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MULTIMODAL TRANSPORT IN INDONESIA: RECENT PROFILE AND STRATEGY DEVELOPMENT

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Abstract: As a large archipelagic country, Indonesia has certain characteristics in terms of its transportation services. Each island or region has its own modes characteristics, the integration of which are still developing. To achieve an efficient transport system, a proportional modal share for each mode must be safeguarded and certain government regulations are needed in their implementation. In its current practice, each mode and its infrastructure was planned independently by the related authority, so that inefficient inter-modal transfer and high intermodal externalities are apparent.

This paper reports a profile of multimodal transport in Indonesia. Overview of the existing supply and demand are presented. The paper also provides an initial benchmarking of the existing multimodal transport performance. Some recommendations on the strategy and measures to improve multimodal transport system in Indonesia is also discussed.

Key Words: multimodal transport, benchmarking, externalities

1. INTRODUCTION

1.1 The Geographical Condition of Indonesia

Indonesia is an archipelago with more than 17,000 islands spread through out the country. Nevertheless, inter-island transportation has not been perceived as having a strategic role. Being the most developed islands Java and Sumatra, in economic sense, have left the other islands behind, and these made that intra island wise transportation mainly roads becomes dominant in carrying both passengers and goods, especially when rail transportation has been decreasing since 1939.

Fulfilling the mobilization needs of these areas are very challenging. Both local and central government still have plenty of work to do in order to develop transportation system which is relevant and proper to the characteristics of distribution, distance, and region. Because of rapid developmental benefit, in many cases, roads network are considered as having more strategic role than other modes of transport.

As roads function as a traffic shark with lack of intermodal facilities, these effect the transport network as a whole. As a result, mobilization from node-to-node becomes in-efficient, transport costs increase as well as intermodal externalities, these subsequently influence the purchasing power of the people.

1.2 Transportation in Global Economy Paradigm Shift

The urgency of multimodal transport in Indonesia can be viewed as having, at least, two perspectives i.e. to improve the competitiveness of national product in global market and to function as a medium for national integration. The increase of trade in the free trade era, indicated by the establishment of WTO/GATS and AFTA/AFAS, demands a more efficient national economy system. Transportation as one of the costs, like it or not, has to be kept at a minimum rate. National logistics system has to be enhanced with a transportation network, which is efficient in its operation, in order to facilitate the volume of passengers and goods in order to be more competitive in the national and international market.

Intermodal transportation is the answer to the global economy transportation demand. Intermodal transportation enables all production/market centers to interact with the international market. This will require a condition where each transport mode ideally has to ‘cooperate-and-compete’ well and connected structurally from the local to the international transport.

1.3 Liberalization of the Transportation Sector

The inability of the government to boost the investment has left the government to entrust transportation infrastructure development to the private sector. Privatization does not occur only in Indonesia, but this is an international trend. As result, transportation is no longer entirely a public-domain. The liberalization of transportation has given a unique impact to Indonesia. Difference in characteristics for each transport mode has made difference in impact to everyone involved in such a matter, not all maybe that positive.

Investment in expressways or toll roads, seemingly promising a high return, has created numerous proposals/business plans from the private sector, especially for some highly potential regions such as Trans Java, Trans Sumatra, and urban toll roads such as in Jakarta, Surabaya, Bandung, and Medan. As of air modes, tariff liberalization has caused the sprouting of more airlines, creating a highly competitive market which causes positive impacts for the consumers. As result, medium-to-long distance traveling has shifted to air modes. On the other hand, railways, buses, and passenger ships operators must rationalize their markets for medium-to-short distance traveling.

Liberalization has resulted positively for service efficiency and infrastructure development acceleration. But, if not regulated properly, this may cause the fall of national transport industries. For example, PT KAI, the sole national rail corporation, is now facing serious problems that question the well being of its services. As a matter of fact, in other countries railways are the backbone of national logistics system and mass transportation in urban areas.

Competition in air modes, bad internal management, rail sector budget arrangement has not fully implemented, and low return on investment have resulted in the decrease of rail services and riderships.

1.4 High Transport Costs and Service Efficiency

Global economy development has demanded for a more efficient transport operations. More efficient transportation services will cause low transport costs of passengers and goods movement. National product's competitiveness and mobility of people will increase and be able to compete with imported products.

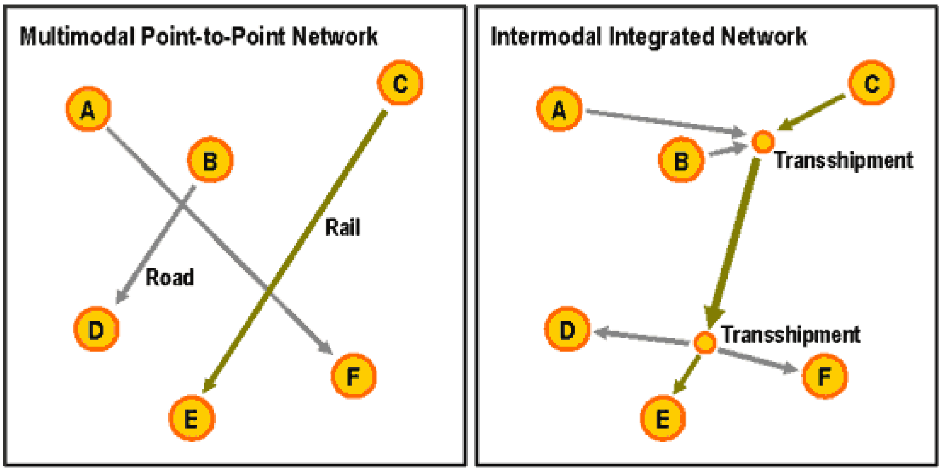
Some facts show that raw material prices at local-owned coal mines is Rp 40,000/MT, yet sold at Rp160,000/MT not including profit margins FOB (Free on Board). This shows that there is a Rp120,000/MT difference for transport and administration costs from its origin to the shipping harbours.

Low efficiency in some collection and distribution nodes has also caused high cost and operating time of transportation systems. This has affected the performance and mobility of that service and will also affect its service capacity.

2. MULTIMODAL NETWORK

Transportation systems with a number of modes can be seen from two different conceptual perspectives:

- Intermodal Transportation Network: a logistic system which is connected to two or more modes. Each mode has a service characteristic which generally enables goods (or passengers) to move to another existing mode in one trip from origin to destination.
- Multimodal Transportation Network: a set of transport modes which provide connection from origin to destination. Even if intermodal transportation can be applied, this is not compulsory.



