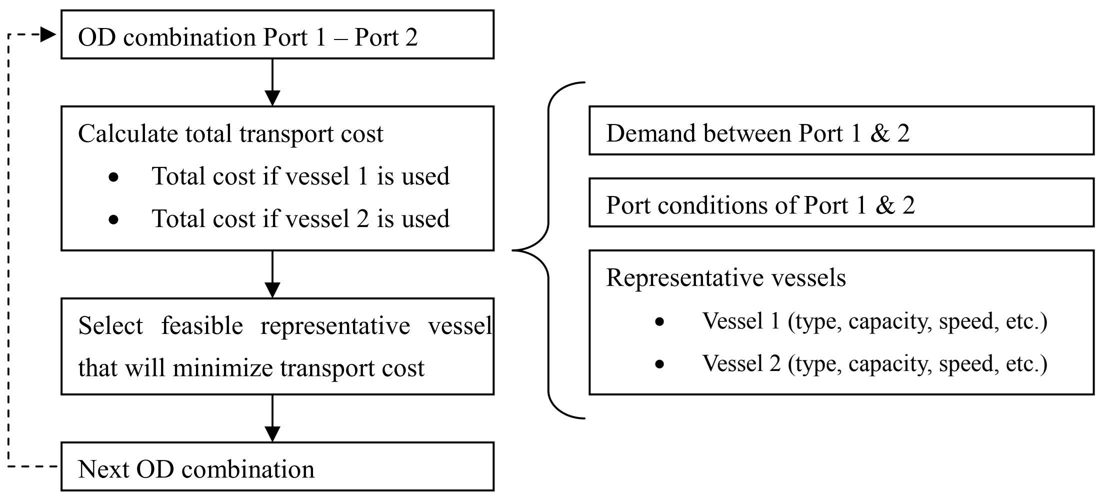
(1) Approach to Fleet Expansion

The fleet estimation requires the estimation of the total fleet tonnage per vessel type and the estimation of the optimal vessel size distribution per vessel type.

There are two approaches used. The first approach is the extrapolation of the current fleet based on the increase of demand. This approach is used in the case where packaging type of the commodity is static and where demand is projected not to increase significantly. This approach is used in the case of liquid cargo. This approach is also used to provisionally estimate the fleet requirement for passenger shipping. The fleet requirement for passenger shipping will vary depending on the nature of the passenger shipping network adopted – which at the moment is still under discussion.

The second approach is to select the vessel type that will be able to serve the transport demand between two ports (or route in the case of multi-port route) at the least cost and feasibly in terms of port facilities and draft requirements. In this case the type of packaging that will be used to serve the demand between two ports will depend on the type of vessel selected to optimally serve between the two ports. Through this approach packaging type is dynamic and will depend on several factors such as the volume of demand, cost parameters, etc. Vessel requirement for dry cargo is analyzed using this vessel cost minimization approach. This approach is necessary because packaging type of dry cargo is interchangeable, for example cement can be carried either by container, conventional or bulker vessel. Moreover, traffic demand for dry cargo will significantly increase thus it is expected that vessel size profile will change markedly. The vessel cost minimization logic is illustrated as follows.

Figure 4.16 Vessel Cost Minimization Algorithm



(2) Shipping Cost for Vessel Cost Minimization Approach

In the vessel cost minimization approach, it is necessary to formulate the cost function of each vessel type and each vessel size. Vessel cost has the following components:

- Fixed cost – capital cost and fixed operational cost which includes repair, dockage, crew wages, food expenses, insurance and lubricants;
- Distance related cost – cost which is increases as the distance traveled by the vessel increases and is composed of fuel cost;
- Cargo related cost – cost which increases as the volume of cargo increases and primarily includes stevedore cost; and,

- Call related cost – cost which increases as the number of port calls increases, which includes berthage, anchorage and pilotage.

Table 4.27 Summary of Cost Parameters of Selected Representative Vessels

Type	DWT	Capital Cost *(mill. Rp/yr)*	Fixed Operation Cost *(mill. Rp/yr)*	Dist. Cost *(mill. Rp/mile)*	Cargo cost *(mill. Rp)*	Call cost *(mill. Rp/call)*
Container	5,000	9,600	3,300	0.04	0.12/TEU	0.98
Container	10,000	10,800	3,700	0.06	0.12/TEU	1.56
Conventional	3,000	6,000	3,000	0.04	0.002/MT	0.71
Conventional	10,000	9,600	4,400	0.07	0.002/MT	1.38
Bulker	10,000	7,200	3,600	0.04	0.002/MT	1.56
Bulker	20,000	13,200	12,000	0.12	0.002/MT	4.53

Source: STRAMINDO Surveys and interviews

(3) Port Conditions for Vessel Cost Minimization Approach

Port conditions are necessary input to check the feasibility of ship calls and to calculate port related costs. Considered port conditions involve (1) port depth, (2) waiting and approach time, (3) cargo handling efficiency and (4) technical feasibility (i.e. if a certain type of vessel can technically operate at the certain port). Port conditions were taken from the DGSC port inventory (dated 1999) and port productivity indicators from a report from PELINDO.

Table 4.28 Cargo Handling Productivity

Vessel Type	Cargo handling productivity
Container	10 TEU/hr/gang
Conventional	20 MT/hr/gang
Bulker	For clean cargo (e.g. cement) · 50 MT/hr/gang For dirty cargo (e.g. coal) · 30,000 DWT – 1,000 MT/hr · 10,000 DWT – 500 MT/hr · 5,000 DWT – 300 MT/hr

Note: figures taken from coal handling performance at Suralaya Coal Terminal

Table 4.29 Notes on Technical Feasibility of Port Operation

Commodity	Notes
Petroleum, CPO and other liquid products	Only tankers are used
Coal and mining products	Only bulkers are used
General cargo, rice and fresh products	Only containers and conventional vessels are used
Agri grains, fertilizer, cement, other grains and wood	Only containers, conventional vessels and bulkers are used

Table 4.30 Port Depth Conditions

	Port Name	Container	Conventional	Bulker		Port Name	Container	Conventional	Bulker
1	Malahayati	4.5	4.5	10.0	51	Meneg / Tanjung W	12.5	12.5	12.5
2	Lhokseumawe	8.5	8.5	10.0	52	Pasuruan	1.8	1.8	1.8
3	Sabang	9.5	9.5	8.0	53	Panarukan	1.0	1.0	1.0
4	Meulaboh	6.5	6.5	6.5	54	Kalianget	10.0	10.0	12.0
5	Kuala Langsa	5.0	5.0	5.0	55	Benoa	8.0	8.0	8.0
6	Belawan	8.0	8.0	8.0	56	Padangbai	5.0	5.0	5.0
7	Pangkalan Susu	5.5	5.5	5.5	57	Celukan Bawang	13.5	13.5	13.5
8	Tanjung Balai As	3.0	3.0	3.0	58	Lembar	6.5	6.5	6.5
9	Kuala Tanjung	10.5	10.5	10.5	59	Bima	8.0	8.0	8.0
10	Sibolga	7.5	7.5	7.5	60	Badas	17.0	17.0	17.0
11	Gunung Sitoli	10.0	10.0	10.0	61	Kupang / Tenau	8.0	8.0	8.0
12	Dumai	10.0	10.0	10.0	62	Waingapu	10.0	10.0	10.0
13	Tanjung Pinang	3.5	3.5	3.5	63	Ende	6.0	6.0	6.0
14	Pekanbaru	5.0	5.0	5.0	64	Maumere	8.0	8.0	8.0
15	Tanjung Balai Ka	5.0	5.0	5.0	65	Kalabahi	5.0	5.0	5.0
16	Kuala Enok	8.0	8.0	8.0	66	Pontianak	7.0	7.0	7.0
17	Bagan Siapi-api	4.0	4.0	4.0	67	Teluk Air	7.0	7.0	7.0
18	Bengkalis	7.5	7.5	7.5	68	Sintete	9.5	9.5	9.5
19	Selat Panjang	10.0	10.0	10.0	69	Ketapang	2.0	2.0	2.0
20	Tembilahan	4.2	4.2	4.2	70	Sampit	5.5	5.5	5.5
21	Rengat	3.0	3.0	3.0	71	Kuala Pembuang	5.0	5.0	5.0
22	Sungai Pakning	10.0	10.0	10.0	72	Samuda	7.5	7.5	7.5
23	Kijang	7.0	7.0	7.0	73	Pulang Pisau	4.5	4.5	4.5
24	Batam	15.0	15.0	15.0	74	Pangkalan Bun	2.0	2.0	2.0
25	Teluk Bayur	10.0	10.0	10.0	75	Sukamara	6.0	6.0	6.0
26	Kuala Tangkal	5.0	5.0	5.0	76	Kumai	2.0	2.0	2.0
27	Talang Dukuh / J	5.0	5.0	5.0	77	Pengatan Mendawa	4.0	4.0	4.0
28	Muara Sabak	5.0	5.0	5.0	78	Banjarmasin	5.0	5.0	5.0
29	Pulau Baai	10.0	10.0	10.0	79	Kotabaru	6.0	6.0	15.0
30	Palembang	6.5	6.5	7.5	80	Balikpapan	12.0	12.0	12.0
31	Pangkal Balam	4.0	4.0	4.0	81	Samarinda	6.6	6.6	6.6
32	Tanjung Pandang	3.0	3.0	3.0	82	Tarakan	8.0	8.0	8.0
33	Muntok	2.0	2.0	2.0	83	Nunukan	6.0	6.0	6.0
34	Panjang	12.0	12.0	12.0	84	Bitung	8.0	8.0	8.0
35	Bakauheuni	6.5	6.5	6.5	85	Manado	3.5	3.5	3.5
36	Tanjung Priok	14.0	10.5	10.5	86	Gorontalo	10.0	10.0	10.0
37	Sunda Kelapa	2.0	2.0	2.0	87	Pantoloan	9.0	9.0	9.0
38	Marunda	5.0	5.0	5.0	88	Toli-toli	8.2	8.2	8.2
39	Kepulauan Seribu	5.0	5.0	5.0	89	Ujung Pandang	11.0	11.0	11.0
40	Kalibaru	5.0	5.0	5.0	90	Pare-pare	9.8	9.8	9.8
41	Muara Karang / M	5.0	5.0	5.0	91	Kendari	5.0	5.0	5.0
42	Muara Baru	9.0	9.0	9.0	92	Ambon	10.0	10.0	10.0
43	Cirebon	7.0	7.0	7.0	93	Bandaneire	7.0	7.0	7.0
44	Banten	14.0	14.0	14.0	94	Ternate	9.0	9.0	9.0
45	Semarang	9.0	9.0	9.0	95	Sorong	11.0	11.0	11.0
46	Cilacap	8.3	8.3	7.5	96	Jayapura	11.0	11.0	11.0
47	Tegal	1.8	1.8	1.8	97	Biak	12.0	12.0	12.0
48	Surabaya	10.5	8.3	8.3	98	Merauke	4.0	4.0	4.0
49	Gresik	3.6	3.6	13.0	99	Manokwari	9.0	9.0	9.0
50	Probolinggo	2.5	2.5	2.5	100	Fak-fak	6.0	6.0	6.0

Note: /1 in meters
/2 in LWS
/3 non-commercial ports are aggregated per province and are represented by an imaginary port. It is assumed that all representative imaginary ports have port depth of 3.5 meters

Table 4.31 Waiting Time and Approach Time Conditions

	Port Name	Container	Conventional	Bulker		Port Name	Container	Conventional	Bulker
1	Malahayati	5.0	5.0	5.0	51	Meneg / Tanjung W	5.0	12.7	5.0
2	Lhokseumawe	5.0	10.0	5.0	52	Pasuruan	5.0	5.0	5.0
3	Sabang	5.0	5.0	5.0	53	Panarukan	5.0	5.0	5.0
4	Meulaboh	5.0	5.0	5.0	54	Kalianget	5.0	5.0	5.0
5	Kuala Langsa	5.0	5.0	5.0	55	Benoa	10.0	15.0	5.0
6	Belawan	48.0	72.0	24.0	56	Padangbai	5.0	5.0	5.0
7	Pangkalan Susu	5.0	5.0	5.0	57	Celukan Bawang	5.0	5.0	5.0
8	Tanjung Balai As	5.0	5.0	5.0	58	Lembar	5.0	22.1	5.0
9	Kuala Tanjung	5.0	25.7	5.0	59	Bima	5.0	5.0	5.0
10	Sibolga	5.0	32.2	5.0	60	Badas	5.0	5.0	5.0
11	Gunung Sitoli	5.0	5.0	5.0	61	Kupang / Tenau	40.0	48.0	24.0
12	Dumai	36.0	48.0	36.0	62	Waingapu	5.0	5.0	5.0
13	Tanjung Pinang	24.0	48.0	5.0	63	Ende	5.0	5.0	5.0
14	Pekanbaru	12.0	24.0	5.0	64	Maumere	5.0	5.0	5.0
15	Tanjung Balai Ka	5.0	5.0	5.0	65	Kalabahi	5.0	5.0	5.0
16	Kuala Enok	5.0	5.0	5.0	66	Pontianak	24.0	48.0	5.0
17	Bagan Siapi-api	5.0	5.0	5.0	67	Teluk Air	5.0	13.8	5.0
18	Bengkalis	5.0	5.0	5.0	68	Sintete	5.0	5.0	5.0
19	Selat Panjang	5.0	5.0	5.0	69	Ketapang	5.0	5.0	5.0
20	Tembilahan	5.0	5.0	5.0	70	Sampit	5.0	9.6	5.0
21	Rengat	5.0	5.0	5.0	71	Kuala Pembuang	5.0	5.0	5.0
22	Sungai Pakning	5.0	5.0	5.0	72	Samuda	5.0	5.0	5.0
23	Kijang	5.0	5.0	5.0	73	Pulang Pisau	5.0	5.0	5.0
24	Batam	12.0	24.0	12.0	74	Pangkalan Bun	5.0	5.0	5.0
25	Teluk Bayur	15.0	25.0	10.0	75	Sukamara	5.0	5.0	5.0
26	Kuala Tangkal	5.0	5.0	5.0	76	Kumai	5.0	46.0	5.0
27	Talang Dukuh / J	5.0	52.9	5.0	77	Pengatan Mendawa	5.0		5.0
28	Muara Sabak	5.0	5.0	5.0	78	Banjarmasin	48.0	72.0	30.0
29	Pulau Baai	5.0	5.0	5.0	79	Kotabaru	5.0	58.9	5.0
30	Palembang	48.0	72.0	48.0	80	Balikpapan	48.0	72.0	5.0
31	Pangkal Balam	5.0	77.8	5.0	81	Samarinda	24.0	48.0	20.0
32	Tanjung Pandang	5.0	50.2	5.0	82	Tarakan	5.0	5.0	5.0
33	Muntok	5.0	5.0	5.0	83	Nunukan	5.0	5.0	5.0
34	Panjang	3.0	4.0	4.0	84	Bitung	40.0	60.0	24.0
35	Bakauheuni	5.0	5.0	5.0	85	Manado	5.0	5.0	5.0
36	Tanjung Priok	24.0	30.0	12.0	86	Gorontalo	5.0	5.0	5.0
37	Sunda Kelapa	5.0	5.0	5.0	87	Pantoloan	5.0	5.0	5.0
38	Marunda	5.0	5.0	5.0	88	Toli-toli	5.0	5.0	5.0
39	Kepulauan Seribu	5.0	5.0	5.0	89	Ujung Pandang	3.0	5.0	4.0
40	Kalibaru	5.0	5.0	5.0	90	Pare-pare	5.0	5.0	5.0
41	Muara Karang / M	5.0	5.0	5.0	91	Kendari	5.0	5.0	5.0
42	Muara Baru	5.0	5.0	5.0	92	Ambon	5.0	10.0	5.0
43	Cirebon	5.0	41.4	5.0	93	Bandaneire	5.0	5.0	5.0
44	Banten	24.0	30.0	12.0	94	Ternate	5.0	5.0	5.0
45	Semarang	5.0	10.0	5.0	95	Sorong	48.0	70.0	5.0
46	Cilacap	5.0	5.0	5.0	96	Jayapura	48.0	72.0	24.0
47	Tegal	5.0	5.0	5.0	97	Biak	35.0	60.0	5.0
48	Surabaya	24.0	40.0	20.0	98	Merauke	5.0	5.0	5.0
49	Gresik	5.0	5.0	5.0	99	Manokwari	5.0	5.0	5.0
50	Probolinggo	5.0	14.0	5.0	100	Fak-fak	5.0	5.0	5.0

Note: /1 waiting time includes waiting time for berth and waiting time for cargo
/2 non-commercial ports are aggregated per province and are represented by an imaginary port. It is assumed that all representative imaginary ports have port waiting time of 5 hrs
/3 units in hours

(4) Vessel Specifications for Vessel Cost Minimization Approach

The vessel cost minimization approach requires the specifications of vessel characteristics in order to facilitate the computation of vessel cost and checking of draft requirements.

Table 4.32 Vessel Specifications of Representative Vessels

Type	DWT	Draft (m)	Speed (knot)	Commissionable days
Container 1	15,000	8.5	12.0	346
Container 2	10,000	7.4	11.0	346
Container 3	5,000	6.0	10.0	346
Conventional 1	10,000	8.4	11.0	338
Conventional 1	5,000	6.0	10.0	338
Conventional 1	3,000	4.5	9.0	338
Conventional 1	1,500	3.0	9.0	338
Bulker 1	30,000	8.5	12.0	350
Bulker 2	10,000	7.8	11.0	350
Bulker 3	5,000	6.7	10.0	350

Note: 20,000 DWT containers and 30,000 DWT containers are also considered

4.6.2. Cargo Ship Expansion

(1) Growth in Vessel Requirement for Liquid Cargo Demand

The domestic tanker fleet will have to be able to cope with the increase in liquid cargo traffic. Table 4.6.7 summarizes the growth in traffic of liquid cargo. Based on the growth of demand, it is expected that the tanker fleet tonnage will also increase by 1.33 times by 2014 and by 1.43 times by 2024.

Table 4.33 Growth in Liquid Cargo Traffic

	2002	2014	2024
MT	86,686,697	113,105,219	120,430,694
MT Growth (2002 = 1.00)	1.00	1.30	1.39
‘000 MT-mile	40,808,389	54,272,041	57,227,078
MT-mile Growth (2002 = 1.00)	1.00	1.33	1.40

Note: Liquid cargo is composed of petroleum, CPO and other liquid cargo. At least 85% of the liquid cargo traffic in ton-mile is petroleum

(2) Growth in Vessel Requirement for Dry Cargo Demand

Based on a port-to-port network structure the vessel requirement for dry cargo is simulated using the minimum cost vessel selection approach. The growth pattern in the simulated vessel requirement is then used as the basis for extrapolation of the current fleet to estimate future fleet requirements.

There are three scenarios considered in the estimation of fleet requirement for dry cargo.

Case 0: Base Case – No changes in fleet specification and port conditions

Case 1: Improved Fleet Case – Improved fleet conditions brought about by ship replacement and modernization. It is assumed that vessels over 35 years old will be replaced by second hand vessels in the next ten years. Vessels over 30 and 25 years old will be replaced in the periods of 2014~2019 and 2019~2024 respectively. As a result vessel speed and commissionable days will improve. Improvement in vessel speed is assumed to apply only to container and conventional vessels.

Table 4.34 Improved Average Speed of Fleet Scenario

Vessel Type	Average Speed (knots)		
	2002	2014	2024
Container (5,000 DWT)	10.0	12.2	11.9
Container (10,000 DWT)	11.0	15.5	13.8
Container (15,000 DWT)	12.0	16.1	14.7
Conventional (1,500 DWT)	9.0	10.8	11.7
Conventional (3,000 DWT)	9.0	10.8	11.7
Conventional (5,000 DWT)	10.0	12.0	13.0
Conventional (10,000 DWT)	11.0	13.2	14.3
Bulker (all)	No change		

Table 4.35 Improved Commissionable Days Scenario

Vessel Type	Commissionable days		
	2002	2014	2024
Container (all)	346	353	359
Conventional (all)	338	349	359
Bulker (all)	350	355	359

Table 4.6.10 shows the summary of waiting time per vessel type at Indonesian ports (based on PELNDO Statistics). Waiting time is comprised of time spent for non- cargo operational activities, including waiting for berth, waiting for cargo, repair time, and approach time.

Table 4.36 Current Non-operational Port Waiting Time at Ports

	Container	Bulker	Conventional
Average (hrs)	10.3	7.3	18.0
Minimum (hrs)	3.0	4.0	4.0
Maximum (hrs)	48.0	48.0	77.8

It can be clearly seen that conventional vessels exhibit very inefficient management of vessel waiting time at ports, thus leading to very low vessel utilization. Berth availability is a contributory factor, but because only a few ports are very congested and that berthing allocation in many cases is on equal terms with containers and bulkers, thus berth space availability is not a significant factor. It is more likely to be because of logistics management and over tonnage. It is therefore possible to improve port waiting time of conventional vessels through the control of national tonnage and through improved management of port vessel time, by coordinating cargo availability at port and vessel calling.

Thus as part of improved fleet case, it is assumed that conventional vessel operators be able to duplicate the level of efficiency of container vessel operators and bulker operators in terms of minimizing waiting time. Moreover, as a support mechanism, the government is assumed be able to sufficiently control over tonnage in conventional vessels as this will greatly aid in minimizing waiting time for cargo at ports.

Case 2: Improved Port Productivity - Improved port productivity in terms of minimizing waiting time and improving cargo handling speed

Table 4.37 Improved Port Productivity Scenario

	2002	2014	2024
Waiting time (2002 = 1.0)	1.0	0.5	0.5
Cargo handling speed (2002 = 1.0)	1.0	1.2	1.2

Based on the scenarios described, the expansion growth of each representative vessel is calculated. The following summarizes the results.

Table 4.38 Case 0: Base Case Simulation Results

Vessel Type	DWT	Fleet DWT (1,000)			Growth (‘02-sim = 1.00)		
		‘02-sim	‘14	‘24	‘02-sim	‘14	‘24
Container	15,000	32	316	789	1.00	9.86	24.68
	10,000	78	176	233	1.00	2.25	2.99
	5,000	379	843	1,275	1.00	2.23	3.37
	all	489	1,334	2,298	1.00	2.73	4.70
Conventional	10,000	0	0	0	1.00	1.00	1.00
	5,000	0	0	0	1.00	1.00	1.00
	3,000	170	424	768	1.00	2.49	4.50
	1,500	1,749	2,564	3,736	1.00	1.47	2.14
	all	1,919	2,987	4,503	1.00	1.56	2.35
Bulker	30,000	51	150	167	1.00	2.92	3.25
	11,000	174	382	578	1.00	2.20	3.33
	6,000	618	747	850	1.00	1.21	1.38
	all	843	1,279	1,595	1.00	1.52	1.89
Dry Cargo Fleet		3,251	5,600	8,396	1.00	1.72	2.58

Note: /1 minimum growth set at 1.0
/2 ’02-sim refers to the estimated fleet based on 2002 demand

Table 4.39 Case 1: Improved Fleet Case Simulation Results

Vessel Type	DWT	Fleet DWT (1,000)			Growth (‘02-sim = 1.00)		
		‘02-sim	‘14	‘24	‘02-sim	‘14	‘24
Container	15,000	32	288	713	1.00	9.02	22.29
	10,000	78	149	208	1.00	1.91	2.66
	5,000	379	790	1,192	1.00	2.09	3.15
	all	489	1,227	2,112	1.00	2.51	4.32
Conventional	10,000	0	0	0	1.00	1.00	1.00
	5,000	0	0	0	1.00	1.00	1.00
	3,000	170	411	706	1.00	2.41	4.14
	1,500	1,749	2,479	3,517	1.00	1.42	2.01
	all	1,919	2,890	4,223	1.00	1.51	2.20
Bulker	30,000	51	148	163	1.00	2.88	3.17
	11,000	174	377	563	1.00	2.17	3.24
	6,000	618	717	794	1.00	1.16	1.29
	all	843	1,242	1,520	1.00	1.47	1.80
Dry Cargo Fleet		3,251	5,359	7,855	1.00	1.65	2.42

Note: /1 minimum growth set at 1.0
/2 ’02-sim refers to the estimated fleet based on 2002 demand

Table 4.40 Case 2: Improved Port Productivity Case Simulation Results

Vessel Type	DWT	Fleet DWT (1,000)			Growth (‘02-sim = 1.00)		
		‘02-sim	‘14	‘24	‘02-sim	‘14	‘24
Container	15,000	32	236	597	1.00	7.38	18.67
	10,000	78	133	176	1.00	1.71	2.26
	5,000	379	654	1,008	1.00	1.73	2.66
	all	489	1,023	1,782	1.00	2.09	3.65
Conventional	10,000	0	0	0	1.00	1.00	1.00
	5,000	0	0	0	1.00	1.00	1.00
	3,000	170	335	586	1.00	1.96	3.44
	1,500	1,749	2,123	2,990	1.00	1.21	1.71
	all	1,919	2,458	3,576	1.00	1.28	1.86
Bulker	30,000	51	134	148	1.00	2.61	2.88
	11,000	174	322	477	1.00	1.86	2.75
	6,000	618	607	674	1.00	0.98	1.09
	all	843	1,063	1,299	1.00	1.26	1.54
Dry Cargo Fleet		3,251	4,544	6,656	1.00	1.40	2.05

Note: /1 minimum growth set at 1.0
/2 ’02-sim refers to the estimated fleet based on 2002 demand

Comparison of the simulated and actual tonnage shows that the actual tonnage is about 1.3 to 1.5 times greater than the simulated fleet tonnage as shown in Table 4.6.15. This is rather expected as the simulated fleet tonnage is very near the theoretical optimum, i.e. the minimum required fleet under perfect conditions such as information of cargo availability and vessel space availability is perfectly known by all, no over competition, etc. In the practical world, such perfect conditions can never be achieved. Thus the simulated results have to be adjusted to account for such factors. This is achieved through the extrapolation of the actual fleet using the simulated growth factors.

Table 4.41 Comparison of Simulated and Actual Fleet DWT per Vessel Type

	Container	Conventional	Bulker/1	Dry cargo fleet
Actual/3	733,327	2,439,600	1,304,049	4,476,976
Simulated	488,700	1,919,365	842,587	3,250,658
Act/Sim	1.50	1.27	1.55	1.38

Note: /1 includes bulkers and barges
/2 Year 2002
/3 provisionary estimated figures

(3) Growth in Vessel Requirement for Passenger Traffic

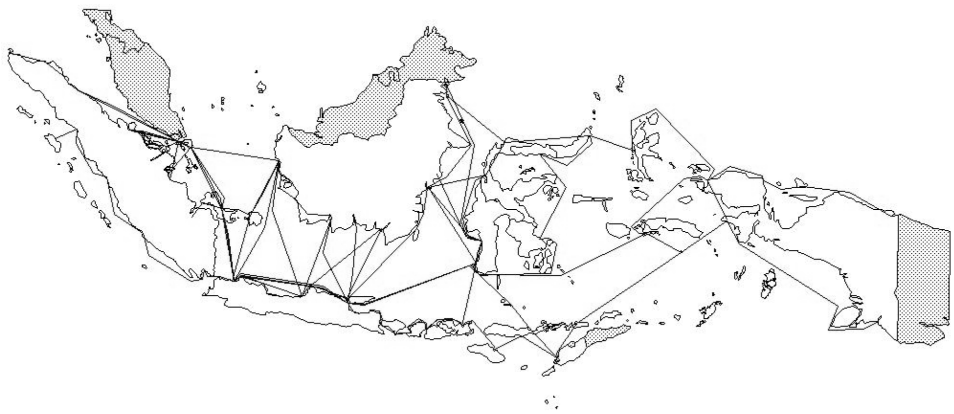
The domestic passenger fleet will have to be able to cope with the increase in passenger traffic (Table 4.6.16).

Table 4.42 Growth in Passenger Traffic

	2002	2014	2024
Pax	12,500,000	18,714,597	18,800,539
Pax Growth (2002 = 1.00)	1.00	1.50	1.50
‘000 pax-mile	5,081,850	7,896,568	7,931,057
Pax-mile Growth (2002 = 1.00)	1.00	1.55	1.56

To be able to estimate the fleet requirements for passenger service, the passenger network needs to be clarified, and the proposed network is as follows.

Figure 4.17 Assumed Network for Passenger Fleet Estimate



Passenger service needs to fulfill minimum frequency of services. Generally shorter distance voyages requires higher frequency of service than longer distance voyages. The following illustrates the minimum frequency requirements assumed for fleet estimation.

Table 4.43 Minimum Frequency of Service

Voyage Distance	Minimum Voyage Frequency
< 500 naut. miles	7 times a week
500 ~ 1,500 naut. miles	3 times a week
over 1,500 naut. miles	1 times a week

There are five representative vessels that were used to estimate the fleet requirements. The physical specifications of each representative type are shown in Table 3.6.18. To calculate for transport cost per vessel type, the cost parameters for each vessel type shown in Table 3.8.19 is used.

Table 4.44 Representative Passenger Vessel Physical Specifications

Vessel ID	Capacity (pax)	GT	Speed (knots)	Draft (m)	Commissionable days
1	2,000	12,000	20	6.0	350
2	1,000	6,000	14	4.2	350
3	500	1,000~2,500	14	3.0	350
4	315	900	12	2.3	350
5	210	700	12	2.0	350
6	150	600	12	1.8	350

Table 4.45 Representative Passenger Vessel Cost Specifications

Vessel ID	Capacity (pax)	Capital Cost (mill. Rp/yr)	Fixed Operating Cost (mill. Rp/yr)	Distance Cost (mill. Rp/nm)	Passenger Cost (mill. Rp/pax)/1	Call Cost (mill. Rp/call)	Fare (Rp/pax -nmile)
1	2,000	9,400	22,000	0.114	0.030	2.74	333
2	1,000	5,300	12,280	0.046	0.024	0.93	333
3	500	4,500	7,000	0.031	0.021	0.50	333
4	315	3,955	6,490	0.026	0.020	0.41	333
5	210	3,753	6,030	0.024	0.020	0.37	333
6	150	3,642	5,782	0.023	0.019	0.34	333

/1 Passenger cost are estimated based on long distance voyages – cost is adjusted based on voyage distance as follows: < 500 nmile, 25%; 500~1,500 nmile, 50%; over 1,500 nmile, 100%.

