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Road Network System in Port Klang, Malaysia and Impacts to Travel Patterns

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Abstract

Road network system is one of the most important infrastructures in any country as it provides the means to move people and goods. Inefficient road network system will disrupt the transportation movement, environment and affect human movement. This paper examines the structure and patterns of the road network system in Port Klang, Malaysia. It found that after implementation of toll on highways, heavy lorries decreased their uses of the tolled highway, and started using regular roads. The building and charging of tolls on the new highway has impacted the travel patterns of users in the area.

Keywords: Road network; Port Klang; human behavioural

1. Introduction

A good road network system can generate economic growth, physical transformation and improved system of maritime connections. As mentioned by Taaffe (1973) cited by Noraini and Zakaria (2010),

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geographers considering a road transportation network system as an aspect of spatial organization would first look specifically at the structure of the network. Linkages and nodes are the basic structural elements of the network. According to Lambert (1997), traffic and transportation are a key logistics activity that provide for the movement of materials and goods from point of origin to point of consumption, and perhaps to their ultimate point of disposal.

2. Literature Review

In the port, transportation is the main activity as it enables transfer of goods from ships to other transportation modes (Noraini and Zakaria, 2010). Over the years, the roles of the ports have been expanded and the relationships between port and city have changed considerably during the second half of the twentieth century (Levinson, 2006). As a result, ports have become increasingly disconnected from cities. The increased intensity of port industrial activity, in combination with urban growth, lack of available land for further expansion, and environmental constraints, have led to the move of port facilities away from city centres (Hoyle, 1989). Thus, transport players are willing to insert the port cities within the global transport chain to cope with normalised logistics systems which are managed by an ever-reducing number of powerful global companies, local and regional specifically in terms of economic development and spatial planning (Ducruet, 2007).

Road network system is one of the most important infrastructures in any country as it provides the means to move people and goods. A road network system manifests properties such as the hierarchy of roads, connectivity, accessibility, linkages and movement. On the other hand, the road network system also influences port city to growth depending on the functions of the effective integration of land use and road network system. A routeway concept is defined by Becth (1971) as a way or road for passage or travel. A highway, or railroad, or pipeline, or waterway, or airway is a route between any two points located on it.

Transport integration is an essential port function of a modern seaport node in which a multimodal transport system develops. As stated by Hoyle (1980), the growth of a port city is fundamentally affected by four sets of separate factors: the land situation, the water situation, the site, and the water site. The balance between these factors influences port city growth which depends on the functions of the effective integration of land use and the road network system. For that reason, the integration of land use and road network system deserves particular attention and research. It is clear of the importance of a road network system in the port city to generate the logistics industry and supply chain.

Travel behavior is the study of what people do over space, and how people use transport. The studies in travel behavior are broad and related to activity analysis and time use studies. Travel pattern is an important topic in the field of transportation engineering and urban planning. The background information is necessary to understand the complex relationship among urban structure, transportation system and the people's activities. The growing volume and complexity of urban travel in developing countries has become a major concern to transportation planners, service providers in urban areas, and policy makers. Designing transport strategies which meet the common political aims for the environment and the society requires a deeper insight into the routines of individual travel behavior (Rahman, 2008).

2.1. Overview of Port Klang

The prime focus of the study is to evaluate the trend and flow of traffic before and after implementation of the new Shapadu Highway from Bukit Raja, Klang towards Port Klang. We have narrowed down the scopes which only focus on the main road network system in the Port Klang area. Port Klang is Malaysia's major gateway and has been recognized as one of the busiest ports in Asia. It is situated on the west coast of Peninsular Malaysia, at the north end of the Straits of Malacca. It is about 6 kilometres southwest of Klang town and 38 kilometres southwest of Kuala Lumpur. This port is well-linked to the others part of Malaysia by road and rail network connections and is located about 70 kilometres from Kuala Lumpur International Airport (KLIA). Furthermore, Port Klang is served by three major gateways which are Northport, Westport and Southport. Figure 1 shows the location of Port Klang.