(a) Multimodal Transportation Network (b) Intermodal Transportation Network

Figure 1. Description of Multi and Intermodal Transportation
(Soure: Rodrigue and Comtois, 2004)

Figure 1 shows the difference between intermodal transportation network and multimodal transportation network. These two principles can be the base of efficient transportation development. In the eyes of national transportation, if efficiency is desired, then ideally in the future multimodal transportation network will be developed based on intermodal transport.

3. NATIONAL TRANSPORTATION CONDITION

3.1 Unbalanced Transportation Market

Table 1 show a national estimation in passengers and goods transportation market in the year 2002. It can be seen in the table that roads dominates the transportation system, with more than 85% as a share, making it called 'traffic shark'.

Table 1. National Transportation Market Estimation Year 2002

	Passengers		Goods	
Mode	Millions/year	%	1,000 tons/year	%
Roads	2,021.08	84.13%	2,514.51	90.34%
Railroads	175.90	7.32%	17.25	0.62%
Rivers	10.31	0.43%	28.00	1.01%
Straits	116.03	4.83%	27.40	0.98%
Sea	42.34	1.76%	194.81	7.00%
Air	36.54	1.52%	1.37	0.05%

With ±7.3% as passenger share, railways comes second. Yet, its share for goods is indeed very low (±0.62%). Both goods and passenger shares are seemingly declining following the decline of service quality, maintenance back-log, and competition with air mode.

Air mode has experienced a quite significant increase, especially in passenger movement as a result of liberalization of air transportation sub sector (its share becomes ± 1.56%). This has resulted in an increase in competitiveness of this mode, especially for long distance travels.

Even if Sumatra, Kalimantan and Papua hold a huge potential for river transportation, river modes are not very popular (share: less than 1%). For example, Jambi, Riau, and South Sumatra have a great history of river transport in the past. In Kalimantan, river transport is supposed to be the backbone of transportation on that island, especially due to the fact that other transportation means have not been well developed.

Low mobilization for passengers in East Indonesia is the main reason why sea shares are very low (1.76% or 42.3 million passengers/year). For goods shipping, sea modes play an important role, but for an archipelago like Indonesia, this number is still very low.

Goods distribution which is based on the island wise concept has resulted in roads being the main choice of transportation especially in Western areas of Indonesia. The role other modes, such as railroads and rivers, to distribute goods in the island itself has not been very well developed. Dry ports as nodes of distribution for goods only exist in 5 locations in Java and Sumatra. The same goes for river modes for goods shipping. Very few goods are transported through rivers in Kalimantan. Coal shipment in *Sungai Danau,* South Kalimantan, is an exception.

Indonesia's spacious area has caused goods production to be done island wise in order to suppress costs and no longer sees Java as the center of industries. Production centers are starting to spread to other islands, especially after the economy crisis in 1998. Security and labor issues are the main issues that are taken into consideration.

In terms of goods or passenger market development, it is very interesting to study about the decision making of mode choices. Each corridor has their own characteristics in developing services other than roads. Ideally, mode to mode shares should be balanced so that high intermodal externalities i.e. economy costs resulted from traffic jams and insufficient roads maintenance can be avoided.

3.2 Multimodal Transport Profile

3.2.1 Passenger Movement

As for passenger transport, roads still dominate the mobility as can be seen in Table 1. Development of roads still dominates inside Java, Sumatra, and crossing of those two islands. As a matter of fact, the crossing mobility volume between Java and Sumatra exceeds mobility volume inside Sumatra itself. Outside Java, the largest land movement occurs between Balikpapan-Banjarmasin, its corridor region and hinterland. For Sulawesi, the only significant mobilization is in South Sulawesi.

Mobilization on the northern parts of Java (*Pantai Utara* or *Pantura*) is still the largest mobilization with Jakarta and Surabaya as the main two origin and destination nodes. Other than that, mobilization between Jakarta-Bandung, Surabaya-Sidoarjo-Malang, Yogyakarta-Solo, Semarang-Solo and other commuter mobilizations also contribute quite significantly to the mobilization in Java as a whole.

In Sumatra, in connected areas such as Medan-Pekanbaru and Padang-Pekanbaru are areas with the largest movement in Sumatra. Connections between Medan and Padang with Riau or Riau as a whole are slightly high due to the fact that Riau is on the border of Singapore and Malaysia. Not only that, but also mobilization between Palembang-Lampung and its surroundings with Jakarta are also quite high. *Lintas Tengah* (Middle Route) is still the most populated intercity connections in Sumatra, even if there is *Lintas Timur* (Eastern Route) as an alternative.

Movement of passenger via sea is more balanced throughout Indonesia. Some movement between Sumatra and Java still use sea modes even if the volume has very much decreased nowadays. Surabaya is the most important node in Java, only second to Jakarta, in terms of sea transportation to Sumatra, Kalimantan and East Indonesia. Sea movement to Kalimantan is higher than movement to Sulawesi, especially South Sulawesi. Most sea movements are long and medium distanced except between North Sulawesi and Maluku. Maluku is now the busiest of sea movement in Indonesia.

The movement of air transportation modes is highly affected by major nodes in each island. Jakarta-Medan became a service route with the highest passenger number, while Jakarta-Surabaya has the second highest. Surabaya became the transit city which distributed and collected routes toward East Indonesia. From Surabaya, the movement is distributed onto Kalimantan regions, Sulawesi-Maluku-Papua, and Bali-Nusa Tenggara. The highest inter-island movement outside Java-Sumatera is the movement from Surabaya-Balikpapan. Basically, air mode movements are long distance inter-island movements, but there are also some average distance and intra-island movements which contribute a pretty high. That is Jakarta-Yogyakarta and Surabaya-Bali, some average distanced routes with a high passengers number.

3.2.2 Goods Transportation

The goods transportation is still dominated by road modes. In the road modes itself, most of the goods transportation services are still serving routes inside Java, Sumatera or between the two islands. The high economic growth of the two islands in comparison with other islands or regions causes highly concentrated goods movements in Java and Sumatera.

