Malaysian Container Seaport-Hinterland Connectivity: Status, Challenges and Strategies

Shu-Ling CHEN\textsuperscript{a}, Jagan JEEVAN\textsuperscript{b}, Stephen CAHOON\textsuperscript{c}

\textsuperscript{a} Senior Lecturer, Australian Maritime College, University of Tasmania, Australia: Email: P.Chen@amc.edu.au, (Corresponding Author)
\textsuperscript{b} PhD Candidate, Australian Maritime College, University of Tasmania, Australia: Email: jjeevan@amc.edu.au
\textsuperscript{c} Director, Sense-T, University of Tasmania, Australia: Email: Stephen.Cahoon@utas.edu.au

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\textbf{ABSTRACT}

This paper adopts a qualitative methodology to assess the Malaysian container seaport-hinterland connectivity from the perspective of its physical properties. The findings reveal that although Malaysia’s major container seaports are connected to the hinterlands through road and rail transport, they are highly dependent on road. These seaports are also connected to inland freight facilities such as dry ports and ICDs, which are positioned as transit points to help connect exporters and importers in the hinterlands to seaports as well as facilitating regional and cross-border trades. This paper suggests that the quality of hinterland connectivity of Malaysian container seaports could be improved by implementing strategies which tackle the existing challenges including overcoming an extremely imbalanced modal split, insufficient rail capacity and limited train services, increasing road congestion and the limitations of space restriction in some inland facilities.

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1. Introduction

To increase trade for a nation, it is necessary to develop trade corridors that integrate ‘the seaport system in a multi-modal transportation network in order to improve market access, fluidity of trade and the integration in an industrial network’ (Merk and Li, 2013, p.21). Therefore, for a seaport to be well connected to its hinterland there must be the availability of efficient transport infrastructure, a range of modal options, and reliable services connecting seaports and hinterlands (Acciaro and McKinnon, 2013).

A seaport’s hinterland may be captive or contested and can impact on seaport competition. For example, Rodrigue and Notteboom (2006) argued that the overlapping hinterland area usually creates marginal competition where seaports and terminals battle with each other using differential corridors, costs and services. They further explain that a seaport’s competitiveness lies in achieving regional accessibility in freight distribution and improving hinterland accessibility and inter-modal efficiency. The hinterland accessibility influences seaport competitiveness.
because the higher the accessibility of an individual seaport, the more potential customers and suppliers that can be reached (Cullinane and Wang, 2009). Nevertheless, hinterland accessibility relies on hinterland connectivity, a key container seaport selection criterion for seaport users (Wiegmanns et al., 2008).

Globalisation has helped countries in South East Asia (SEA) improve their trade performance. The Association of Southeast Asian Nations (ASEAN) (2014) reported that the average annual growth rate of overall ASEAN trade was 9.2% during the period 1993 to 2013. The fast pace of increase in trade in this region has resulted in a growing volume of containers being transported through various transport nodes in hinterlands of ASEAN, with a substantial capacity of transport infrastructure and services being required to assist seaports meet the demand for the container trade (UNESCAP and KMI, 2007). Similarly, Malaysia as one of the countries in ASEAN, has also had significant international trade performance as indicated by an average growth rate of 9.6% during the period 1993 to 2013 (Department of Statistics Malaysia 2015). This was reflected in an impressive increase of container trade from 900,000 TEUs in 1990 to 20.8 million TEUs in 2013 (MOT 2014). The significant growth is due to the strategic location of Malaysian seaports being between the Indian Ocean, Pacific Ocean and South China Sea. The three major container seaports of Port Klang, Port of Tanjung Pelepas (PTP) and Penang Port are the backbone of the Malaysian international trade and economy. With the potential for increasing container volumes evident in these seaports, there is greater pressure on the seaport sector to improve hinterland connectivity so as to efficiently and effectively facilitate container cargo flows from the foreland to hinterland.

This paper analyses Malaysian container seaports’ connectivity with their hinterlands and explores their challenges and the implications for strategies. Connectivity is measured from a dimension of physical properties including transport connections i.e. rail and road and the linkage with inland freight facilities. Data for analysis were mainly collected through relevant literature including government statistical data, and reports from the United Nation Economic and Social Commission for Asia and the Pacific (UNESCAP). In addition to secondary research, other data were obtained through interviewing container seaport operators, seaport authorities, rail operator and intermodal terminal operators in Malaysia.

In the following section, this paper discusses the hinterland connectivity of container seaports including its concept and measurement. Section 3 explains the hinterland of Malaysian container seaports and analyses trade performance and container flows of major container seaports, followed by the measurement of the seaports’ hinterland connectivity in terms of its physical infrastructure in Section 4. Section 5 discusses the implications for strategies, and section 6 concludes the paper.

2. Hinterland connectivity of seaports and measurement

2.1. Seaport-hinterland connectivity

From a seaport perspective, its hinterland is an area containing the majority of export/import related businesses, which cannot be delimited because hinterlands differ in terms of time, distance, transport mode and commodity (Notteboom, 2008). Market dynamics in trade, supply chain and logistics systems may impose challenges to seaports to maintain a static hinterland (Notteboom, 2008). Considering such market development of seaports, Notteboom and Rodrigue (2007) reassessed the seaport-hinterland relationship from macro-economic, physical and logistical perspectives. The macro-economic hinterland perspective is a function of transport demand, representing a set of logistical sites with some focusing on production and consumption, while the physical hinterland perspective relates to the transport supply that considers the network of modes and terminals connecting the seaport and hinterland. The logistical hinterland perspective however, is more focused on how trade flows are organised while considering the existing macro-economic and physical setting. Modal choice in combination with maritime and inland freight distribution synchronisation tends to be the main issues from the logistical hinterland perspective. Accordingly, the seaport-hinterland relationship is not only related to physical transport networks but also to global supply chain networks, which involves different actors. As a result, the supply chain management concept could be a useful means of managing seaport hinterlands (Notteboom and Rodrigue, 2007).