Fig. 1. Port Klang, Source : www.gettingaround.net/pages/poc-...ysia.php

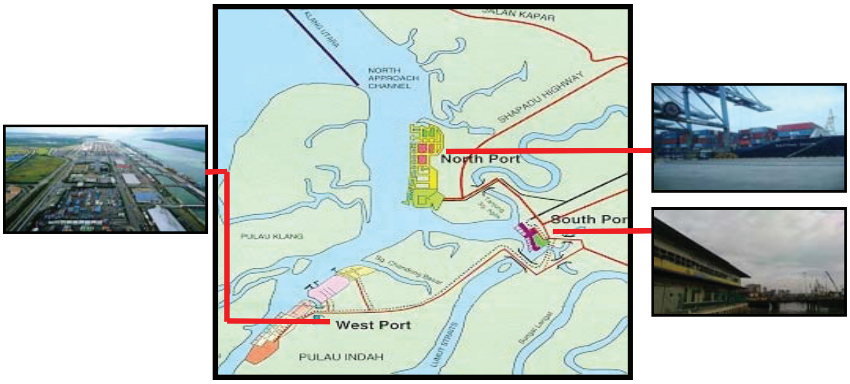

Fig. 2. Location of Port Klang, Source: www.pka.gov.my/Background.asp

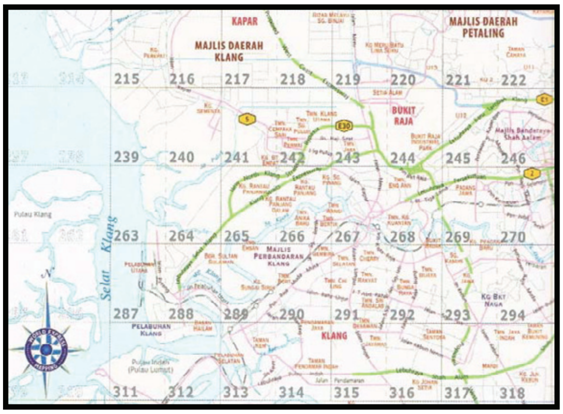

Fig. 3. Shapadu Highway, Source : GPS Street Directory, Kuala Lumpur &Klang Valley, 2010

Port Klang has sufficient capacity to go further in the years ahead. Port Klang has been selected as the area of interest in this study based on several criteria such as urban population (Brinkhoff, 2006), freight forwarders and logistics agents (International Transport Journal, 2006). Several indicators that have not been included in the study to avoid redundant values are total quay, administrative and suburban population and surface of the metropolitan urbanised area (Ducruet, 2007). Based on these criteria, Port Klang has been identified as a potential world class port city of the future. Specifically, based on logistics activities, port throughputs and infrastructures.Ducruet (2007) ranked Port Klangat number 34 of the top 100 port cities in the world.

Table 1: Ranking Port City in the World (Ducruet, 2007).

Rank on FI	PORT CITY	Integration type			Rank on FI	PORT CITY	Integration type		
		Sea-land	Port-city	Logistic-intermodal			Sea-land	Port-city	Logistic-intermodal
1	Tokyo-Yokohama	-	-	-	51	Durban	-	-	+
2	Osaka-Kobe	+	-	-	52	Rio de Janeiro	-	+	-
3	Rotterdam-Europoort	+	-	+	53	Saint-Petersburg	-	-	+
4	Hamburg	+	-	+	54	Dublin	-	+	-
5	New York-New Jersey	-	-	-	55	Philadelphia	-	+	-
6	London	-	-	-	56	Southampton	+	-	-
7	Antwerp	+	-	-	57	Brisbane	-	-	-
8	Los Angeles-Long Beach	-	-	+	58	Leixoes-Porto	-	+	+
9	Hong Kong	-	+	-	59	Copenhagen	-	-	+
10	Barcelona	+	+	+	60	Felixstowe	-	-	-
11	Miami-Port Everglades	-	-	+	61	Beirut	+	+	+
12	Busan	-	+	+	62	Savannah	+	-	+
13	Singapore	-	+	-	63	Mumbai (Bombay)	+	-	-
14	Shanghai	-	-	-	64	Portland OR	-	-	+
15	Bremen-Bremerhaven	-	-	-	65	Callao-Lima	+	+	-
16	Valencia	+	-	+	66	Chennai (Madras)	+	-	+
17	Genoa	+	-	+	67	Jacksonville	-	-	+
18	Nagoya	+	-	-	68	Fremantle-Perth	+	-	-
19	Seattle-Tacoma	+	-	+	69	Incheon-Seoul	-	+	+
20	Houston	-	+	+	70	Qingdao	-	+	+
21	Manila	-	-	+	71	Cape Town	-	-	+
22	Montreal	-	+	+	72	Abidjan	+	+	+
23	Bangkok	+	-	+	73	Trieste	+	-	-
24	Melbourne	-	-	-	74	Leghorn (Livorno)	+	-	+
25	Buenos Aires	-	-	+	75	Tanjung Perak-Surabaya	+	-	-
26	Vancouver BC	-	-	+	76	Ho Chi Minh City	+	-	-
27	Piraeus-Athens	-	+	+	77	Dalian	-	-	+
28	Marseilles	+	+	+	78	Haifa	+	+	+
29	Kaohsiung	-	+	+	79	Casablanca	+	+	-
30	Tanjung Priok-Jakarta	+	-	+	80	Boston MA	-	+	-
31	Baltimore	-	-	+	81	Izmir	+	+	+
32	Le Havre	-	-	-	82	Taichung	-	-	+
33	Lisbon	+	+	+	83	Zeebrugge	-	-	-
34	Port Klang-Kuala Lumpur	-	+	-	84	Auckland	-	-	+
35	Sydney-Port Botany	-	-	-	85	Algeciras	-	-	+
36	Gothenburg	-	+	+	86	Keelung-Taipei	-	-	-
37	Oslo	-	+	+	87	Hakata-Fukuoka	+	-	-
38	Helsinki	-	+	-	88	Thessaloniki	-	+	+
39	Dubai	-	+	-	89	Dammam	+	+	+
40	Bilbao	+	+	+	90	Aarhus	+	-	+
41	Oakland-San Francisco	-	-	+	91	Halifax	+	-	-
42	Charleston	+	-	+	92	Kitakyushu	-	-	-
43	Tianjin	+	-	+	93	Karachi	-	-	-
44	Colombo	-	+	+	94	Santos	-	-	-
45	New Orleans	-	-	+	95	Port Said	-	-	+
46	Jeddah	-	+	+	96	Lagos-Apapa	+	-	-
47	Amsterdam	-	+	-	97	Dunkirk	+	-	+
48	Haydarpasa-Istanbul	-	-	-	98	Limassol	-	-	-
49	Naples	-	+	+	99	Glasgow	-	+	-
50	Liverpool	-	+	-	100	Xiamen	-	-	-