The selection of the type of passenger vessel is incorporated in the fleet estimate. Passenger vessel type in this case includes: (1) purely passenger vessel; (2) passenger cum Ro-Ro vessel; and (3) passenger cum cargo vessel. Assuming that Ro-Ro services and cargo services could be competitively priced, there will be sufficient cargo, especially general cargo that will use the service. The selection is based on the appropriateness of the type of service according to the following criteria:

Table 4.46 Criteria for Passenger Vessel Type Selection

Type	Criteria
Passenger Vessel	For trunk routes (routes which serve as backbone of the network). Trunk route vessels have to serve large amounts of passengers and have to call at many ports serving as the linkage between main regions. Operation needs to be simplified so that efficient passenger operation can be achieved – thus only passenger vessels with no or limited cargo carrying capacity only.
Passenger cum Ro-Ro Vessel	For vessels that serve high passenger demand and routes that have potential demand for Ro-Ro (for example routes that are currently being served by Ro-Ro vessels) and at mid-distances – i.e. 500~700 nautical miles. These type of conditions are very typical for cross-Jawa Sea routes between Jawa and Kalimantan and Kalimantan and Sulawesi. The use of Ro-Ro vessels is advantageous because it will yield at higher revenues.
Passenger cum Cargo Vessel	All other routes. However, the cargo carrying capacity will vary depending on the situation. If cargo demand is present, cargo services will lead to higher revenues for operators – thus considered more advantageous than operating purely passenger vessel only.

Based on these assumptions, the following fleet requirements will be required. Based on the demand forecast for maritime passengers, demand will be flat from 2014 onwards. Thus, it is taken that fleet requirements will increase from the present up to 2014 and will be stable from thereon. The following is the results of the fleet estimation.

Table 4.47 Estimated Passenger Fleet Requirements from 2014 Onwards

Vessel ID	Capacity (pax)	Passenger Type	Passenger/ RoRo Type	Passenger/ Cargo Type	All Types
1	2,000	16	-	-	**16**
2	1,000	25	10	8	**42**
3	500	27	6	19	**52**
4	315	-	-	-	**-**
5	210	-	1	12	**13**
6	150	-	-	31	**31**
All		**68**	**17**	**70**	**154**

(4) Estimated Future Fleet Expansion

Based on the estimated growth in fleet requirement, the current fleet is extrapolated for the benchmark years 2014 and 2024. In the case of dry cargo fleet, the tonnage per vessel size (in DWT) is first extrapolated then the total tonnage per vessel type (i.e. container, conventional and bulker) is adjusted to conform to the simulated growth of tonnage per vessel type.

Table 4.6.22, Table 4.6.23, and Table 4.6.24 summarizes the estimated fleet for Case 0, Case 1, and Case 2 respectively.

Table 4.48 Case 0: Base Case Fleet Estimate

Type	DWT	2002		2014		2024	
		DWT/3	Units	DWT/3	Units	DWT/3	Units
Container	1,000 - 2,000	1	1	1	1	1	1
	2,000 - 4,000	46	15	58	19	69	23
	4,000 - 8,000	321	53	400	67	476	79
	8,000 - 12,000	112	11	142	14	148	15
	12,000 - 18,000	192	14	1,062	76	2,088	149
	Over 18,000	61	3	339	17	666	34
	Sub-total	**733**	**97**	**2,002**	**194**	**3,448**	**301**
Conven-Tional	0 - 1,000	318	637	517	1,034	812	1,625
	1,000 - 2,000	296	198	481	321	756	504
	2,000 - 4,000	472	157	1,300	433	2,539	846
	4,000 - 8,000	810	162	897	179	967	193
	over 8,000	543	54	602	60	649	65
	Sub-total	**2,440**	**1,208**	**3,797**	**2,028**	**5,724**	**3,233**
Bulker	1,000 - 4,000	13	5	9	4	11	4
	4,000 - 8,000	74	12	53	9	64	11
	8,000 - 15,000	101	9	133	12	213	19
	over 15,000	399	13	695	23	822	27
	Sub-total	**587**	**40**	**890**	**48**	**1,111**	**62**
Barge	2,500 - 5,000	391	104	473	126	451	120
	5,000 - 10,000	307	41	676	90	856	114
	10,000 - 15,000	19	1	54	4	51	4
	Sub-total	**717**	**147**	**1,203**	**221**	**1,358**	**238**
Tanker	0 - 1,000	51	101	67	135	71	142
	1,000 - 4,000	532	213	707	283	746	298
	4,000 - 8,000	371	62	494	82	521	87
	8,000 - 15,000	248	23	329	30	347	32
	15,000 - 25,000	360	18	479	24	505	25
	25,000 - 35,000	405	14	539	18	568	19
	over 35,000	180	5	239	6	252	6
	Sub-total	**2,146**	**434**	**2,855**	**578**	**3,010**	**609**
Cargo Vessels Total		**6,653**	**1,869**	**10,710**	**2,977**	**14,780**	**4,374**
Passenger/2	0 - 1,500 GT	72	162	18	44	18	44
	1,500 - 4,000 GT	42	17	81	46	81	46
	4,000 - 6,000 GT	136	25	180	33	180	33
	over 6,000 GT	118	10	189	16	189	16
	Sub-total	**368**	**214**	**467**	**139**	**467**	**139**
Pass./ Ro-Ro	0 - 4,000 GT	15	5	21	7	21	7
	4,000 - 6,000 GT	29	6	48	10	48	10
	over 6,000 GT	8	1	-	-	-	-
	Sub-Total	**52**	**12**	**69**	**17**	**69**	**17**
Passenger Vessels Total		**420**	**226**	**536**	**156**	**536**	**156**

/1 in thousands

/2 Includes purely passenger and passenger cum cargo vessels

/3 Pure Ro-Ro vessels are considered to be part of container and conventional fleet tonnage

Table 4.49 Case 1: Fleet Estimate under Improved Fleet Conditions

Type	DWT	2002		2014		2024	
		DWT/3	Units	DWT/3	Units	DWT/3	Units
Container	1,000 - 2,000	1	1	1	1	1	1
	2,000 - 4,000	46	15	55	18	65	22
	4,000 - 8,000	321	53	377	63	451	75
	8,000 - 12,000	112	11	121	12	134	13
	12,000 - 18,000	192	14	977	70	1,910	137
	Over 18,000	61	3	311	16	609	31
	Sub-total	**733**	**97**	**1,842**	**180**	**3,170**	**279**
Conven-Tional	0 - 1,000	318	637	493	986	756	1,512
	1,000 - 2,000	296	198	459	306	704	469
	2,000 - 4,000	472	157	1,243	414	2,309	770
	4,000 - 8,000	810	162	885	177	957	191
	over 8,000	543	54	593	59	641	64
	Sub-total	**2,440**	**1,208**	**3,673**	**1,942**	**5,367**	**3,007**
Bulker	1,000 - 4,000	13	5	9	3	10	4
	4,000 - 8,000	74	12	50	8	59	10
	8,000 - 15,000	101	9	129	12	204	19
	over 15,000	399	13	676	23	786	26
	Sub-total	**587**	**40**	**865**	**46**	**1,059**	**59**
Barge	2,500 - 5,000	391	104	454	121	418	111
	5,000 - 10,000	307	41	667	89	827	110
	10,000 - 15,000	19	1	54	4	49	4
	Sub-total	**717**	**147**	**1,175**	**214**	**1,294**	**226**
Tanker	0 - 1,000	51	101	67	135	71	142
	1,000 - 4,000	532	213	707	283	746	298
	4,000 - 8,000	371	62	494	82	521	87
	8,000 - 15,000	248	23	329	30	347	32
	15,000 - 25,000	360	18	479	24	505	25
	25,000 - 35,000	405	14	539	18	568	19
	over 35,000	180	5	239	6	252	6
	Sub-total	**2,146**	**434**	**2,855**	**578**	**3,010**	**609**
Cargo Vessels Total		**6,653**	**1,869**	**10,367**	**2,871**	**14,029**	**4,114**
Passenger/2	0 - 1,500	72	162	18	44	18	44
	1,500 - 4,000	42	17	81	46	81	46
	4,000 - 6,000	136	25	180	33	180	33
	over 6,000	118	10	189	16	189	16
	Sub-total	**368**	**214**	**467**	**139**	**467**	**139**
Pass./ Ro-Ro	0 - 4,000	15	5	21	7	21	7
	4,000 - 6,000	29	6	48	10	48	10
	over 6,000	8	1	-	-	-	-
	Sub-Total	**52**	**12**	**69**	**17**	**69**	**17**
Passenger Vessels Total		**420**	**226**	**536**	**156**	**536**	**156**

/1 in thousands
/2 Includes purely passenger and passenger cum cargo vessels
/3 Pure Ro-Ro vessels are considered to be part of container and conventional fleet tonnage

Table 4.50 Case 2: Fleet Estimate under Improved Fleet and Port Productivity

Type	DWT	2002		2014		2024	
		DWT/3	Units	DWT/3	Units	DWT/3	Units
Container	1,000 - 2,000	1	1	1	1	1	1
	2,000 - 4,000	46	15	46	15	55	18
	4,000 - 8,000	321	53	315	53	383	64
	8,000 - 12,000	112	11	110	11	114	11
	12,000 - 18,000	192	14	806	58	1,608	116
	Over 18,000	61	3	257	12	513	26
	Sub-total	**733**	**97**	**1,535**	**150**	**2,674**	**236**
Conven-Tional	0 - 1,000	318	637	399	798	614	1,229
	1,000 - 2,000	296	198	371	248	572	381
	2,000 - 4,000	472	157	957	319	1,831	610
	4,000 - 8,000	810	162	836	167	914	183
	over 8,000	543	54	561	56	613	61
	Sub-total	**2,440**	**1,208**	**3,124**	**1,588**	**4,545**	**2,464**
Bulker	1,000 - 4,000	13	5	7	3	8	3
	4,000 - 8,000	74	12	41	7	48	8
	8,000 - 15,000	101	9	106	10	165	15
	over 15,000	399	13	587	20	683	23
	Sub-total	**587**	**40**	**740**	**39**	**905**	**49**
Barge	2,500 - 5,000	391	104	384	102	356	95
	5,000 - 10,000	307	41	571	76	705	94
	10,000 - 15,000	19	1	49	4	45	4
	Sub-total	**717**	**147**	**1,004**	**182**	**1,106**	**193**
Tanker	0 - 1,000	51	101	67	135	71	142
	1,000 - 4,000	532	213	707	283	746	298
	4,000 - 8,000	371	62	494	82	521	87
	8,000 - 15,000	248	23	329	30	347	32
	15,000 - 25,000	360	18	479	24	505	25
	25,000 - 35,000	405	14	539	18	568	19
	over 35,000	180	5	239	6	252	6
	Sub-total	**2,146**	**434**	**2,855**	**578**	**3,010**	**609**
Cargo Vessels Total		**6,653**	**1,869**	**9,243**	**2,465**	**12,368**	**3,500**
Passenger/1	0 - 1,500	72	162	18	44	18	44
	1,500 - 4,000	42	17	81	46	81	46
	4,000 - 6,000	136	25	180	33	180	33
	over 6,000	118	10	189	16	189	16
	Sub-total	**368**	**214**	**467**	**139**	**467**	**139**
Pass./ Ro-Ro	0 - 4,000	15	5	21	7	21	7
	4,000 - 6,000	29	6	48	10	48	10
	over 6,000	8	1	-	-	-	-
	Sub-Total	**52**	**12**	**69**	**17**	**69**	**17**
Passenger Vessels Total		**420**	**226**	**536**	**156**	**536**	**156**

/1 in thousands
/2 Includes purely passenger and passenger cum cargo vessels
/3 Pure Ro-Ro vessels are considered to be part of container and conventional fleet tonnage

4.6.3. Cabotage Analysis

According to DGSC, the government intends to carry out cabotage right for seven commodities: coal, oil, CPO, fertilizer, rice and rubber within a couple of years. It is also envisioned that in the long-term DGSC will be able to fully implement cabotage. This section intends to roughly estimate the effect of such polices.

(1) Current Conditions

STRAMINDO conducted an OD survey and with this data, the current share of Indonesian and foreign flagged vessels in the carriage of each commodity may be determined. The following Tables illustrate the results of the estimation.

Table 4.51 Distribution of Domestic Sea Traffic carried per Vessel Flag

	Share in tons carried	
	Indonesian Flag	**Foreign Flag**
Break	60%	40%
Container	81%	19%
Dry Bulk	40%	60%
Liquid Bulk	39%	61%
All	47%	53%

Table 4.52 Distribution of Flag of Carrier for Each Select Commodity

	Flag of Carrier	
Commodity	**Indonesian**	**Foreign**
Oil	39%	61%
CPO	62%	38%
Coal	40%	60%
Fertilizer	74%	26%
Wood	72%	28%
Rice	62%	38%
Rubber/1	65%	35%

/1 No data – assumed to be 2% of general cargo (STRAMINDO Survey)
/2 % refers to percentage of sea traffic in MT – estimated from sample data
/3 see Appendix for complete profile of all key commodities
Source: STRAMINDO Survey

Table 4.53 Details of Flag of Carrier per Key Commodity

Comm	Pack	Indonesian	Foreign	MT - all	MT - Indo	MT - For
Oil	L. Bulk	39%	61%	82.6	32.1	50.5
	Total	39%	61%	82.6	32.1	50.5
CPO	L. Bulk	62%	38%	2.5	1.6	0.9
	Total	62%	38%	2.5	1.6	0.9
Oliquid	L. Bulk	34%	66%	1.6	0.5	1.1
	Total	34%	66%	1.6	0.5	1.1
Coal	D. Bulk	40%	60%	16.3	6.5	9.8
	Total	40%	60%	16.3	6.5	9.8
Mine	D. Bulk	23%	77%	4.4	1.0	3.4
	Total	23%	77%	4.4	1.0	3.4
Rice	Break	44%	56%	1.2	0.5	0.7
	Cont	100%	0%	0.1	0.1	-
	Total	48%	52%	1.3	0.6	0.7
Agrain	Break	46%	54%	0.1	0.0	0.0
	Cont	93%	7%	0.7	0.7	0.0
	D. Bulk	13%	87%	0.4	0.1	0.4
	Total	62%	38%	1.2	0.7	0.5
Fertilizer	Break	83%	17%	2.7	2.2	0.5
	Cont	100%	0%	-	-	-
	D. Bulk	66%	34%	3.1	2.0	1.1
	Total	74%	26%	5.8	4.3	1.5
Cement	Break	42%	58%	4.3	1.8	2.5
	Cont	100%	0%	0.3	0.3	-
	D. Bulk	81%	19%	0.4	0.3	0.1
	Total	48%	52%	5.0	2.4	2.6
Ograin	Break	69%	31%	1.8	1.2	0.6
	Cont	85%	15%	0.3	0.2	0.0
	D. Bulk	24%	76%	0.2	0.1	0.2
	Total	66%	34%	2.3	1.5	0.8
Fresh	Break	87%	13%	0.2	0.1	0.0
	Cont	99%	1%	0.1	0.1	0.0
	Total	93%	7%	0.3	0.3	0.0
Wood	Break	70%	30%	9.6	6.7	2.9
	Cont	97%	3%	0.4	0.4	0.0
	D. Bulk	52%	48%	0.4	0.2	0.2
	Total	70%	30%	10.4	7.3	3.1
GC	Break	54%	46%	12.2	6.5	5.7
	Cont	78%	22%	9.4	7.4	2.0
	Total	64%	36%	21.6	13.9	7.7

All Commodities	Break	60%	40%	32.0	19.2	12.8
	Cont	81%	19%	11.3	9.2	2.1
	D. Bulk	40%	60%	25.3	10.2	15.1
	L. Bulk	39%	61%	86.7	34.2	52.5
	TOTAL	47%	53%	155.3	72.8	82.5

*MT in millions

Oliquid – Other liquid cargo (e.g. chemicals)
Mine – Mining and quarry products
Agrain – Agricultural grains (e.g. legumes)
Ograin – Other granular cargo (e.g. sugar)
Fresh – fresh products (e.g. fruits and meat)
GC – others or general cargo

Source: STRAMIDNO Survey

(2) Projected MT Carried per Flag Type

The projected share in sea traffic carriage between Indonesian and foreign flagged vessels is calculated by assuming that there will be no shifting service of national or foreign flag vessel from one commodity to another. Once cabotage is imposed, foreign flagged vessels will no longer operate in Indonesia and will be subsequently replaced by a newly acquired (new or second-hand); or, that the foreign flag vessel will change registry to Indonesian registry.

The cabotage program of DGSC is envisioned be implemented as follows:

Table 4.54 Assumption of Share of Indonesian Vessel in Carriage of the Selected Seven Priority Commodities With and Without Cabotage Program

Commodity	Pack Type	Case 1: Without		Case 2: With	
		2002	Up to 2014	2002	Up to 2014
Oil	L. Bulk	38.9%	38.9%	38.9%	100%
CPO	L. Bulk	62.0%	62.0%	62.0%	100%
Coal	D. Bulk	39.8%	39.8%	39.8%	100%
Fertilizer	Break	82.9%	82.9%	82.9%	100%
	Container	100.0%	100.0%	100.0%	100%
	D. Bulk	65.6%	65.6%	65.6%	100%
Wood	Break	69.8%	69.8%	69.8%	100%
	Container	97.4%	97.4%	97.4%	100%
	D. Bulk	51.7%	51.7%	51.7%	100%
Rice	Break	43.6%	43.6%	43.6%	100%
	Container	100.0%	100.0%	100.0%	100%
Rubber	Break	36.2%	36.2%	36.2%	100%
	Container	97.0%	97.0%	97.0%	100%

Table 4.55 Assumption of Share of Indonesian Vessel in Carriage of Other Commodities With and Without Cabotage Program

Pack Type	Case 1: Without		Case 2: With	
	2002	Up to 2024	2002	Up to 2024
Break Bulk	52.5%	52.5%	52.5%	100%
Container	80.4%	80.4%	80.4%	100%
Dry Bulk	26.6%	26.6%	26.6%	100%
Liquid Bulk	33.9%	33.9%	33.9%	100%

(3) Estimation Results

The following Tables details the results of the estimation of the effect of the envisioned Cabotage Program.

Table 4.56 Estimated Share of Indonesian and Foreign Flag Vessel in Domestic Sea Traffic Without Cabotage Program

		% Indonesian			ton - All Flags			ton - Indonesian			ton - Foreign		
Commodity	Pack Type	2002	2014	2024	2002	2014	2024	2002	2014	2024	2002	2014	2024
Oil	L. Bulk	38.9%	38.9%	38.9%	82,573,069	105,122,702	106,144,487	32,135,217	40,910,927	41,308,578	50,437,853	64,211,775	64,835,909
	TOTAL	**38.9%**	**38.9%**	**38.9%**	**82,573,069**	**105,122,702**	**106,144,487**	**32,135,217**	**40,910,927**	**41,308,578**	**50,437,853**	**64,211,775**	**64,835,909**
CPO	L. Bulk	62.0%	62.0%	62.0%	2,519,402	5,729,058	11,089,751	1,562,354	3,552,755	6,877,076	957,048	2,176,303	4,212,675
	TOTAL	**62.0%**	**62.0%**	**62.0%**	**2,519,402**	**5,729,058**	**11,089,751**	**1,562,354**	**3,552,755**	**6,877,076**	**957,048**	**2,176,303**	**4,212,675**
Coal	D. Bulk	39.8%	39.8%	39.8%	16,631,433	31,347,858	38,029,664	6,617,394	12,472,836	15,131,425	10,014,039	18,875,023	22,898,240
	TOTAL	**39.8%**	**39.8%**	**39.8%**	**16,631,433**	**31,347,858**	**38,029,664**	**6,617,394**	**12,472,836**	**15,131,425**	**10,014,039**	**18,875,023**	**22,898,240**
Fertilizer	Break	82.9%	82.9%	82.9%	2,720,575	2,842,498	2,988,021	2,255,625	2,356,711	2,477,364	464,950	485,787	510,657
	Container	100.0%	100.0%	100.0%	-	222,457	209,826	-	222,457	209,826	-	-	-
	D. Bulk	65.6%	65.6%	65.6%	3,057,733	2,989,911	2,940,740	2,006,519	1,962,014	1,929,747	1,051,214	1,027,897	1,010,993
	TOTAL	**73.8%**	**75.0%**	**75.2%**	**5,778,308**	**6,054,866**	**6,138,587**	**4,262,144**	**4,541,182**	**4,616,938**	**1,516,164**	**1,513,684**	**1,521,650**
Wood	Break	69.8%	69.8%	69.8%	9,029,230	7,138,141	7,162,438	6,302,402	4,982,422	4,999,382	2,726,827	2,155,718	2,163,056
	Container	97.4%	97.4%	97.4%	779,057	644,432	653,035	758,801	627,677	636,056	20,255	16,755	16,979
	D. Bulk	51.7%	51.7%	51.7%	172,630	134,110	85,449	89,250	69,335	44,177	83,380	64,775	41,272
	TOTAL	**71.6%**	**71.7%**	**71.9%**	**9,980,916**	**7,916,683**	**7,900,922**	**7,150,453**	**5,679,434**	**5,679,615**	**2,830,463**	**2,237,249**	**2,221,307**
Rice	Break	43.6%	43.6%	43.6%	740,283	838,672	859,557	322,730	365,622	374,728	417,554	473,049	484,830
	Container	100.0%	100.0%	100.0%	349,305	437,496	497,715	349,305	437,496	497,715	-	-	-
	TOTAL	**61.7%**	**62.9%**	**64.3%**	**1,089,589**	**1,276,168**	**1,357,272**	**672,035**	**803,119**	**872,443**	**417,554**	**473,049**	**484,830**
Rubber (assumed at 2% of GC)	Break	36.2%	36.2%	36.2%	245,144	611,108	1,069,359	88,742	221,221	387,108	156,402	389,887	682,251
	Container	97.0%	97.0%	97.0%	218,494	658,688	1,171,439	211,939	638,927	1,136,295	6,555	19,761	35,143
	TOTAL	**64.9%**	**67.7%**	**68.0%**	**463,638**	**1,269,795**	**2,240,798**	**300,681**	**860,148**	**1,523,403**	**162,957**	**409,647**	**717,394**
Oil, CPO, Coal, Fertilizer, Wood, Rice, Rubber	Break	70.4%	69.3%	68.2%	12,735,232	11,430,418	12,079,376	8,969,499	7,925,977	8,238,582	3,765,733	3,504,441	3,840,794
	Container	98.0%	98.1%	97.9%	1,346,856	1,963,073	2,532,014	1,320,046	1,926,557	2,479,892	26,810	36,516	52,122
	D. Bulk	43.9%	42.1%	41.7%	19,861,795	34,471,880	41,055,853	8,713,163	14,504,185	17,105,349	11,148,632	19,967,695	23,950,504
	L. Bulk	39.6%	40.1%	41.1%	85,092,471	110,851,760	117,234,238	33,697,571	44,463,682	48,185,654	51,394,900	66,388,078	69,048,584
	TOTAL	**44.3%**	**43.4%**	**44.0%**	**119,036,355**	**158,717,131**	**172,901,482**	**52,700,279**	**68,820,400**	**76,009,477**	**66,336,076**	**89,896,731**	**96,892,005**
Oil, CPO, Coal, Fertilizer, Wood, Rice, Rubber (% of all commodities)	Break	N/A	N/A	N/A	39%	23%	15%	46%	28%	19%	29%	16%	11%
	Container	N/A	N/A	N/A	11%	6%	4%	14%	7%	5%	1%	1%	0%
	D. Bulk	N/A	N/A	N/A	76%	79%	74%	83%	85%	82%	72%	75%	69%
	L. Bulk	N/A	N/A	N/A	99%	98%	97%	99%	98%	98%	98%	98%	97%
	TOTAL	N/A	N/A	N/A	**76%**	**66%**	**55%**	**71%**	**58%**	**47%**	**80%**	**73%**	**63%**
Non-Select Commodities	Break	52.5%	52.5%	52.5%	19,711,768	38,825,582	67,365,624	10,348,150	20,382,390	35,365,147	9,363,618	18,443,192	32,000,477
	Container	80.4%	80.4%	80.4%	10,553,144	31,393,927	56,419,986	8,488,918	25,253,183	45,384,070	2,064,226	6,140,745	11,035,915
	D. Bulk	26.6%	26.6%	26.6%	6,234,205	9,277,120	14,428,147	1,658,526	2,468,053	3,838,415	4,575,678	6,809,067	10,589,732
	L. Bulk	33.9%	33.9%	33.9%	1,223,529	2,253,240	3,196,762	414,258	762,894	1,082,349	809,270	1,490,345	2,114,413
	TOTAL	**55.4%**	**59.8%**	**60.6%**	**37,722,645**	**81,749,869**	**141,410,518**	**20,909,852**	**48,866,520**	**85,669,981**	**16,812,793**	**32,883,349**	**55,740,538**
All Commodities	Break	59.9%	56.3%	54.9%	32,447,000	50,256,000	79,445,000	19,441,306	28,308,366	43,603,728	13,005,694	21,947,634	35,841,272
	Container	81.2%	81.5%	81.2%	11,900,000	33,357,000	58,952,000	9,664,547	27,179,740	47,863,963	2,235,453	6,177,260	11,088,037
	D. Bulk	40.3%	38.8%	37.7%	26,096,000	43,749,000	55,484,000	10,516,307	16,972,238	20,943,764	15,579,693	26,776,762	34,540,236
	L. Bulk	39.5%	40.0%	40.9%	86,316,000	113,105,000	120,431,000	34,086,101	45,226,576	49,268,003	52,229,899	67,878,424	71,162,997
	TOTAL	**47.0%**	**48.9%**	**51.4%**	**156,759,000**	**240,467,000**	**314,312,000**	**73,708,261**	**117,686,920**	**161,679,458**	**83,050,739**	**122,780,080**	**152,632,542**

Table 4.57 Estimated Share of Indonesian and Foreign Flag Vessel in Domestic Sea Traffic With Cabotage Program

		% Indonesian			ton - All Flags			ton - Indonesian			ton - Foreign		
Commodity	Pack Type	2002	2014	2024	2002	2014	2024	2002	2014	2024	2002	2014	2024
Oil	L. Bulk	38.9%	100.0%	100.0%	82,573,069	105,122,702	106,144,487	32,135,217	105,122,702	106,144,487	50,437,853	-	-
	TOTAL	38.9%	100.0%	100.0%	82,573,069	105,122,702	106,144,487	32,135,217	105,122,702	106,144,487	50,437,853	-	-
CPO	L. Bulk	62.0%	100.0%	100.0%	2,519,402	5,729,058	11,089,751	1,562,354	5,729,058	11,089,751	957,048	-	-
	TOTAL	62.0%	100.0%	100.0%	2,519,402	5,729,058	11,089,751	1,562,354	5,729,058	11,089,751	957,048	-	-
Coal	D. Bulk	39.8%	100.0%	100.0%	16,631,433	31,347,858	38,029,664	6,617,394	31,347,858	38,029,664	10,014,039	-	-
	TOTAL	39.8%	100.0%	100.0%	16,631,433	31,347,858	38,029,664	6,617,394	31,347,858	38,029,664	10,014,039	-	-
Fertilizer	Break	82.9%	100.0%	100.0%	2,720,575	2,842,498	2,988,021	2,255,625	2,842,498	2,988,021	464,950	-	-
	Container	100.0%	100.0%	100.0%	-	222,457	209,826	-	222,457	209,826	-	-	-
	D. Bulk	65.6%	100.0%	100.0%	3,057,733	2,989,911	2,940,740	2,006,519	2,989,911	2,940,740	1,051,214	-	-
	TOTAL	73.8%	100.0%	100.0%	5,778,308	6,054,866	6,138,587	4,262,144	6,054,866	6,138,587	1,516,164	-	-
Wood	Break	69.8%	100.0%	100.0%	9,029,230	7,138,141	7,162,438	6,302,402	7,138,141	7,162,438	2,726,827	-	-
	Container	97.4%	100.0%	100.0%	779,057	644,432	653,035	758,801	644,432	653,035	20,255	-	-
	D. Bulk	51.7%	100.0%	100.0%	172,630	134,110	85,449	89,250	134,110	85,449	83,380	-	-
	TOTAL	71.6%	100.0%	100.0%	9,980,916	7,916,683	7,900,922	7,150,453	7,916,683	7,900,922	2,830,463	-	-
Rice	Break	43.6%	100.0%	100.0%	740,283	838,672	859,557	322,730	838,672	859,557	417,554	-	-
	Container	100.0%	100.0%	100.0%	349,305	437,496	497,715	349,305	437,496	497,715	-	-	-
	TOTAL	61.7%	100.0%	100.0%	1,089,589	1,276,168	1,357,272	672,035	1,276,168	1,357,272	417,554	-	-
Rubber (assumed at 2% of GC)	Break	36.2%	100.0%	100.0%	245,144	611,108	1,069,359	88,742	611,108	1,069,359	156,402	-	-
	Container	97.0%	100.0%	100.0%	218,494	658,688	1,171,439	211,939	658,688	1,171,439	6,555	-	-
	TOTAL	64.9%	100.0%	100.0%	463,638	1,269,795	2,240,798	300,681	1,269,795	2,240,798	162,957	-	-
Oil, CPO, Coal, Fertilizer, Wood, Rice, Rubber	Break	70.4%	100.0%	100.0%	12,735,232	11,430,418	12,079,376	8,969,499	11,430,418	12,079,376	3,765,733	-	-
	Container	98.0%	100.0%	100.0%	1,346,856	1,963,073	2,532,014	1,320,046	1,963,073	2,532,014	26,810	-	-
	D. Bulk	43.9%	100.0%	100.0%	19,861,795	34,471,880	41,055,853	8,713,163	34,471,880	41,055,853	11,148,632	-	-
	L. Bulk	39.6%	100.0%	100.0%	85,092,471	110,851,760	117,234,238	33,697,571	110,851,760	117,234,238	51,394,900	-	-
	TOTAL	44.3%	100.0%	100.0%	119,036,355	158,717,131	172,901,482	52,700,279	158,717,131	172,901,482	66,336,076	-	-
Oil, CPO, Coal, Fertilizer, Wood, Rice, Rubber (% of all commodities)	Break	N/A	N/A	N/A	39%	23%	15%	46%	36%	15%	29%	0%	N/A
	Container	N/A	N/A	N/A	11%	6%	4%	14%	7%	4%	1%	0%	N/A
	D. Bulk	N/A	N/A	N/A	76%	79%	74%	83%	93%	74%	72%	0%	N/A
	L. Bulk	N/A	N/A	N/A	99%	98%	97%	99%	99%	97%	98%	0%	N/A
	TOTAL	N/A	N/A	N/A	76%	66%	55%	71%	76%	55%	80%	0%	N/A
Non-Select Commodities	Break	52.5%	52.5%	100.0%	19,711,768	38,825,582	67,365,624	10,348,150	20,382,390	67,365,624	9,363,618	18,443,192	-
	Container	80.4%	80.4%	100.0%	10,553,144	31,393,927	56,419,986	8,488,918	25,253,183	56,419,986	2,064,226	6,140,745	-
	D. Bulk	26.6%	26.6%	100.0%	6,234,205	9,277,120	14,428,147	1,658,526	2,468,053	14,428,147	4,575,678	6,809,067	-
	L. Bulk	33.9%	33.9%	100.0%	1,223,529	2,253,240	3,196,762	414,258	762,894	3,196,762	809,270	1,490,345	-
	TOTAL	55.4%	59.8%	100.0%	37,722,645	81,749,869	141,410,518	20,909,852	48,866,520	141,410,518	16,812,793	32,883,349	-
All Commodities	Break	59.9%	63.3%	100.0%	32,447,000	50,256,000	79,445,000	19,441,306	31,812,808	79,445,000	13,005,694	18,443,192	-
	Container	81.2%	81.6%	100.0%	11,900,000	33,357,000	58,952,000	9,664,547	27,216,255	58,952,000	2,235,453	6,140,745	-
	D. Bulk	40.3%	84.4%	100.0%	26,096,000	43,749,000	55,484,000	10,516,307	36,939,933	55,484,000	15,579,693	6,809,067	-
	L. Bulk	39.5%	98.7%	100.0%	86,316,000	113,105,000	120,431,000	34,086,101	111,614,655	120,431,000	52,229,899	1,490,345	-
	TOTAL	47.0%	86.3%	100.0%	156,759,000	240,467,000	314,312,000	73,708,261	207,583,651	314,312,000	83,050,739	32,883,349	-

5. DATABASE AND DEMAND ANALYSIS LEARNING SESSION

5.1. Technology Transfer Program for STRAMINDO

As an integral part of the STRAMINDO study objective, technology transfer programs are consciously and actively pursued throughout the implementation of the study. One strategic request of the partner agency, DGSC, is that they be given training in maritime system planning. STRAMINDO then provided in-depth learning sessions in this regard. Training sessions were conducted from 28 October to 31 October, 2003 in STRAMINDO Project Office in Jakarta. In all, seven DGSC staffs working in strategic offices in DGSC Headquarters participated in and completed the program.