Connectivity refers to the ability of linking the nodes in a network to one another. Rietveld (1995) argued that the quality of transport networks depends on both the features and how the links are connected; hence suggesting that attention should be paid to the cost and quality aspects of interconnectivity. De Langen and Sharypova (2013, p.98) further described the connectivity of transport networks as ‘an attribute of a network that indicates whether it is possible to reach all nodes from all other nodes’.

Seaport connectivity is a sub-network of the transport network with interdependent components including the hinterland, seaport and foreland; the connectivity is what captures seaports’ ability to manage flows between the foreland and the hinterland (Pafioti et al., 2014). Hinterland connectivity of container seaports, which is the focus of this paper, is of importance to a container seaport’s competitiveness. Of interest, there is no specific definition of seaport-hinterland connectivity in the literature. Therefore, this paper applies the definition of transport network connectivity by De Langen and Sharypova (2013) and maritime connectivity by Merk and Li (2013), to describe seaport-hinterland connectivity as a network with a collection of transport infrastructure and services enabling containers to be transported to and from seaports. Within the network, the seaport has the central role that connects with other transport nodes in the hinterland. This involves connectivity between physical infrastructure, institutions and people in the network (Bhattacharyay, 2012).

Development of seaport-hinterland connectivity contributes to regional economic development and sustainability by reducing transportation costs, improving quality of the goods and services and facilitating intra-regional trade and investment (UNECE, 2010). Efficient transportation linkages to the hinterland will also contribute to the integration of those geographically disadvantaged areas and thus wider increased economic activities (Bhattacharyay, 2012).

2.2. Measurement of seaport-hinterland connectivity

The extant studies on seaport connectivity measurement tend to extensively focus on foreland connectivity (Pafioti et al., 2014), see for example Wilmsmeier et al. (2006), Wilmsmeier and Hoffman (2008); Wilmsmeier and Sanchez (2009), Wilmsmeier and Martinez-Zarzoso (2010), Marquez-Ramos et al. (2011), and Cullinane and Wang (2009). In addition, the Liner Shipping Connectivity Index (LSCI) is published by the United Nations Conference on Trade and Development (UNCTAD) to measure a country’s connectivity to maritime shipping and trade facilitation. As for the hinterland connectivity measurement, there is
relatively limited research due to the unavailability of data (Pafioti et al., 2014). In addition, there is no international standard for measuring hinterland connectivity although a few indices appear to be in use, such as the Logistics Performance Indices (LPI), Trading Across Borders Indices and the Enabling Trading Index, each of which have some measures linked to hinterland transport, for example efficiency of costs, time and transport infrastructure (UNECE, 2010). In the academic literature, there are only a few studies related to port-hinterland connection and its performance such as De Langen and Chouly (2004), De Langen (2008), De Langen and Sharypova (2013), Acciaro and McKinnon (2013). Of note, Pafioti et al. (2014) considered both foreland and hinterland connectivity and proposed an integrated methodology to measure seaport connectivity resulting in a seaport connectivity index that required further testing.

Acciaro and McKinnon (2013) suggested that the hinterland connectivity of seaports can be measured by the density of inland transport networks, the accessibility to key industrial and logistical centres (measured by transit time and transport costs), the range of modal options available to carriers, the capacity of the main corridors, and the reliability of deliveries across the hinterland. Meanwhile De Langen and Sharypova (2013) developed an indicator to measure a seaport’s intermodal connectivity, using the data from a number of inland nodes, connected to a seaport with weekly rail/barge connections provided by 26 European seaports. Kunaka and Carruthers (2014) argued that the availability of transport connection with seaports and the capacity of inland facilities where seaports are linked are important for assessing seaport-hinterland connections.

The availability of transport connections, in particular the existence of a modal shift from one mode to another, such as seaports to dry ports or industrial zones may affect the competitiveness of the product in the market (Wisetjindawat et al., 2007). The inland transport facilities linked to seaports, for example container freight stations and dry ports, will benefit customers in terms of service, which includes time and cost (Kunaka and Carruthers, 2014); and their capacity should have the ability to accommodate a large amount of containers and efficient transport connections through road and rail to destinations (Rosō, 2008). In summary, it appears that physical properties of the seaport-hinterland network are the basis of the measurement of seaport-hinterland connectivity. These include seaport-hinterland transport connections, modal options, and inland facilities. In addition, reliability measures such as the frequency of transport services connecting seaports and inland nodes, time and costs are also used. Accordingly, this paper investigates the hinterland connectivity of Malaysian container seaports focusing on the physical properties of the seaport-hinterland network.