International goods movements are highly dependent in sea modes. For national movement or inter-islands, sea modes only give a little share of transportation (7%). Figure 2 illustrates the distribution of sea transportation of goods from the point of loading and unloading. Loading activities are high in Kalimantan and Sumatera of which mostly go to Java (45.06% of unloading). For international movements, the transportations are still pointing to Java, while for overseas movements, every island already has its important nodes which specifically deliver the goods abroad.

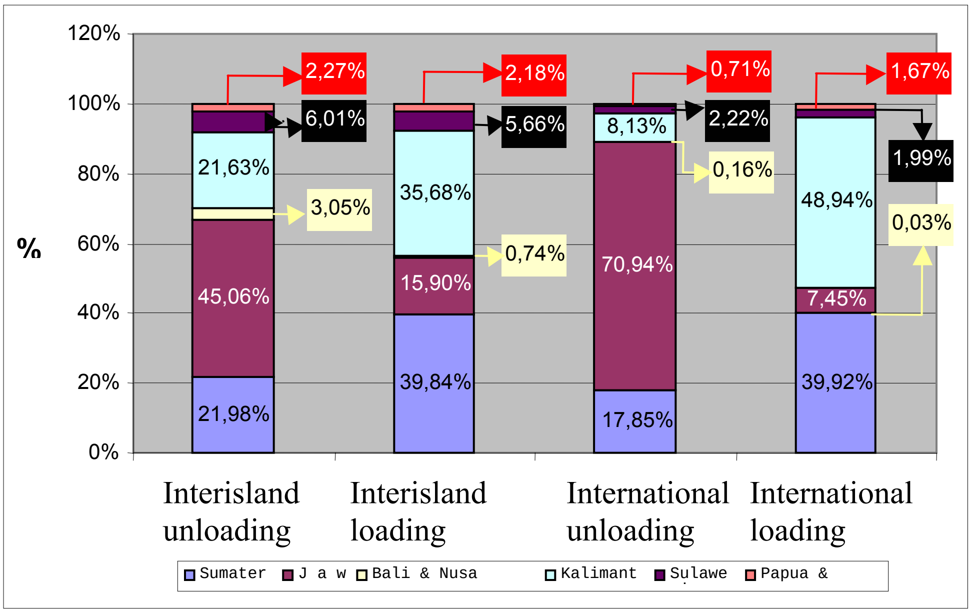


Figure 2. In-Harbour Loading and Unloading of Goods Transportation
(Source: BPS, 2002)

Based on the inter-port data, the inter-island movement of goods is in fact increasing. The movement between Surabaya-Balikpapan became the largest, followed by the movement between Surabaya-Jakarta. The inter-island goods transportation data shows that the movements are generally happening from west Indonesia towards East Indonesia, and vice-versa. Surabaya became an important node because the city is a distributor and collector of those movements. In comparison to Jakarta, Surabaya has the largest sea modes inter-island goods movement.

The inter-island goods movements by sea modes consisted of 3 kinds of goods, namely general cargo, container, and dry-bulk. General cargo still has the largest share in comparison with the other kind of goods, and general cargo services are prominent in every port (primary, secondary, and tertiary ports). Container transportations only serve the movements between primary ports such as Medan, Jakarta, Surabaya, and Makassar. However, there are some non-primary port which also serves container movements, such as Pontianak. In the other hand, dry bulk transportations are served mainly in Kalimantan's ports, and distributed to Jakarta and Batam. This kind of service in Kalimantan is related to Kalimantan as a main production of coal.

Air modes serve only a little share of goods transportation in comparison with sea and road modes. Only a little part of goods is served by this mode, such as fresh goods, express cargos, mails, and vulnerable goods.

3.3 Transportation Infrastructures

3.3.1 Road Transportation Infrastructures

A. Roadways

General condition of roads provisions in Indonesia is illustrated in Table 2. It is seen that the effect of Indonesian economic crisis is still happening until year 2002, where the quantity of damaged roads (unstable condition) is about 39.4% of total roads in Indonesia, including 15,739 km of National and Provincial roads and 113,215 km of District (*Kabupaten)*/City roads.

Under the context of road and traffic development priorities, it is necessary to qualify which roadway is more important or prioritized to be handled. The strategic qualification of roadways is done based on these criteria:

- Road Function: % of arterial roadways
- Traffic: AADT (pcu/day)
- Connectivity: % connected roads
- Big cities connection: the number of National Activity Center (PKN), Regional Activity Center (PKW), and Local Activity Center (PKL) connected.

Table 2. General Condition of Road Infrastructure in Indonesia Year 2002

Road status	Length (km)	Road condition			
		Good	Average	Lightly Damaged	Heavily Damaged
National roadway	26,886	64.3%	24.0%	6.9%	4.8%
Provincial roadway	37,164	34.1%	32.1%	16.9%	16.9%
Kabupaten roadway	240,946	19.0%	34.0%	28.5%	18.5%
City roadway	25,518	9.0%	87.0%	4.0%	0.0%
Total	330,495	23.6%	37.1%	23.6%	15.8%

Source: Directorate General of Regional Infrastructures, Department of Settlement and Regional Infrastructure, 2003 (2002)

The total length of roads in Indonesia is about 33,242 km, wherein about 3,340 km of it (10.05%) is not yet connected. The highest proportion of unconnected routes is in Papua (41.25%), followed by Kalimantan (17.83%), and the Maluku (17.14%). In the other islands, unconnected routes are under 10%.

Table 3. National Strategic Roads Qualification

Route	Road function (% of arterial)	AADT (pcu/day)	Connectivity %	Number of PKN, PKW, and PKL**)
SUMATERA				
East Route *)	92.73 %	6,720 pcu/day	100 %	14 cities
Central Route	66.87 %	5,459 pcu/ day	99.49 %	18 cities
West Route	3.78 %	2,724 pcu/ day	89.00 %	12 cities
JAWA				
North Route/ Pantura *)	95.73 %	15,051 pcu/day	100 %	29 cities
Central Route	81.79 %	14,454 pcu/ day	100 %	17 cities
South Route	54.65 %	5,661 pcu/ day	99.37 %	12 cities
KALIMANTAN				
South Route*)	71.30 %	2,472 pcu/day	98.15 %	20 cities
Central Route	11.58 %	1,393 pcu/ day	89.46 %	7 cities
North Route	9.54 %	3,26 pcu/ day	44.35 %	2 cities
SULAWESI				
West Route*)	46.27 %	4,543 pcu/ day	100 %	13 cities
Central Route	100 %	4,804 pcu/ day	100 %	12 cities
East Route	100 %	2,578 pcu/ day	100 %	4 cities
BALI				
South Route*)	86.65 %	13,810 pcu/ day	86.65 %	3 cities
North Route	64.57 %	3,826 pcu/ day	100 %	4 cities
FLORES				
South Route*)	100 %	1,615 pcu/ day	100 %	4 cities
North Route	57 %	66 pcu/ day	100 %	2 cities
TIMOR				
North Route*)	100 %	4,671 pcu/ day	100 %	3 cities
South Route	97.22 %	71 pcu/ day	97.22 %	1 cities
PAPUA				
Borderline Route*)	100 %	619 pcu/ day	68.13 %	3 cities
Central Route	29.04 %	689 pcu/ day	55.09 %	8 cities