3. Problem Statement

Several problems have been identified that limit a road network system from meeting the standard of green logistics in Malaysia. The major problems that have been identified are the connectivity and accessibility of the road network system in the study area. Port Klang is a “last mile connectivity” for freight and cargo movement to transfer the goods. The connectivity and accessibility of the road network system in Port Klang is not efficient and create traffic congestion in the area. (Port Klang Authority, 2010 cited by Noraini and Zakaria 2010)

Furthermore, the criteria for road design in the study area such as the width of lanes, load bearing standards and junctions have not been established. In terms of width of lane, the existing narrow widths of lane in Port Klang are not suitable to cater for the capacity of freight and private vehicle movement from or to the port city. The size and width of current road lanes cannot accommodate the capacity of vehicles based on traffic volumes in Port Klang. (Port Klang Authority, 2010)

Recent traffic volume information showed that there was a significant decrease of vehicles using New North Klang Straits Bypass (NNKSB) after toll implementation. This, despite the fact that travelling became more convenient (no congestion) and time was significantly saved due to better running speed compared to before the toll implementation. The NNKSB was structurally constructed for medium and heavy lorries usage. However, the reluctance of these drivers to use the new facility would cause traffic congestion on the North Klang Straits Bypass (NKSB), as well as overloading or overstressing its pavement structure.(Klang Municipal Council, 2010)

The main cause of the problem could be the “out-of pocket money” incurred by motorists to pay the toll charges that are relatively higher than other tolled roads in the area. Other factors could be the longer and inconvenience road gradients on newer highways, on which they have to travel and manoeuvre, especially when their lorries are fully loaded. The reduction in travelling time is not highly significant as compared to the lorry drivers’ out-of pocket money for the toll..(Klang Municipal Council, 2010)

4. Findings

4.1. Network

The current road network system in Port Klang consists of federal road and city roads. Maintenance of federal roads is the responsibility of Public Works Department through the provision of the Federal Government. Persiaran Raja Muda Musa and Jalan Kem are part of the alignment of Federal Road 2 that connects the study area to nearby cities such as Klang, Shah Alam, Petaling Jaya, and Kuala Lumpur.

4.2. Operational Evaluation of Existing Roads

Operational assessments of the existing roads are based on the comparison between volumes of traffic during peak hours and the capacity of the existing road. The capacity of an existing road is determined by the width of road lanes, road width, traffic distributions, the composition of traffic, obstructions in the road side and the slope of the road. Table 2 shows the operation of main roads in the study area. Federal Highway 2 (Klang-Shah Alam) operates more than 54% above the capacity of existing roads. Similarly, North Klang Straits Expressway operates more than 40% above the capacity of existing roads, while Federal Route 2 (Port Klang-Northport) has reached the capacity of existing roads.