Figure 5.1 Learning Session

Top-right: Participants learning practical skills in maritime transport planning

Top-left: Program participants (from bottom-left clock-wise) Mr. Budi (DGSC), Ms. Indah (DGSC), Mr. Erwin (DGSC), Mr. Andri (Teaching assistant), Mr. Agus (DGSC), Ms. Een (DGSC). Not on photo Mr. Robin (DGSC) and Mr. Darmawan (DGSC).

Bottom-left: Dr. Espada (trainor) giving hands-on instructions to Ms. Indah and Mr. Budi.

5.2. Program Outline

The four-day training session covers items listed in the succeeding pages. To maximize the absorption of practical skills in maritime planning, session covers essential theoretical concepts, practical methodology and computer skills. Computer skills training covers working knowledge in Advanced MSECxel, Visual Basic and JICA-STRADA. Hands-on exercises were given much emphasis to ensure that participant will be able to gain workable knowledge as much as possible.

Lectures notes of the program are attached as Annex.

Session 1

10:00 ~ 15:00, 28 October

- Overview of the program
- Practical planning methodology for maritime transport system planning
- Developing Models for G/A Forecast
- Sea traffic forecast: regression analysis using MSExcel
- Loading/unloading forecast: exercise in using two-tier models
- Practical forecasting under limited data availability

Session 2

10:00 ~ 15:00, 29 October

- OD Matrix Development
- Data Requirements for OD Forecast
- OD forecast: Fratar Method
- OD Forecast exercise: introduction to Visual Basic and MSExcel

Session 3

10:00 ~ 15:00, 30 October

- Data requirements for Fleet Estimation
- Fleet estimation based on port-to-port network
- Fleet estimation exercise: using Visual Basic and MSExcel

Session 4

10:00 ~ 15:00, 31 October

- Fleet estimation based on multi-port liner network system
- Introduction to Transit Assignment of JICA-STRADA
- Simulation preparation and simulation
- Using the simulation results
- Wrap-up and graduation

ANNEXES

ANNEX OF SECTION 1

1.1 Contents of Technical Report 1 Data CD

Filename	Folder	Description
FILES IN SURVEY RESULTS FOLDER		
A001 – A075	Organisasi_A	▪ Organization chart ▪ Filename correspond to shipping comp. interview form-A Q5
C_01 – C_37	Organisasi_C	▪ Organization chart ▪ Filename correspond to shippers and forwarders interview form Q4
Multiple files	Report	▪ Survey report ▪ Survey manual ▪ Coding System
AB_Perusahaan 1. Comm_code 2. Perusahaan_AB 3. Perusahaan_A_FA 4. Perusahaan_A_FA_English 5. Perusahaan_B_Kapal 6. Port 7. Port_Code 8. Shipcomp_Code 9. Zone_Code	Seaport Survey	 ▪ Commodity code ▪ Shipping company interview survey results - Form A ▪ Shipping company interview survey results - Form A ▪ Shipping company interview survey results - Form A ▪ Shipping company interview survey results - Form B ▪ Port survey result ▪ Coding System of port ▪ Coding System of shipping company ▪ Coding System of zone
C_Ekspedisi 1. Comm_code 2. Ekspedisi_C 3. Ekspedisi_C_FA 4. Ekspedisi_C_FA_English 5. Forwarder_Code 6. Port 7. Port_Code 8. Zone_Code	Seaport Survey	 ▪ Commodity code ▪ Cargo owner/forwarder interview survey results ▪ Cargo owner/forwarder interview survey results ▪ Cargo owner/forwarder interview survey results ▪ Coding System of forwarder company ▪ Port survey results ▪ Coding System of port ▪ Coding System of zone
D_Penumpang 1. D_Penumpang 2. Port 3. Port_Code 4. Pro_Code 5. Zone_Code	Seaport Survey	 ▪ Passenger interview survey result ▪ Port survey result ▪ Coding System of port ▪ Coding System of province ▪ Coding System of zone
E_Cargo 1. Comm_Code 2. E_Cargo 3. Flag_Code 4. Index_Code	Seaport Survey	 ▪ Commodity code ▪ Database of cargo moving ▪ Coding System of Flag ▪ Coding System of Index type

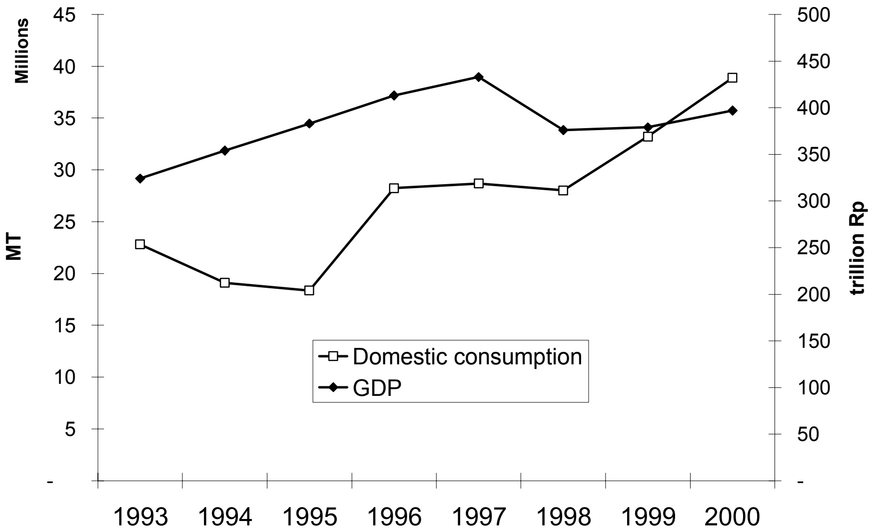
5. Load_Code 6. Pack_Code 7. Port 8. Port_Code 9. Pro_Code 10. Ship_Code 11. Zone_Code		▪ Coding System of Loading and Unloading ▪ Coding System of Packaging type ▪ Port survey result ▪ Coding System of port ▪ Coding System of province ▪ Coding System of ship ▪ Coding System of zone
FILES UNDER MARITIME TRAFFIC DATABSE		
2002 Freight OD adjusted		▪ Estimated current freight OD
2002 Passnger OD adjusted		▪ Estimated current passnger OD
FILES UNDER MARITIME TRAFFIC DATABSE		
C01 – C13	Freight Demand Forecast	▪ Forecasted freight OD
Passnger OD Forecast	Passnger Demand Forecast	▪ Forecasted sea passenger OD

ANNEX OF SECTION 4

4.1 Models for Domestic Sea Freight Forecast by Commodity

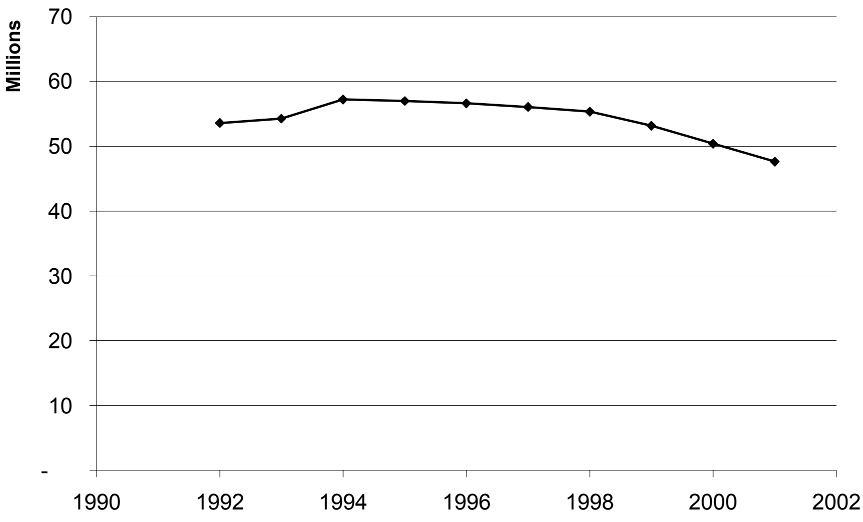
(1) Forecasted Petroleum Sea Traffic

Figure 4.1.1 Petroleum Domestic Consumption and GDP



/ Source: BPS

Figure 4.1.2 Trend in Domestic Production of Petroleum



/1 Source: Directorate of Oil and Petroleum

Figure 4.1.3 Trend in Import and Export of Petroleum

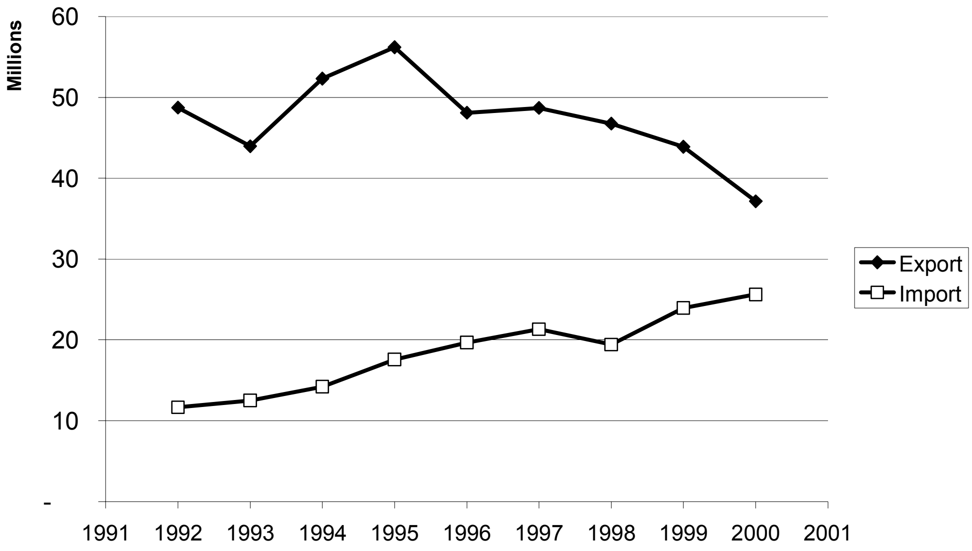


Table 4.1.1 Assumptions Used in the Forecast of Petroleum Sea Traffic

ITEM	ASSUMPTION
Consumption	Consumption of petroleum has a elasticity of 1.33 with respect to GDP - calibrated from the data from 1993 to 2000
Export	Share of exports of domestically produced petroleum decreases by 5% year on year - average rate of decline from 1996 to 2000
Import	Import volume will adjust based on the deficit/surplus of production, consumption, and export
Production	Production from active reserves per province will naturally decline and is somewhere in the range of 3% to 15% per annum. There are three scenarios assumed for the opening of new major reserves: (1) no new reserves are found {low case}, (2) the rate of new reserve opening is the same as that of the period 1992 to 2001 {mid case}, the rate of new reserve opening is double that of the period 1992 to 2001 {mid case}
Sea traffic	Sea traffic increases by 0.2 times for every unit increase of domestically consumed oil production but decreases by 0.1 times for every unit increase of petroleum import – based on the trend from 1996 to 1997

Figure 4.1.4 Projected Demand and Production of Petroleum

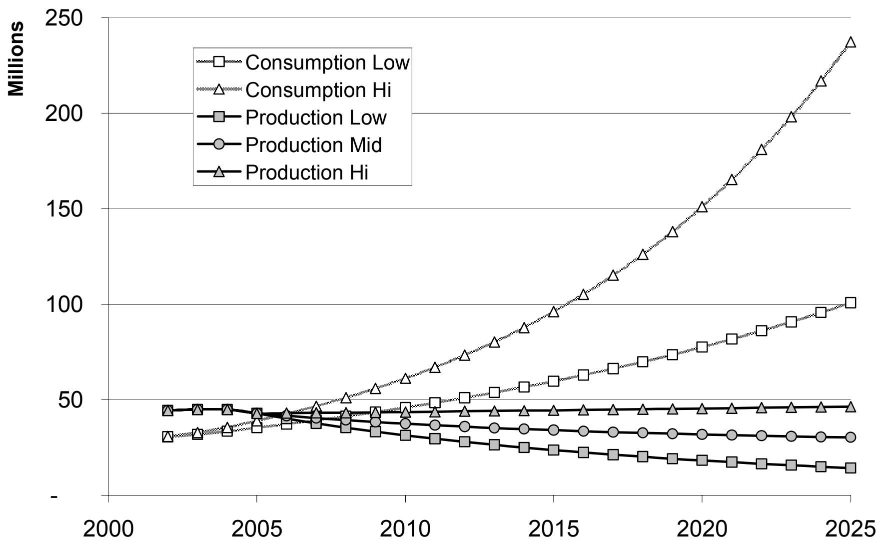
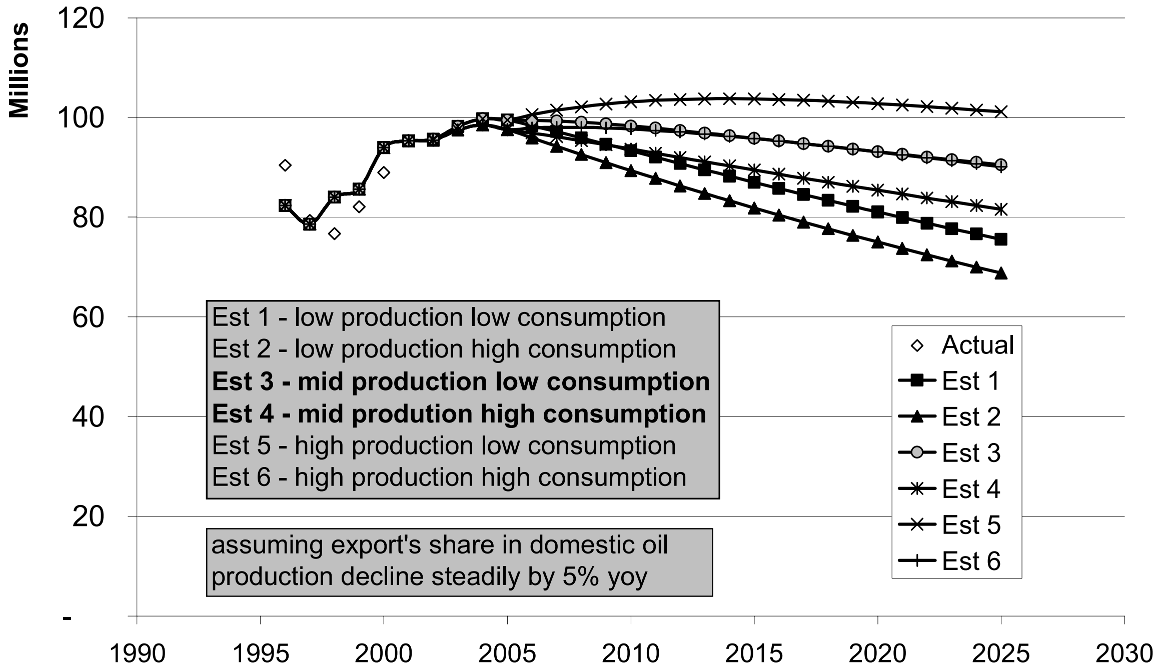


Figure 4.1.5 Projected Sea Traffic of Petroleum



(2) Forecasted General Cargo Sea Traffic

Figure 4.1.6 General Cargo and GDP Trend

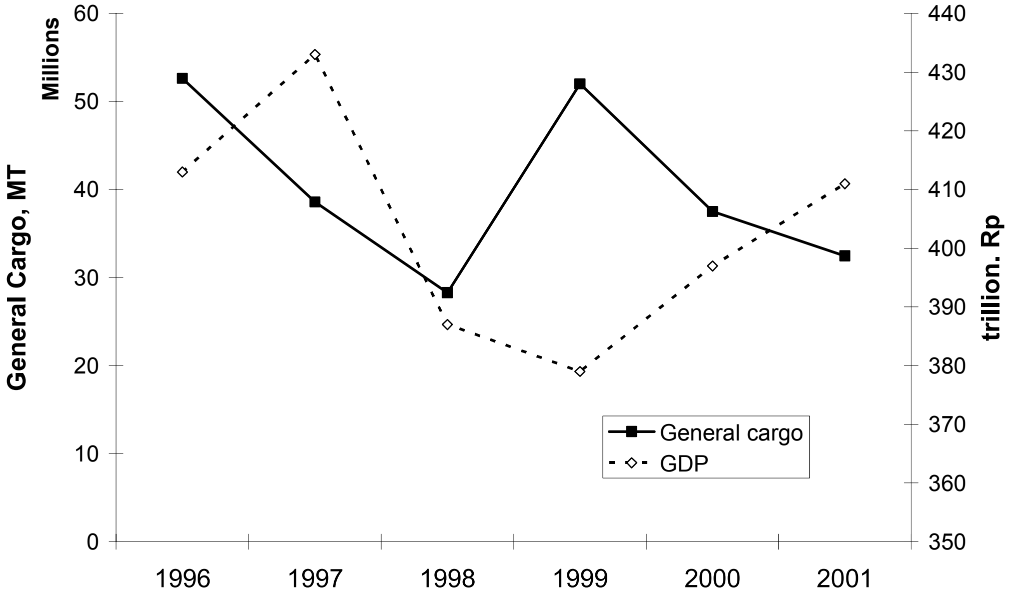
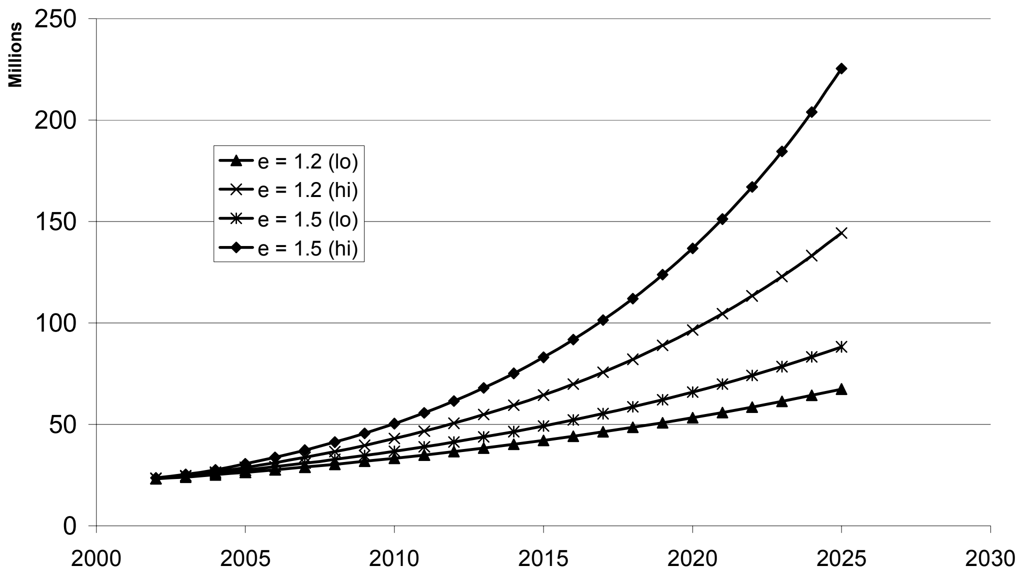


Table 4.1.2 Assumptions Used in the Forecast of General Cargo Sea Traffic

ITEM	ASSUMPTION
Sea traffic	Based on trend from 1996 to 2001, the elasticity of general cargo sea traffic to GDP is 1.2. However, an independent assessment of DGSC, pegs the elasticity of general cargo sea traffic to GDP at 1.5. Both parameters are used to forecast General Cargo sea traffic based on the low GDP and high GDP growth scenario.

Figure 4.1.7 Forecasted General Cargo Sea Traffic



(3) Forecasted Coal Sea Traffic

Figure 4.1.8 Trend in Production and Consumption of Coal

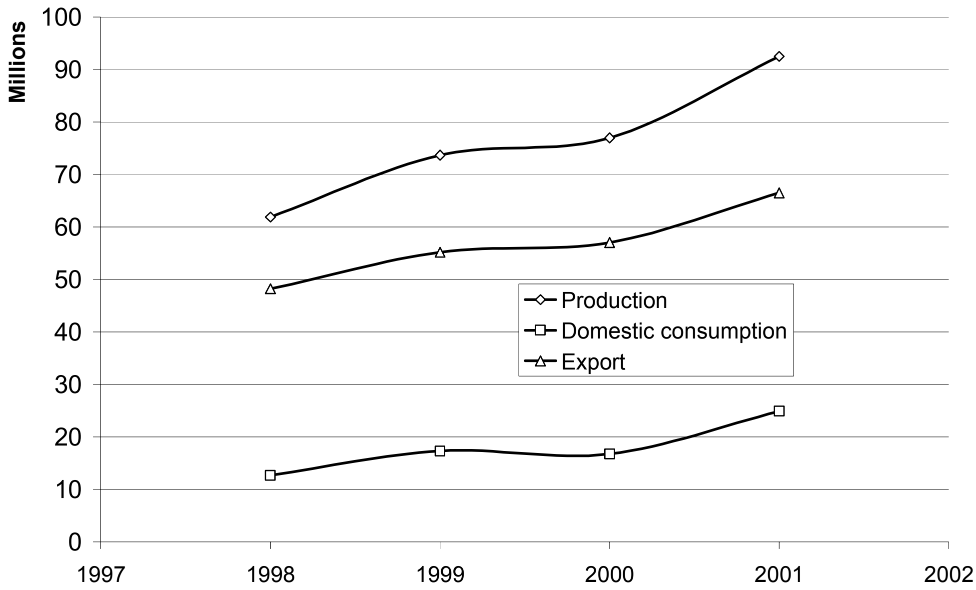


Table 4.1.3 Assumptions Used in the Forecast of Sea Traffic of Coal

ITEM	ASSUMPTION
Consumption	Consumption will increase by 2,000,000 MT per year as the base case – adopted modified from government estimates. The growth however, is expected to slow down in the future by half starting from 2010 as a result of shifting to gas as the primary energy source. For the low case and high case scenario, the rate of increase is half and double of the mid-case rate respectively.
Export	Export will increase annually by 2,500,00 MT per year up to 2010. From thereon, the rate will slow down by 50%.
Import	No imports
Production	Production will follow demand (domestic consumption + export) – of which the control total is adjusted to conform to government estimates.
Sea traffic	In 2001, for every 1 MT of coal domestic demand results in 0.67 MT of coal sea traffic. This trend is assumed to continue in the future.

Figure 4.1.9 Projected Demand and Supply of Coal

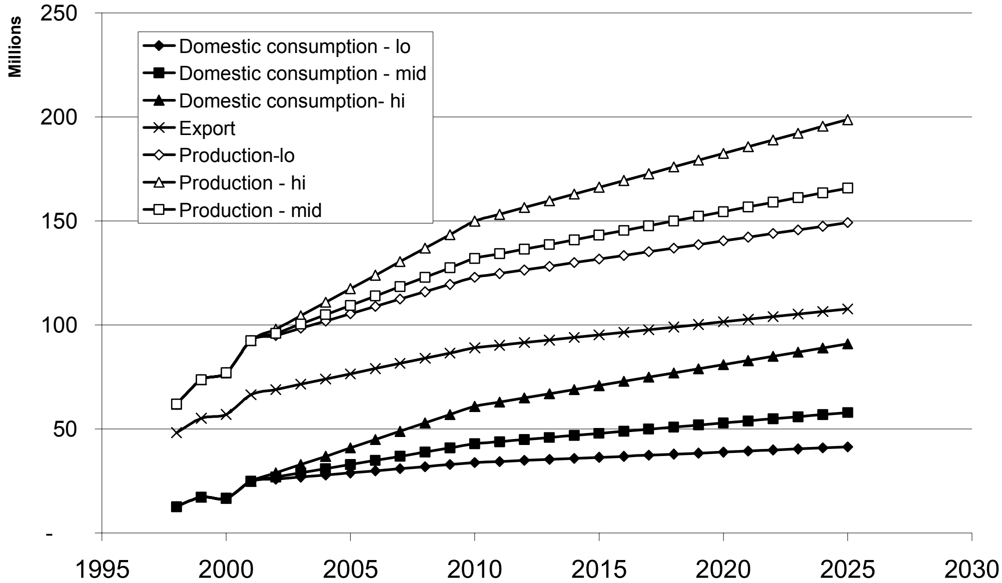
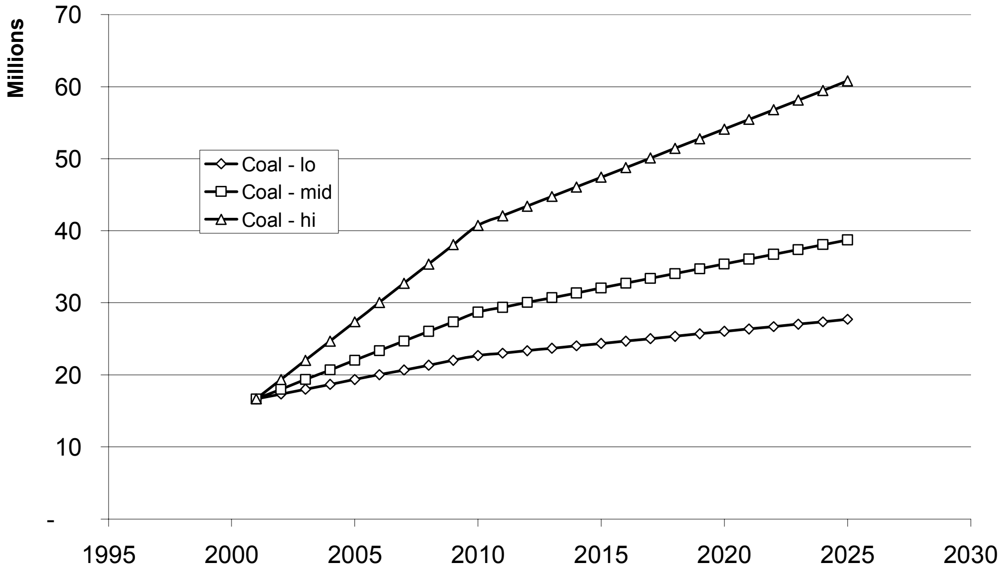


Figure 4.1.10 Projected Coal Sea Traffic



(4) Forecasted Wood Sea Traffic

Figure 4.1.11 Trend in Wood Production

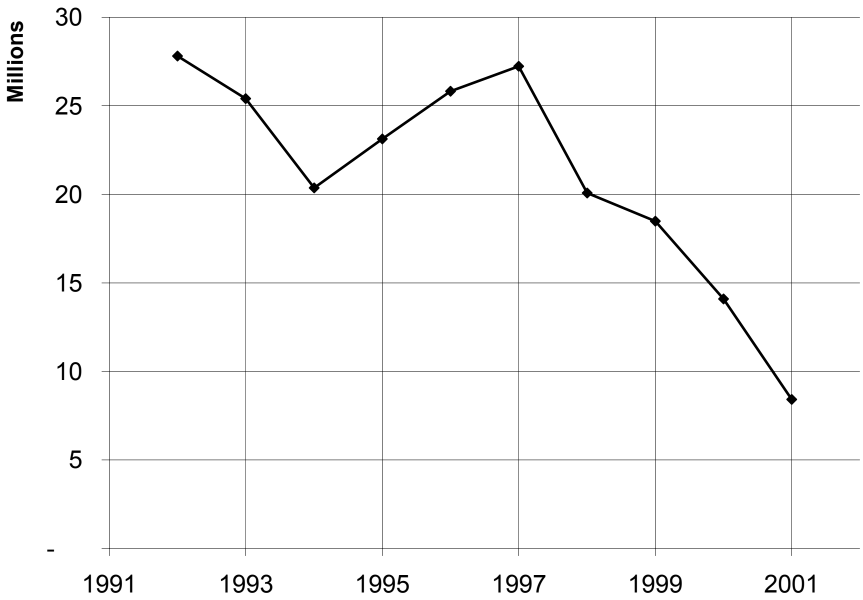


Figure 4.1.12 Trend in Wood Products Export

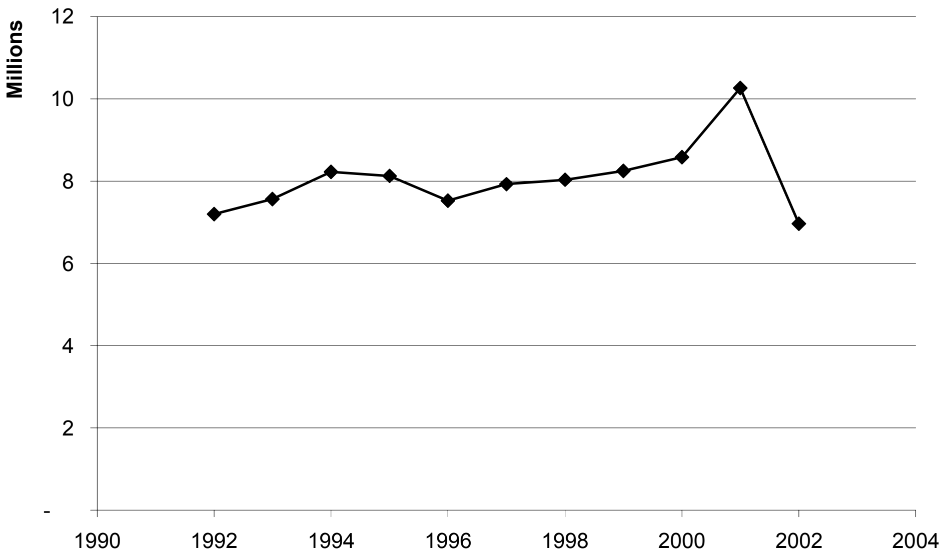


Table 4.1.4 Assumptions Used in the Forecast of Future Sea Traffic of Wood

ITEM	ASSUMPTION
Consumption	Consumption will be constrained by supply
Export	Production is assumed to be maintained at the current level
Imports	No imports
Production	In 2002, production is 12 million cubic meter (≈ 8 million MT). Based on government regulation, annual production is constrained at 7 million MT (≈ 5 million MT). At the high case, it is assumed that the current levels are maintained and at the low case, the government regulation is reached. The mid-case is taken as the average of the low and high case.
Sea Traffic	In 2001, for every 1 MT of wood domestic demand results in 1.24 MT of wood sea traffic. This trend is assumed to continue in the future.