3. Malaysia container seaports and their hinterlands

More than three quarters of Malaysia’s total land is open to maritime water and this geographical landscape justifies the importance of the maritime industry for the nation’s economic growth. With a geographical advantage, the maritime industry in Malaysia has been extremely important since the 1970s (Third Malaysia Plan, 1976). This is evident by the volume of cargo handled increasing from 23.1 million tonnes in 1980 to 539 million tonnes in 2010 (Tenth Malaysia Plan, 2011). The major seaports in Malaysia include Port Klang, Penang Port, Johor Port including PTP, Kuantan Port and Bintulu Port. Others such as Lumut Port, Sabah Port, Kuching Port, Rajang Port and Miri Port are regional seaports (MIMA, 2015). These seaports underpin Malaysia’s economy by connecting the maritime network and the inland transport system. Of importance, Port Klang, PTP and Penang Port are the nation’s most dominant container ports. Figure 1 indicates the location of major seaports in Malaysia.

Penang Port is located in the northern region of peninsular Malaysia and geographically close to Thailand. It serves as the main gateway for shippers in the northern States of Malaysia and also the southern provinces of Thailand (Penang Port, 2015). There are several industrial estates in northern Malaysia using Penang Port as their main gateway for export and import, such as Bukit Kayu Hitam, Padang Besar, Pengkalan Kubor, Prai, Mak Mandin, Kulim, and Bayan Lepas (Federal Department of Town and Country Planning, 2013).

Port Klang is strategically located in the central region of peninsular Malaysia consisting of Selangor, Negeri Sembilan and Malacca, and is about 40 km from the capital city Kuala Lumpur and of proximity to the commercial and industrial hub of the country as well as the country’s most populous region such as Kapar, Bukit Jalil, Shah Alam, Selangor and Subang (Chai and Im, 2009). The seaport also serves the trade corridor to Southern Thailand.

PTP is located in the southern region of peninsular Malaysia and adjacent to the Port of Singapore. It is situated on the eastern side of the mouth of the Pulai River in South-West Johor (PTP, 2015). Although transshipment is its core activity, PTP handles small volumes of imported commodities and exported commodities (MOT, 2013). Its hinterlands include Tanjung Langsat Industrial Park, Pasir Gudang, Iskandar Region, Nusajaya Tech Park and Jurong in Singapore (MITI, 2013).

Table 1 shows the container traffic of the three major container seaports between 2009 and 2014. Port Klang handled 10.95 million TEUs in 2014, which is about 50% of the total nation’s container traffic of 22.37 million TEUs (MOT 2015). The main operators of Port Klang, West Port and North Port, contributed 67% and 33% respectively to the total throughput (Salisbury, 2015). PTP is recognised as an ideal container seaport for global and regional transhipment, handling about 8.23 million TEUs, accounting for 36.8% of the nation’s total container traffic (MOT, 2015). Penang Port, which is an important container hub for the Indonesia-Malaysia-Thailand Growth Triangle, handled 1.27 million TEUs (PPC, 2015). It accounted for 5.7% of the total container traffic.

Table 2 shows the container flows of each container seaport in 2014. Port Klang was the only seaport with slightly more import containers (17.9% of its total containers) than exports (17.7%). This is due to the seaport being close to the capital city and the populated region which

![Fig. 1. Location of Malaysian container seaports](source: Adapted from Federal Department of Town and Country Planning (2013))
demands more imported consumption goods. PTP and Penang Port were the only ports that handled more export containers. Of note, among the three seaports PTP handled the highest transhipment containers (94.3%) but the lowest imports (1.7%) and exports (3.9%). This is evidence that PTP is positioned as a transhipment hub in the region. Penang Port had the least transhipment containers compared with 64.3% in Port Klang and 94.3% in PTP.

Table 1

<table>
<thead>
<tr>
<th>Port</th>
<th>2009</th>
<th>2010</th>
<th>2011</th>
<th>2012</th>
<th>2013</th>
<th>2014 % of the total container traffic in 2014</th>
</tr>
</thead>
<tbody>
<tr>
<td>Port Klang</td>
<td>8.4</td>
<td>8.77</td>
<td>9.42</td>
<td>9.22</td>
<td>10.35</td>
<td>10.95 48.9</td>
</tr>
<tr>
<td>PTP</td>
<td>5.68</td>
<td>5.73</td>
<td>7.28</td>
<td>7.02</td>
<td>7.65</td>
<td>8.23 36.8</td>
</tr>
<tr>
<td>Penang Port</td>
<td>0.94</td>
<td>0.95</td>
<td>1.17</td>
<td>1.14</td>
<td>1.21</td>
<td>1.27  5.7</td>
</tr>
</tbody>
</table>

Source: Adapted from MOT (2015)

Table 2

2014 Container Flows of Three Major Malaysian Container Seaports

<table>
<thead>
<tr>
<th>Flow (TEUs) / Seaport</th>
<th>Port Klang</th>
<th>PTP</th>
<th>Penang Port</th>
</tr>
</thead>
<tbody>
<tr>
<td>Import</td>
<td>1,962,431</td>
<td>143,887</td>
<td>563,557</td>
</tr>
<tr>
<td>(17.9%)</td>
<td>(1.7%)</td>
<td>(44.5%)</td>
<td></td>
</tr>
<tr>
<td>Export</td>
<td>1,942,773</td>
<td>322,792</td>
<td>594,255</td>
</tr>
<tr>
<td>(17.7%)</td>
<td>(3.9%)</td>
<td>(47%)</td>
<td></td>
</tr>
<tr>
<td>Transhipment</td>
<td>7,040,600</td>
<td>7,765,434</td>
<td>107,900</td>
</tr>
<tr>
<td>(64.3%)</td>
<td>(94.3%)</td>
<td>(8.5%)</td>
<td></td>
</tr>
<tr>
<td>Total</td>
<td>10,945,804</td>
<td>8,232,113</td>
<td>1,265,712</td>
</tr>
</tbody>
</table>

Source: Adapted from MOT (2015)

4. Performance of seaport-hinterland connectivity

This section provides discussion on how hinterland connectivity of Malaysian major container seaports is measured in terms of physical infrastructure (Bhattcharyay, 2012), including the availability of transport networks to hinterlands and linked inland facilities.

