THE 30th IAPH WORLD PORTS CONFERENCE

7 - 12 May 2017 Bali Nusa Dua Convention Center, Bali - Indonesia

A comprehensive design for efficient Indonesian maritime transport network: A strategy for Indonesia's inclusive growth

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Session IV Maritime Transport Network and Port Innovation

Enabling Trade. Energizing The World

Outline

- A. Background
- B. Analyses : highlights
- C. Results transport design
- D. Results economic evaluation
- E. Findings Recommendations

Logo

Background

- 1) Background problem:
- Logistic costs for Indonesia were estimated at 26% of GDP (World Bank, 2013)
- Demand for domestic freight transport is estimated to grow strongly in 2030: on average, 5 times than that of 2013, with average annual growth rate of 6.3% (Indii, 2012)



2) Objective:

- Preparation of a comprehensive design (capacities, routes, sizes, service frequencies, impacts)
- Impact evaluation of the transformation (2015-30) of the domestic container transport network towards a more efficient network that realizes scale effects, and
- Analysing the impact of the transformation to reduce economic disparity



- Drewry: pendulum may cause 15 % reduction in cost
- McKinsey: point-to-point service; projection total TEU 28 mln (throughput) by 2030 (2013 : 3 mln TEU); strong cost reduction from rationalizing shipping service (larger size ships)
- WB: additional benefits from pendulum may only be 5% cost reduction; multi-port calls unattractive
- Most of these studies don't take into account container handling/port cost and value of time
- A comprehensive study of Indonesian freight transport system is needed.



Logo

Research framework





DGST (Directorate General of Sea Transport) 2013, total demand: 3 mln TEU

- 455 ships, Total capacity : 2,86 mln DWT
- Time efficiency of ships: pay load 65 % of available time
- Time spend in ports (during pay load trips): 73 %
- Average load factor (LF): 53%
 - <1600 DWT LF: 81 %
 - >15000 DWT LF : 43 %



Most TEU.km is delivered by ships in the 400 - 600 TEU range. Load factor for small ships (<200 TEU) is reasonably high but larger ship sizes have low to very low load factor.



Analysis: Schematization of Logistics chain

- Based on trade between regions
- Multi-modal chain
- Implemented for the total network



economies (Indoterm)

• Cost components in the (maritime) transport chain

Cost component	Type of cost
Life cycle cost for shipping	Out-of-pocket cost;direct cost to the producer/consumer
Handling costs at ports	u u
Value of time	Indirect cost to the economy; ultimately also a cost to the producer/consumer

- Life cycle cost : price which should be charged by the ship owner/operator to cover all variable and fixed costs during the lifetime of the ship
- Total economic (generalized) cost = out-of-pocket cost + VoT * total transport time time





- Largest Economy in South East Asia
- GDP :894.9 billion USD (2012)
- GDP growth: 5.78%
 (2013)
- GDP per capita : USD
 5477 (2014)

Trade relations between 32 major ports in Indonesia

Design problem: how can we design efficient maritime shipping network that is able to reduce trade cost between Java and the rest of Indonesia

Input data: trade O/D matrix between 34 major cities in Indonesia

Minimization of two (conflicting) objectives:

Z1: total transportation costs at maritime networks + transport cost at hinterland networks + cost of transshipments (measure of user cost)

Z2: total sum of all port-to-port operational costs of all shipping lines (as a measure of operator cost)



Analysis: Exploring efficient maritime network designs



Minimum operator cost network:

- Similar to the Seatollway design
- Prioritizing freight flow consolidation

Compromise network:

 Balancing the user and operator costs

Minimum user cost network:

- Has lower total user cost
- High density network with many direct connections and less consolidated

flows



National shipping network model: fleet deployment analysis



- Schematization and computation for 2030 scenario using Omnitrans model:
- Ship size and frequency for major shipping trajectories in 2030
- Ship size and port rotation schedule are determined using the cost model





Analysis: example simulation for West and Central Indonesia

• Route: Tanjung Priok – Tanjung Perak - Makassar

BRUNEI DARUSSALAM PACIFIC OCEAN ALAYSIA MALAYSIA INDONESIA MOR-LESTE National capital ARAFURA SEA Provincial capital Town, village Lesser Sunda Islands TIMOR nternational boundar INDIAN OCEAN tain road econdary road Major airpor AUSTRALIA