Figure 4.1.13 Forecasted Wood Production

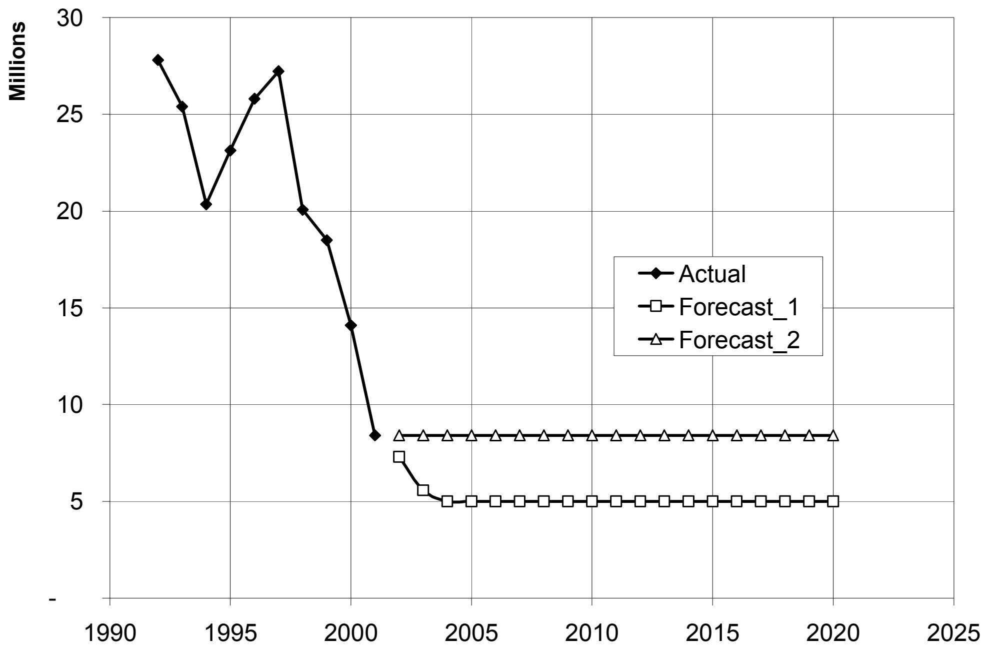
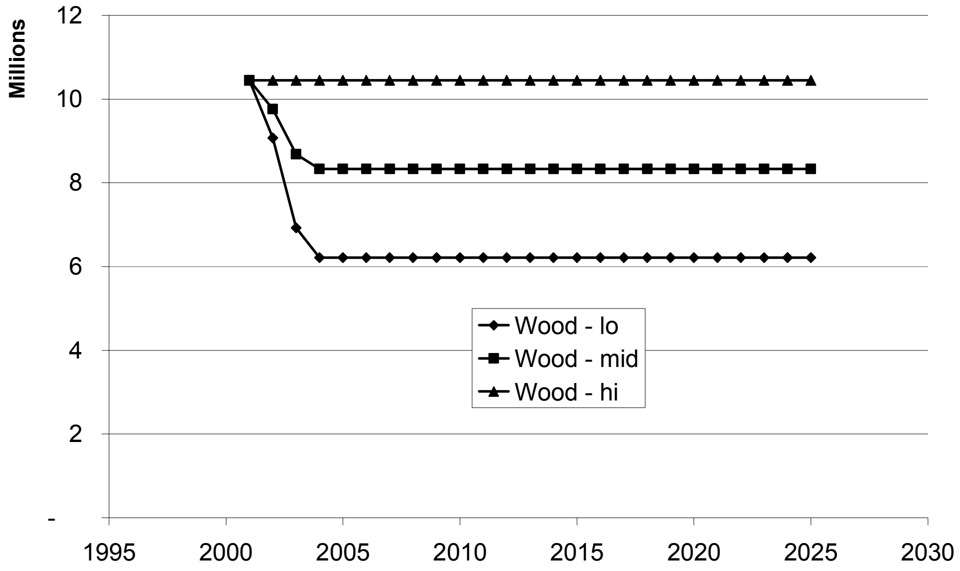


Figure 4.1.14 Forecasted Forestry Products Sea Traffic



(5) Forecasted Fertilizer Sea Traffic

Figure 4.1.15 Trend in Demand and Supply of Fertilizer

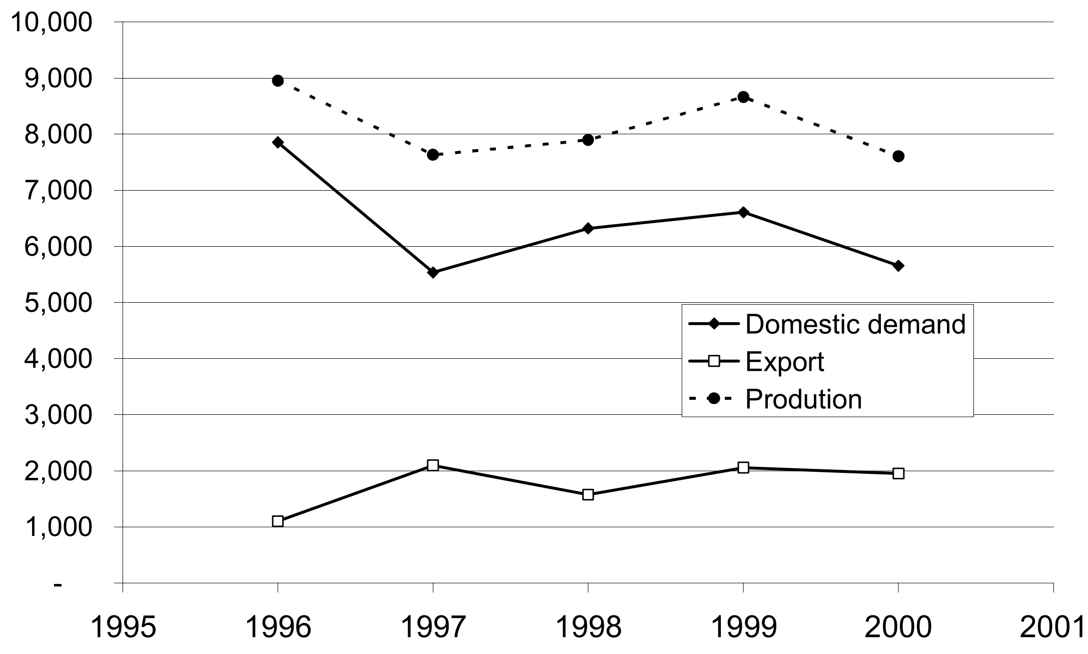


Table 4.1.5 Assumptions Used in the Forecast of Sea Traffic of Fertilizer

ITEM	ASSUMPTION
Consumption	Consumption will follow the growth in agricultural production (with rice as the benchmark). As a base case, it is assumed that agricultural production will be constrained by land and that self-sufficiency will not be reached. At the high case (1), Urea, SP-36 and Amsul fertilizer utilization rate will continue to decrease as the trend from 1996 to 2001 and other types of fertilizers continue it 5-year declining trend. As upper mid-case (2), Urea, SP-36 and Amsul fertilizer utilization rate will remain as it is and other types of fertilizers continue decline. As lower mid-case (3), Urea, SP-36 and Amsul fertilizer utilization rate will remain as it is and other types of fertilizers remain at current levels. For discussion purposes, it is also assumed that self-sufficiency will be attained – which will result in much higher consumption of
Export	Export has remained stable for the last four years and is assumed to continue this trend.
Imports	No imports
Production	Production level can be able to cope with domestic and export demands
Sea Traffic	In 2001, for every 1 MT of domestic demand results in 1.07 MT of sea traffic. This trend is assumed to continue in the future.

Figure 4.1.16 Forecasted Demand of Fertilizer ('000 MT)

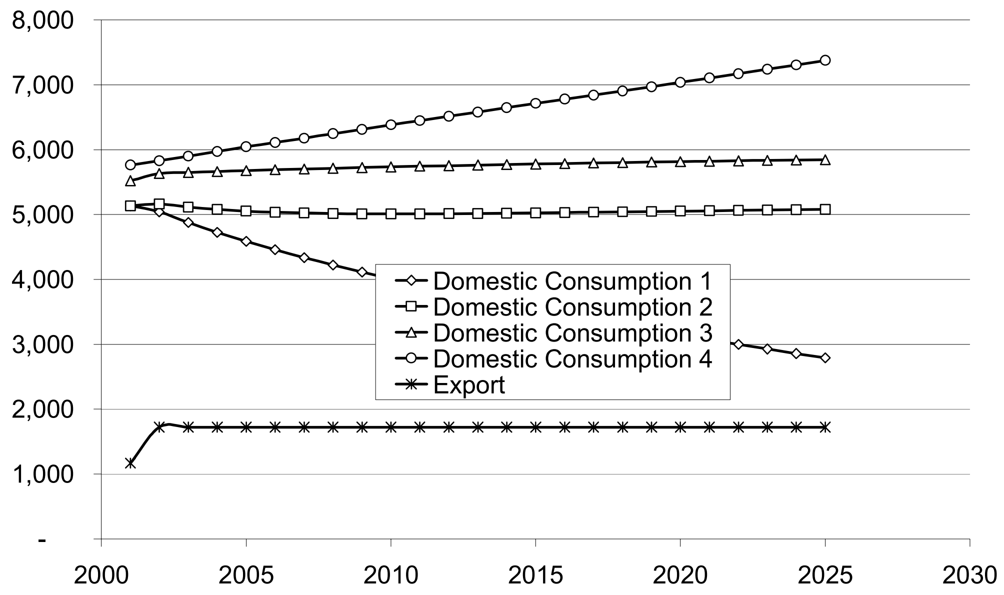
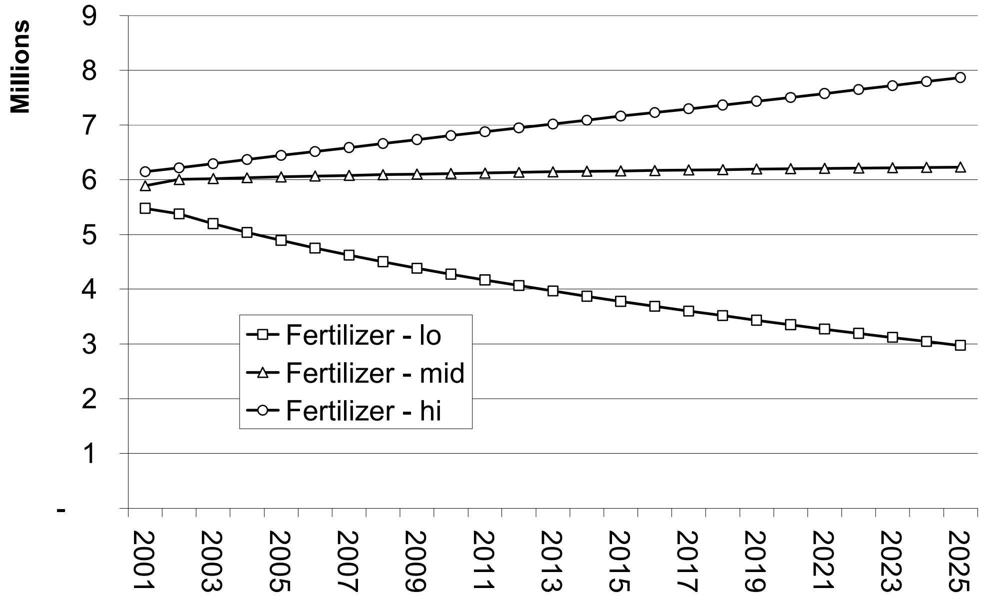


Figure 4.1.17 Forecast Seaborne Traffic of Fertilizer



(6) Forecasted Cement Traffic

Figure 4.1.18 Trend in Demand and Supply of Cement

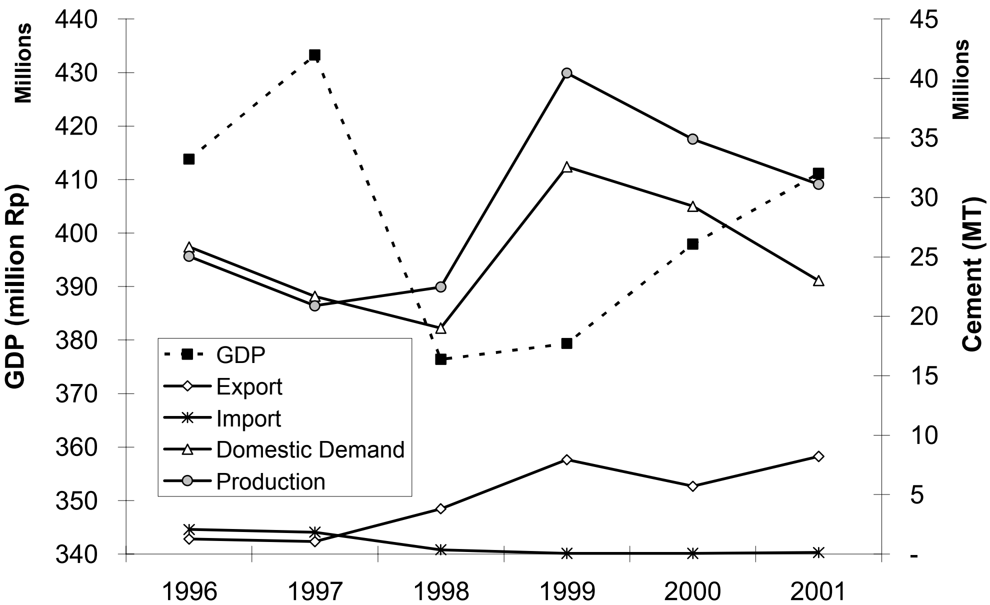


Table 4.1.6 Assumptions Used in the Forecast of Sea Traffic of Cement

ITEM	ASSUMPTION
Consumption	Based on the trend from 1996 to 2001, the elasticity of consumption to GDP is 0.9 (model 1). According to an Indonesian Cement Association estimate, the elasticity of demand to GDP is 1.4 (Model 2). Based on this two models – two scenarios are assumed, low GDP growth and high GDP growth
Export	Exports have remained stable since 1999 and is assumed to remain stable at 7 million MT
Import	No imports
Production	Production can cope with both domestic demand and exports
Sea Traffic	In 2001, for every 1 MT of domestic demand results in 0.22 MT of sea traffic. This trend is assumed to continue in the future.

Figure 4.1.19 Forecasted Demand of Cement

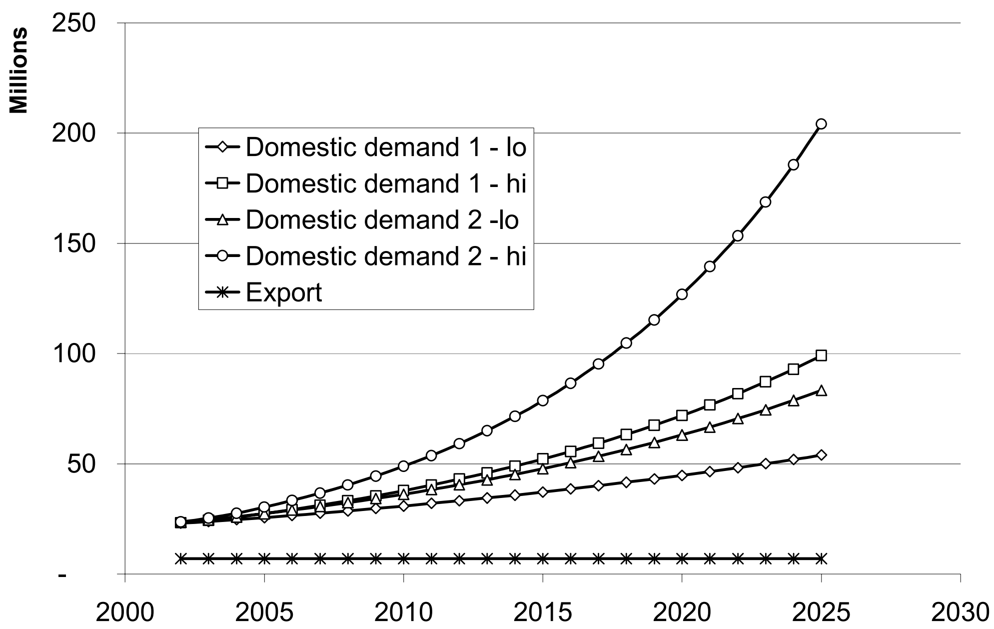
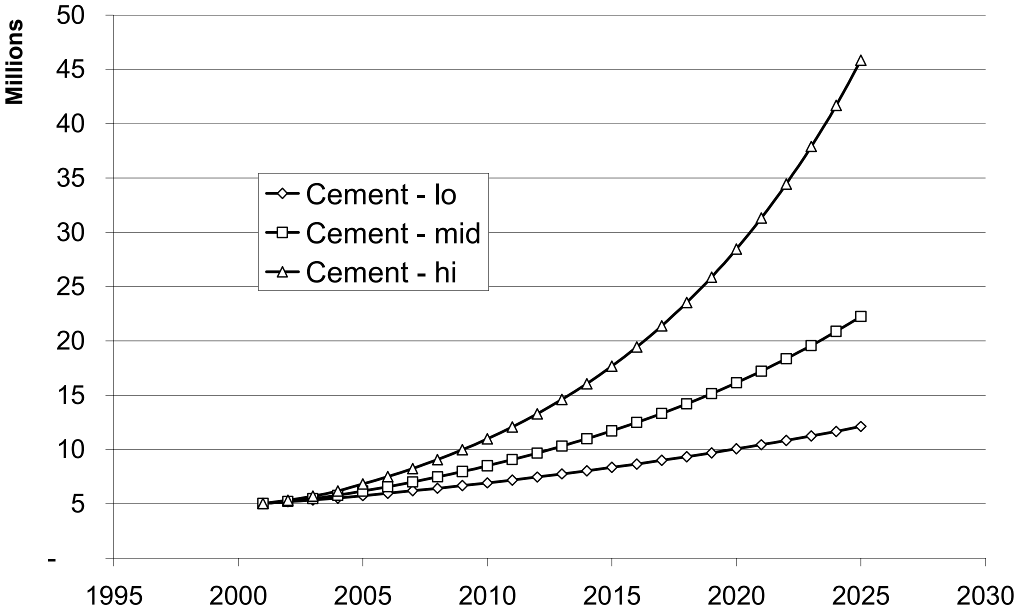


Figure 4.1.20 Forecasted Seaborne Cement Traffic



(7) Forecasted CPO Sea Traffic

Figure 4.1.21 Trend in CPO Demand and Supply

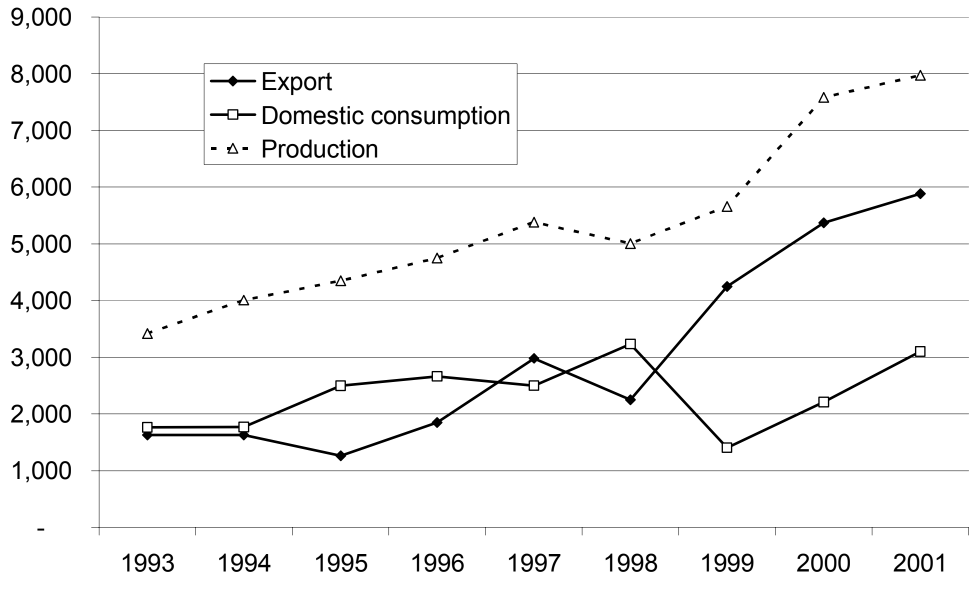


Table 4.1.7 Assumptions Used in the Forecast of Sea Traffic of CPO

ITEM	ASSUMPTION
Consumption	CPO Consumption rate per capita has an elasticity of 0.97 to GDP per capita – based on the trend from 1993 to 1998. Both the low GDP growth and high GDP growth scenario is assumed
Export	Export will increase at a constant rate of 400,000 MT per year – based on the average rate of growth from 1990 to 2001
Import	No imports
Production	Production can cope with domestic demand and export
Sea Traffic	In 2001, for every 1 MT of domestic demand results in 0.86 MT of sea traffic. This trend is assumed to continue in the future.

Figure 4.1.22 Forecasted Demand of CPO

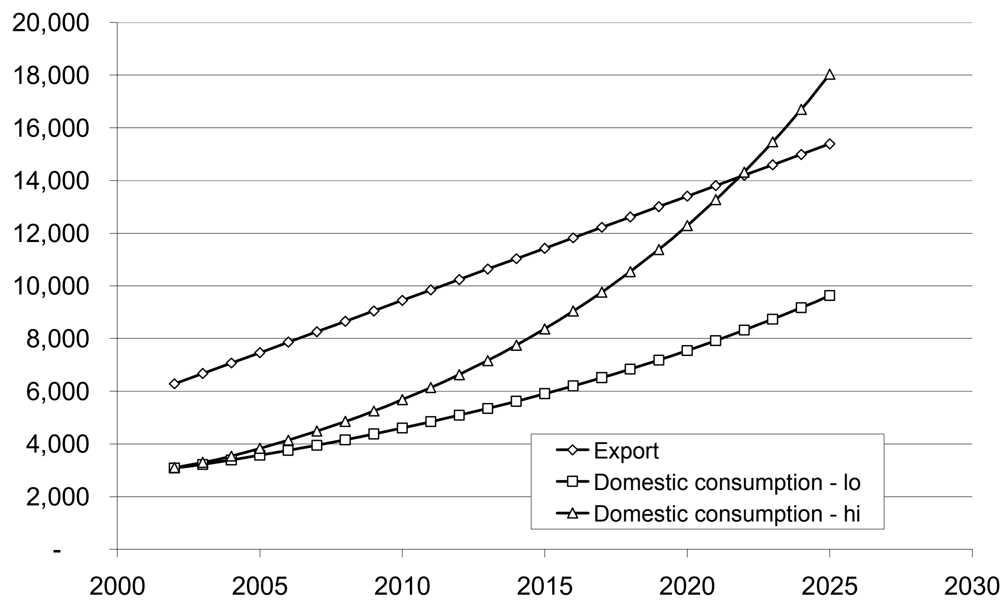
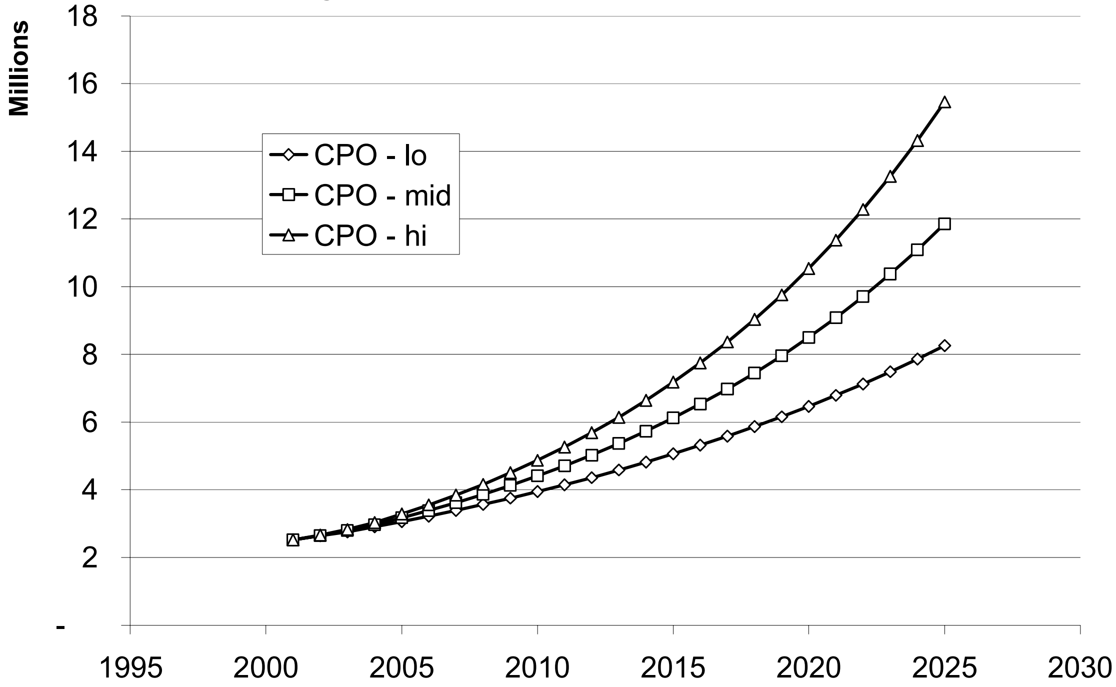


Figure 4.1.23 Forecasted CPO Sea Traffic



(8) Forecasted Rice Sea Traffic

Figure 4.1.24 Trend in Demand and Supply of Rice

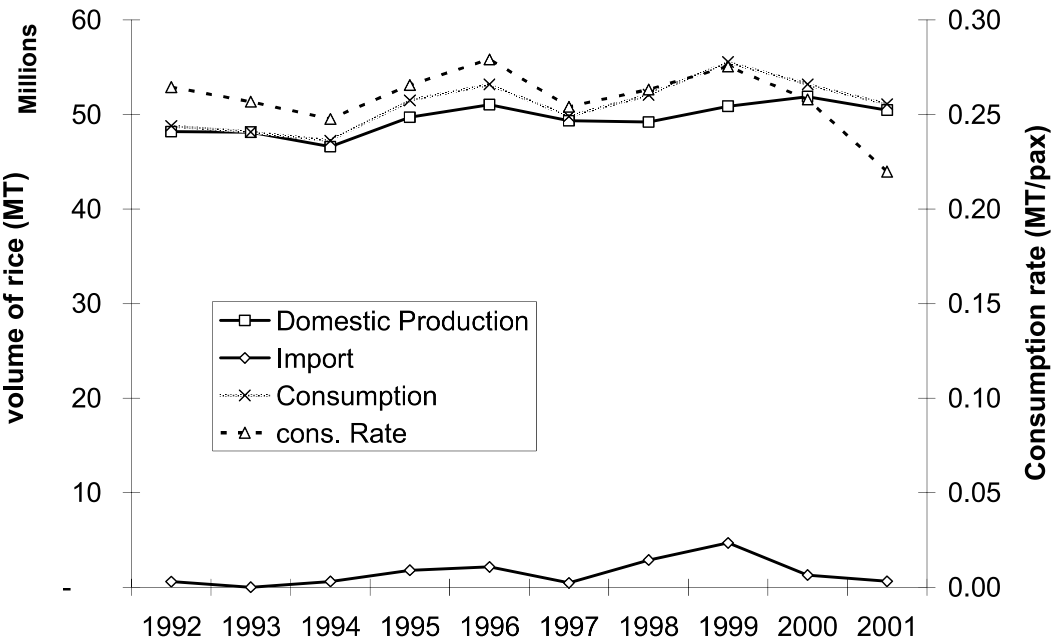


Table 4.1.8 Assumptions Used in the Forecast of Future Demand and Supply of Rice

ITEM	ASSUMPTION
Consumption	Consumption per capita is 250 kg per annum – based on average for the period 1993 to 2001
Export	No export
Import	Import would be able to cover the slack between demand and domestic production
Production	Low estimate - production is constrained by land; Mid estimate – time-series trend from 1991 to 2001 will be sustained; High estimate – self-sufficiency can be attained
Sea Traffic	In 2001, for every 1 MT of domestic demand results in 0.03 MT of sea traffic. This trend is assumed to continue in the future.