Table 2: Main Road Operation in Study Area (Klang Municipal Council (2002))

Road Segment	Peak Hours Volume (Vehicle/Hour)	Existing Road Capacity (Vehicle/Hour)	The Ratio of Volume/Capacity
Federal Road 2 (FR2) (Klang-Shah Alam)	8,600	5,600	1.54
Federal Route 2 (Persiaran Raja Muda Musa)	3,300	5,600	0.59
State Road B10 (Pandamaran-Johan Setia)	1,700	2,800	0.61
Federal Route 2 (Port Klang-Northport)	5,600	5,600	1.00
North Klang Straits Highway (Klang-Northport)	7,800	5,600	1.40

4.3. Road Accidents

Road accidents in the area showed that the accidents rates had declined from 2,176 cases in the year 2000 to 1,303 cases in 2001. Most accidents occurred on the federal roads especially on Federal Route 2 that links Kuala Lumpur to Port Klang. The high composition of heavy vehicles was one of the main factors for numerous accidents in the district.

4.4. Traffic Conditions Before Toll Implementation

The North Klang Strait Bypass Highway (NKSB) isa 8.5 kilometers highway with two interchanges, namely Kapar Interchange and Meru Interchange. The existing NKSB is the only route to Port Klang and since then, the number of traffic volume has increased tremendously. As such, The New North Klang Straits Bypass Highway (NNKSB) is an alternative route for vehicles to destinations within the vicinity of Port Klang (MITRANS 2002).

The New North Klang Straits Bypass Highway (NNKSB) is 17.5 kilometers long and has three interchanges namely Bukit Raja Interchange, Kapar Interchange and Pelabuhan Utara Interchange. Before toll implementation on the NNKSB, the total number of vehicles counted at Bukit Raja (Station 1) was 78,187 vehicles, which comprises of 53.14% car/taxi, 8.74% van, 10.50% medium lorry, 10.92% heavy lorry, 0.78% bus and 15.92% motorcycle. At Shapadu Old Toll (Station 6) number of vehicles counted were 31225 vehicles, and consist of 38.13% car/taxi, 8.05% van, 11.00% medium lorry, 23.03% heavy lorry, 0.60% bus, and 19.19% motorcycle. However, total 4-wheeled vehicles (toll able) at Station 1 and Station 2 were 65737 and 25233 vehicles, respectively, over the 16-hour counting period (Noraini and Zakaria, 2010)

4.5. Traffic Conditions After Toll Implementation

After toll implementation on 15th May 2002 on the NNKSB, an interesting and expected scenario with regard to traffic volume and composition was found at Station 1 and Station 2. At Station 1, the number of 4-wheeled vehicles recorded was 55681 (a drop of 15.30% compared to volume before toll being imposed), of which 86.93% travelled on NKSB, and 13.07% used the NNKSB road. Similarly, at Station 6, the total of 4-wheeled vehicle counted was 20667 (a drop of 18.10%) with 74.51% vehicles use the NKSB road and the remainder 25.49% vehicles use NNKSB road. It seems that the percentage of medium and heavy lorries that were not using the NNKSB were quite significant (reduction of 2% to7%).

The present traffic volume information gathered showed that there was a significant decrease of vehicles using the NNKSB after toll implementation, although travelling became more convenient (no congestion) and time was significantly saved due to better running speed compared to the earlier situation.

4.6. Comparison Before and After Toll Implementation

As a whole, the traffic volume study conducted indicates that over 67% of four-wheeled vehicles are using either NKSB or NNKSB before and after the implementation of toll and the other 33% vehicles use the KESAS highway route. Although the decline in percentage of four-wheeled vehicles using the NNKSB between Port Klang and Bukit Raja is obvious, studies showed that the overall percentage of four-wheeled vehicles using the Shapadu controlled highway (NKSB and NNKSB) remains the same before and after implementation of the toll.

5. Conclusion

This paper has focused on the highway infrastructure development in a port city. It found that the impacts of the road network system in Port Klang towards human travel patterns affect the road network system itself. In order to achieve sustainable development, we need to know how people behave in travel before implementing and enforcing something new which may impact the people's lives.