Optimum ship size for multi port call service

Total cost : 4431 mln \$/year

Conditions:

- 2030 trade volumes;
- Improved turnaround time at the hubs : 2 days
- Improved container handling cost : 100 \$/TEU

Total cost : 4470 mln \$/year

Optimum ship sizes for point-to-point service





Result: comparison of characteristics of maritime transport 2013 vs 2030

• Logistics cost from Jakarta to Indonesian regions in 2030



	2013	Upgraded 2030
Total load (mln TEU)	3	14
Average (out-of-pocket) cost (\$/TEU)	646	302
Average load factor (%)	47	80
Time efficiency (%)	65	90
# of ships	455	173



Ship size (TEU)



Result: Overview of cost elements



To 200 То To 400 To 500 To 600 To 700 To 800 To 900

300





To To To and 1,000 1,100 1,200 over



Shocks formulation

- 1. Direct shipping cost efficiency
 - Reduction in the sea transportation margin, origin-destination specifics
 - Logistic curve time-path, gradual toward 2030
 - Omnitrans Model (Verhaeghe, et al, 2015),
 - Matrix V(o,d)
 - Magnitude (29-70% reduction), see OD matrix slide.
- 2. Iceberg cost reduction
 - Average 1% reduction iceberg trade cost.
 BAU: 90/100 tomatoes reach destination, In 2030 90.9/100.
- 3. Reduction of foreign trade cost
 - Increase export price FOB
 - Reduce Import price CIF
- 4. Indirect logistics cost
 - reduces logistic expenses (such as the costs of organizing and monitoring deliveries, and the costs of holding inventories).



1 Direct shipping cost

		rmCt	umBar	tiauProv	e pRi	ambi	umSel	aBel	engkulu	Bundmer	X	JaBar	Banten	JaTengDIY	JaTim	KalBar	KalTeng	KalSel	KalTim	sulut	Gorontalo	SulTeng	SulaSel	SulBar	SulTra	Bali	NTB	Ę	Maluku	MalUt	PapuaBar	PapuaProv
		2 N	S S S	4	۵. ۲	9	7 S	8	86	9	11	12	13	14	15	16	17	18	19	8	1	8	33	24	25	26	5	8	3	8	뛊	3
1 NAD											-53	-53	-53	-59	-59																	
2 SumUt											-53	-53	-53	-59	-59							0.00	18	07	21	23	24	26	28	29		
3 SumBar											-54	-54	-54									10.00	20	2 2	2 20	20	20	20	20	20	-	
4 RiauProv																						20.00									-	
5 KepRi						-44					-51	-51	-51									-30.00									-	
6 Jambi					-44						-49	-49	-49									40.00										
7 SumSel											-57	-57	-57									-50.00									_	
8 BaBel																						-60.00									_	
9 Bengkulu											-54	-54	-54								_											
10 Lampung											-60	-60	-60																			
11 DKI	-5	3 -53	3 -54		-51	-49	-57		-54	-60						-51	-55	-55	-57				-51	-51					-31		-61	-68
12 JaBar	-5	3 -53	3 -54		-51	-49	-57		-54	-60						-51	-55	-55	-57				-51	-51					-31		-61	-68
13 Banten	-5	3 -53	3 -54		-51	-49	-57		-54	-60						-51	-55	-55	-57				-51	-51					-31		-61	-68
14 JaTengDI	Y -5	9 -59	Э														-59	-59	-55	-52			-59	-59					-50		-68	-54
15 JaTim	-5	9 -59	9														-59	-59	-55	-52			-59	-59					-50		-68	-54
16 KalBar											-51	-51	-51																			
17 KalTeng											-55	-55	-55	-59	-59																	
18 KalSel											-55	-55	-55	-59	-59																	
19 KalTim											-57	-57	-57	-55	-55																	
20 SulUt														-52	-52								-70									
21 Gorontal	o																															
22 SulTeng																																
23 SulaSel											-51	-51	-51	-59	-59					-70											-61	
24 SulBar											-51	-51	-51	-59	-59																	
25 SulTra																																
26 Bali																																
27 NTB																																
28 NTT																																
29 Maluku											-31	-31	-31	-50	-50																-29	
30 MalUt																																
31 PapuaBa	r										-61	-61	-61	-68	-68								-61						-29			
32 PapuaPro	v										-68	-68	-68	-54	-54																	