Figure 4.1.25 Forecasted Production for Rice

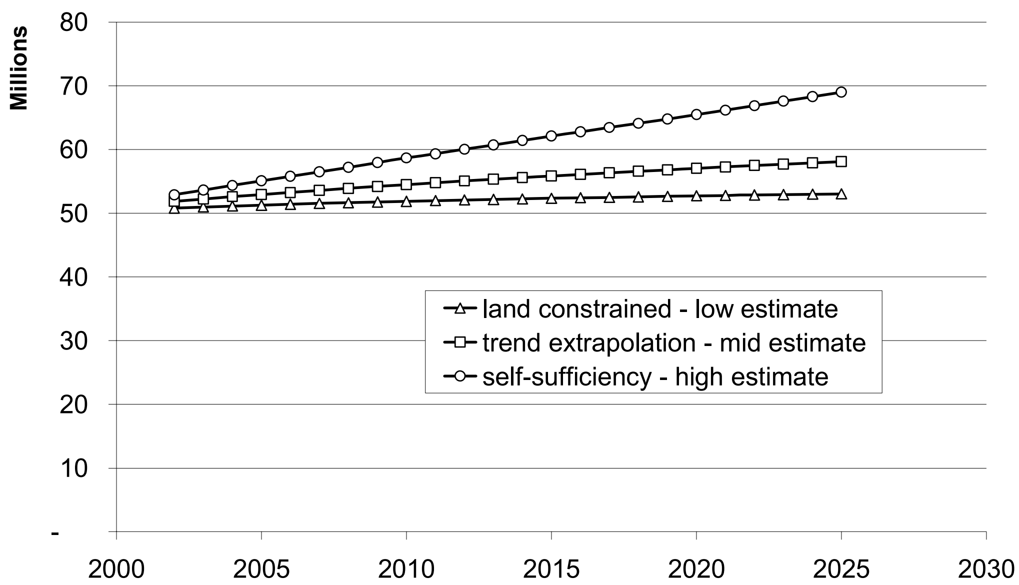
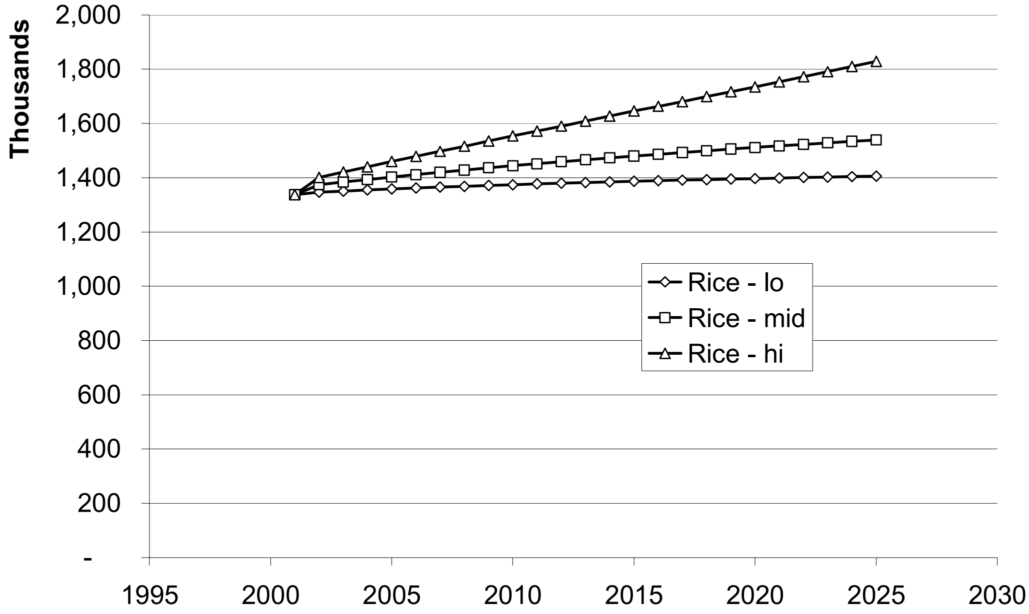


Figure 4.1.26 Forecasted Rice Sea Traffic

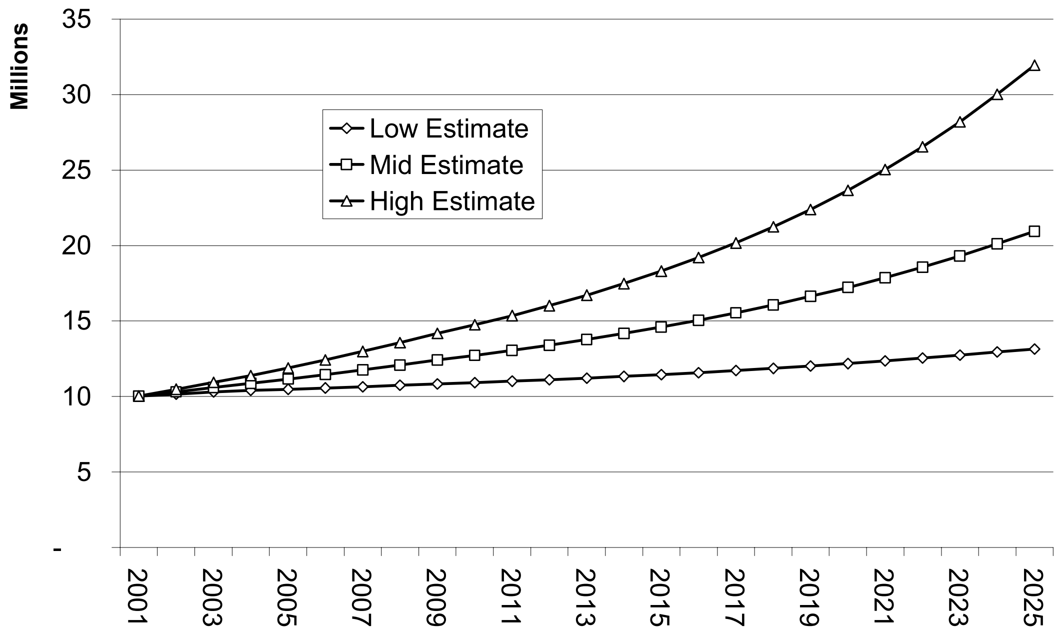


(9) Forecast of Non-key Commodities Sea Traffic

Table 4.1.9 Assumptions Used in the Forecast of Future Demand and Supply of Rice

ITEM	ASSUMPTION
Sea Traffic	Non-key commodities sea traffic will increase in line with the weighted average of all key commodities – basically assuming that the key commodities growth is representative of all other commodities

Figure 4.1.27 Forecasted Sea Traffic of Non-Key Commodities



4.2 Passenger Demand Forecast Models

4.2.1. Passenger Generation and Attraction Model

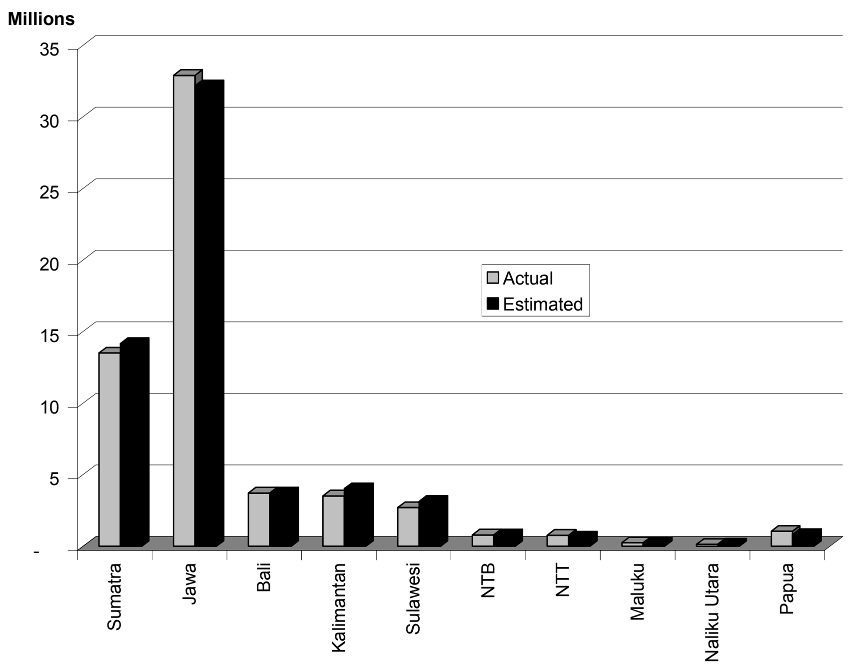
(1) Regional level air + inter island + ferry trip generation/attraction model

$$Trate_r = \exp(a) G^b D^c$$
$$Trate_r = air + \text{inter island} + \text{ferry trips per 100 population}$$
$$G = \text{Gross Domestic Product per capita}$$
$$\mathrm{D} = \begin{cases} 2 & \text{if Bali} \\ 0 & \text{otherwise} \end{cases}$$
$$r = region$$
$$a, b, c = parameters$$

Table 4.2.1 Trip Generation/Attraction per Region Model Calibration Results

Calibration Data Set	Trips generated and attracted per region (2002) Population per region (2002) GDP per region (2002)
Observations	10
Model fitness	$R^2 = 0.95$
Parameters	a = 2.92 t-stat = 40.8 b = 0.51 t-stat = 5.4 c = 2.03 t-stat = 8.4

Figure 4.2.1 Comparison of Estimated and Actual Trip Generation/Attraction per Region



(2) Zone level air + inter island trip generation/attraction model

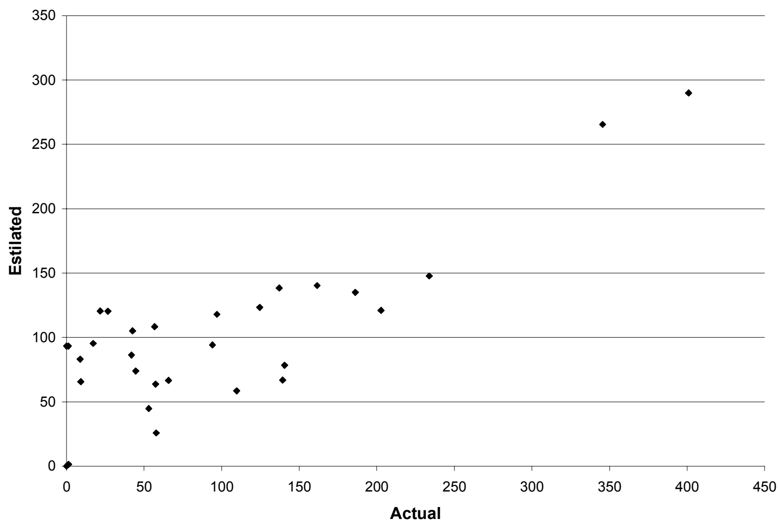
$$Trate_t^z = Trate_{t=0}^z \left(\frac{Trest_t^z}{Trest_{t=0}^z} \right)$$

$$Trest = \text{Estimated trip per 100 population}$$
$$= a + b\ln(G) + c\ln(D1) + d\ln(D2)$$
$$z = zone$$
$$t = year$$
$$G = GDP/cap$$
$$D1 = \begin{cases} 1 & \text{if z = Riau or Papua} \\ 0 & \text{otherwise} \end{cases}$$
$$D2 = \begin{cases} 1 & \text{if z = NAD} \\ 0 & \text{otherwise} \end{cases}$$
$$a,b,c,d = parameter$$

Table 4.2.2 Trip Generation/Attraction per Zone Model Calibration Results

Calibration Data Set	Trips generated and attracted per zone (2002) Population per zone (2002) GDP per zone (2002)
Observations	30
Model fitness	$R^2 = 0.54$
Parameters	a = 53.9 t-stat = 3.4 b = 107.8 t-stat = 5.4 c = -74.6 t-stat = -1.3 d = -153.3 t-stat = -2.1

Figure 4.2.2 Estimated and Actual Trip Generation/Attraction Rate per Zone



4.2.2. Air vs. Inter-island Modal Split Model

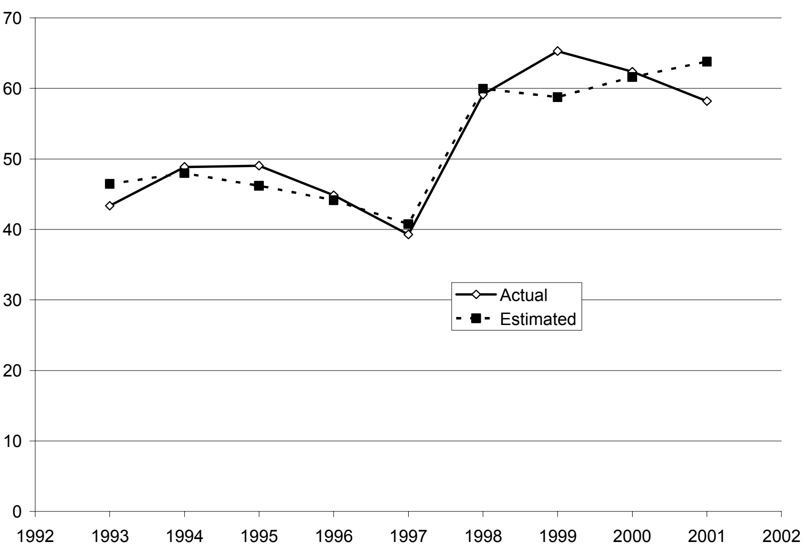
(1) Macroscopic Model

$$
\begin{aligned}
S_t &= \exp(a) G^b GR^c P^d \\
S &= \text{share of inter-island trips vs. air trips} \\
G &= \text{GDP per capita in millions} \\
\mathrm{GR} &= \mathrm{GDP_t / GDP_{t-1}} \\
P &= \text{population in million} \\
\mathrm{t} &= \text{year} \\
a,b,c,d &= \textit{parameters}
\end{aligned}
$$

Table 4.2.3 Macroscopic Airline vs. Inter-island Modal Split Model Calibration Results

Calibration Data Set	Inter-island passengers and airline passengers from 1993 to 2001 GDP and population from 1992 to 2001
Observations	9
Model fitness	0.88
Parameters	a = -15.0 t-stat = -3.5 b = -1.7 t-stat = -3.8 c = -0.5 t-stat = -1.3 d = 5.5 t-stat = 5.1

Figure 4.2.3 Comparison of Estimated and Actual Trip Share of Inter-island vs. Airline



ANNEX OF SECTION 5

5.1 Lecture Notes of Martime System Planning Technology Transfer Program

STRAMINDO TECHNOLOGY TRANSFER PROGRAM

Session 1

STRAMNDO Conference room, BBD Plaza, Jakarta
28 ~ 31 October 2003

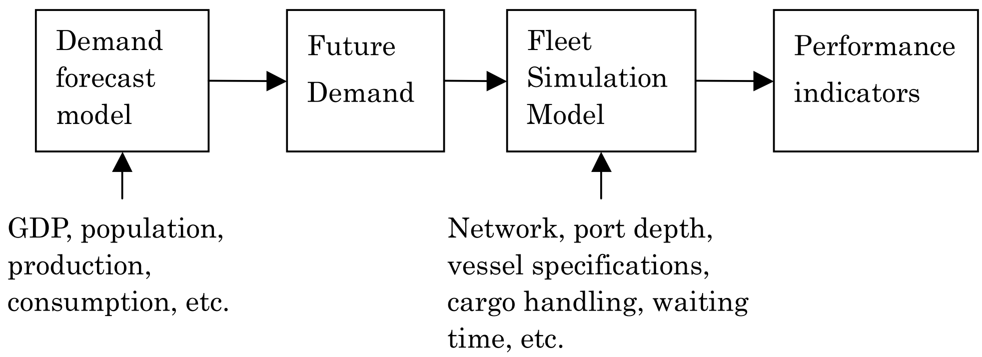
Lecture Notes

1. Practical planning methodology to maritime transport planning

One important aspect of maritime transport planning is the determination of the future fleet requirements, for the purpose of determining the extent and nature of needed investment and to determine how proposed projects will affect the performance of the maritime transport system.

The process typically involves two models: (1) The demand forecast model and (2) fleet simulation model. The demand forecast model inputs socio-economic information and outputs the future sea traffic. The fleet simulation model inputs the future demand as well as the properties of the future maritime transport system, such as configuration of liner routes, port depth, etc to determine the performance of the system, including fleet requirements, transport cost, etc.

Fundamentally, the process can be illustrated as follows:

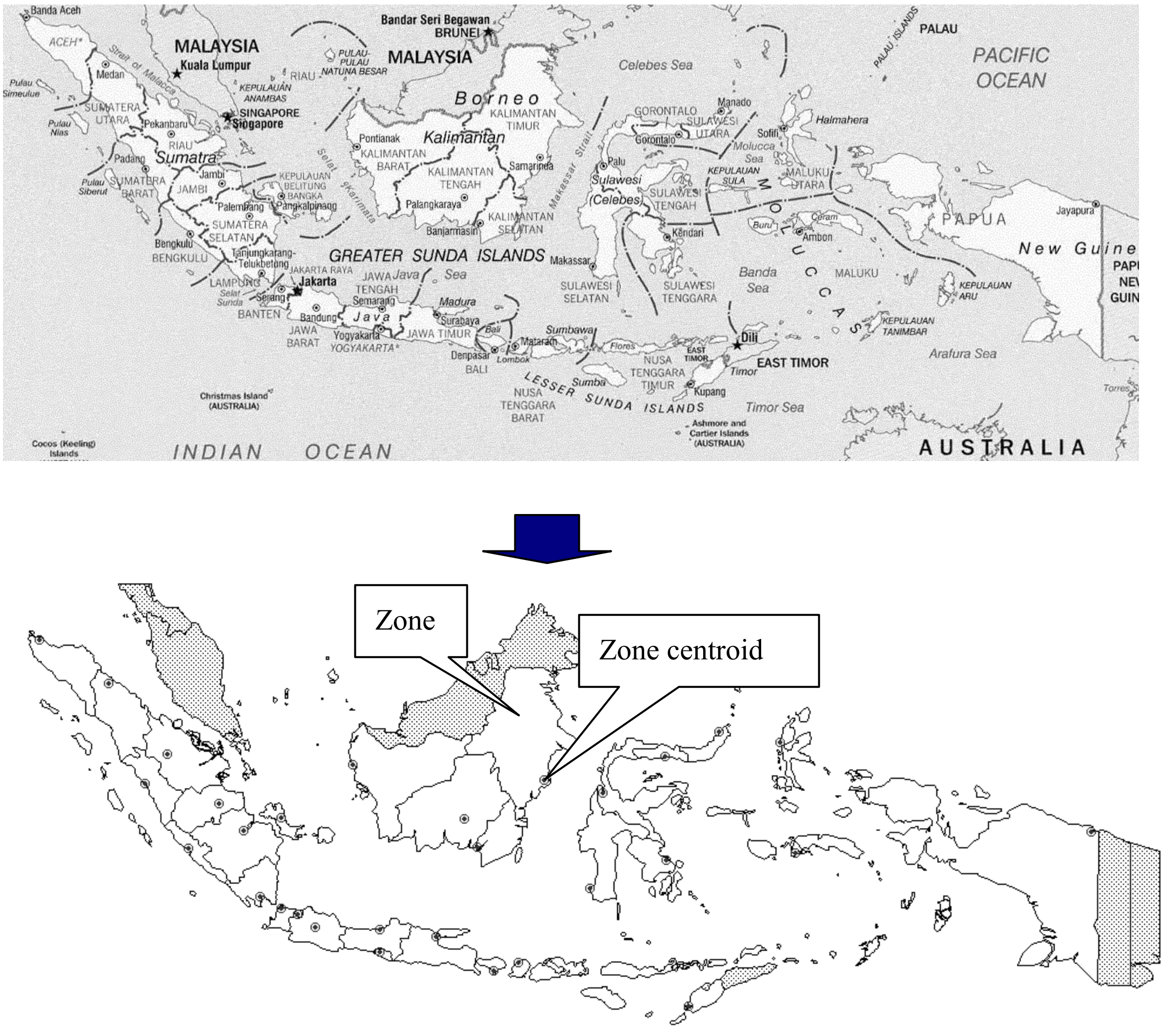


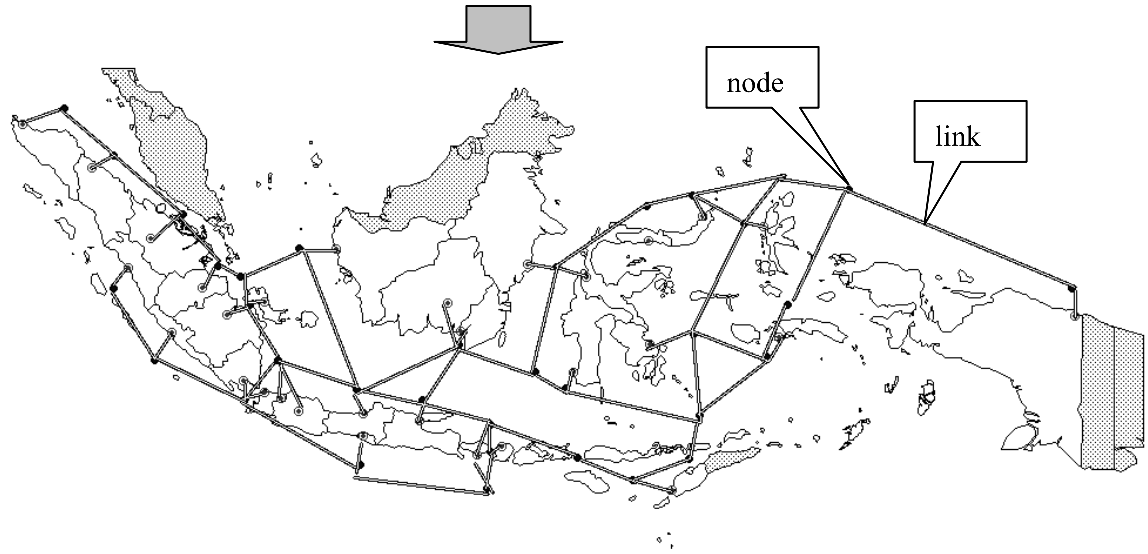
Physical elements of the transport system

- Zones
- Network
- Modes

Since transportation involves the movement of people and cargo from one place to another, transport system planning invariably requires the representation of the geographical space of the study area. This is usually achieved by a zoning system.

A **zone** is an area taken to be homogeneous and demand coming to and coming from the zone is explained by the characteristics of the zone (e.g. population, GDP, etc.). The zone is represented geographically by a single point called the zone centroid. For cargo or passengers to move from one zone to another, the linkages between zone centroids have to be defined. These linkages represent shipping routes or generally it is called the transport **network**, which is comprised of nodes and links. Finally, to allow cargo and passenger to move along the links, the transportation system requires transport **modes** (for example ships, airplanes, railroad, etc.)





☝ Zones are typically made to coincide with administrative borders – e.g. provincial borders, to take advantage of available statistic (e.g. population) which is usually aggregated by administrative region.

4-Step Demand Model

The 4-Step demand forecast is the most popular methodology in transport planning and. The 4-step model essentially divides the process into 4 distinct steps, making the process easier to manage.

Step 1: Generation and attraction (G/A) – how much traffic is generated or attracted by a zone

Step 2: Origin and Destination (OD) – how much of the generated traffic goes one zone to another

Step 3: Modal Split – if there are more than two modes between two zones, how much of the demand will using each mode

Step 4: Network Assignment – given the network, how will the demand move around the network to go from one zone to another

2. Developing Models for G/A forecast

G/A forecast is done using the following model:

$$G_i = g(\alpha, Z_i)$$
$$A_i = a(\beta, Z_i)$$

G = demand generated by zone i
A = demand attracted by zone i
Z = attributes of zone i
$g(.)$ = demand generation model
$a(.)$ = demand attraction model
α, β = parameters

In maritime transport, total sea traffic statistics is generally available. Thus, a two-tier model is sometimes used. And it is has the following form.

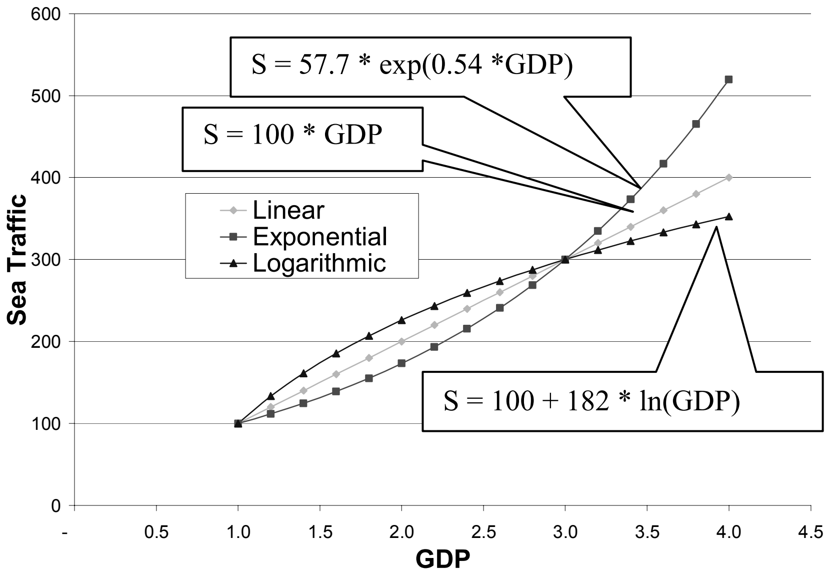
$$S = s(\gamma, Z)$$
$$G_i = S \frac{g(\alpha, Z_i)}{\sum_x g(\alpha, Z_x)}$$
$$A_i = S \frac{a(\beta, Z_i)}{\sum_x a(\beta, Z_x)}$$

S = sea traffic
$s(.)$ = sea traffic model
γ = parameters

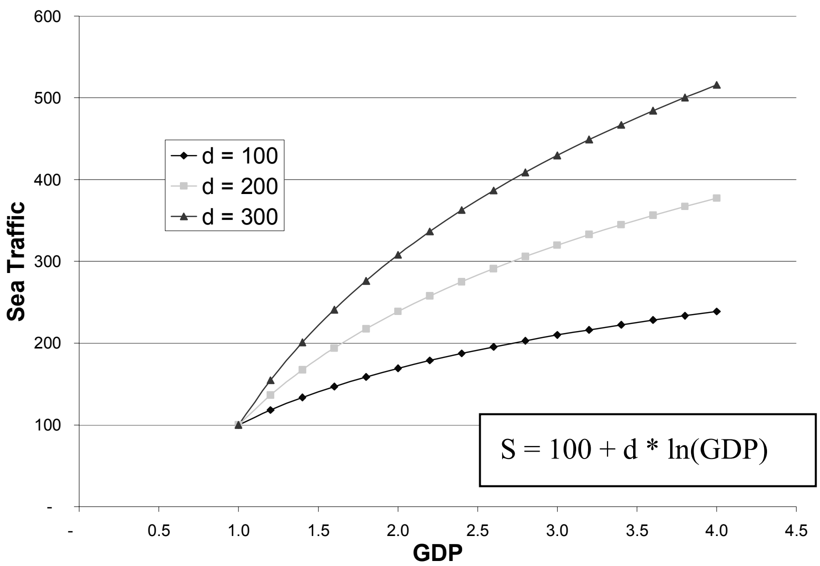
The key to G/S forecast is therefore to develop the model. A model, is a terminology used to denote something that represents a system in a simplified form for the purpose of analyzing the system. One of the most important purposes is to predict how the system will react to a stimulus. In the case of demand forecast, models are used to predict how sea traffic demand will change in relation changes in the socio-economic nature of the study area (e.g. GDP).

The development of the model requires the analyst to specify two items: model form and model parameters.

The model form means the form of the equation used. The following are some examples illustrating the difference in the results of the model as a result of the choice of model form.



The choice of parameters is the other aspect of model development. The following illustrates the difference of results based on the selection of model parameters.



As can be seen in the two examples, the choice of model form and model parameters will greatly affect the results of the model developed. Thus, the analyst should be very careful when developing the models to be used for analysis.

The selection of model form and model parameters is done by trying to **imitate past trends as closely as possible** – with the assumption that the relationships between key variables will remain valid in the future.

It is therefore important to have good data - in terms of quantity and quality - to calibrate the model.

The typical data needed for G/A model development are as follows:

- Sea traffic for several years
- Loading and unloading at ports for several years
- GDP data
- Production and consumption data
- Population
- Etc.