Note: *) = the most strategic route in each island
**) PKN: National Activity Center, PKW: Regional Activity Center, PKL: Local Activity Center
Source: Planning and International Cooperation Bureau, Department of Settlement and Regional Infrastructure, 2003

As it has shown in Table 3 above, the Java Pantura Route could have been the most strategic route with the highest number AADT and strategic cities connected. While if one look at it from the traffic aspect, it is shown that Java island has the highest volume, followed by Sumatera and Sulawesi. The traffic volume (AADT in pcu/day) shows the intensity of economic activities in the regions generally.

In the context of the roads utilization for transportation, the existing roads fall into class II, IIIA, IIIB, and IIIC where class II has the maximum axle load 10 tons. The other 3 classes have the maximum axle load 8 tons. Table 4 shows the length of roads by each class and region in Indonesia.

Table 4. Road (km) Length by Each Class in Indonesia

Province	Road Class				Total
	II	IIIA	IIIB	IIIC	
Sumatera	459	7,534	9,709		17,704
Java	2,048	7,132	5,619	1,894	16,695
Sulawesi		2,695	6,392		9,089
Kalimantan		2,457	5,702		8,159
Bali+NT+Maluku+Papua	315	3,441	4,612	1,975	10,345
Indonesia	2,823	23,261	32,037	3,869	61,992

Source: Directorate of Land Transportation, Department of Communication (2003)

However, Java has the best road infrastructure quality compared to the other regions of Indonesia. In Sulawesi, Kalimantan, Maluku, Papua, and most of Sumateran provinces, there has not been a roadway with class II that can accept 10 tons axle load. This aspect is considerable in developing national logistic systems, where in Sumatera, Kalimantan, Sulawesi, and Papua most of raw materials are produced. Limited axle load will affect the economy of scale.

B. Terminal

Road transportation terminals are one of roadways infrastructures for people/goods loading and/or unloading activities, and also regulater the arrivals and departures of the vehicles. In the SK Ditjen Perhubungan Darat No. 76/AJ.102/DRJD/2000 about Roadway Transportation Network Nodes Regulation it has been stated 108 locations of type A passengers terminals in all around Indonesia, while the type B and type C terminals are regulated by Local Governments.

Table 5. Road Transport Passenger Terminal Provision in Indonesia

Island	Existing terminal locations	Type A Terminals	
		Built	Not built
Sumatera	89	16	16
Java + Bali	160	8	43
Kalimantan	40	5	3
Sulawesi	45	7	6
NTT, Maluku, Papua	51	2	2
Total (Indonesia)	385	38	70

Source: Directorate of Land Transportation, Department of Communication (2003)

C. Trains and Railways

Railways network that existed in Indonesia generally were the ones that were built during the Netherlands Colonial era, consisting of a total length 6,482 km that is only available in Java and Sumatera. Table 6 shows the railways' total length data in Indonesia.

Table 6. Railways Length year 1995 to 2001 (in meters)

According to the Route								
Description	Year							Growth (%)
	1995	1996	1997	1998	1999	2.000	2.001	
1. Main	4,266,955	4,228,447	4,228,447	4,317,991	4,292,322	4,327,163	4,327,163	0.24
2. Branch	813,116	323,596	323,596	247,047	323,596	225,903	225,903	-13.84
Total	5,080,071	4,552,043	4,552,043	4,565,038	4,615,918	4,553,066	4,553,066	-1.73

Source: Directorate of Land Transportation, Department of Communication (2003)

Available railway bridges are classified into two, these are steel bridges and concrete bridges. As time goes by, the amount of steel bridges all across Indonesia decreased, and replaced with concrete bridges which are more economical and easier to maintain. It is recorded at year 1995 there are 81,726 tons of steel bridges decreased into 79,894 tons in year 1999, while concrete bridges are increasing from 14,804 m^3 in year 1995 into 22,275 m^3 in year 2000. Table 7 describes the data of the bridges in Java and Sumatera.

Table 7. Railroad Bridges Provision in Indonesia

No.	Region	Upper Structure		Sub-Structure Pillars (Unit)	Upper Structure is Passable by		
		Steel (tons)	Concrete (m^3)		20 tons (unit)	15 tons (unit)	13 tons (unit)
1	Java	65,746	12,286	630,658	2,307	1,136	248
	Sumatera						
2	ESU	4,984	920	46,146	185	51	118
3	ESB	4,404	212	62,038	14	12	223
4	ESS	7,005	2,626	36,317	91	75	75
	Total	82,139	16,044	775,159	2,597	1,274	664

Source: Directorate of Land Transportation, Department of Communication (2003)

There are 3 categories of signal systems applied in Indonesian Railroad Network, namely electronic interlocking system, all-relay/NX-interlocking system, and electro-mechanical interlocking system. The significant growth came from signal electrification where electric signal only available in 13 main railway stations in year 1995, and became available in 200 stations in year 2002.

Table 8. Condition of Indonesian Railways Signal and Telecommunication

No.	Data	Unit
A.	Signal Location	
1.	In-station signal equipments	553
2.	Blockways signal equipments	538
3.	CTC/CTS signalings	15
4.	Signalized Route doors	1,127
B.	Telecommunication condition	
1.	Radio network	103
2.	Train dispatching	989
3.	Telecommunication equipments	30,113
C.	Electricity	
1.	Catenary network	468
2.	Powerhouses	35
3.	Signal Power Supply	34

Source: Directorate of Land Transportation, Department of Communication (2003)

Total railway stations in Indonesia which consisted of main stations and class 1, 2, 3 is 571 units. The detailed description of the data is illustrated in Table 9. In the context of multimodal transportation provision, the function of train stations as intermodal nodes is very important. Unfortunately, more specific data about facility provision and intermodal connection in every station is unavailable.