4.1. Rail transport connections

The total railway route length in Malaysia is about 1,641 km. By 2013, about 80% of railway lines were single-track and 20% were double-track with a maximum speed limit of 70 km per hour (UNESCAP, 2013). However, the double-track railway network was increased to 774 km (47%) after the completion of the electrified double track project in Ipoh-Padang Besar in November 2014 (ASEAN-Japan Transport Partnership, AJTP, 2015). Railway lines use metre-gauge (narrow gauge) which limits the ability of providing the double-stack container service (Malaysia Freight Transport, 2012). Figure 2 shows the Malaysian rail network which is operated by the only operator - the Malaysian Railway Limited (KTM).

Importantly, Padang Besar-Johor Baharu rail is part of the Singapore-Kunming Rail Link network. The rail network has the main catchment of industrial area such as Ipoh, Klang Valley and connects transport nodes such as major container seaports (Penang port, Port Klang and PTP) and four dry ports located near Padang Besar, Ipoh, Seremban and Segamat. The three container seaports all provide a train service of six trips per day connecting to other nodes in the hinterland. Each train service is able to carry 64 TEUs per trip which is lower than the world average capacity of 66 TEUs per trip (Woodburn, 2011).

According to the joint Traffic Agreement 1954, alandbridge train service operates between KTMB and the State Railway of Thailand (SRT).

The rail service links the Malaysian seaports, that is, Port Klang and Penang Port both have railheads with the ICDs at Lat Krabang in Thailand through the border crossing of Padang Besar (UNESCAP, 2013). Expected benefits gained from this so-called a landbridge service are just in time (JIT) delivery, simplification in documentation procedure and lower unit transport costs (UNESCAP, 2012). However, this service is hardly used because of the poor condition and shortage of locomotives faced by SRT, and hence the majority of cargo travels from the nearby provinces of Thailand by truck to the border of Malaysia and then transfers to Penang Port through the rail network (UNESCAP, 2013). As a result, the number of landbridge train services has been reduced to two per month from an average of four to six per month (Mahendran, 2014), and the volume of cargoes transported decreased from 216,000 tons in 2004 to 19,000 tons in 2013 (MITI, 2013). The inefficiency of the landbridge train service resulted in the imbalance of transport modes used by Malaysian seaports as well as the Malaysian-Thailand border and underutilisation of the inter-regional multi-modal opportunities between the two countries (UNESCAP, 2012).

![Fig.2. Malaysia’s Railway Network](source: UNESCAP (2015))

Although the existing Malaysia rail network connects container seaports and hinterlands, it is not well utilised. This is evidenced by a low share of rail freight of containers of about 2% (Table 3). As shown in Table 3, the number of containers shipped by rail in 2013 was 343,395 TEUs, which is a slight increased from 302,736 TEUs from 2004. However, the percentage of the total container freight decreased to 1.6% in 2013 from 2.7% in 2004. The extreme imbalance of modal split in land freight transport creates challenges to seaports’ hinterland connectivity as a result of road congestion.

4.2. Road transport connections

The road network in Malaysia covers about 210,658 km, of which 79% is paved and 1,969 km are expressways (PWD, 2014). The road network covers three sub-networks i.e. Malaysian Federal Roads System,
Penang Port is connected to the North-South and East-West highways. The main issues faced by this port is the high traffic volume and congestion in the city centre, narrow road widths and many one way routes (Aziz & Mohammad, 2013, ASIRT, 2015). These issues have become major constraints on seaport-hinterland connections. In addition, the first Penang Bridge was the only connection to the Penang Island other than ferry. Freight hauliers were unable to use ferries to the mainland because of the limited capacity of ferry. The bridge has a low capacity of only four lanes (two in each direction) to cater for the catchment zone in Penang Island (ASIRT, 2015). Recently, the opening of the second Penang Bridge and the increase of lanes from four to six on the first bridge has improved road congestion at Penang Port.

Port Klang has a good road network connecting with other parts of Malaysia through the North-South Expressway, Klang Valley Expressway and Federal Highway 2 (PKA, 2015). However, there have been some issues impacting on the quality of linkage to and from Port Klang resulting in traffic congestion (Anor et al., 2012). One of the issues is the narrow width of road lanes to and from Port Klang, which is not able to accommodate the increased capacity of hauliers required for the growing container traffic in Port Klang, and as a result creates congestion. Moreover, the behavior of haulage drivers taking a detour from the bypass highway and using the main State roads to avoid toll payments also impacts on the congestion (Anor et al., 2012). Another consequence however, is the heavier dependence on road transport, thereby worsening the road conditions.