3. Sea traffic forecast: regression analysis using MSExcel

The most widely used methodology to calibrate G/A models is regression analysis. Regression analysis is a methodology to determine model parameters that will minimize the errors of the model. Error is a measure of deviation between the observed (or measured) results and the results of the model.

As an illustrative example, the development of the sea traffic model for dry cargo will be illustrated.

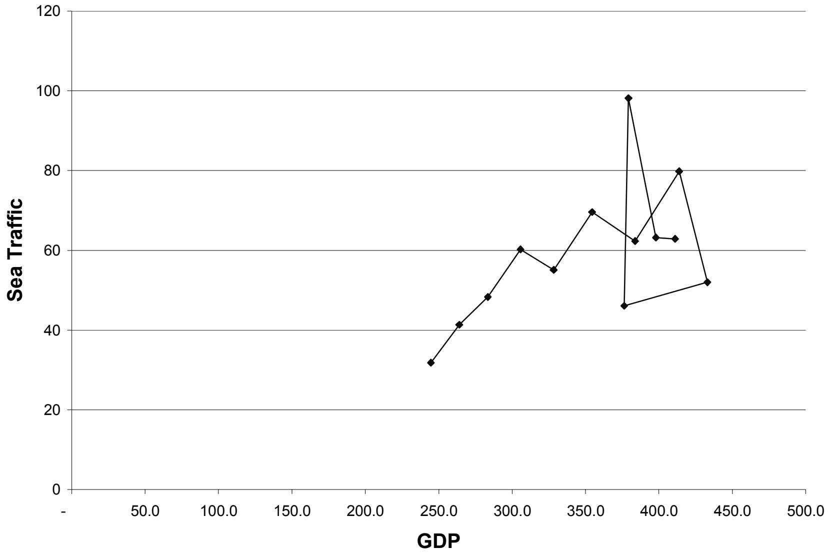
The first requirement is data and the following data is used.

(Million ton/year)

	GDP		International Cargo					Domestic				
Year	1993 price (Trillion)	Growth Rate(%)	General	Bulk	Container	Liquid	Total	General	Bulk	Container	Liquid	Total
1988	226.4											
1989	244.7	8.1	37.2			95.0	132.3	31.8			45.1	76.9
1990	264.0	7.9	46.2			92.1	138.2	41.3			53.6	94.9
1991	283.5	7.4	59.6			106.7	166.3	48.3			71.2	119.5
1992	305.7	7.8	72.9			107.9	180.8	60.2			72.5	132.7
1993	328.3	7.4	109.7			107.0	216.7	55.1			74.4	129.5
1994	354.6	8.0	138.1			100.6	238.8	69.6			77.5	147.1
1995	383.8	8.2	189.5			88.7	278.2	62.3			84.4	146.7
1996	413.8	7.8	72.5	62.1	36.4	166.1	337.1	52.6	26.3	0.9	90.4	170.1
1997	433.2	4.7	61.3	39.1	13.4	153.3	267.1	38.6	13.4	0.0	81.6	133.6
1998	376.4	-13.1	40.2	71.5	12.8	142.3	266.8	28.3	14.3	3.5	79.0	125.2
1999	379.4	0.8	47.0	105.0	22.2	164.5	338.8	52.0	38.7	7.5	82.1	180.2
2000	397.9	4.9	53.1	90.8	15.0	205.6	364.5	37.5	22.2	3.5	88.9	152.1
2001	411.1	3.3	55.8	124.9	22.4	209.7	412.7	32.5	26.1	4.3	87.1	149.9
2002	426.3	3.7										
2003	440.8	3.4										
2004	458.5	4.0										

Source: Cargo data are from DGSC annual statistics and economic data are from BPS annual year book.
GDP in 2002 - 2004 are estimates in "Asian Development Outlook 2003" by ADB

A graphical representation of the GDP and the sea traffic shows an unclear trend as follows. Prior to 1997, the trend was clear between GDP and sea traffic, but after the financial crisis, the trend exhibited a new relationship between GDP and sea traffic. To remedy this situation other factors are considered or a dummy variable is used.



After a series of trial and error a log-linear model is used and has the following form:

$$S_t = \alpha + \beta \ln(GDP_t) + \gamma \ln\left(\frac{GDP_t}{GDP_{t-1}}\right) + \sigma \ln(D_t)$$

The basic data is as follows:

Year	Dry Cargo	GDP	Growth	Dummy
1989	31.8	244.7	1.08	1.0
1990	41.3	264.0	1.08	1.0
1991	48.3	283.5	1.07	1.0
1992	60.2	305.7	1.08	1.0
1993	55.1	328.3	1.07	1.0
1994	69.6	354.6	1.08	1.0
1995	62.3	383.8	1.08	1.0
1996	79.8	413.8	1.08	1.0
1997	52	433.2	1.05	10.0
1998	46.1	376.4	0.87	10.0
1999	98.2	379.4	1.01	0.5
2000	63.2	397.9	1.05	2.0
2001	62.9	411.1	1.03	2.0

Regression analysis requires that the model form is linear (i.e. Y = a + bX1 + cX2 + …) thus it is necessary to transform the model form into a linear form.

$$S_t = \alpha + \beta \ln(GDP_t) + \gamma \ln\left(\frac{GDP_t}{GDP_{t-1}}\right) + \sigma \ln(D_t)$$

$$\Downarrow$$

$$Y = a + bX1 + cX2 + dX3$$
$$X1 = \ln(GDP_t)$$
$$X2 = \ln\left(\frac{GDP_t}{GDP_{t-1}}\right)$$
$$X3 = \ln(D_t)$$

☝ If using exponential model forms, the transformation is done as follows:

$$S = \alpha \exp(\beta GDP)$$

$$Y = a + bX$$
$$Y = \ln(S)$$
$$a = \ln(a)$$
$$bX = \beta GDP$$

The basic data is converted is as follows:

Year	Dry Cargo	GDP	Growth	Dummy
1989	31.8	244.7	1.08	1.0
1990	41.3	264.0	1.08	1.0
1991	48.3	283.5	1.07	1.0
1992	60.2	305.7	1.08	1.0
1993	55.1	328.3	1.07	1.0
1994	69.6	354.6	1.08	1.0
1995	62.3	383.8	1.08	1.0
1996	79.8	413.8	1.08	1.0
1997	52	433.2	1.05	10.0
1998	46.1	376.4	0.87	10.0
1999	98.2	379.4	1.01	0.5
2000	63.2	397.9	1.05	2.0
2001	62.9	411.1	1.03	2.0

Y	X1	X2	X3
31.8	5.5	0.08	-
41.3	5.6	0.08	-
48.3	5.6	0.07	-
60.2	5.7	0.08	-
55.1	5.8	0.07	-
69.6	5.9	0.08	-
62.3	6.0	0.08	-
79.8	6.0	0.08	-
52.0	6.1	0.05	2.3
46.1	5.9	(0.14)	2.3
98.2	5.9	0.01	(0.7)
63.2	6.0	0.05	0.7
62.9	6.0	0.03	0.7

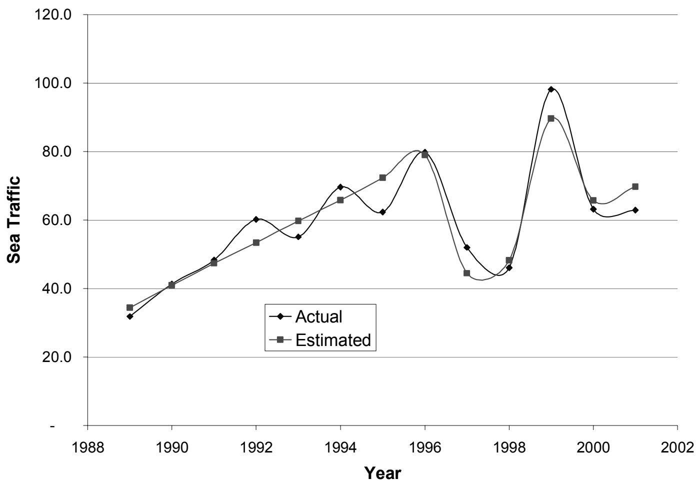
To perform regression analysis using MSExcel follow the following steps:

1) Open regression analysis dialog box: Tool >Data Analysis > Regression
2) Input the Y-Range and X-Range as well as the output range
3) Click OK and interpret the results

The resulting parameters are as follows:

Parameters	**Value**	**t-stat**	**R coeff.**
a	-423.9	-6.48	0.94
b	84.5	7.54	
c	-83.9	-2.09	
d	-17.8	-6.36	

Year	Actual	Estimated
1989	31.8	34.4
1990	41.3	41.0
1991	48.3	47.4
1992	60.2	53.4
1993	55.1	59.8
1994	69.6	65.8
1995	62.3	72.3
1996	79.8	79.0
1997	52.0	44.5
1998	46.1	48.2
1999	98.2	89.6
2000	63.2	65.7
2001	62.9	69.7



Exercise: Perform the same analysis for liquid cargo.

4. Loading/unloading forecast

Exercise: Calculate the future generated and attracted demand for each zone using the <u>two-tier model</u>

The generated and attracted dry cargo for each zone was calculated using the following model:

$$G_i = g(\alpha, GDP_i)$$
$$A_i = g(\beta, GDP_i, pop_i)$$

The resulting generation and attraction results are as follows.

	2002		2014		2024	
Zone	**Gen**	**Att**	**Gen**	**Att**	**Gen**	**Att**
1	0.5	0.1	0.8	0.1	1.5	0.2
2	1.4	4.3	3.0	5.8	3.7	12.1
3	3.6	0.8	4.6	0.9	11.8	2.4
4	6.6	7.1	16.4	8.5	22.6	21.4
5	0.9	0.4	2.2	0.7	2.5	1.1
6	3.9	0.5	10.1	0.8	13.1	1.7
7	0.9	0.5	1.8	1.1	2.0	1.7
8	0.0	0.1	0.1	0.2	0.1	0.2
9	8.4	0.8	10.6	0.8	30.6	1.9
10	6.2	7.3	7.9	10.1	16.5	17.1
11	0.0	0.5	0.0	0.9	0.1	1.1
12	1.0	10.8	1.0	28.0	2.4	37.7
13	2.0	7.9	2.9	10.5	5.7	26.8
14	-	-	-	-	-	-
15	5.5	7.2	6.1	16.5	19.4	21.7
16	0.1	1.0	0.1	2.0	0.2	3.0
17	0.6	0.9	1.2	1.2	2.0	2.5
18	0.8	0.3	1.8	0.3	2.4	0.8
19	10.3	6.5	25.3	14.9	37.0	14.4
20	10.9	4.3	16.5	8.1	31.5	9.5
21	0.3	1.1	0.7	1.4	0.9	3.3
22	0.0	0.1	0.0	0.1	0.0	0.2
23	0.6	0.6	1.2	0.9	1.7	1.2
24	3.7	3.4	4.0	8.3	7.3	8.7
25	0.1	0.9	0.3	2.4	0.4	2.8
26	0.2	0.6	0.4	1.0	0.6	1.3
27	0.1	0.5	0.1	0.6	0.3	1.1
28	1.0	0.6	2.0	1.0	3.1	1.4
29	0.2	0.2	0.2	0.4	0.4	0.5
30	0.5	1.2	1.1	2.8	1.9	4.0
TOTAL	70.4	70.4	122.7	130.2	222.0	201.8

million tons/year

Using the sea traffic forecast model developed above and the assumption that GDP will increase by 7% from 2005 and onwards. Calculate for years 2014 and 2024.

5. Practical forecasting under limited data availability

In actual practice, data is in a lot of times limited, thus the analyst must be resourceful to be able to make do with whatever data is available. For example, in Indonesia, it is past data on loading and unloading of coal is not available. However, past data on production and consumption of coal per zone is available. In such case, one solution is to assume that the current ratio of loading and production and the ratio of unloading and consumption is assumed to remain constant. The model for is as follows:

$$G_i = \mu \times P(\cdot),\ \ \mu = \frac{G_i}{P} \text{ for year 2003}$$

$$A_i = \kappa \times C(\cdot),\ \ \kappa = \frac{A_i}{C} \text{ for year 2003}$$

P(.) = production a function
C(.) = consumption a function

STRAMINDO TECHNOLOGY TRANSFER PROGRAM

Session 2

STRAMNDO Conference room, BBD Plaza, Jakarta
28 ~ 31 October 2003

Lecture Notes

1. OD Matrix Development

The Origin-Destination (OD) Matrix (or Table) is a database showing the quantity of demand between any two-zones. It has the typical form as follows:

	D(1)	**D(2)**	**D(3)**	**……..**	**…….**	**D(j)**	**…….**	**D(J)**	Σ
O(1)	v(1,1)	v(1,2)	v(1,3)	…..	…..	v(1,j)	…..	v(1,J)	**G(1)**
O(2)	v(2,1)	v(2,2)	v(2,3)	…..	…..	v(2,j)	…..	v(2,J)	**G(2)**
O(3)	v(3,1)	v(3,2)	v(3,3)	…..	…..	v(3,j)	…..	v(3,J)	**G(3)**
……	…..	…..	…..	…..	…..	…..	…..	…..	**……**
……	….	…..	…..	…..	…..	…..	…..	…..	**……**
O(i)	v(i,1)	v(i,2)	v(i,3)	…..	…..	v(i,j)	…..	v(i,J)	**G(i)**
……	…..	…..	…..	…..	…..	…..	…..	…..	**……**
O(I)	v(I,1)	v(I,2)	v(I,3)	…..	…..	v(I,j)	…..	v(I,J)	**G(I)**
Σ	**A(1)**	**A(2)**	**A(3)**	**……..**	**……..**	**A(j)**	**……..**	**A(J)**	

$$\sum_j v_{i,j} = G_i$$

$$\sum_i v_{i,j} = A_j$$

$$S = \sum G_i = \sum A_j = \sum_i \sum_j v_{i,j}$$

O(i) is orgin zone *i*
D(j) is destination zone *j*
v(i,j) is the demand from zone *i* to zone *j*

To estimate the OD Table, it is in many cases not practical to collect all the OD data due to large amount of data needed – for example in Indonesia, to collect one year data from all ports would require more than 180,000 data entries. To handle such large volume of data would require significant manpower and time to encode and analyze. It is more practical to take a sample. To determine the sample size, the analyst must balance cost and accuracy. In STRAMINDO for example, the sampling rate is 1 month data.

Usually a survey is taken to determine the distribution of destination of demand originating from a zone and/or the distribution of origin of demand destining to a zone.
Using the former, the following illustrates the methodology of OD Matrix development.

$$\sum_j \tilde{v}_{i,j} = \tilde{G}_i$$

$$r_{i,j} = \frac{\tilde{v}_{i,j}}{\tilde{G}_i} \approx \frac{v_{i,j}}{G_i}, \quad \sum_i r_{i,j} = 1.0$$

$$v_{i,j} = r_{i,j} \times G_i \quad \rightarrow \text{expansion}$$

$$\tilde{v}_{i,j} = \text{sampled volume of demand from zone i to zone j}$$

$$\tilde{G}_i = \text{sampled volume of demand from zone i}$$

$$r_{i,j} = \text{OD rate}$$

Similar equations can be easily derived if we use demand coming to a zone, instead of demand originating from a zone.

2. Data Requirements for OD Forecast

As described above, to develop the OD Matrix, we need to determine two items either from a survey or from published statistics: (1) OD rates and (2) expansion factor. In actual practice, OD rates are determined through an OD survey, while the expansion factor is determined from published statistics.

In the case of STRAMINDO the OD rates were determined from voyage reports and the LK3.The LK3 reports were collected from 23 strategic ports. Since the LK3 covers only the 23 strategic ports, to determine OD rates between non-strategic ports, the voyage reports were use. The LK3 documents were given higher credence, because the LK3 is well documented and compliance is higher than the Voyage Report. The following figure illustrates how the two data sources were used.

	Strategic port	**Other ports**
Strategic ports	LK3	LK3
Other ports	LK3	Voyage Report

The expansion factor is determined from annual loading and unloading data collected from ADPEL. As can be easily discerned, the expansion factor is very critical to ensure that there is no “bias” in the results, especially of the OD Matrix desired details the type of commodity.

Exercise: Using the sample OD data below and the loading data, develop the OD Matrix.

Results of Survey

	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
1	2,036	25,470	-	16,253	-	-	-	-	84	-	-	-	58	-	953
2	1,462	71,592	2,953	51,222	47	9,677	-	-	1	88,479	4,953	-	657	-	56,175
3	-	100,740	3,168	46,210	-	578	-	1,345	4,987	137,303	-	-	219,569	-	3
4	-	199,478	18	964,439	3,397	6,947	1,046	-	15,906	247,530	44	2,408	669	-	8,307
5	-	1,554	-	9,292	24,116	225	1,809	3,556	-	40,297	1,682	8	7,362	-	1,560
6	-	1,756	6,272	35,902	397	17	855	21	2,075	1,411	4,327	123,173	490,518	-	209
7	-	2,752	-	7,850	18	489	2,609	-	503	130,744	285	-	16,575	-	3,638
8	-	-	193	-	1,848	1,625	-	69	-	3,308	-	-	-	-	89
9	-	8,684	2,326	46,275	0	22,121	16,426	-	-	95,752	-	1,665,667	4,410	-	33,546
10	1,987	66,505	52,473	94,715	2,052	23,132	28,618	221	23,743	23,742	1,065	3,521	104,621	-	10,596
11	-	246	-	61	221	1,476	-	-	125	4,425	166	-	66	-	656
12	-	1,008	-	-	30	2,703	-	174	5,669	31,098	-	6,374	37,903	-	6,395
13	-	51,112	6,736	545	416	-	28	-	6,375	12,453	24,896	-	27,335	-	224
14	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
15	-	65,523	19,939	35,427	561	5,990	9,140	5,359	11,243	22,354	67	6,149	3,557	-	54,692
16	-	-	-	-	-	-	-	-	-	-	-	-	-	-	2,766
17	-	28,338	-	19	209	-	23	-	251	41,320	20	-	1,797	-	13,621
18	-	3,168	486	-	9,176	1,073	-	-	719	4,973	4,422	798	12,179	-	55,535
19	-	14,985	2,581	12,022	142	160	-	-	569	99,298	11,013	369,951	60,067	-	130,842
20	302	1,948	-	8,947	2,358	331	-	-	8,957	38,003	-	2,081	51,105	-	167,479
21	-	-	-	-	-	-	-	-	-	19,046	-	-	-	-	27,721
22	-	-	-	-	-	-	-	-	-	-	-	-	-	-	191
23	-	-	-	-	-	-	-	-	-	335	2,120	-	7,673	-	746
24	-	2,128	330	20,695	-	-	-	-	2,109	107,560	-	-	11,944	-	281,652
25	-	-	-	921	-	-	-	-	-	8	-	-	1,358	-	3,014
26	-	-	-	-	-	-	-	-	4,702	33	-	-	-	-	2,154
27	-	-	-	-	-	-	-	-	-	85	-	-	-	-	6,752
28	-	-	-	690	-	-	-	-	-	21,879	-	-	5,420	-	4,105
29	-	-	-	2,340	1,734	-	-	-	-	1,156	-	15	53	-	525
30	31	-	1,949	1	-	-	9,568	-	-	7,208	2,372	112	900	-	11,750

	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30
1	-	-	-	-	5,087	1,012	-	-	-	-	-	420	-	-	-
2	-	23	-	-	-	-	-	451	716	-	-	3,388	-	-	-
3	-	-	-	1,869	879	-	-	-	-	386	-	-	-	482	565
4	-	9,187	1,589	11	2,654	-	-	660	-	5,884	553	-	403	91	-
5	-	1,824	165	1,982	1,420	-	-	-	-	-	-	-	-	-	-
6	-	79	1	151	3	-	-	24	-	8	277	-	-	-	-
7	-	65	-	-	-	-	-	-	-	-	-	-	-	-	2,432
8	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
9	-	-	19	33,435	2,295	-	-	-	-	-	-	-	-	-	-
10	492	74,698	186	52,015	39,673	7,513	-	1,878	35,806	-	128	814	809	-	25,057
11	-	12	193	296	4	-	-	-	-	-	480	1,292	-	-	-
12	-	-	225	17,492	17	-	-	103	400	-	-	-	-	-	-
13	-	152	2,507	24,736	287	-	-	-	115	-	-	-	163	142	6,834
14	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
15	23,982	1,253	8,909	96,454	106,091	56,607	802	7,271	136,691	2,113	19,956	37,770	20,930	6,657	22,039
16	10	-	-	-	-	7,861	-	-	-	-	11	3,869	-	-	-
17	2	194	2,109	12	37	-	-	28	152	-	27	91	37	2	-
18	2,138	292	2,092	8,777	711	98	4	351	63	655	-	-	-	-	-
19	49,236	317	3,037	475,660	25,770	2,365	2,304	35,524	62,498	31,315	19,665	277	946	2,224	9,154
20	18,082	5,420	5,544	41,880	117,481	1,099	1,923	220	85,740	6,029	9,781	-	-	357	2,987
21	-	-	2	2,923	-	7,455	664	-	-	-	151	-	6,156	5,780	1,157
22	-	-	0	-	51	3	-	-	687	-	-	-	-	0	-
23	1,305	-	4	47	46,518	397	-	841	1,090	-	-	-	-	-	-
24	3,342	-	4	78,469	55,531	88,158	2,358	45,682	431	13,961	9,963	19,480	28,575	9,087	40,209
25	-	-	69	11,786	-	-	-	-	77	-	176	938	83	-	6,802
26	3,648	-	-	-	-	8	-	-	-	37	659	1,808	2,685	-	1,192
27	65	-	-	635	-	-	-	3,168	27	-	730	6,148	83	-	-
28	-	-	-	4,765	-	9,599	-	-	7,649	92,532	1,510	924	37,452	4,782	1,595
29	-	-	1	370	-	3,813	216	-	31	-	-	1	1,062	39	4,637
30	-	-	16	380	582	146	30	-	3,243	1,073	3,169	-	7,450	2,254	79,434

Expansion Data

Zone	Loading
1	520,404
2	1,372,699
3	3,582,742
4	6,587,720
5	905,390
6	3,941,684
7	909,867
8	31,118
9	8,406,785
10	6,182,175
11	44,644
12	1,046,807
13	2,012,029
14	-
15	5,454,989
16	62,692
17	635,983
18	795,046
19	10,278,049
20	10,949,090
21	336,466
22	8,749
23	561,924
24	3,651,635
25	135,566
26	184,252
27	110,778
28	1,002,850
29	189,738
30	540,903
TOTAL	**70,442,775**

3. OD Forecast: Fratar Method

OD Forecast intends to forecast the future OD Matrix. There are two mainly used methodologies: Gravity Model and the Fratar Model. For urban transport planning, the Gravity Model is often used but for maritime transport, the Fratar Model is typically used. The Fratar Model uses two important assumptions:

- The distribution of future trips from a given origin is proportional to the present trip distribution
- The future distribution is modified by the growth factor for the zone to which these trips are attached

The Fratar Model has the following form:

$$\hat{v}_{i,j} = \left(G_i \times f_i\right) \frac{v_{i,j} \times h_j}{\sum_x \left(v_{i,x} \times h_x\right)}$$

$$\hat{v}_{i,j} = \text{future } v_{i,j}$$
$$f_i = \text{growth of generation of demand from zone } i$$
$$h_j = \text{growth of attraction of demand to zone } j$$

The growth factor is determined from the loading and unloading forecast.

$$f_i = \frac{G_i \rightarrow future}{G_i \rightarrow present}, \quad h_j = \frac{A_j \rightarrow future}{A_j \rightarrow present}$$

4. OD Forecast Exercise: Introduction to Visual Basic

In actual practice, it is necessary to develop a tool to perform the Fratar Model to estimate the future OD Matrix. There are commercially available tools such as the JICA-STRADA but by combining Visual Basic (VB) and MSExcel, the analyst can effectively perform the same task. This approach will be introduced as part of an exercise to solve the following problem.

Exercise: Estimate the Future OD Matrix for the Year 2014 and 2024, using the following present OD Matrix and growth factors.

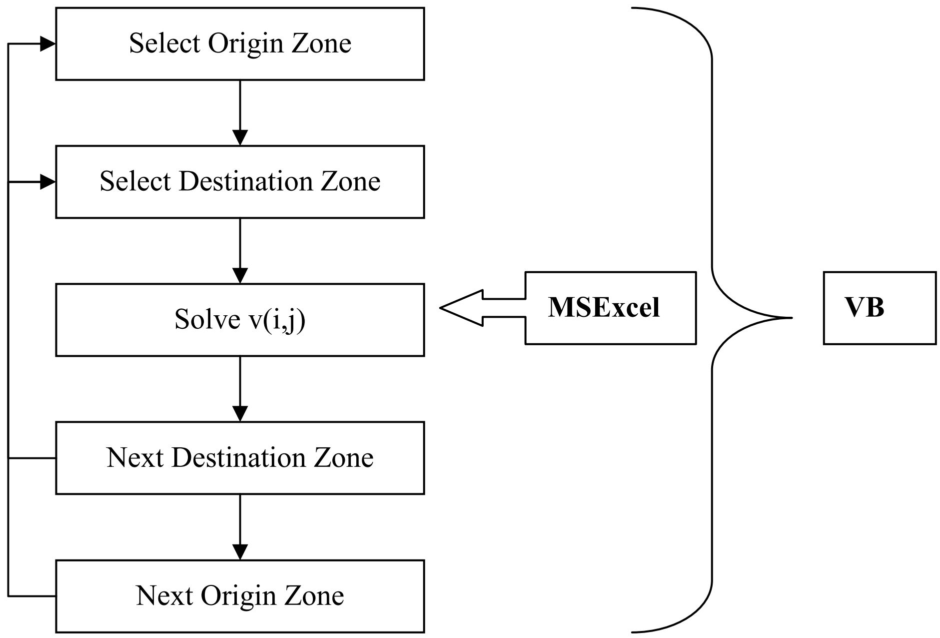
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
1	20,627	258,014	-	164,643	-	-	-	-	849	-	-	-	583	-	9,650
2	6,876	336,792	13,891	240,963	223	45,523	-	-	4	416,233	23,302	-	3,090	-	264,263
3	-	696,652	21,910	319,561	-	3,997	-	9,302	34,487	949,500	-	-	1,518,399	-	21
4	-	893,209	81	4,318,489	15,210	31,106	4,684	-	71,224	1,108,371	198	10,781	2,996	-	37,195
5	-	14,530	-	86,866	225,444	2,104	16,909	33,243	-	376,703	15,725	72	68,817	-	14,582
6	-	10,369	37,037	212,016	2,347	101	5,047	122	12,256	8,334	25,552	727,378	2,896,684	-	1,233
7	-	14,908	-	42,528	96	2,648	14,132	-	2,725	708,267	1,541	-	89,790	-	19,707
8	-	-	843	-	8,065	7,088	-	299	-	14,433	-	-	-	-	390
9	-	37,805	10,127	201,469	0	96,306	71,513	-	-	416,874	-	7,251,800	19,199	-	146,047
10	18,173	608,151	479,835	866,114	18,767	211,526	261,698	2,017	217,113	217,105	9,740	32,193	956,697	-	96,896
11	-	1,130	-	278	1,017	6,781	-	-	575	20,329	764	-	301	-	3,012
12	-	9,627	-	-	286	25,818	-	1,662	54,149	297,042	-	60,888	362,047	-	61,086
13	-	623,059	82,107	6,647	5,077	-	340	-	77,705	151,800	303,476	-	333,214	-	2,730
14	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
15	-	453,858	138,110	245,392	3,885	41,488	63,313	37,120	77,878	154,840	464	42,595	24,639	-	378,837
16	-	-	-	-	-	-	-	-	-	-	-	-	-	-	11,945
17	-	204,132	-	138	1,507	-	163	-	1,806	297,645	145	-	12,943	-	98,120
18	-	23,381	3,587	-	67,729	7,918	-	-	5,308	36,709	32,638	5,894	89,900	-	409,927
19	-	108,314	18,659	86,897	1,028	1,160	-	-	4,113	717,752	79,605	2,674,109	434,177	-	945,765
20	5,729	36,895	-	169,463	44,662	6,263	-	-	169,660	719,822	-	39,415	967,990	-	3,172,278
21	-	-	-	-	-	-	-	-	-	90,187	-	-	-	-	131,267
22	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1,792
23	-	-	-	-	-	-	-	-	-	3,084	19,503	-	70,596	-	6,864
24	-	9,458	1,467	91,971	-	-	-	-	9,374	478,015	-	-	53,081	-	1,251,706
25	-	-	-	4,949	-	-	-	-	-	44	-	-	7,295	-	16,194
26	-	-	-	-	-	-	-	-	51,183	359	-	-	-	-	23,449
27	-	-	-	-	-	-	-	-	-	532	-	-	-	-	42,275
28	-	-	-	3,588	-	-	-	-	-	113,745	-	-	28,178	-	21,342
29	-	-	-	27,763	20,571	-	-	-	-	13,715	-	181	625	-	6,230
30	129	-	8,007	3	-	-	39,305	-	-	29,610	9,745	461	3,698	-	48,269
TOTAL	51,533	4,340,285	815,660	7,089,738	415,915	489,828	477,104	83,765	790,408	7,341,052	522,398	10,845,767	7,944,940	-	7,223,071