Table 9. Train Stations in Indonesia

Region	Main Station	Class I	Class II	Class III
Java	26	37	76	395
Sumatera	5	9	22	98
Total	31	46	98	493

Source: Directorate of Land Transportation, Department of Communication (2003)

D. Ferry Ports

By the year of 2003, there are 111 ferry ports spread across Indonesia, 34 of which being operated by PT. ASDP and the rest (77 ports) are still operated by UPT Penyeberangan (Ferry Unit Operator of the Sea Communication Dir. Gen.).A ferry port, in general, is consisted of two parts: (1) seaside facilities, which is known as the berth and all of its equipments, (2) landside facilities, which is known as the terminal and all of its equipments.

Most of these ferry ports are in good conditions. Based on the berthing facilities, ferry ports can be divided as:
- The movable bridge system (68 ports)
- Ponton system (10 ports)
- Parabolic / ship ways / timber berth system (38 ports)
- Berth that use standard seaport berthing system.

3.3.2 Sea Transportation Infrastructure

The Directorate General of Sea Communication divides ports into two groups, namely public ports and special ports. Public ports are defined as ports that give services to transport goods and passengers generally. There are two ownerships for this kind of ports, the first is ports which belong to BUMN (state-owned companies) which is under the management of PELINDO I-IV, and second is the ports that belong to the central government. The government's ports are usually local ports and not transit ports, while PELINDO I-IV handles the administration of the privatized and commercial ports.

Table 10. The Ports Hierarchy

Type of Ports	Port Category	Number		
		Commercial	Non-Commercial	Total
Public Ports	International Hub	2		2
	International	18		18
	National	75	170	245
	Regional	16	123	139
	Local		321	321
Total Number of Public Ports				725
Special Ports	Industry, Mining, Forestry			565
	Fishery			591
Total Number of Special Ports				1,156
TOTAL				1,881

Source: Directorate of Sea Transportation, Department of Communication (2003)

The infrastructure has a limited capacity due to the limited space, facilities, geographical obstacles and the hierarchy that controls it. The development of an infrastructure must be fitted with those conditions and the development plan for goods and passangers transportation and the hierarchy projection of the ports which is managed in the transportation system.

Ports are considered as transit ports or as the destination point for goods and passengers from or to another province. The existing data of the overall existing port infrastructures reveal that the total length of berth is 140,362 meters, the storage area is 817,226 m^2, the open storage area is 1,742,877 m^2, and the passenger terminal area is 41,292 m^2.

3.3.3 Air Transportation Infrastructure

Airports function as the interconnections of the air transportation network or as transfer points for passengers or goods intra or inter-modes. An airport is also the gate of a region, a national, or a local, which make them a very important node for a country / a region. These days, a modern airport functions not only as a terminal, but also as an integrated business center and sometimes also represents a country to the international world.

The facilitations of the air transportation infrastructure in Indonesia is shown by the number and classifications of the airports, in which there is a total of 185 public airports consisting of 24 first-class airports, 15 second-class airports, 20 third-class airports, 38 fourth-class airports, 48 fifth-class airports. 23 airports are being managed by PT Angkasa Pura I and PT Angkasa Pura II, and the rest are being managed by UPT of the Ministry of Communication and the Batam Authority. Table 11 shows the current composition of the airports ownership.

Table 11. Composition of The Airports Ownership

Airport's Operator	Airport Class						Non-Class	Total
	Primary	I	II	III	IV	V		
PT. AP – I	2	11	-	-	-	-	-	13
PT. AP –II	2	6	2	-	-	-	-	10
Batam Authority	-	1	-	-	-	-	-	1
Directorate General of Air Comm.	-	2	15	20	38	48	38	161
Civil / Military	-	-	-	-	-	-	-	21
Local Authority	-	-	-	-	-	-	494	494

Source: Directorate of Air Transportation, Department of Communication (2003)

Table 12. Availability of Airport Infrastructure Across Indonesia

Characteristics		Amount
Passengers Departure		34,526,764
Aircraft Movement		652,216
Freight Movement		351,403
Terminal Capacity (m2)		407,191
Runway length	Length (m)	102,873
	Width (m)	1,884
Apron Capacity	Length (m)	8,167
	Width (m)	2,152
	Area (m2)	1,944,336

Source: Directorate of Air Transportation, Department of Communication (2003)

Landside facilities are consisted of the passenger terminal, the freight terminal, a curbside with parking spaces, an access to the airport, meteorology facilities and airport security. Airside facilities consisted of runways, taxiways, apron, air navigation facilities, PKP-PK facilities, aircraft hangars, and a ground handling. The length of the runway, taxiway and the area of the apron are the most important air facilities, because they determine the characteristics of the aircrafts that are allowed to land and take-off from the airport. Table 12 shows a summary of the availability of infrastructures in the airports in Indonesia.

3.4 Intermodal Externalities

Several studies show the occurrence of intermodal externalities (waste of time, vehicle operating costs, and the road maintenance) as a consequence of the unbalanced condition in the transportation market in Indonesia.

Elim and Yohan (2002) showed that for a shifting of freight movement to the railways becoming 10% of the freight transportation in Java Island, there is a potential saving about Rp 69.83 millions / hour ≈ Rp 254.87 billions / year, which is equal to 2.82% of the total APBN (National Budget) for the transportation sector in the year of 2002 (about Rp 9,050 billions). Taufik (2002) also suggests that some railway investments in Sumatra Island can save 11.3 times larger compared to some roadway investment.