2 Model's trade matrix (without diagional)

2030	1 NAD	2 SumUt	3 SumBar	4 RiauProv	5 KepRi	6 Jambi	7 SumSel	8 BaBel	9 Bengkulu	10 Lampung	11 DKI	12 JaBar	13 Banten	14 JaTengDIY	15 JaTim	16 KalBar	17 KalTeng	18 KalSel	19 KalTim	20 SulUt	21 Gorontalo	22 SulTeng	23 SulaSel	24 SulBar	25 SulTra	26 Bali	27 NTB	28 NIT	29 Maluku	30 MalUt	31 PapuaBar	32 PapuaProv
1 NAD		*****	1474	821	6685	461	926	241	260	497	2126	3721	1068	555	1133	497	111	995	1159	62	22	78	167	16	105	125	93	72	72	33	115	354
2 SumUt	6781		5256	8236	*****	2452	5750	842	1753	2818	7438	*****	3077	4528	5576	1851	725	7699	7295	373	210	545	1158	120	865	901	614	578	315	164	500	1653
3 SumBar	885	3907		6490	2431	2098	3984	127	576	1210	2762	3844	1086	949	1189	275	110	1178	1344	66	27	55	117	19	84	84	70	71	59	37	93	298
4 RiauProv	572	*****	6875		4075	2064	3698	128	1231	1864	7891	*****	7607	3981	3371	515	51	2179	3997	110	22	63	119	10	147	243	147	86	135	18	83	210
5 KepRi	4069	*****	2486	3245		1142	4841	1866	641	2766	*****	*****	3672	3811	2474	2317	829	*****	9717	686	231	523	1146	96	831	485	373	457	213	142	325	961
6 Jambi	377	1969	2452	2901	1040		3487	76	968	1120	1863	4304	1600	1262	1317	142	28	772	818	45	11	27	81	6	51	73	45	39	33	12	41	98
7 SumSel	590	2844	4390	3445	5519	2307		620	4402	*****	6532	8064	2926	5469	8357	556	547	5797	5628	399	126	413	1099	69	595	770	474	376	205	90	237	675
8 BaBel	133	474	95	113	3093	60	554		50	237	3685	6458	2209	572	1363	312	56	848	1081	42	11	35	69	5	40	36	27	24	14	8	21	71
9 Bengkulu	85	429	226	410	438	313	2420	32		852	360	751	240	206	400	74	24	220	269	15	6	16	29	4	21	19	14	17	16	9	21	66
10 Lampung	665	1421	1382	1100	3741	1441	*****	284	1548		4213	9745	2951	1799	3031	649	143	932	1234	68	38	205	169	23	183	267	195	189	98	32	164	401
11 DKI	6363	*****	9360	6420	*****	4883	*****	3275	3113	*****		*****	*****	*****	*****	7980	4896	*****	*****	2076	640	3002	6706	578	2231	4765	3502	2159	984	519	1007	2958
12 JaBar	6736	*****	*****	*****	*****	4233	*****	2675	3266	*****	*****		*****	*****	*****	6346	6037	*****	*****	2893	840	3037	8935	566	4543	5081	5183	2437	1101	600	1210	6055
13 Banten	1389	6512	4836	2868	9785	1411	5675	792	1083	6408	*****	*****		7815	6383	2226	1277	*****	*****	749	210	704	1969	154	875	1006	1052	645	274	161	271	1244
14 JaTengDIY	1078	3261	1705	1559	4413	854	3063	1031	468	2412	*****	*****	*****		*****	2629	1334	******	*****	506	194	496	1158	160	1160	2599	1710	763	318	152	460	1239