	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	TOTAL
1	-	-	-	-	51,528	10,252	-	-	-	-	-	4,258	-	-	-	520,404
2	-	108	-	-	-	-	-	2,122	3,369	-	-	15,940	-	-	-	1,372,699
3	-	-	-	12,928	6,079	-	-	-	-	2,667	-	-	-	3,333	3,906	3,582,742
4	-	41,135	7,115	49	11,884	-	-	2,955	-	26,347	2,477	-	1,804	408	-	6,587,720
5	-	17,052	1,542	18,527	13,274	-	-	-	-	-	-	-	-	-	-	905,390
6	-	467	5	894	20	-	-	141	-	46	1,634	-	-	-	-	3,941,684
7	-	351	-	-	-	-	-	-	-	-	-	-	-	-	13,174	909,867
8	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	31,118
9	-	-	84	145,566	9,993	-	-	-	-	-	-	-	-	-	-	8,406,785
10	4,497	683,074	1,702	475,643	362,785	68,703	-	17,177	327,427	-	1,171	7,440	7,400	-	229,130	6,182,175
11	-	55	886	1,358	20	-	-	-	-	-	2,206	5,933	-	-	-	44,644
12	-	-	2,151	167,083	162	-	-	988	3,818	-	-	-	-	-	-	1,046,807
13	-	1,853	30,564	301,535	3,500	-	-	-	1,397	-	-	-	1,989	1,735	83,301	2,012,029
14	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
15	166,117	8,683	61,713	668,114	734,865	392,101	5,556	50,362	946,824	14,638	138,231	261,621	144,976	46,112	152,658	5,454,989
16	44	-	-	-	-	33,950	-	-	-	-	45	16,708	-	-	-	62,692
17	13	1,400	15,192	84	264	-	-	204	1,096	-	194	655	265	15	-	635,983
18	15,783	2,157	15,440	64,784	5,246	720	31	2,592	467	4,835	-	-	-	-	-	795,046
19	355,892	2,291	21,954	3,438,200	186,270	17,092	16,654	256,778	451,750	226,356	142,145	2,001	6,838	16,079	66,169	10,278,049
20	342,492	102,653	105,009	793,271	2,225,240	20,822	36,418	4,172	1,624,038	114,202	185,259	-	-	6,762	56,572	10,949,090
21	-	-	12	13,841	-	35,302	3,146	-	-	-	713	-	29,148	27,372	5,477	336,466
22	-	-	1	-	476	24	-	-	6,454	-	-	-	-	1	-	8,749
23	12,011	-	36	428	427,977	3,654	-	7,740	10,031	-	-	-	-	-	-	561,924
24	14,852	-	19	348,730	246,789	391,788	10,480	203,020	1,917	62,047	44,277	86,574	126,993	40,384	178,695	3,651,635
25	-	-	369	63,327	-	-	-	-	412	-	944	5,039	446	-	36,546	135,566
26	39,717	-	-	-	-	89	-	-	-	402	7,173	19,677	29,229	-	12,975	184,252
27	409	-	-	3,973	-	-	-	19,834	170	-	4,572	38,490	521	-	-	110,778
28	-	-	-	24,774	-	49,901	-	-	39,765	481,048	7,851	4,802	194,703	24,861	8,292	1,002,850
29	-	-	11	4,394	-	45,237	2,564	-	368	-	-	12	12,596	457	55,012	189,738
30	-	-	66	1,560	2,390	600	125	-	13,324	4,408	13,018	-	30,606	9,259	326,322	540,903
TOTAL	951,827	861,279	263,873	6,549,064	4,288,763	1,070,236	74,974	568,086	3,432,628	936,997	551,909	469,151	587,515	176,779	1,228,229	70,442,775

	2002		2014		2024	
Zone	**Gen**	**Att**	**Gen**	**Att**	**Gen**	**Att**
1	1.0	1.0	1.9	1.8	3.2	3.2
2	1.0	1.0	1.7	1.6	3.1	3.3
3	1.0	1.0	2.1	2.1	2.8	2.8
4	1.0	1.0	1.8	1.6	2.4	2.4
5	1.0	1.0	1.2	1.3	2.5	2.4
6	1.0	1.0	1.8	1.9	3.1	3.2
7	1.0	1.0	1.6	1.8	2.5	2.6
8	1.0	1.0	1.2	1.3	1.9	2.0
9	1.0	1.0	1.7	1.5	2.2	2.1
10	1.0	1.0	1.3	1.3	2.4	2.5
11	1.0	1.0	1.9	1.8	2.7	2.9
12	1.0	1.0	1.3	1.3	2.6	2.4
13	1.0	1.0	1.5	1.4	2.7	2.8
14	1.0	1.0	1.5	1.6	2.8	2.6
15	1.0	1.0	1.6	1.4	2.7	2.6
16	1.0	1.0	1.2	1.1	2.0	2.2
17	1.0	1.0	1.9	2.1	2.8	2.6
18	1.0	1.0	1.8	1.9	2.8	2.9
19	1.0	1.0	2.1	2.0	2.9	2.8
20	1.0	1.0	1.2	1.2	2.3	2.1
21	1.0	1.0	1.6	1.6	2.3	2.4
22	1.0	1.0	1.4	1.4	1.9	2.0
23	1.0	1.0	1.3	1.4	2.7	2.6
24	1.0	1.0	1.1	1.1	2.3	2.1
25	1.0	1.0	1.4	1.4	2.0	2.1
26	1.0	1.0	1.8	1.7	2.5	2.7
27	1.0	1.0	1.9	2.0	3.4	3.6
28	1.0	1.0	1.9	1.7	2.5	2.4
29	1.0	1.0	2.0	2.1	2.6	2.6
30	1.0	1.0	1.2	1.2	1.7	1.7

GF = X(20??)/X(2002)

The simulation flow to solve the Fratar Model problem is as follows.



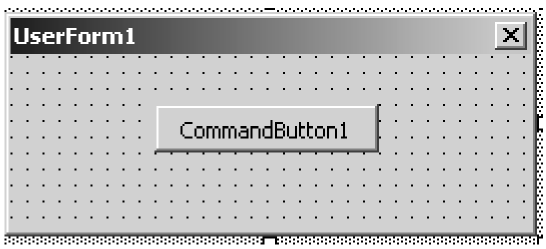
The "looping" of calculation can actually be done manually (for example using MSExcel), but in the case of actual practice the number of zones is usually more than 100, which will result in more than 10,000 calculation steps – very impractical to be done manually. An easy way is employ a user-defined computer program to perform the "looping" automatically. If using MSExcel, the use of Visual Basic is the best way in terms of ease of development. The role of MSExcel and VB is illustrated in the figure above.

Introduction to Visual Basic

Visual Basic is available as a stand-alone programming software and it is also embedded as a sub-program in MSExcel.

VB interacts with the program user using a Windows environment – thus the user will find the interaction with VB very similar to operating any Windows application. Thus the programmer has to provide the interface of the user and VB.

The most common used interface is the "Command Button". The command button is a simple "button" when clicked will activate a set of commands. Moreover, the "Command Button" has to be placed in a "User Form" as shown below.



To create the “User Form”use the following steps:

Step 1: Activate VB Editor

From Excel click, [Tool>Macro>Visual Basic Editor]

Step 2: Create the “user form”

From VB editor click, [Insert>User Form]
From VB editor/toolbox window click, [command button icon] and drag along the user form to define the location and size of the command button.

If the toolbox menu is not visible click, [View>Toolbox]

At this stage, the interface is formed than when the software is run [from VB, Run>Run Sub/UserForm] the user can activate a set of commands by clicking onto the “command button”.

To enter the commands which the software will execute, double click the command button when running the VB editor or when the command button is selected click [View>Code] and to return to edit the user form click [View>object].

There are many commands that can be performed by Visual Basic but the most useful for “looping” is the For/Next command and it has the following example syntax.

```
For xxx = 1 to 30
        v = xxx
Next
```

In the above commands, the value of xxx is first set as 1 then the software executes all succeeding commands and when the computer reads the “Next” command line, the computer goes back to the “For xxx = 1 to 30” line and assigns the value of xxx as 2 and again repeats the same calculation until the “Next” command line is reached and the process is repeated all over again until the final value of xxx = 30 is reached. In this case, the value of variable *v* changed 30 times starting from 1 up to 30.

This “For/Next” command is therefore very useful when solving the Fratar Model problem.

Another useful command for VB use is the Cells(i,j) command. This command is particularly important when we integrate VB and MSExcel. The cells command allows the VB to get the value of any particular cell from MSExcel and also to input any value into a MSExcel worksheet.

For example:

xxx = Cells(1,2) , variable xxx is assigned to the value of *cell 1B* in Excel worksheet
Cells(3,2) = 3, *cell 3B* in Excel worksheet is assigned value of 3
Cells(4,1) = Cells(4,2), *cell 4A* in Excel worksheet is assigned value of *cell 4B*
Cells(5,1 + 2) = cells(6, 1), *cell 5C* is assigned value of *cell 6A*
Cells(5,1 + x) = cells(6, 1), if x = 2 *cell 5C* is assigned value of *cell 6A*

☝ Make sure when you run the VB sub program, you run VB under the appropriate worksheet.

Combining the “looping” capability of VB and its excellent compatibility with MSExcel, the Fratar Method could be easily solved.

Some Useful Commands in MSExcel

Two very useful commands in MSExcel is the command “vlookup( )” and “hlookup( )”.

Vlookup ( ) Searches for a value in the leftmost column of a table, and then returns a value in the same row from a column you specify in the table.

Vlookup(*value to be searched*, *table to be searched*, *column to be searched*)

Hlookup ( ) Searches for a value in the top row of a table or an array of values, and then returns a value in the same column from a row you specify in the table or array.

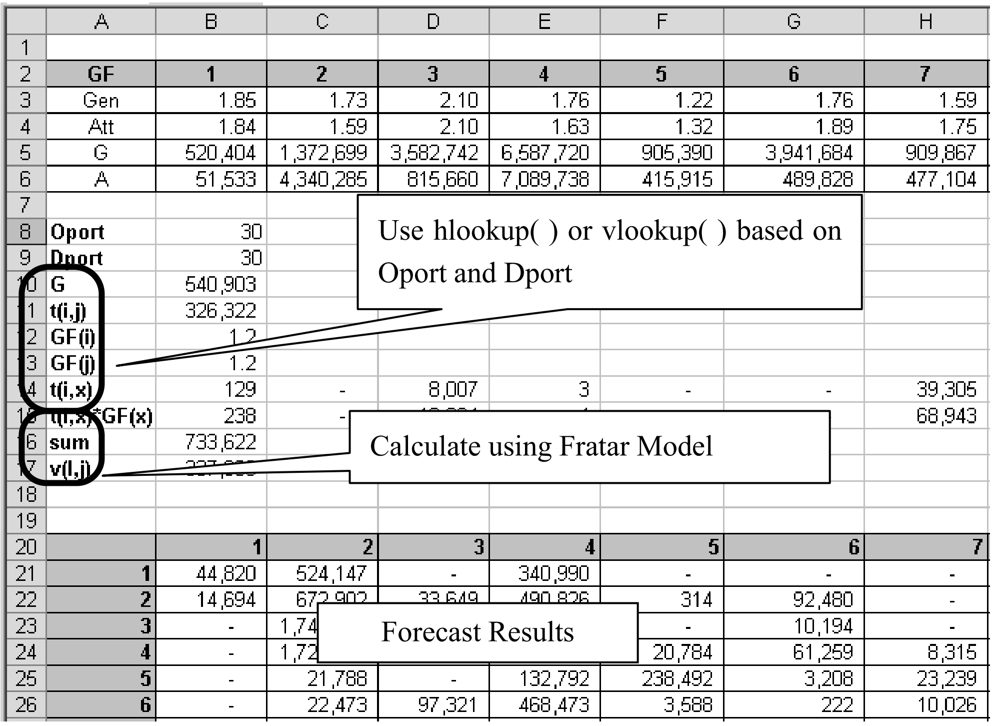
Hlookup(*value to be searched*, *table to be searched*, *row to be searched*)

Using the “vlookup( )” or the “hlookup( )” function, elements of an OD table can be easily extracted for calculation. This is particularly useful in solving the Fratar Model problem.

Solving the Fratar Model using VB and MSExcel

The approach used in this case to solve the Fratar Model is to calculate the $v(i,j)$ using MSExcel and to use VB to “loop” the calculations.

Step 1: Set-up the calculation for $v(i,j)$ using MSExcel



	A	B	C	D	E	F	G	H
1								
2	GF	1	2	3	4	5	6	7
3	Gen	1.85	1.73	2.10	1.76	1.22	1.76	1.59
4	Att	1.84	1.59	2.10	1.63	1.32	1.89	1.75
5	G	520,404	1,372,699	3,582,742	6,587,720	905,390	3,941,684	909,867
6	A	51,533	4,340,285	815,660	7,089,738	415,915	489,828	477,104
7								
8	Oport	30						
9	Dport	30						
10	G	540,903						
11	t(i,j)	326,322						
12	GF(i)	1.2						
13	GF(j)	1.2						
14	t(i,x)	129	-	8,007	3	-	-	39,305
15	t(i,x)*GF(x)	238	-	[illegible]	[illegible]			68,943
16	sum	733,622						
17	v(i,j)	[illegible]						
18								
19								
20		1	2	3	4	5	6	7
21	1	44,820	524,147	-	340,990	-	-	-
22	2	14,694	[illegible]	[illegible]	[illegible]	314	92,480	-
23	3	-	[illegible]			-	10,194	-
24	4	-	[illegible]			20,784	61,259	8,315
25	5	-	21,788	-	132,792	238,492	3,208	23,239
26	6	-	22,473	97,321	468,473	3,588	222	10,026

NOTE: The current OD Matrix is in a separate worksheet.

Step 2: Make VB sub-program to “loop” the calculation using the “For/Next” routine and to record the results in MSExcel.

```
For oport = 1 To 30                     'loop oport
        For dport = 1 To 30             'loop dport

                Cells(8, 2) = oport     'input oport
                Cells(9, 2) = dport     'input dport

                Cells(20 + oport, 1 + dport) = Cells(17, 2)     'record results

        Next
Next
```

Step 3: Provide the appropriate inputs and run the program.

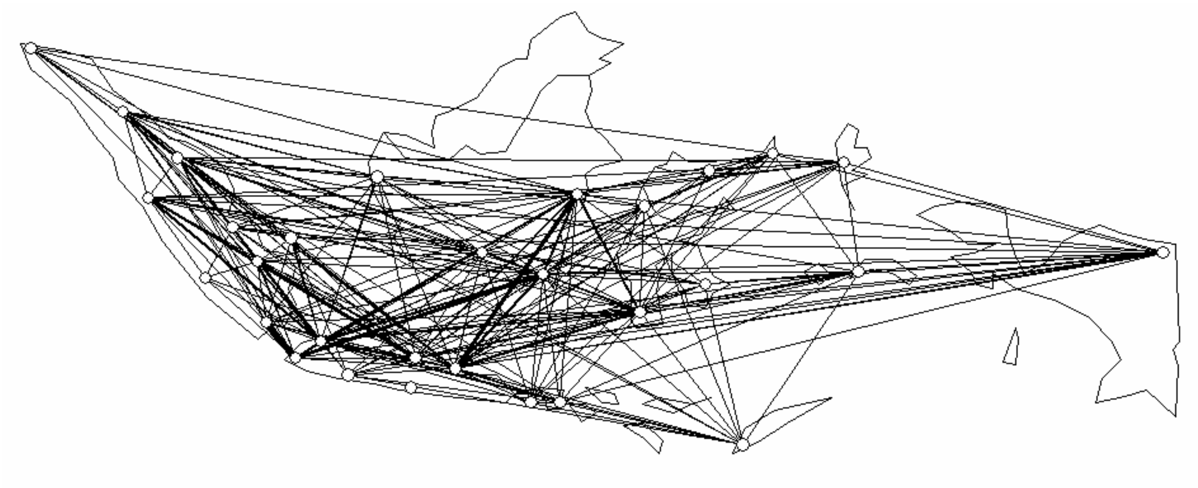
STRAMINDO TECHNOLOGY TRANSFER PROGRAM

Session 2 (supplemental)

STRAMNDO Conference room, BBD Plaza, Jakarta
28 ~ 31 October 2003

Lecture Notes

It is often instructive for the analyst to graphically see the "desire lines". Desire lines are a graphical representation of the OD Matrix. Zones are plotted on a map and the demand between two zones is represented by a line between the two zone centroids. The extent of the volume of the demand is shown in the thickness of the line.



JICA-STRADA can make such a map. The following exercise will illustrate the basic procedure. Make the desire Line for dry cargo in Indonesia using a regional zoning system.

	1	2	3	4	5	6	7
1	8,677	17,148	339	48	24	6	17
2	4,641	3,693	3,506	1,863	433	202	465
3	969	11,449	6,979	2,778	330	30	123
4	117	2,156	1,102	736	138	224	221
5	51	107	4	20	70	30	13
6	52	184	29	619	13	233	63
7	47	92	4	18	13	40	326

1 – Sumatra
2 – Jawa & Bali
3 – Kalimantan
4 – Sulawesi
5 – NTT & NTB
6 – Maluku
7 - Papua

STEP 1: Input the OD matrix using OD Matrix Manipulator

Make new OD Table [File>New]
- Specify number of zones
- Enter OD data
- Save file and Exit

STEP 2: Develop zone map using Point Reader

- Open Bitmap file of Map of Indonesia
- Establish distance scale
- Input zone centroid location
    - Job Menu>Get Zone
    - Specify zone coordinate file
    - Specify number of zones
    - Locate zone location
    - Trace map borders
    - End Job

STEP: Develop OD Lines Using Desire Line Viewer

- Open zone coordinates
- Open OD Matrix
- Specify OD Display parameters

STRAMINDO TECHNOLOGY TRANSFER PROGRAM

Session 3

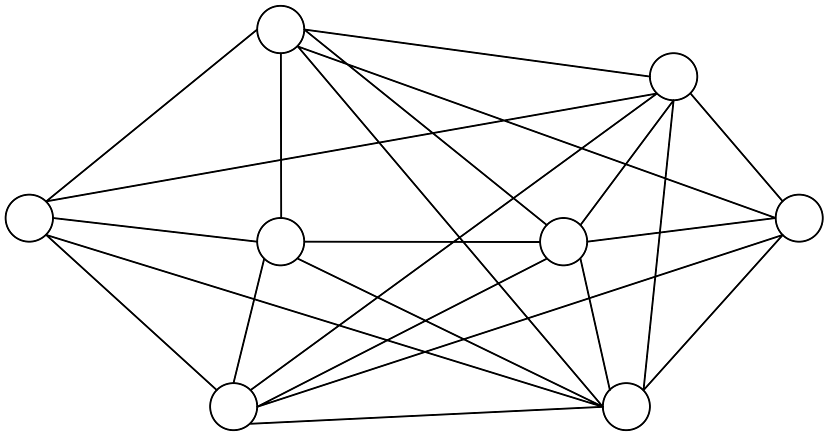
STRAMNDO Conference room, BBD Plaza, Jakarta
28 ~ 31 October 2003

Lecture Notes

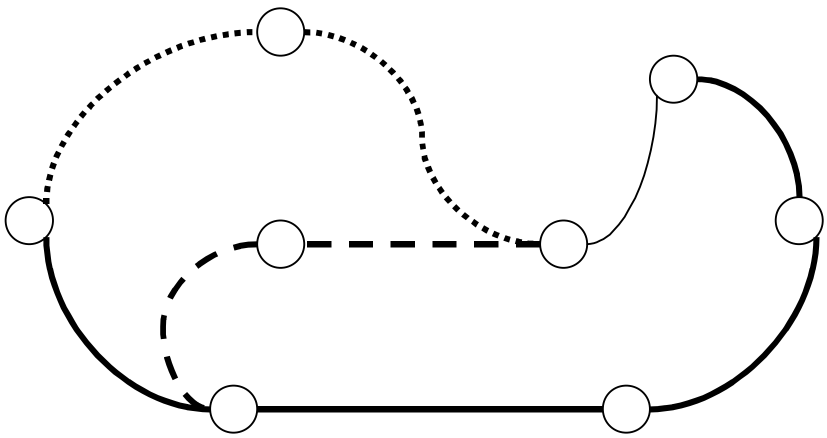
1. Types of Network Used in Maritime Transport Planning

There are three main types of network used in maritime transport planning. The choice of network significantly affects the fleet composition.

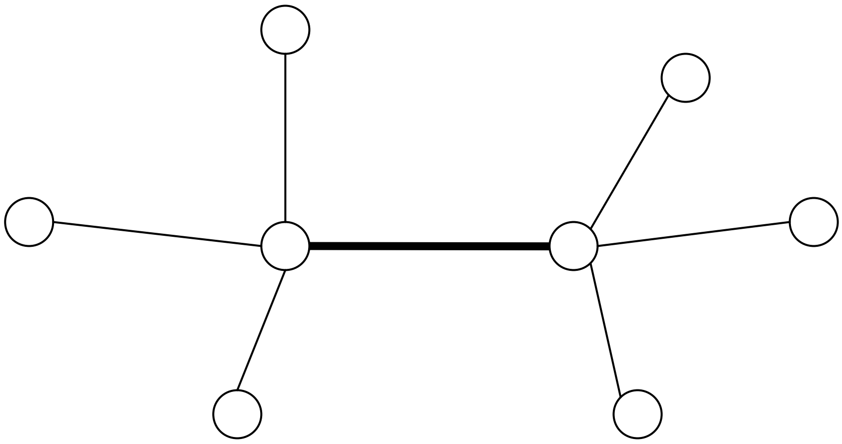
Type 1: Port-To-Port



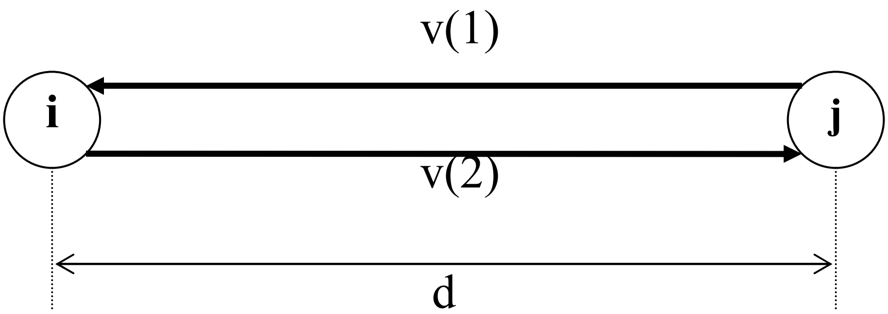
Type 2: Multi-Port Liner Network



Type 3: Hub-Spoke Liner Network



2. Fleet Estimation Based on Port-to-Port Network



The port-to-port network is the easiest network to estimate the fleet requirements. The following is the fundamental procedure when estimating fleet requirements. Because vessels under the port-to-port network voyage back and forth between two ports, it is suffice to analyze separately each OD pair. The fleet requirement is the summation of vessel requirement for all OD pairs.

The following is the computation needed to solve for the vessel requirement to serve the demand between the two zones.

Assumption regarding vessel specifications:

Cap = vessel capacity (MT)
Sp = vessel speed (naut. mile/hr)
Ch = Cargo handling speed (MT/hr)
Wt = waiting time at port (hr)
Com = commissionable days

$$rVcap = \frac{\max(v_1, v_2)}{cap}$$

$$aveL1 = \frac{v_1}{rVcap},\ aveL2 = \frac{v_2}{rVcap}$$

$$timeV = \frac{2 \times (aveL1 + aveL2)}{Ch} + \frac{2d}{sp} + 2Wt$$

$$Vm = \frac{com}{timeV}$$

$$Vreq = \frac{rVcap}{Vm}$$

note: User has to make sure that units of variables are consistent by applying appropriate conversion factors.

rVcap = required voyages to serve the demand
aveL1 = ave. cargo loaded and unloaded per voyage
timeV = required time needed to complete one voyage
Vm = number of voyages a vessel can make in 1 year
Vreq = required number of vessels

In transport system planning, it is necessary to calculate transport cost. Typically for maritime transport planning, transport cost is decomposed into four types:

- Fixed Cost (Rp/yr)
    - Capital cost – depreciation and interest
    - Fixed operation cost – crew, administration, food, lubrication, insurance, etc.
- Distance related cost (Rp/mile) – fuel cost
- Cargo related cost (Rp/MT) – cargo handling cost
- Call related cost (Rp/call) – berthage, anchorage, pilotage, etc.

Based on the operational variables calculated, the transport cost is calculated as follows:

$$\begin{aligned} Fixed &= price \times Vreq \\ Dist &= price \times (2 \times rVcap \times d) \\ Cago &= price \times 2 \times (v1 + v2) \\ Call &= price \times 2 \times rVcap \\ \text{Total Cost} &= Fixed + Dist + Cago + Call \end{aligned}$$

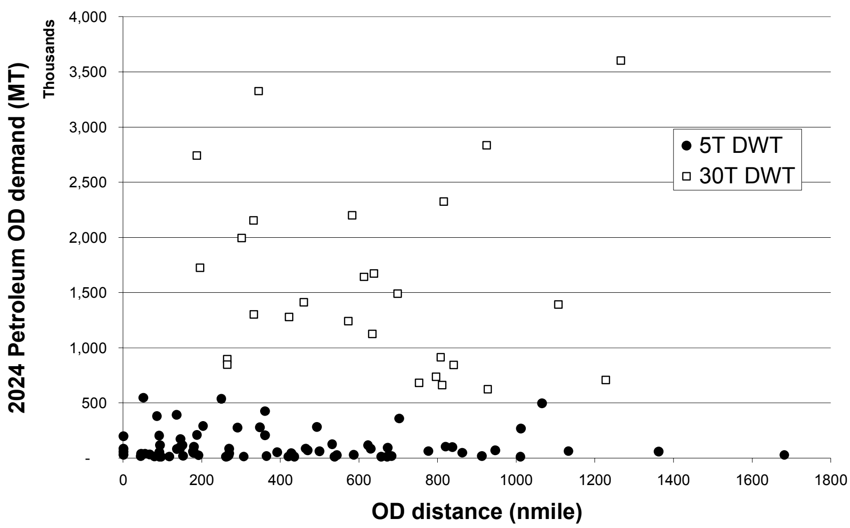
Depending on the nature analysis, the analyst may either (1) assume a particular vessel type or (2) provide a set of vessel types for which the optimal vessel type may be chose.

In the former case, the calculation is very straightforward, while in the latter case it is necessary

for the analyst to define the definition of what is the optimal vessel.
Typical case is that the optimal vessel is the vessel the will have the least transport cost. To determine the optimal vessel, the analyst has to calculate the transport cost of each ***representative*** vessel type and select the vessel that will lead to the lowest transport cost.

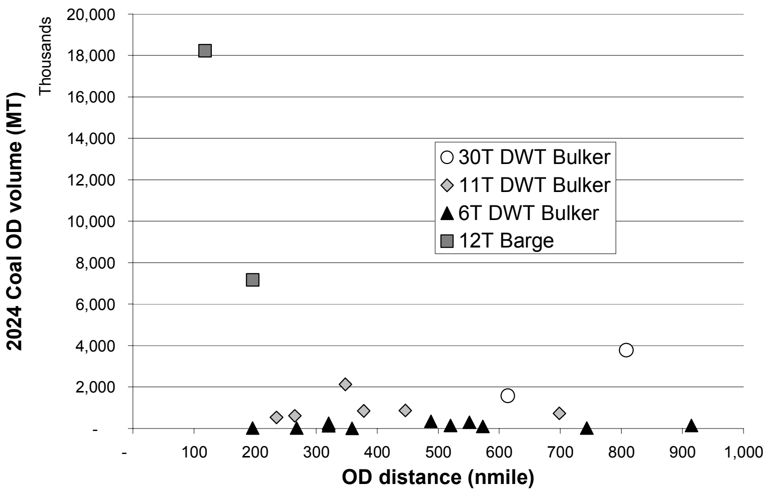
There are many factors that will affect the selection of the least cost vessel, including distance, volume, etc.

Selection of Optimal Tanker Size based on Demand and Distance



/1 Draft conditions are not considered

Selection of Optimal Bulk Vessel Size and Type based on Demand and Distance



/1 Draft conditions are not considered

Other factors that need to be considered are port depth, suitability of vessel type to cargo, minimum frequency of service, and other special concerns.

☝ It is important to check the correspondence of the estimated fleet based on the current demand and the actual fleet in operation. If there is deviation between the two, the estimated fleet must be adjusted to conform to the actual fleet in recognition of the factors that prevent the realization of the theoretical optimal fleet. Examples of factors are imperfect information, weather, contractual issues, over competition, etc. For example in STRAMINDO, the simulated fleet has to be adjusted to account for such factors.

Comparison of Simulated and Actual Fleet DWT per Vessel Type in STRAMINDO

	Container	Conventional	Bulker/1	Dry cargo fleet
Actual/3	733,327	2,439,600	1,304,049	4,476,976
Simulated	488,706	1,919,365	842,587	3,250,658
Act/Sim	1.50	1.27	1.55	1.38

/1 includes bulkers and barges
/2 Year 2002
/3 estimated figures

3. Data Requirements for Fleet Estimation

The most critical aspect for fleet estimation is the quality of input data. The following are the input data used in the STRAMINDO. The summary is as follows.