PTP is well connected to Kuala Lumpur and Singapore via the North-South Highway Link and Malaysia-Singapore Second Link respectively (PTP, 2015). Nevertheless, the quality of the connection is impacted on by the damaged infrastructure and facilities, such as roads, flyovers, road dividers and traffic lights, caused by the heavy load of freight vehicles. In particular, the State government is unable to undertake upgrading works due to the heavy congestion in the city, which is similar in Port Klang.

In summary, each container seaport has a road network to its hinterlands, however, the quality of connections requires improvement. In addition to the issues of high congestion and the heavily used road infrastructure as discussed above, the high number of road accidents in the congested area, especially close to main seaports, is another problem affecting the quality of road connectivity. For example, MOT (2013) reported that in 2013 there were 199,551 accidents in Selangor and Kuala Lumpur (nearest city to Port Klang), 64,600 cases in Johor (nearest city to PTP) and 39,391 accidents in Penang. The main reasons for the accidents include hauliers that bypass expressways or highways and use roads not designed for freight vehicles; overloading of trucks to reduce costs, leading to the deterioration of the roadway, rutting, fatigue cracking, and in certain cases structural failure (creating a vulnerable situation for motorcyclists, bicyclists and pedestrians); and less capability of handling the extra heavy commercial vehicle in emergency situations (Karim et al., 2013). All these existing problems of the Malaysian road network will affect the efficiency of road connection between seaports and their hinterlands and impact on the level of container dispersion and concentration at the promised time, which may reduce the level of attractiveness of seaports (Notteboom, 2008).

The fact that Malaysia heavily relies on road transportation for the land freight logistics task has a significant environmental impact on communities, such as noise and vibration by freight vehicles (Hanaoka & Regmi, 2011). Similar to other developing countries, the very high share of road freight over rail in Malaysia is highly related to energy consumption, pollution, congestion and delays, thus affecting the competitiveness of the seaports (Wilmsemeier et al., 2014).

### 4.3. Linkage with inland freight facilities

The container seaport system could be better connected if inland freight facilities are included to connect stakeholders in the supply chain through the seaport. In Malaysia, there are several major inland freight facilities including four dry ports, Padang Besar Cargo Terminal (PBCT), Ipoh Cargo Terminal (ICT), Nilai Inland Port (NIP) and Segamat Inland Port (SIP), and freight terminals such as Sungei Way Inland Clearance Depot and Bukit Kayu Hitam. They are all connected to container seaports either by road or rail transports or both (see Table 4).

PBCT is located at the border of Thailand and serves the south Thailand market. It is located 158 km north of Penang Port and 588 km north of Port Klang. It is connected to Port Penang and Port Klang via road and rail transport networks (Jeevan et al., 2014). The volume of containers from southern Thailand through PBCT was 100,371 TEUs in 2013 (Jeevan et al., 2015). The landbridge train service mentioned serves the inland trade corridor Port Klang - Penang Port - PBCT - Lat Krabang (Thailand).

ICT is located 181 km south of Penang Port and 250 km south of Port Klang. It mainly serves the northern industrial area of Malaysia through intermodal transportation, and is the only dry port connected with all major Malaysian container seaports through road and rail links. It handled 40,100 TEUs in 2013 (Jeevan et al., 2015). However, the connectivity of this dry port to the hinterland location in short distance (less than 15 km) has become an issue because local hauliers are reluctant to provide short

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**Table 3**: Containers Carried by Rail and Road (2004-2013)

<table>
<thead>
<tr>
<th>Year/TEUs</th>
<th>Rail</th>
<th>%</th>
<th>Road</th>
<th>%</th>
<th>Total TEUs</th>
</tr>
</thead>
<tbody>
<tr>
<td>2004</td>
<td>302,736</td>
<td>2.7</td>
<td>11,038,555</td>
<td>97.3</td>
<td>11,341,271</td>
</tr>
<tr>
<td>2005</td>
<td>310,011</td>
<td>2.6</td>
<td>11,735,902</td>
<td>97.4</td>
<td>12,045,913</td>
</tr>
<tr>
<td>2006</td>
<td>339,037</td>
<td>2.5</td>
<td>13,129,611</td>
<td>97.5</td>
<td>13,468,648</td>
</tr>
<tr>
<td>2007</td>
<td>333,688</td>
<td>2.2</td>
<td>14,837,208</td>
<td>97.8</td>
<td>15,170,896</td>
</tr>
<tr>
<td>2008</td>
<td>283,939</td>
<td>1.3</td>
<td>16,072,493</td>
<td>98.7</td>
<td>16,256,432</td>
</tr>
<tr>
<td>2009</td>
<td>266,722</td>
<td>1.7</td>
<td>15,592,424</td>
<td>98.3</td>
<td>15,859,146</td>
</tr>
<tr>
<td>2010</td>
<td>238,251</td>
<td>1.3</td>
<td>17,935,543</td>
<td>98.7</td>
<td>18,173,794</td>
</tr>
<tr>
<td>2011</td>
<td>282,352</td>
<td>1.4</td>
<td>19,696,354</td>
<td>98.6</td>
<td>19,978,706</td>
</tr>
<tr>
<td>2012</td>
<td>331,870</td>
<td>1.6</td>
<td>20,224,855</td>
<td>98.4</td>
<td>20,556,725</td>
</tr>
<tr>
<td>2013</td>
<td>343,395</td>
<td>1.6</td>
<td>20,532,923</td>
<td>98.4</td>
<td>20,876,318</td>
</tr>
</tbody>
</table>