15 JaTim	3098	7562	1894	4219	5721	1830	8028	1541	648	5216	*****	*****	*****	*****		3083	3335	*****	*****	1948	729	1276	3640	604	3668	*****	5623	1952	718	487	1225	3462
16 KalBar	404	1072	282	364	3532	82	609	263	138	549	2976	4467	1320	1140	1724		239	7575	4852	152	61	62	221	32	185	158	111	112	60	35	77	229
17 KalTeng	198	403	193	105	1966	187	891	376	115	110	1407	*****	1360	2065	4141	2271		9105	4441	118	113	558	427	75	745	970	624	423	194	82	246	643
18 KalSel	183	532	201	184	773	84	475	162	41	111	1472	6831	916	1456	4780	581	867		4818	89	55	239	961	46	434	476	307	233	103	45	144	408
19 KalTim	504	6763	2393	883	7452	823	1648	1478	597	1711	*****	*****	8891	######	*****	4378	3029	*****		1899	700	5209	7503	579	4747	2698	1782	1674	943	423	1212	2534
20 SulUt	71	362	47	54	804	53	334	65	45	63	446	1485	237	423	795	297	104	586	2180		780	683	107	79	446	107	80	222	642	691	599	1030
21 Gorontalo	32	108	26	23	307	14	69	12	4	24	251	447	132	381	518	174	125	430	1214	423		446	53	8	61	53	26	26	81	65	61	158
22 SulTeng	128	440	59	114	371	37	267	61	20	139	705	801	309	245	638	121	83	1703	9086	436	242		332	263	526	23	15	73	63	68	81	186
23 SulaSel	261	464	102	194	1518	121	466	173	76	179	2313	4147	974	1542	5637	663	633	4442	8684	282	219	1343		580	2857	407	326	953	427	114	382	1126
24 SulBar	10	103	6	9	183	3	50	7	3	11	134	245	65	121	507	39	17	173	539	80	14	507	206		29	7	6	18	11	5	9	21
25 SulTra	115	395	76	97	831	55	217	46	50	147	925	1341	289	884	1484	263	291	1488	3599	219	114	768	1236	103		56	54	211	340	71	235	494
26 Bali	156	392	180	181	696	87	384	79	75	383	2985	4566	655	2400	4179	333	351	3524	2066	89	44	130	275	36	135		1808	308	79	39	134	401
27 NTB	137	805	177	159	679	84	317	513	49	262	2010	2900	1614	781	9597	244	174	1173	1260	63	24	95	181	23	141	1145		226	58	26	63	354
28 NTT	118	367	120	109	838	53	188	55	23	104	1223	1453	536	507	1008	143	127	937	1831	92	35	180	651	30	139	71	95		252	55	141	504
29 Maluku	24	171	31	22	516	14	88	11	14	54	613	858	238	772	1058	47	24	311	679	82	19	17	38	5	95	9	12	56		33	124	230
30 MalUt	27	313	30	23	417	7	144	25	17	39	325	461	120	263	410	94	17	433	620	471	53	58	51	5	63	15	15	37	85		65	153
31 PapuaBar	27	191	84	69	465	25	48	13	27	104	882	1230	569	782	941	65	40	1036	1971	387	54	35	95	14	138	61	35	127	452	68		743
32 PapuaProv	139	4975	158	169	736	67	265	3560	57	162	4610	6114	5744	1071	*****	173	109	2132	1884	195	61	80	174	11	656	37	493	141	64	16	149	