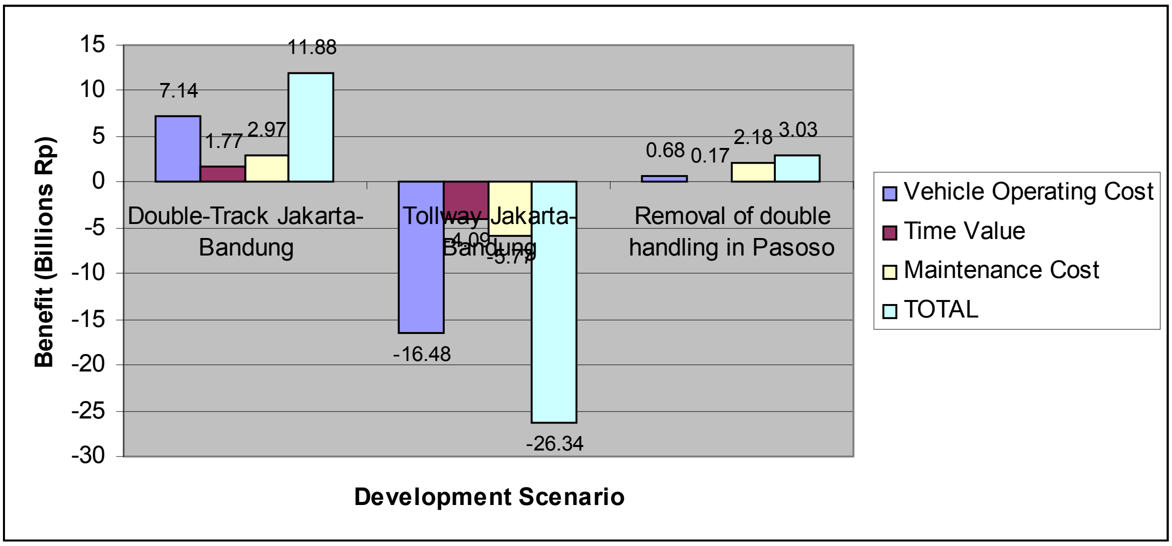


Figure 3. Benefit of Some Scenarios of Freight Transportation Network Development in Bandung-Jakarta Corridor

An example of the study on Indonesia's Railway Master Plan (LPPM-ITB and PT. KAI, 2004) is the case of goods transportation between Bandung and Tanjung Priok. There are 3 solution scenarios, namely double-track railways, toll ways, and the overcoming of the double-handling in Pasoso. The benefit profile (VOC saving, time value, and road maintenance) is shown in Figure 3. Toll ways are considered to be counter-productive, because they make the delay even worse and the high maintenance cost. The shifting to trains with the double-track between Jakarta and Bandung and the double-handling solution in Pasoso give a much higher benefit. These findings once again indicate that the rational load share between modes and the efficiency of the transhipment in the interconnections between freight terminals are the keys to a good intermodal transportation.

4. NATIONAL MULTIMODAL TRANSPORTATION SYSTEM DEVELOPMENT

4.1 Basic Condition for the Development of the National Transportation

In an intermodal transportation system, the market may be characterized based on modes' comparative advantages. Table 13 and Table 14 show the recommendation as the result of a study by R&D Body of Ministry of Communication and the LPPM-ITB (2003) regarding the Intermodal Transportation Network for Domestic Passengers.

For goods transportation, the roles between the transportation modes are recommended in Table 15 and Table 16. This recommendation is more "island-wise", because the operations between islands are dominated by sea modes which characters fit in this case (large capacity and low cost, only need ports' infrastructures and route management or sailing routes).

Table 13. Idealization for the Intra-Island Intermodal Passenger Transportation Network

	Bus	Business Train	Executive Train	Airplane
Short-Distance Trip				
Economy Class	++++	++++	++	+
Business Class	++	++++	+++	+
Executive Class	+	++	++++	++
Medium-Distance Trip				
Economy Class	++	++++	+	+
Business Class	+++	++++	++++	+
Executive Class	+	+	+++	++++
Long-Distance Trip				
Economy Class	+++	++++	++	+
Business Class	++	+++	++++	+
Executive Class	+	+	++	++++

Note: ++++ highly recommended +++ recommended ++ less recommended + not recommended

Table 14. Idealization for the Inter-Island Intermodal Long-Distance Passenger Transportation Network

	Economy-Class Ship	Executive-Class Ship	Airplane
Economy Class	++++	+	+
Business Class	+	+	+++
Executive Class	+	+	++++

Notes: ++++ highly recommended +++ recommended ++ less recommended + not recommended

Table 15. Idealization for the Intra-Island Freight Transportation Network

	Roadway Mode	Railway Mode	Air Mode
Short-Distance Trip			
Postal and goods with small loads	+++	+	+
Fresh goods	+++	+	+++
Small Container	+++	+++	+
Large Container	++	++++	+
Dry bulk	+	++++	+
Medium-Distance Trip			
Postal and goods with small loads	++	+++	+++
Fresh goods	+++	++	++++
Small Container	+++	+++	+
Large Container	+++	++++	+
Dry bulk	+	++++	+

Note : ++++ highly recommended +++ recommended ++ less recommended + not choosen

Table 16. Idealization for the Intra-Island Long-Distance Freight Transportation Network

	Roadway Mode	Railway Mode	Air Mode	Sea Mode*
Postal and goods with small loads	+	+++	++++	+
Fresh goods	+	+	++++	+
Small Container	++	++++	+	+++
Large Container	+	++++	+	+++
Dry bulk	+	++++	+	+++

Notes : ++++ highly recommended +++ recommended ++ less recommended + not recommended
* Only in Sumatra Island.
For the movement of goods between islands, it is recommended to use the sea mode.

The strategy for the development of goods transportation should be based on the goods characteristics, the modes characteristics, and the distance. Several studies suggest that railways are better for the dry bulk cargo for having a large capacity and being able to go to a long distance. Airplanes are superior in speed for the transportation of goods with a high economical value, perishables such as fruits, postal, etc. Private goods transportation or courier services may be served appropriately by roadway.

4.2 The Concept of National Multimodal System Development

4.2.1 The Intermodality Concept

The intermodality is influenced by space, time, structure, network patterns, the number of interconnections and linkages, and types or characteristics of the vehicles and terminals. Intermodal transportation development is generally based on some of these conceptions :
- The nature and quantity of the commodities / passangers transported,
- The available transportation modes,
- The origin and destination,
- The value of the commodities / passangers and the trip frequency.

There are four definitions of the main functions of the intermodal transportation, which are :
- *Composition.* Collecting and consolidating goods / passangers in a terminal / node which allows intermodal interfaces between the local / regional distribution system and the national / international distribution system.
- *Connection.* The movement of goods / passangers between a minimum of two terminals / node. The efficiency of this connection is usually derived from the economies of scale.
- *Transfer / Interchange,* the transfer process between modes in a terminal. The main function of an intermodal takes place in a terminal / node which provides the movement continuity in the transportation chain.
- *Decomposition.* The fragmentation process of goods / passangers in the nearest terminal from the destination and transferring it into the local / regional distribution network.