The toll collection on a new highway has served to encourage road users, especially heavy vehicles drivers, to find alternative routes in order to avoid paying the toll. This has led to congestions in certain parts of the roads and highways in Port Klang area, especially those that are not tolled or charge lesser tolls. This has defeated the main objective of providing more efficient transportation network by building newer tolled roads. Thus, it is imperative that transportation planners recognize the travel patterns and behaviours of motorists, especially truck drivers, in dealing with supposedly efficient highways that charge high user fees. Otherwise, the benefits of providing them may not be as great as expected.

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References

Banga, I. (1992).*Ports and their hinterlands in India* 1700-1950, New Delhi: Manohar.Banister, D. (1995). *Transport and urban development*. Oxford, Alexandrine Press.
Basu, D.K. (1985). *The rise and growth of the colonial port cities in Asia*.Lanham,University of California.
Becth, J. E. (1971). *A geography of transportation and business logistics.*Wm.C.Brown.
Bobzin, H. (2006). *Principles of network economics*, Berlin Heidelberg: Springer-Verlag.
Coyle, J.J., Bardi, E.J. & Langley, C.J. (2003).
Coyle, J.J., E. J. (2000). *Transportation.* Ohio: South-Western College Publishing.
Ducruet, C. (2007). *A metageography of port-city relationships*. Ports, cities, and global supply chains, Ashgate (Ed.) 157-172.
Hoyle, B., R. K. (1998).*Modern transport geography.* Chichester: John Wiley & Sons.
Department of Public Works.*A guide on geometric design of roads: ArahanTeknikJalan.* Kuala Lumpur
Frain, J. (1970). *Transportation and distribution for European markets.* London: Butterworth&Co.Ltd.

Fujita, M. & Mori, T (1996), *The role of ports in the making of major cities: self-agglomeration and hub-effect*. Journal of Development Economics, vol.49 (1).pp.93-120.
Hall, R. W. (1987). Consolidation Strategy: Inventory, Vehicles and Terminals. *Journal of Business Logistics, 8*, 57-73.
Hoyle, B.S. (1989), *The port-city interface: trends, problems, and examples*, Geoforum, vol.20, pp. 429-435.
Jabatan Perancangan Bandar, Semenanjung Malaysia*. RancangankawasankhasPelabuhanKlang 2015.*
Jean-Paul Rodrigue, B. S. (2001). Green logistics (the paradoxes of).
Johnson, S. (1993). *The Earth Summit:The United Nations conference on environment and development (UNCED)*. Graham &Trotman, London.
Kerajaan Negeri Selangor (1999). *Strategipembangunanmampandan agenda 21 Selangor*: *kawasansensitifalamsekitar*. Bangi: LESTARI, UniversitiKebangsaan Malaysia.
Lambert, D.M., J. R. (1997).*Fundamentals of logistics management.*Irwin McGraw-Hill.
Lowe, J. C. (1975). *The geography of movement.* Washington: Houghton Mifflin Company.
Lumsden, K.R. (1998) *LogistikensGrunder*, Studentlitteratur, Lund.
MajlisPerbandaranKlang (2010), Interview with town planning officers, June 16th 2010.
MajlisPerbandaranKlang (2002). *KajianlaporanteknikalrancangantempatandaerahKlang2002-2015.*
NorainiAnorand Zakaria Ahmad(2010)*"The effectiveness of a road transportation network system in a port city: Towards green logistics in Malaysia." Proceeding Malaysian Universities Transportation Research Forum and Conference MUTRFC 2010, UniversitiTenagaNasional,Malaysia.*
Ortuzar, J.d.D, L. G. (1994). *Modelling transport.* London: John Wiley & Sons Ltd.
Pinder, h. &. (1981). *Cityport industrialization and regional development: Spatial analysis and planning strategies.*Britain: Pergamon Press.

Sadler, I. (2007). *Logistics and supply chain integration.* London: Athenaeum Press, Gateshead, Tyne & Wear.

Taaffe, E.J., H. L. (1973). *Geography of transportation.* London: Prentice-Hall.

The management of business logistics: Asupply chain perspective, Cincinnati, OH: Thomson Learning.

Tan, T.-Y. (2007). Port Cities and hinterlands: A Comparative study of Singapore and Calcutta. *Journal Of Political Geography*, 851-865.

Thalmann, P. (2004). *The dynamics of freight transport development: a UK and Swiss comparison.*Great Cornwall,England: MPG Books Ltd, Bodmin, Cornwall.

Thomas, I. (2002). *Transportation networks and the optimal location of human activities.* Massachusetts: Edward Elgar Publishing Limited.

Woxenius, J. (2007), *Alternative transport network designs and their implications for intermodal transhipment technologies*, European Transport n.35,pp. 27-45.