Source: Adapted from MOT (2014)
<table>
<thead>
<tr>
<th>Seaports</th>
<th>Hinterland</th>
<th>Distance (Km)</th>
<th>Duration (Hrs) -road</th>
<th>Duration (Hrs) -rail</th>
<th>Train services</th>
<th>Linked inland facilities</th>
<th>Transport connection to seaports</th>
</tr>
</thead>
<tbody>
<tr>
<td>Penang Port</td>
<td>Bukit Kayu Hitam</td>
<td>135</td>
<td>1hrs 45minutes</td>
<td>Not applicable</td>
<td>Not applicable</td>
<td>PBCT (158km)</td>
<td>Road/Rail</td>
</tr>
<tr>
<td></td>
<td>Padang Besar</td>
<td>166</td>
<td>2hrs 05minutes</td>
<td>5hrs 16mins</td>
<td>6 trips per day</td>
<td>ICT (181 km)</td>
<td>Road/Rail</td>
</tr>
<tr>
<td></td>
<td>Hatayai, Thailand</td>
<td>238</td>
<td>4hrs</td>
<td>6hrs 39mins</td>
<td>2 trains per week</td>
<td>Bukit Kayu Hitam inland clearance depot (135km)</td>
<td>Road / Rail</td>
</tr>
<tr>
<td></td>
<td>Pengkalan Kubor</td>
<td>315</td>
<td>4hrs 49mins</td>
<td>No rail link</td>
<td>Not applicable</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Prai</td>
<td>17.3</td>
<td>Less than 45 minutes</td>
<td>Not applicable</td>
<td>Not applicable</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Mak Mandin</td>
<td>4.0</td>
<td>Less than 15 minutes</td>
<td>Not applicable</td>
<td>Not applicable</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Kulim</td>
<td>29.6</td>
<td>Less than 1hr</td>
<td>Not applicable</td>
<td>Not applicable</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Bayan Lepas</td>
<td>28.4</td>
<td>Less than 1hr</td>
<td>Not applicable</td>
<td>Not applicable</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Port Klang</td>
<td>Kapar</td>
<td>24.3</td>
<td>1hrs</td>
<td>Not applicable</td>
<td>Not applicable</td>
<td>PBCT (558km)</td>
<td>Road/Rail</td>
</tr>
<tr>
<td></td>
<td>Bukit Jalil</td>
<td>4.5</td>
<td>Less than 1 hr</td>
<td>Not applicable</td>
<td>Not applicable</td>
<td>ICT (250km)</td>
<td>Road/Rail</td>
</tr>
<tr>
<td></td>
<td>Shah Alam</td>
<td>24.2</td>
<td>1hr</td>
<td>Not applicable</td>
<td>Not applicable</td>
<td>SIP (255km)</td>
<td>Road/Rail</td>
</tr>
<tr>
<td></td>
<td>Selayang</td>
<td>64.6</td>
<td>1hr 15mins</td>
<td>4.7hrs</td>
<td>6 trips per day</td>
<td>NIP (93km)</td>
<td>Road/Rail</td>
</tr>
<tr>
<td></td>
<td>Hatayai, Thailand</td>
<td>476</td>
<td>6hrs 14mins</td>
<td>13hrs</td>
<td>2 trains per week</td>
<td>Sungai way inland clearance depot (36km)</td>
<td>Road/Rail</td>
</tr>
<tr>
<td></td>
<td>Subang</td>
<td>32.7</td>
<td>Less than 1hr</td>
<td>2.4hrs</td>
<td>6 trips per day</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Padang Besar</td>
<td>538</td>
<td>5hrs 45mins</td>
<td>11hrs 30mins</td>
<td>2 trains per week</td>
<td>ICT (238km)</td>
<td>Road/Rail</td>
</tr>
<tr>
<td>PTP</td>
<td>Pasir Gudang</td>
<td>43.5</td>
<td>2hrs</td>
<td>3hrs</td>
<td>6 trips per day</td>
<td>ICT (551km)</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Nusajaya Tech Park</td>
<td>10.4</td>
<td>Less than 1 hr</td>
<td>Not applicable</td>
<td>Not applicable</td>
<td>SIP (188km)</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Jurong</td>
<td>22</td>
<td>2.5hrs</td>
<td>Not applicable</td>
<td>Not applicable</td>
<td>NIP (300km)</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Iskandar Regional development Authority</td>
<td>25.7</td>
<td>Less than 1hr</td>
<td>Not applicable</td>
<td>Not applicable</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Tanjung Langsat Industrial Park</td>
<td>56.7</td>
<td>2.5hrs</td>
<td>Not applicable</td>
<td>Not applicable</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

*Source: Interviews; Nazery (2012); Nasir (2014)*
distance delivery service because of the unattractive freight rate. As a consequence, it takes time for ICT to find hauliers to deliver such service, which causes delays and additional charges on shippers and consignees. Despite ICT being physically well connected to seaports, the result is less reliable hinterland connectivity to seaports in terms of time and costs. Consequently, the competitiveness of seaports will be affected because as a network based entity the dry port is unable to support door-to-door service in the least time given the competitive freight rate (Hall, 2002, Kunaka & Carruthers, 2014).