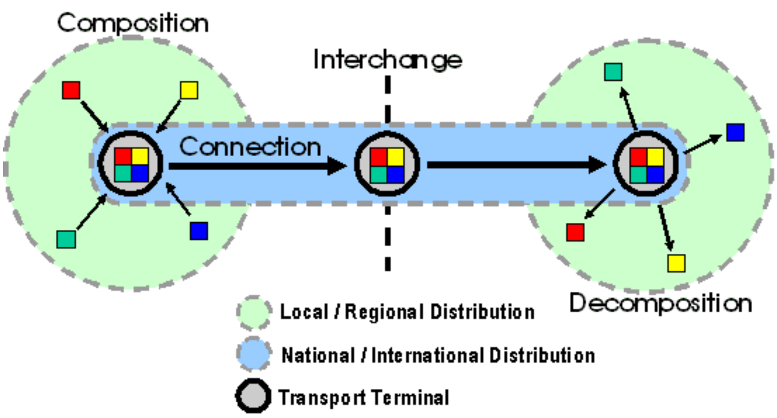


Figure 4. Intermodal Transportation Chain
(Source : Rodrigue and Comtois, 2004)

The possibilities of idealizing for the conditions in Indonesia (see Table 13 to Table 16) for the logistic system as suggested by the intermodal transportation chain in Figure 4 are :
- The national / international connection function should be applied evenly by the train modes and roadways via arterial roads / tollways (inland) and sea modes (inter-island).
- The best transhipment point as the connector between the national / international and local / regional distribution is the railway station / multi-modal dry port, port, and some roles of the airport.
- The composition / decomposition function is ideally to be done by the roadway mode.

4.2.2 The Multimodal Transportation Network System

The theoretical concept of the multimodal transportation network system is shown in Figure 5. The multi-modal transportation system integrates different geographical scales of a global transportation service into a local one. By developing the transportation infrastructure from each mode and the intermodal facilities, a region will have an access to the global market. Therefore, a number of parameters in the regional transportation need to be transformed or at least modified in a significant way. The multimodal movement consists of a series of centers/hubs that compete, in which the movement collects or continues it to the regional and local transportation network.

Based on the geographical scale, the traffic regulation is being coordinated at the local level by the distribution center, usually consists of a transportation terminal, or at the global level by an articulation point which consists of transportation terminals having both the intra-modal or inter-modal function.

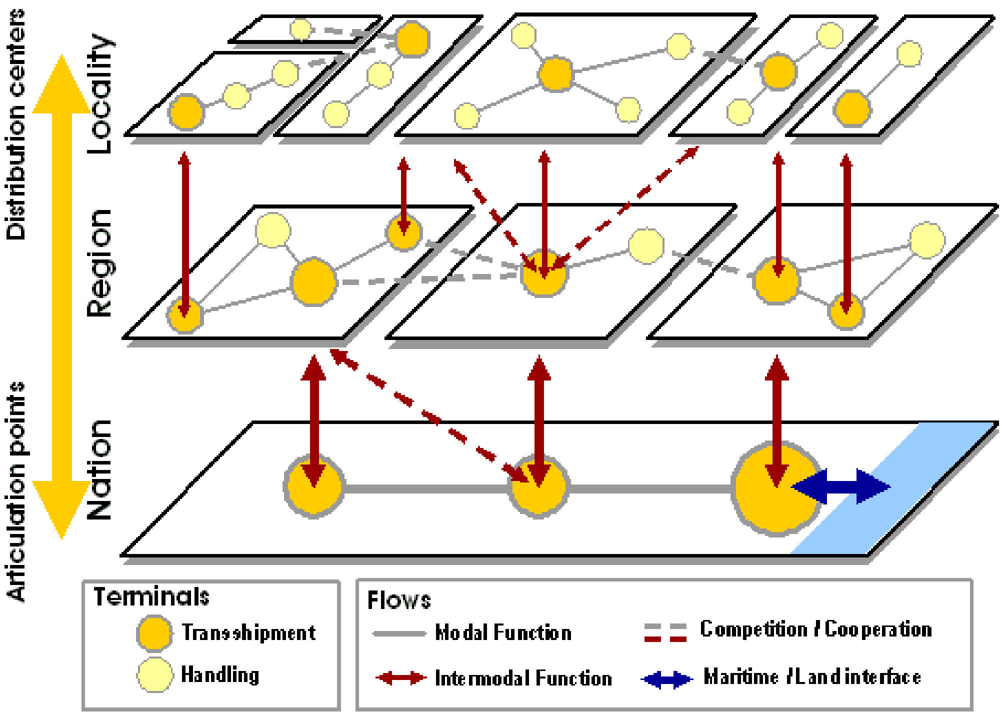


Figure 5. The Concept of the Multimodal Transportation Network
(Source : Rodrigue and Comtois, 2004)

4.2.3 Development of the National Logistic System

To develop an efficient network for the multimodal transportation infrastructures in Indonesia according to the theoretical recommendation in Figure 5 some conditions must be fulfilled, for example :

- The transportation network must be functional in the hierarchy with considerations to the management status,
- The transportation network must work together with considerations to the comparative advantages,

- The network provision must be fitted with the regional palnning so it can fulfill the needs of the movement according to the economic activities pattern.

For the regional condition and the management system in Indonesia, the provision of the infrastructures for every city as shown in Table 17 and the required logistic network based on Figure 5 is recommended.