- 1. Result by regions (GDP)
- 2. Results in selected regions
- 3. National results



The impact on regional GDP of all four components combined in 2030





Highlight on Papua Province

Real GDP (Papua Province, % Deviation from baseline)





Selected national macroeconomic impacts



Selected macroeconomic impact (% deviation from baseline)



Summary of economic impact

- Improved shipping services as suggested and outlined from model simulation, increase moderately Indonesian GDP (by 1% in more than BAU in 2030), and improved others macroeconomic indicators, particularly export (1.9% more than BAU).
- It substantially increases GDP of selected regions particularly in the Eastern regions (Papua Province, 8.6%, West papua, 6.6%).
 - Regional impact varies by their economic structures, in particular, its relative importance of shipping services, and the relative size of its inter-regional trade in their regional economies.
- Substantially larger increase in national output should be complemented by other measures (e.g., land transport improvement), but this specific upgrade has large potential to reduce regional disparity.



Findings and Recommendations

- Strong reduction (50%) of (out-of-pocket) transport cost is possible in the future (2030) based on
 - scale effect (adaptation of the fleet necessary),
 - decreased port handling cost, and
 - improvement of logistic efficiency
- Ship operation cost can/will decrease substantially ; port performance will become crucial (dwell time, turnaround time, handling cost)
- Scale effects are not sufficiently large to compensate for transhipment costs; multi-port calls are less effective than point-to-point connections
- With high port handling cost and port dwelling time, the optimal network service tends to form point-to-point connections.
- In the future port handling will become the dominant cost
 - currently : ship 1/2 port 1/2
 - in 2030 : ship 1/3 port 2/3
- There appears a strong reluctance with ship operators to use larger ship sizes due to the risks of under-use (irregular service, over-supply)



Recommendations

- Reduction of port related costs (handling cost, dwell time cost) will be crucial to reduce total logistics costs, especially in remote regions.
- Stimulate the creation of a regular service and an overall efficient load planning management (reduce risks)
- Develop a synchronized (with other investment programs and objectives) transport subsidy strategy for Eastern Indonesia
- Assessment of the indirect effects of transport development on the economic development of the eastern regions
- Upgrade the ship monitoring data base (accuracy, completeness)



Thank You

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Backup slides

• Appendix



- Projected trade volume magnitude: 5 times from demand in 2013 , from 2.8 MTEU to 14.2 MTEU
- 432 OD flows in 2030 between 36 major economic regions in Indonesia and 32 major ports
- Assuming sufficient competition and efficient use of ship size and frequency
- Only small changes in port related costs (Dwell time, handling cost, ship-turn around time)
- Trucking cost: 0.57 \$/TEU.km
- Value of time: 50 \$/TEU.day
- Container handling cost: 150 \$/TEU



Aggregate logistics performance



Total travel time

- Mean: 5.54 days
- Variance: 23. 47 days
- Minimum: 0.85 days
- Maximum: 26.70 days
- Range: 25.85 days

Histogram for "Total Economic cost (\$)"

Total economic cost

- Mean: 1260 \$/TEU
- Variance: 178 \$/TEU
- Minimum: 667 \$/TEU
- Maximum: 3,188 \$/TEU
- Range: 2,521 \$/TEU





Maritime and Land Transport Costs



Histogram for "Land financial based cost"





Histogram for "Maritime time based cost (\$)"

Histogram for "Land time based cost (\$)"





- 1. Reduction of Port related costs:
 - Handling/transshipment cost
 - Dwell time cost
- 2. Reduction of congestion:
 - Ship turn-around time
 - Hinterland congestion
- 3. Ensuring adequate port capacity to accommodate growth
- 4. Utilizing modes of transport that have better economy of scale -> towards multimodal transport system





- Average port related cost for shipments from Jakarta: 650 \$/TEU
- Reduction of handling and dwell time cost will substantially increase the connectivity to remote regions





Composition of port related cost from Surabaya (\$/TEU)

 Average port related cost for shipments from Surabaya: 700 \$/TEU



Impact of policy interventions on Total Economic Cost



- Without improvements:
 - High frequency truck-based shipments, unit cost: 0.57 \$/TEU.km
 - Dwell time at port: 5 days
 - Handling cost: 150 \$/TEU
 - Mean: 1260 \$/TEU, variance : 178 \$/TEU, max:
 3,188 \$/TEU, min: 667 \$/TEU



- After improvements:
 - Mixed of transport modes with better econom of scale (train), unit cost: 0.45 \$/TEU.km
 - Dwell time at port: 3 days
 - Handling cost: 100 \$/TEU
 - Mean: 1042 \$/TEU, variance: 169 \$/TEU, max
 2,816 \$/ TEU, min: 464 \$/TEU



Ensuring adequate port capacity to accommodate growth



- Current port capacities need upgrading to sufficiently facilitate movements of container in 2030.
- Sensitivity analysis for different trade growth is crucial to plan appropriate investments.