NIP is located 50 km south of Kuala Lumpur and 93 km south of Port Klang. It is connected to Port Klang and PTP by road transport only. NIP handled 175,000 TEUs in 2013 increasing from 15,000 TEU in 2000 (Jeevan et al., 2015). SIP is located in the southern peninsula of Malaysia, 212 km south of Kuala Lumpur and 188 km north of PTP, and is connected to PTP and Port Klang by road and rail transport. Regarding the three intermodal terminals, Sungei Way Inland Container Depot is connected to Port Klang by road; Bukit Kayu Hitam, located in the north, is connected to Penang Port by the landbridge road service to Thailand.

All Malaysian dry ports support container seaports by adding space to perform some of the seaports’ functions so that the congestion issues in container seaports can be relieved (MOT, 2013). These functions include being interface nodes linking production zones with seaports, providing customs clearance services, warehousing, container storage and value-added services and benefit to seaport stakeholders. As a result, these dry ports are connecting points for intermodal transport systems that help distribute containers to and from seaports’ hinterlands (Jeevan et al., 2014). Not all of the four dry ports are connected via road and rail transport system to seaports, for example in NIP, there is only a road transport service provided despite there being a nearby rail system. With the growing number of containers handled by NIP, the use of road transport produces more environmental issues and increases traffic congestion in the seaport zone (Jeevan et al., 2015).

PBCT has potential to attract more customers from southern Thailand because the international customers can gain the benefits of distance, price and time from utilising the transport network connecting PBCT, Penang Port and Port Klang. On the other side, NIP is the highest contributor in terms of container volume to Port Klang and PTP. However, the constraint of space at PBCT and NIP in particular for empty containers impacts on supporting the container seaports. In general, short-range dry ports are designed for reducing space and capacity constraints at seaports and local traffic congestion (Roso et al., 2009). However, NIP as a short-range dry port to Port Klang, has become less able to support the seaport’s increasing number of containers. As a consequence, increased congestion, dwell time and over utilisation of existing facilities in Port Klang may occur and cause inefficient connectivity between the seaport and the hinterland. Table 4 summarises hinterland connections of Penang Port, Port Klang and PTP respectively, including major hinterlands and distances, transport connections, travel time between transport nodes in the hinterland, number of rail services, and connected inland facilities.

5. Strategies for enhancing hinterland connectivity

Several issues impact on the quality of hinterland connectivity of Malaysian container seaports. These include an extremely imbalanced modal split, insufficient rail capacity and limited train services, road congestion and space constraint of some inland facilities. Given the trade growth of the nation, Malaysian container seaports have an important role in facilitating trade through good hinterland connectivity leading to efficient and effective international supply chains. The findings have implications for strategies to enhance the efficiency and reliability of connectivity between seaports and their hinterlands. The following are strategies recommended for modal shift, freight facility development and capacity enhancement.

5.1. Enhancing rail capacity to promote modal shift

A short lead time has driven Malaysian container seaports’ heavy dependence on road transport even if traffic congestion often occurs. Other factors contributing to this is the limitation of rail transport capacity such as single track systems, limited numbers of service, no rail links in certain inland freight terminals and poor condition of wagons. Given that the transport cost by rail is less than road in Malaysia (based on interview findings), using rail transport would be preferred by exporters and importers in the hinterland if the rail network capacity can be improved, and thus they can gain comparative advantages from the modal split in terms of time and costs. The empirical study by Jeevan et al. (2015) found that Malaysian seaport stakeholders are concerned about the nation’s development of intermodal supply chains and logistics networks and acknowledged the importance of a modal split in improving the competitiveness of seaports by enhancing seaport-hinterland accessibility and reliability.

To tackle the problem of an extremely imbalanced modal share in the Malaysian multi-modal freight transport system, the government has projects in place to improve rail infrastructure, such as upgrading the single track rail to electrified double track systems in the North-South rail link to enhance the train capacity and increase the speed of container transfer to and from seaports and vice versa. When completed, the rail operator should increase the number of service linking seaports to hinterlands and encourage stakeholders to utilise the rail network. In fact, the Malaysian rail system possesses several advantages. Firstly, the maximum speed of a freight train can reach 70 kilometres per hour, far faster than the world average between 30-50 kilometres per hour (Berg and De Langen, 2014). Although the average world figure comprises all levels of efficiencies, it provides an indication that Malaysian rail transport has a potential role for undertaking the nation’s freight task.

Secondly, in comparison to the road freight cost, rail freight transport is cheaper. For example, according to the data collected from an interview, the cost of shipping a container from PBCT to Penang Port via rail is about RM 2,690/TEUs compared with RM 3,370/TEUs by road. Shippers from Thailand and Malaysia potentially receive almost a 25% lower price if they choose the rail service when sending their containers to Penang Port. However, the services have not been utilised much due to the shortage of locomotives and limited services as mentioned in section 4.1.