INPUT DATA	SOURCE
Cost parameters (Cargo)	Company survey and interview
Cargo handling productivity	PELINDO port report and other port data
Vessel Specifications (Cargo)	On-board survey and typical ship designs
Passenger Vessel Specifications	PELNI financial data and company interviews
Port Depth	DGSC Port Inventory
Port Waiting and Approach Time	PELINDO port report

Cost Parameters of Selected Representative Vessels

Type	DWT	Capital Cost (mill. Rp/yr)	Fixed Oper. Cost (mill. Rp/yr)	Dist. Cost (mill. Rp/mile)	Cargo cost (mill. Rp)	Call cost (mill. Rp/call)
Container	5,000	9,600	3,300	0.04	0.12/TEU	0.98
Container	10,000	10,800	3,700	0.06	0.12/TEU	1.56
Conventional	3,000	6,000	3,000	0.04	0.002/MT	0.71
Conventional	10,000	9,600	4,400	0.07	0.002/MT	1.38
Bulker	10,000	7,200	3,600	0.04	0.002/MT	1.56
Bulker	20,000	13,200	12,000	0.12	0.002/MT	4.53

Cargo Handling Productivity

Vessel Type	Cargo handling productivity
Container	10 TEU/hr/gang
Conventional	20 MT/hr/gang
Bulker	For clean cargo (e.g. cement) o 50 MT/hr/gang For dirty cargo/1 (e.g. coal) o 30,000 DWT – 1,000 MT/hr o 10,000 DWT – 500 MT/hr o 5,000 DWT – 300 MT/hr

/1 figures taken from coal handling performance at Suralaya Coal Terminal

Vessel Specifications of Representative Vessels (Cargo)

Type	DWT	Draft (m)	Speed (knot)	Commissionable days
Container 1	15,000	8.5	12.0	346
Container 2	10,000	7.4	11.0	346
Container 3	5,000	6.0	10.0	346
Conventional 1	10,000	8.4	11.0	338
Conventional 1	5,000	6.0	10.0	338
Conventional 1	3,000	4.5	9.0	338
Conventional 1	1,500	3.0	9.0	338
Bulker 1	30,000	8.5	12.0	350
Bulker 2	11,000	7.8	11.0	350
Bulker 3	6,000	6.7	10.0	350

/1 20,000 DWT containers and 30,000 DWT containers are also considered

Vessel Specifications of Representative Vessels (Passenger)

Type	Cap (Pax)	Req'd Draft (m)	Speed (knot)	Com days	Call time (hr)	Capital cost/yr	Fixed oper cost/yr	cost/n mile	cost/ pax	cost/ call
1	2000	5.90	20	350	3.0	9,400	22,200	0.114	0.030	2.74
2	1000	4.20	14	350	3.0	5,300	12,280	0.046	0.024	0.93
3	500	2.90	14	350	3.0	4,500	7,000	0.031	0.021	0.50
4	315	2.34	12	350	1.0	3,955	6,490	0.026	0.020	0.41
5	210	2.01	14	350	1.0	3,753	6,030	0.024	0.020	0.37
6	150	-	12	350	1.0	3,642	5,782	0.023	0.019	0.34

Cost in million Rp

Port Depth Conditions

	Port Name	Container	Conventional	Bulker		Port Name	Container	Conventional	Bulker
1	Malahayati	4.5	4.5	10.0	51	Meneg / Tanjung W	12.5	12.5	12.5
2	Lhokseumawe	8.5	8.5	10.0	52	Pasuruan	1.8	1.8	1.8
3	Sabang	9.5	9.5	8.0	53	Panarukan	1.0	1.0	1.0
4	Meulaboh	6.5	6.5	6.5	54	Kalianget	10.0	10.0	12.0
5	Kuala Langsa	5.0	5.0	5.0	55	Benoa	8.0	8.0	8.0
6	Belawan	8.0	8.0	8.0	56	Padangbai	5.0	5.0	5.0
7	Pangkalan Susu	5.5	5.5	5.5	57	Celukan Bawang	13.5	13.5	13.5
8	Tanjung Balai As	3.0	3.0	3.0	58	Lembar	6.5	6.5	6.5
9	Kuala Tanjung	10.5	10.5	10.5	59	Bima	8.0	8.0	8.0
10	Sibolga	7.5	7.5	7.5	60	Badas	17.0	17.0	17.0
11	Gunung Sitoli	10.0	10.0	10.0	61	Kupang / Tenau	8.0	8.0	8.0
12	Dumai	10.0	10.0	10.0	62	Waingapu	10.0	10.0	10.0
13	Tanjung Pinang	3.5	3.5	3.5	63	Ende	6.0	6.0	6.0
14	Pekanbaru	5.0	5.0	5.0	64	Maumere	8.0	8.0	8.0
15	Tanjung Balai Ka	5.0	5.0	5.0	65	Kalabahi	5.0	5.0	5.0
16	Kuala Enok	8.0	8.0	8.0	66	Pontianak	7.0	7.0	7.0
17	Bagan Siapi-api	4.0	4.0	4.0	67	Teluk Air	7.0	7.0	7.0
18	Bengkalis	7.5	7.5	7.5	68	Sintete	9.5	9.5	9.5
19	Selat Panjang	10.0	10.0	10.0	69	Ketapang	2.0	2.0	2.0
20	Tembilahan	4.2	4.2	4.2	70	Sampit	5.5	5.5	5.5
21	Rengat	3.0	3.0	3.0	71	Kuala Pembuang	5.0	5.0	5.0
22	Sungai Pakning	10.0	10.0	10.0	72	Samuda	7.5	7.5	7.5
23	Kijang	7.0	7.0	7.0	73	Pulang Pisau	4.5	4.5	4.5
24	Batam	15.0	15.0	15.0	74	Pangkalan Bun	2.0	2.0	2.0
25	Teluk Bayur	10.0	10.0	10.0	75	Sukamara	6.0	6.0	6.0
26	Kuala Tangkal	5.0	5.0	5.0	76	Kumai	2.0	2.0	2.0
27	Talang Dukuh / J	5.0	5.0	5.0	77	Pengatan Mendaw	4.0	4.0	4.0
28	Muara Sabak	5.0	5.0	5.0	78	Banjarmasin	5.0	5.0	5.0
29	Pulau Baai	10.0	10.0	10.0	79	Kotabaru	6.0	6.0	15.0
30	Palembang	6.5	6.5	7.5	80	Balikpapan	12.0	12.0	12.0
31	Pangkal Balam	4.0	4.0	4.0	81	Samarinda	6.6	6.6	6.6
32	Tanjung Pandang	3.0	3.0	3.0	82	Tarakan	8.0	8.0	8.0
33	Muntok	2.0	2.0	2.0	83	Nunukan	6.0	6.0	6.0
34	Panjang	12.0	12.0	12.0	84	Bitung	8.0	8.0	8.0
35	Bakauheuni	6.5	6.5	6.5	85	Manado	3.5	3.5	3.5
36	Tanjung Priok	14.0	10.5	10.5	86	Gorontalo	10.0	10.0	10.0
37	Sunda Kelapa	2.0	2.0	2.0	87	Pantoloan	9.0	9.0	9.0
38	Marunda	5.0	5.0	5.0	88	Toli-toli	8.2	8.2	8.2
39	Kepulauan Seribu	5.0	5.0	5.0	89	Ujung Pandang	11.0	11.0	11.0
40	Kalibaru	5.0	5.0	5.0	90	Pare-pare	9.8	9.8	9.8
41	Muara Karang / M	5.0	5.0	5.0	91	Kendari	5.0	5.0	5.0
42	Muara Baru	9.0	9.0	9.0	92	Ambon	10.0	10.0	10.0
43	Cirebon	7.0	7.0	7.0	93	Bandaneire	7.0	7.0	7.0
44	Banten	14.0	14.0	14.0	94	Ternate	9.0	9.0	9.0
45	Semarang	9.0	9.0	9.0	95	Sorong	11.0	11.0	11.0
46	Cilacap	8.3	8.3	7.5	96	Jayapura	11.0	11.0	11.0
47	Tegal	1.8	1.8	1.8	97	Biak	12.0	12.0	12.0
48	Surabaya	10.5	8.3	8.3	98	Merauke	4.0	4.0	4.0
49	Gresik	3.6	3.6	13.0	99	Manokwari	9.0	9.0	9.0
50	Probolinggo	2.5	2.5	2.5	100	Fak-fak	6.0	6.0	6.0

/1 in meters
/2 in LWS
/3 non-commercial ports are aggregated per province and are represented by an imaginary port. It is assumed that all representative imaginary ports have port depth of 3.5 meters

Waiting Time and Approach Time Conditions

	Port Name	Container	Conventional	Bulker		Port Name	Container	Conventional	Bulker
1	Malahayati	5.0	5.0	5.0	51	Meneg / Tanjung W	5.0	12.7	5.0
2	Lhokseumawe	5.0	10.0	5.0	52	Pasuruan	5.0	5.0	5.0
3	Sabang	5.0	5.0	5.0	53	Panarukan	5.0	5.0	5.0
4	Meulaboh	5.0	5.0	5.0	54	Kalianget	5.0	5.0	5.0
5	Kuala Langsa	5.0	5.0	5.0	55	Benoa	10.0	15.0	5.0
6	Belawan	48.0	72.0	24.0	56	Padangbai	5.0	5.0	5.0
7	Pangkalan Susu	5.0	5.0	5.0	57	Celukan Bawang	5.0	5.0	5.0
8	Tanjung Balai As	5.0	5.0	5.0	58	Lembar	5.0	22.1	5.0
9	Kuala Tanjung	5.0	25.7	5.0	59	Bima	5.0	5.0	5.0
10	Sibolga	5.0	32.2	5.0	60	Badas	5.0	5.0	5.0
11	Gunung Sitoli	5.0	5.0	5.0	61	Kupang / Tenau	40.0	48.0	24.0
12	Dumai	36.0	48.0	36.0	62	Waingapu	5.0	5.0	5.0
13	Tanjung Pinang	24.0	48.0	5.0	63	Ende	5.0	5.0	5.0
14	Pekanbaru	12.0	24.0	5.0	64	Maumere	5.0	5.0	5.0
15	Tanjung Balai Ka	5.0	5.0	5.0	65	Kalabahi	5.0	5.0	5.0
16	Kuala Enok	5.0	5.0	5.0	66	Pontianak	24.0	48.0	5.0
17	Bagan Siapi-api	5.0	5.0	5.0	67	Teluk Air	5.0	13.8	5.0
18	Bengkalis	5.0	5.0	5.0	68	Sintete	5.0	5.0	5.0
19	Selat Panjang	5.0	5.0	5.0	69	Ketapang	5.0	5.0	5.0
20	Tembilahan	5.0	5.0	5.0	70	Sampit	5.0	9.6	5.0
21	Rengat	5.0	5.0	5.0	71	Kuala Pembuang	5.0	5.0	5.0
22	Sungai Pakning	5.0	5.0	5.0	72	Samuda	5.0	5.0	5.0
23	Kijang	5.0	5.0	5.0	73	Pulang Pisau	5.0	5.0	5.0
24	Batam	12.0	24.0	12.0	74	Pangkalan Bun	5.0	5.0	5.0
25	Teluk Bayur	15.0	25.0	10.0	75	Sukamara	5.0	5.0	5.0
26	Kuala Tangkal	5.0	5.0	5.0	76	Kumai	5.0	46.0	5.0
27	Talang Dukuh / J	5.0	52.9	5.0	77	Pengatan Mendawa	5.0		5.0
28	Muara Sabak	5.0	5.0	5.0	78	Banjarmasin	48.0	72.0	30.0
29	Pulau Baai	5.0	5.0	5.0	79	Kotabaru	5.0	58.9	5.0
30	Palembang	48.0	72.0	48.0	80	Balikpapan	48.0	72.0	5.0
31	Pangkal Balam	5.0	77.8	5.0	81	Samarinda	24.0	48.0	20.0
32	Tanjung Pandang	5.0	50.2	5.0	82	Tarakan	5.0	5.0	5.0
33	Muntok	5.0	5.0	5.0	83	Nunukan	5.0	5.0	5.0
34	Panjang	3.0	4.0	4.0	84	Bitung	40.0	60.0	24.0
35	Bakauheuni	5.0	5.0	5.0	85	Manado	5.0	5.0	5.0
36	Tanjung Priok	24.0	30.0	12.0	86	Gorontalo	5.0	5.0	5.0
37	Sunda Kelapa	5.0	5.0	5.0	87	Pantoloan	5.0	5.0	5.0
38	Marunda	5.0	5.0	5.0	88	Toli-toli	5.0	5.0	5.0
39	Kepulauan Seribu	5.0	5.0	5.0	89	Ujung Pandang	3.0	5.0	4.0
40	Kalibaru	5.0	5.0	5.0	90	Pare-pare	5.0	5.0	5.0
41	Muara Karang / M	5.0	5.0	5.0	91	Kendari	5.0	5.0	5.0
42	Muara Baru	5.0	5.0	5.0	92	Ambon	5.0	10.0	5.0
43	Cirebon	5.0	41.4	5.0	93	Bandaneire	5.0	5.0	5.0
44	Banten	24.0	30.0	12.0	94	Ternate	5.0	5.0	5.0
45	Semarang	5.0	10.0	5.0	95	Sorong	48.0	70.0	5.0
46	Cilacap	5.0	5.0	5.0	96	Jayapura	48.0	72.0	24.0
47	Tegal	5.0	5.0	5.0	97	Biak	35.0	60.0	5.0
48	Surabaya	24.0	40.0	20.0	98	Merauke	5.0	5.0	5.0
49	Gresik	5.0	5.0	5.0	99	Manokwari	5.0	5.0	5.0
50	Probolinggo	5.0	14.0	5.0	100	Fak-fak	5.0	5.0	5.0

/1 waiting time includes waiting time for berth and waiting time for cargo
/2 non-commercial ports are aggregated per province and are represented by an imaginary port. It is assumed that all representative imaginary ports have port waiting time of 5 hrs
/3 units in hours

4. Fleet Estimation Exercise

Based on the following OD demand, estimate the fleet requirement based on a port-to-port network using only one container type (10,000 DWT). Neglect the effect of port depth and assume that waiting time at all ports is the following:

Case 1: 12 hours
Case 2: 6 hours

	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	TOTAL
1	20,627	258,014	-	164,643	-	-	-	-	849	-	-	-	583	-	9,650	-	-	-	-	51,528	10,252	-	-	-	-	-	4,258	-	-	-	520,404
2	6,876	336,792	13,891	240,963	223	45,523	-	-	4	416,233	23,302	-	3,090	-	264,263	-	108	-	-	-	-	-	2,122	3,369	-	-	15,940	-	-	-	1,372,699
3	-	696,652	21,910	319,561	-	3,997	-	9,302	34,487	949,500	-	-	1,518,399	-	21	-	-	-	12,928	6,079	-	-	-	-	2,667	-	-	-	3,333	3,906	3,582,742
4	-	893,209	81	4,318,489	15,210	31,106	4,684	-	71,224	1,108,371	198	10,781	2,996	-	37,195	-	41,135	7,115	49	11,884	-	-	2,955	-	26,347	2,477	-	1,804	408	-	6,587,720
5	-	14,530	-	86,866	225,444	2,104	16,909	33,243	-	376,703	15,725	72	68,817	-	14,582	-	17,052	1,542	18,527	13,274	-	-	-	-	-	-	-	-	-	-	905,390
6	-	10,369	37,037	212,016	2,347	101	5,047	122	12,256	8,334	25,552	727,378	2,896,684	-	1,233	-	467	5	894	20	-	-	141	-	46	1,634	-	-	-	-	3,941,684
7	-	14,908	-	42,528	96	2,648	14,132	-	2,725	708,267	1,541	-	89,790	-	19,707	-	351	-	-	-	-	-	-	-	-	-	-	-	-	13,174	909,867
8	-	-	843	-	8,065	7,088	-	299	-	14,433	-	-	-	-	390	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	31,118
9	-	37,805	10,127	201,469	0	96,306	71,513	-	-	416,874	-	7,251,800	19,199	-	146,047	-	-	84	145,566	9,993	-	-	-	-	-	-	-	-	-	-	8,406,785
10	18,173	608,151	479,835	866,114	18,767	211,526	261,698	2,017	217,113	217,105	9,740	32,193	956,697	-	96,896	4,497	683,074	1,702	475,643	362,785	68,703	-	17,177	327,427	-	1,171	7,440	7,400	-	229,130	6,182,175
11	-	1,130	-	278	1,017	6,781	-	-	575	20,329	764	-	301	-	3,012	-	55	886	1,358	20	-	-	-	-	-	2,206	5,933	-	-	-	44,644
12	-	9,627	-	-	286	25,818	-	1,662	54,149	297,042	-	60,888	362,047	-	61,086	-	-	2,151	167,083	162	-	-	988	3,818	-	-	-	-	-	-	1,046,807
13	-	623,059	82,107	6,647	5,077	-	340	-	77,705	151,800	303,476	-	333,214	-	2,730	-	1,853	30,564	301,535	3,500	-	-	-	1,397	-	-	-	1,989	1,735	83,301	2,012,029
14	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
15	-	453,858	138,110	245,392	3,885	41,488	63,313	37,120	77,878	154,840	464	42,595	24,639	-	378,837	166,117	8,683	61,713	668,114	734,865	392,101	5,556	50,362	946,824	14,638	138,231	261,621	144,976	46,112	152,658	5,454,989
16	-	-	-	-	-	-	-	-	-	-	-	-	-	-	11,945	44	-	-	-	-	33,950	-	-	-	-	45	16,708	-	-	-	62,692
17	-	204,132	-	138	1,507	-	163	-	1,806	297,645	145	-	12,943	-	98,120	13	1,400	15,192	84	264	-	-	204	1,096	-	194	655	265	15	-	635,983
18	-	23,381	3,587	-	67,729	7,918	-	-	5,308	36,709	32,638	5,894	89,900	-	409,927	15,783	2,157	15,440	64,784	5,246	720	31	2,592	467	4,835	-	-	-	-	-	795,046
19	-	108,314	18,659	86,897	1,028	1,160	-	-	4,113	717,752	79,605	2,674,109	434,177	-	945,765	355,892	2,291	21,954	3,438,200	186,270	17,092	16,654	256,778	451,750	226,356	142,145	2,001	6,838	16,079	66,169	10,278,049
20	5,729	36,895	-	169,463	44,662	6,263	-	-	169,660	719,822	-	39,415	967,990	-	3,172,278	342,492	102,653	105,009	793,271	2,225,240	20,822	36,418	4,172	1,624,038	114,202	185,259	-	-	6,762	56,572	10,949,090
21	-	-	-	-	-	-	-	-	-	90,187	-	-	-	-	131,267	-	-	12	13,841	-	35,302	3,146	-	-	-	713	-	29,148	27,372	5,477	336,466
22	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1,792	-	-	1	-	476	24	-	-	6,454	-	-	-	-	1	-	8,749
23	-	-	-	-	-	-	-	-	-	3,084	19,503	-	70,596	-	6,864	12,011	-	36	428	427,977	3,654	-	7,740	10,031	-	-	-	-	-	-	561,924
24	-	9,458	1,467	91,971	-	-	-	-	9,374	478,015	-	-	53,081	-	1,251,706	14,852	-	19	348,730	246,789	391,788	10,480	203,020	1,917	62,047	44,277	86,574	126,993	40,384	178,695	3,651,635
25	-	-	-	4,949	-	-	-	-	-	44	-	-	7,295	-	16,194	-	-	369	63,327	-	-	-	-	412	-	944	5,039	446	-	36,546	135,566
26	-	-	-	-	-	-	-	-	51,183	359	-	-	-	-	23,449	39,717	-	-	-	-	89	-	-	-	402	7,173	19,677	29,229	-	12,975	184,252
27	-	-	-	-	-	-	-	-	-	532	-	-	-	-	42,275	409	-	-	3,973	-	-	-	19,834	170	-	4,572	38,490	521	-	-	110,778
28	-	-	-	3,588	-	-	-	-	-	113,745	-	-	28,178	-	21,342	-	-	-	24,774	-	49,901	-	-	39,765	481,048	7,851	4,802	194,703	24,861	8,292	1,002,850
29	-	-	-	27,763	20,571	-	-	-	-	13,715	-	181	625	-	6,230	-	-	11	4,394	-	45,237	2,564	-	368	-	-	12	12,596	457	55,012	189,738
30	129	-	8,007	3	-	-	39,305	-	-	29,610	9,745	461	3,698	-	48,269	-	-	66	1,560	2,390	600	125	-	13,324	4,408	13,018	-	30,606	9,259	326,322	540,903
TOTAL	51,533	4,340,285	815,660	7,089,738	415,915	489,828	477,104	83,765	790,408	7,341,052	522,398	10,845,767	7,944,940	-	7,223,071	951,827	861,279	263,873	6,549,064	4,288,763	1,070,236	74,974	568,086	3,432,628	936,997	551,909	469,151	587,515	176,779	1,228,229	70,442,775

Use VB and MSExcel to calculate efficiently. Moreover, use 10MT/TEU average loading factor of containers.

<u>Estimate the improvement in fleet requirements due to improvement in port conditions.</u>

STRAMINDO TECHNOLOGY TRANSFER PROGRAM

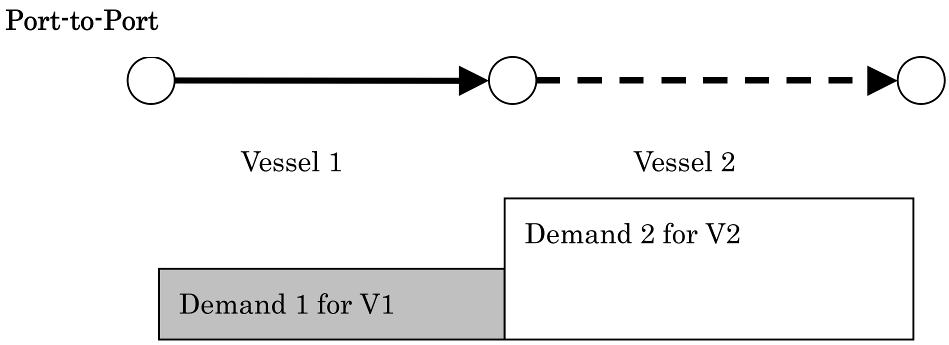
Session 4

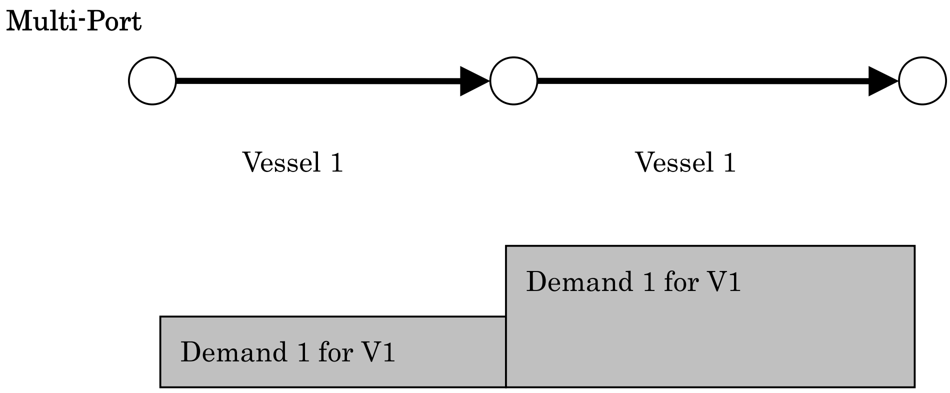
STRAMNDO Conference room, BBD Plaza, Jakarta
28 ~ 31 October 2003

Lecture Notes

1. Fleet Estimation Based on a Multi-Port Liner Network

The multi-port liner network is typically used in passenger shipping, wherein the vessels calls at several ports. Because the same vessel is used to traverse along a route, the nature of the demand served is different from a port-to-port network demand. The following illustrates the difference.





In the case of port-to-port network, the demand between one OD pair is handled by one vessel and the demand for another OD pair is handled by another vessel. Thus the planner can assign a different type of vessel for OD pair. In the case of multi-port liner network, the same vessel serving one OD pair will have to serve another adjunct OD pair. Thus the formula for calculating vessel requirement will have to be adjusted as follows.

$$rVcap = \frac{\max[\max(v_1, v_2)_1, \max(v_1, v_2)_2, \Lambda\ , \max(v_1, v_2)_i, \Lambda\ ]}{cap} \quad i \text{ refers to voyage leg}$$

$$aveL_i = \frac{(v_1 + v_2)_i}{rVcap}$$

$$timeV = \frac{2 \times \left(\sum aveL_i\right)}{Ch} + \frac{2\sum d_i}{sp} + 2 \sum_{\forall call\ port} Wt$$

$$Vm = \frac{com}{timeV}$$

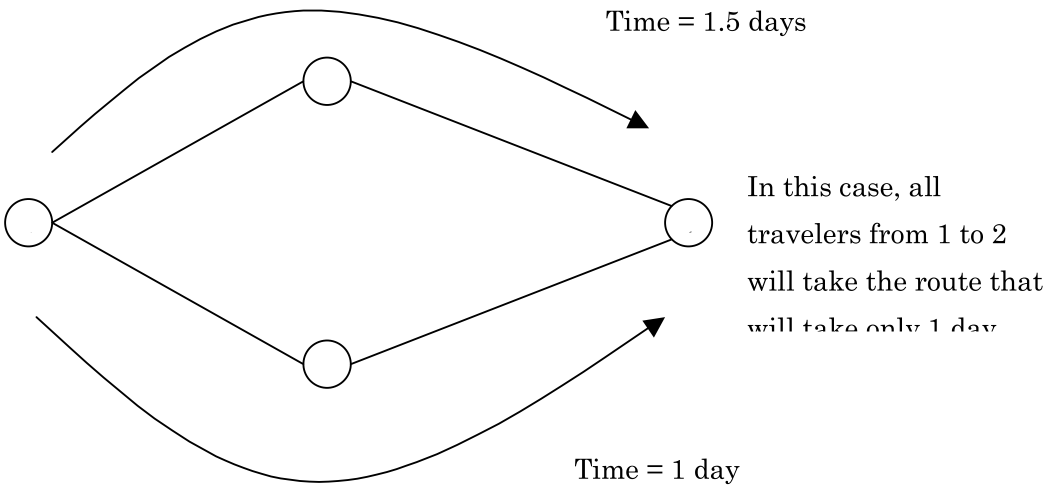
$$Vreq = \frac{rVcap}{Vm}$$

Transport cost is calculated similarly as the port-to-port case. The fleet requirement is the summation of vessel requirement for all routes.

Thus, the computational procedure for multi-port liner network fleet estimation is the determination of demand at each leg of each route. This is done using network assignment.

Network assignment mimics the decision made by travelers in selecting routing system. The analyst must decide how the traveler decides through an assumption. Typical case is that the traveler will choose the route that will take the least time – or the so-called shortest path method. There are many widely used definition of what is the shortest path (cost, time, or any combination of attributes), but the simplest is the path with the shortest distance.

The following illustrates the scheme.

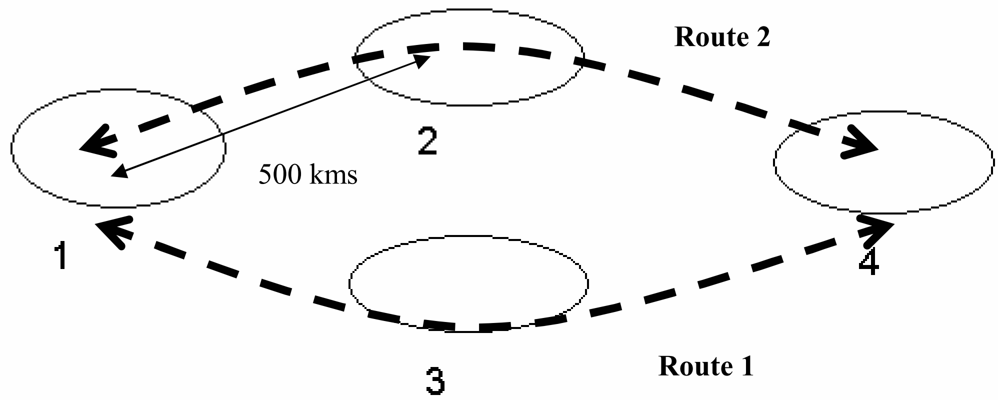


2. Introduction to Transit Assignment of JICA STRADA

To perform transit assignment, the following items needs to be prepared:

- OD Matrix – transport demand
- Network – connectivity between zone centroids and framework of transit routes
- Transit routes – Form and nature of transit routes
- Assignment parameters – cost parameters, identity of zone centroids, etc.

The following example is illustrated to guide the learner to be familiar of transit assignment:



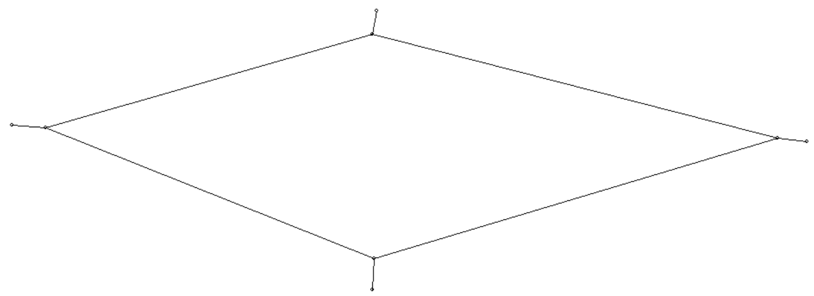
OD Table

	1	2	3	4
1	-	-	-	1000
2	-	-	-	500
3	-	-	-	-
4	-	-	-	-

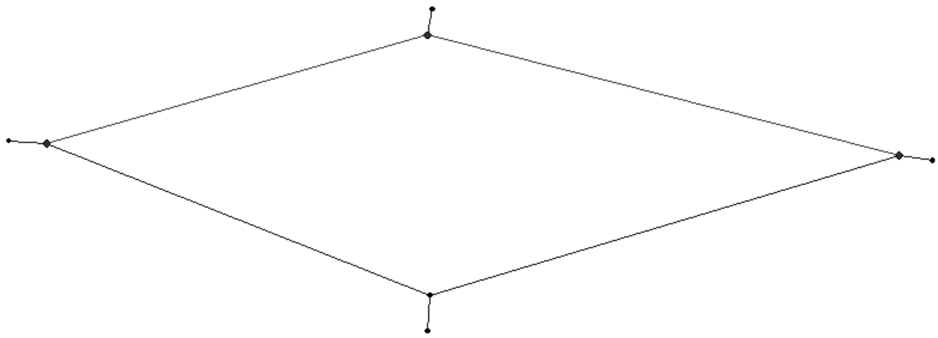
STEP 1: Make OD Matrix using OD Matrix Manipulator

STEP 2: Make Network Using Point Reader

☝ A transit line must be laid on a network link
☝ A transit line should not start at a zone centroid, thus it is necessary to utilize a small link between the zone centroid and the starting node of a transit line.



STEP 3: Make Transit Lines Using Transit Line Editor



STEP 4: Set Network Assignment Parameters Using Parameter Editor TRN

STEP 5: Simulate Using Transit Assignment

STEP 6: Check Simulation Results Using Transit Reporter

3. Practical Usage of Transit Assignment Results

The results of the Transit Assignment is stored in text format in filename with extension of *.tre. For practical fleet assignment estimation the analyst should extract segment demand for the NSEGMENT REPORT. Check JICA STRADA Manual for the format of the output results.

Once segment demand is extracted, the analyst can then perform fleet estimation using the formulas developed in Section 1 of this document.