Table 17. The Recommendation for the Transportation Infrastructure Provision According to the City Hierarchy

City Hierarchy	Transportation Function	Road Network	Railway Network	Port*)	Airport*)
PKN (National Activity Center)	The national distribution & international relations	Primary Artery	Main Lines	International / National Relations	Internasional/ Domestic, Distribution Center
PKW (Regional Activity Center)	The regional distribution between cities/districts within a province	Primary Collector	Branch Lines	Regional	Domestic, Not the Distribution Center
PKL (Local Activity Center)	The local distribution between sub-district within a city/district	Primary Local	Regional and Urban Lines	Local	

Note : *) If needed and feasible technically and economically

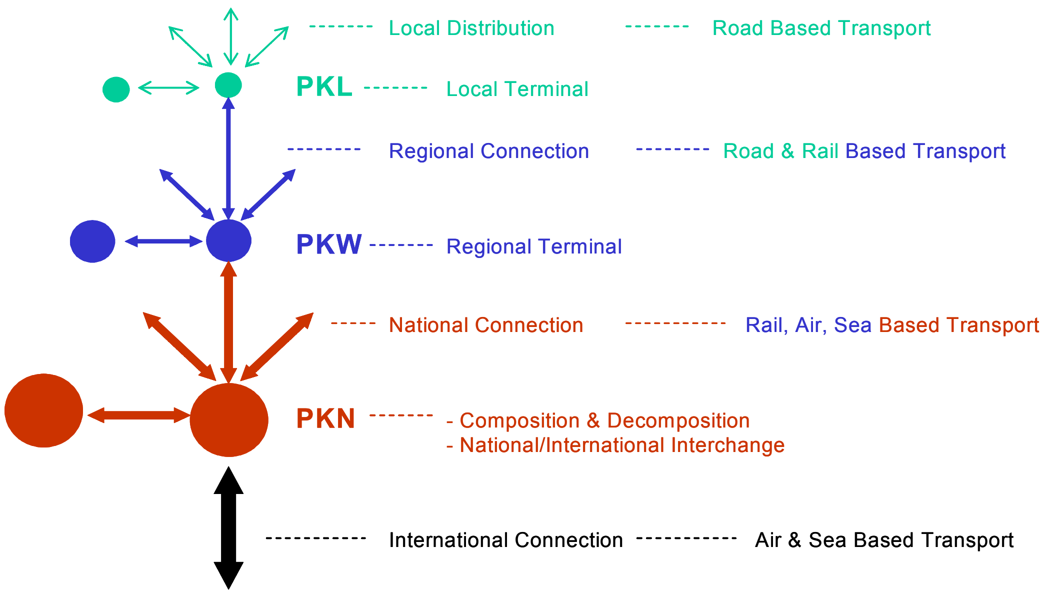


Figure 6. The Hierarchy Concept of the National Multimodal Logistics System in Indonesia

4.3 Strategic Intermodal Node Development

Based on some best practices in some countries and studies on the terminal or node development for the intermodal benefits, there are a few conclusions in the intermodal node development:

1. The node development should consider its relationship with other modes to make it easier for the passengers to reach their destinations.
2. The terminal is a transportation node which functions not only as the departure point or the arrival point, but also as the transit point in which the terminal movement will be continued by means of other modes to reach its destination.

3. In the transportation system development with an intermodal or multimodal perspective, the terminal is an important node as the transfer point.
4. In the transportation system development with an intermodal or multimodal perspective, it is important to consider the superiority of each mode currently and the needs of efficiency and also the effectiveness of the movement of the passengers or goods.

In the light of in the intermodal terminal development, the basic structure for intermodal terminal in Indonesia is suggested. Figure 8 shows a number of suggested locations for the terminal development with an intermodal perspective of passenger transportation.

In Figure 7 it is shown that the intermodal terminal development is based on islands. On the early phase regions that are being developed as the areas with intermodal terminals are areas with a high passenger movement. In the Sumatra Island, Medan and Batam are the top priorities for the intermodal terminal development, and then Jakarta and Surabaya nodes in the Java Island. Makassar and Manado are the top priorities for the intermodal terminal main development, while in the case of Papua, Jayapura is the first option. Sorong may be the next option, considering the very large area of the Papua Island.

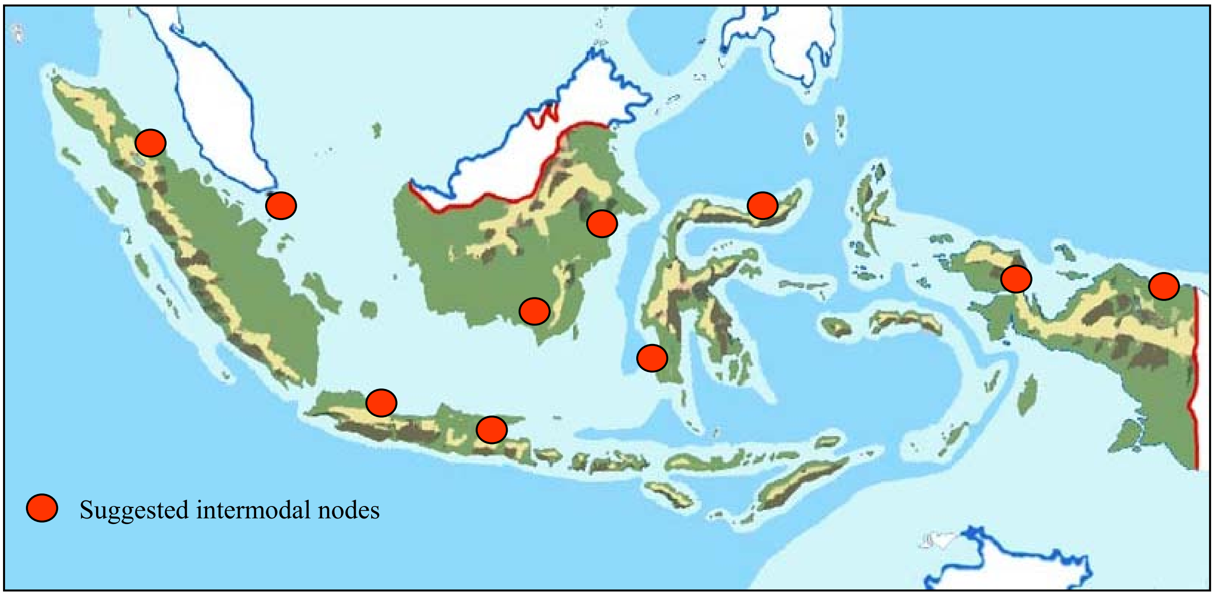


Figure 7. The Development of The Strategic Nodes for Intermodal Transportation

5. CLOSING REMARKS

Based on the discussion in the previous parts several remarks are worth noting here:
- Strategic multimodal transportation needs to be developed to gain optimum transportation services.
- Inter/multi-modal transportation development must comply with the regional planning strategy.
- Some regulated system is needed where the demand is low and irregular, and services cannot depend on the free market.
- Development of an effective inter/multi-modal system should consider region’s characteristics.
- Jakarta, Medan, Batam, Surabaya, Banjarmasin, Makassar and Jayapura could be promoted to become strategic inter/multi-modal transportation nodes.

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