Thirdly, the institutional integration of rail and road operation within the rail freight transport network is able to enhance the efficiency of implementing the modal shift strategy. This is due to the institutional structure of the Malaysian rail freight transport system in which KTMB is the only rail operator in the nation which also owns a container haulage company called Multimodal Freight to provide door-to-door service. When considering the comparative rail freight transport cost and the integrated operational structure, it is suggested that strengthening the Malaysian rail freight system with double tracks and an increased number and quality of wagons and utilising the system by increasing service
This study suggests an addition, dry port operator interviewees expressed that simplifying the main agenda in the government plan entitled the Malaysian Plan. In order to prioritise rail transportation development, improvement in road quality and capacity in freight facilities needs to be streamlined as a strategic regional transport corridor. Its container seaports serve the inland trade corridors to Thailand and Singapore, which are important trading partners of Malaysia. However, under development of rail facilities, in particular in southern Malaysia and southern Thailand, encourages the use of landbridge rail service. Strategies are needed for improving the connection of the trade corridors. These include upgrading rail infrastructure and utilising the landbridge rail system to connect Thailand-Malaysia-Singapore so as to improve intermodal freight transportation. National plans to prioritise rail transportation development, improvement in road quality and improving capacity in freight facilities needs to be streamlined as a main agenda in the government plan entitled the Malaysian Plan. In addition, dry port operator interviewees expressed that simplifying trade procedures such as custom clearance at the inland border to Thailand and Singapore will contribute the connectivity in terms of time.

5.2. Improvement in road congestion

In addition to enhancing rail transport capacity, the authors suggest some changes required to improve road traffic congestion, such as:

- Encouraging all the haulages’ containers to be cleared for tariffs, customs, health and taxation charges at inland locations away from the ports. This would help reduce port congestion but could raise additional security concerns.
- Moving non-maritime port activities (mostly value-added production and packaging services) inland.
- Increasing police patrols on the roads to prevent trucks being overloaded and accessing roads which are not permitted, and impose fines on hauliers against the traffic regulation.
- Upgrading road infrastructure such as road lanes’ expansion.

5.3. Capacity enhancement of inland freight facilities and further development

One of the issues related to the operations’ inland facilities affecting the hinterland connectivity of seaports is the transport service provision for a short distance. Road transportation is ideal for relatively short distance container distribution because of its high flexibility to access multiple destinations (Miau et al., 2012). However, in Malaysia, road freight transportation owners prefer long destination trips to gain more profits. There is a problem of finding hauliers delivering containers from the dry port ICT to the hinterland destination in a short distance, which contributes to inefficient hinterland connectivity of a seaport in terms of increased dwelling time in the dry port.

To overcome this situation, the authors suggest that ICT could provide its own haulier services for short distances rather than seeking the hauliers who are reluctant to deliver short distance services. This approach is adopted by another dry port (NIP) that provides its own inland transport services to cater for their customers from various distances.

Utilisation of the capacity of inland freight facilities connected to container seaports will help the hinterland connectivity. However, it was found that dry ports such as PBCT and NIP have a limitation of space. This study suggests a location pooling strategy encouraging cooperation between dry ports and inland freight terminals such as ICDs in a close proximity. For example, there is an inland container depot called Bukit Kayu Hitam which is only 44 kilometres from PBCT. The ICD does not have a space limitation and therefore can help PBCT accommodate the overflow traffic received from seaports. This strategy is expected to effectively reduce congestion, dwell time and over utilisation of existing facilities in seaports and divert stakeholders from seaports to the freight facilities so as to enhance connectivity between seaports and hinterland.

This study considers that the hinterland connectivity of the major container seaports in the west to east part of Malaysia would be improved if a new dry port can be built in Gemas (Figure 3), which is close to Port Klang and located at a rail link junction connecting Padang Besar-Singapore and east coast Malaysia. This suggestion is based on the dry port SIP having a disadvantage of being located away from manufacturers and being affected by frequent flash floods in Segamat district close to the dry port. These issues have resulted in the loss in transport infrastructure lining to SIP (interview findings). With the new dry port Gemas, it will provide a transport link between east and west coast Malaysia and help to generate more containers from east-coast Malaysia especially from Kota Bharu, Kuala Terengganu and Kuantan to Port Klang, PTP or Penang Port. It not only increases the trade of Malaysian seaports located along the Malacca Strait but also boosts the trade from South China Sea.

6. Conclusion

This paper overviewed the Malaysian container seaport system and assessed the seaport-hinterland connectivity from the physical properties perspective including transport connections and inland freight facilities. Travel time between transport nodes in the hinterland and number of rail services were also provided for supporting the evaluation. The findings revealed that although Malaysian major container seaports are connected to the hinterlands through road and rail transport but are highly dependent
on road. These seaports are also connected to inland freight facilities such as dry ports and ICDs, which operate as a transit point to help connect exporters and importers in the hinterlands to seaports and facilitate regional and cross-border trades. This paper also identified challenges of Malaysia’s hinterland connectivity including an imbalanced modal share, insufficient rail capacity and limited services, road congestion and space constraints of inland facilities. It has recommended strategies for coping with the existing challenges of seaport-hinterland connectivity, in particular for road transport and inland facilities. These findings also help to expose new areas requiring further study within the Malaysian transport related sector.

As a seaport-hinterland network involves connectivity of physical infrastructure, institutions and people, the measurement of hinterland connectivity of container seaports should also be undertaken considering the institution and people dimensions, for example, how collaboration or coordination among the actors in the seaport-hinterland network can enhance the connectivity. This is an area worthwhile for further empirical study.

References


MALAYSIA FREIGHT TRANSPORT, (2012), Part of BMI’s industry survey and forecasts series. 85 Queen Victoria Street London.


THIRD MALAYSIA PLAN, (1976), Sectorial development
programmes, transport and communications. Kuala Lumpur Malaysia: Economy Planning Unit, Prime Minister’s Department.


UNESCAP, (2013), Monograph Series on Transport Facilitation of International Railway Transport in Asia and the Pacific, United Nation Economic and Social Commission for Asia and the Pacific.


