ปัจจัยในการเลือกด่านส่งออกสำหรับผู้ส่งออกยางพาราในจังหวัดตรังไปยังท่าเรือปีนัง

นางสาวชนิกานต์ แคล้วพันธ์

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MODE CHOICE SELECTION FOR RUBBER EXPORT: TRANG TO PENANG PORT

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การศึกษาครั้งนี้มีวัตถุประสงค์เพื่อวิเคราะห์ช่องทางการส่งออกยางพาราจากโรงงานในจังหวัดตรังไปยังท่าเรือปีนัง โดยการนำหลักการวิเคราะห์ต้นทุน (Cost-Model Analysis) มาพัฒนาและวิเคราะห์เพื่อแสดงให้เห็นถึงความสอดคล้องกันของต้นทุน และระยะทางของการขนส่งต่อเนื่องหลายรูปแบบ (Intermodal Transport) ในแต่ละด่านส่งออก ดังนี้ ท่าเรือกันตัง ด่านสะเดา และด่านปาดังเบซาร์ นอกจากนี้ยังมีการนำเอาเทคนิคกระบวนการลำดับชั้นเชิงวิเคราะห์ (The Analytical Hierarchy Process: AHP) มาประยุกต์ใช้ในการศึกษาครั้งนี้ด้วย โดยมีเกณฑ์หลัก 3 เกณฑ์ ดังต่อไปนี้ ปัจจัยด้านเศรษฐกิจ ปัจจัยด้านท่าเรือและด่านส่งออก และปัจจัยด้านการขนส่ง ซึ่งผลการวิเคราะห์แสดงให้เห็นว่า การเลือกด่านส่งออก ขึ้นอยู่กับการตอบสนองความต้องการของผู้ส่งออกเอง ที่คำนึงถึงปัจจัยและสภาพการณ์ของการส่งออก เมื่อพิจารณาเรื่องต้นทุน ผู้ส่งออกให้น้ำหนักในการเลือกส่งออกทางด่านท่าเรือกันตังมากที่สุด ผู้ส่งออกเลือกส่งออกทางด่านสะเดา เมื่อต้องการการขนส่งที่รวดเร็ว และ ด่านปาดังเบซาร์ เมื่อผู้ส่งออกคำนึงถึงความปลอดภัยของการเคลื่อนย้ายสินค้าเป็นสิ่งสำคัญ

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This paper analyzed the transport alternative routes for delivering rubber from Trang province to Penang port. A Cost-Model is used to develop and justify the correspondence of cost and distance of intermodal transport in each choice; Kantang port, Sadao border, and Padang Besar border. Then, the Analytical Hierarchy Process (AHP) is applied for this analysis. Effectiveness mode is evaluated through three main factors; economics, port/customs and transportation factors. The results show that Kantang port is the primary choice for exporters focusing on cost, Sadao border is the most attractive when focusing on time. Lastly, Padang Besar border will be considered as first when the safety of the product movement becomes most important.

Field of Study: Logistics Management Student's Signature .....

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INTRODUCTION

1.1 Problem statement

Rubber is one of the Top 10 export products of Thailand. In 2015, the majority of rubber was exported to China. About 56.6 percent of the total export was Standard Thai Rubber (STR) for use in the tire industry, 11.5 percent was concentrated latex for the Malaysian glove industry and 7.7 percent was ribbed smoked sheets (RSS) for the Japanese market (Kristanee Pisitsupakul, 2015).

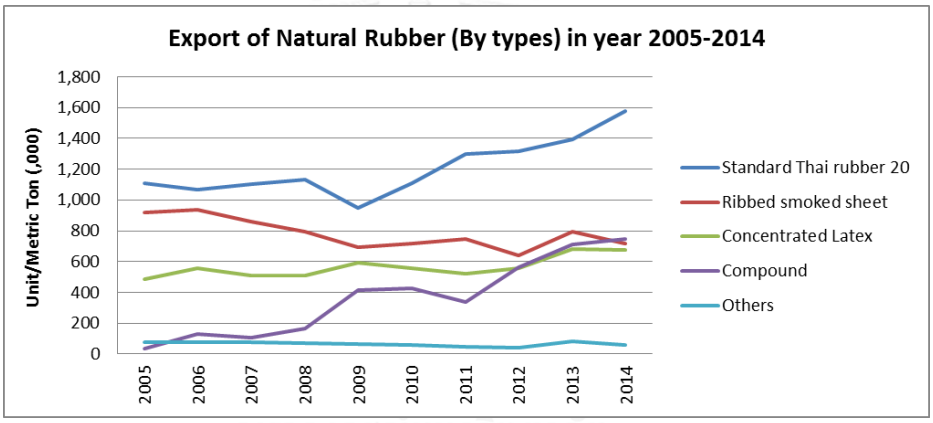

Figure 1 The export volume of natural rubber (by types) in year 2005-2014.

In 2015, the International Rubber Study Group (IRSG) has estimated the natural rubber demand that would be increased by about 12.4 million tons from the previous year. They also have forecasting the rubber export in 2016, by the cooperation among the private companies and the rubber manufacturing in three countries consist Thailand, Indonesia and Malaysia has measured the rubber exporting in the market that the export volume will keep increasing so it will makes the demand of natural rubber getting higher too (IRSG, 2015).

Table 1 The supply and demand of natural rubber in the world (Unit: Thousand Tons).

Year	2014	2015	2016
Supply	11,696	12,071	12,443
Demand	11,926	12,364	12,766
Net Balance	-230	-294	-323
Stock at the end of year	2,684	2,390	2,067

According to above mentioned, the natural rubber is one of the most important agriculture products of Thailand (IRSG & EIU, 2015). So, it is crucial to plan and manage the natural rubber export well. In particular, careful consideration must be given to the development of the transportation infrastructure which can lead to support the country's economics. At present, the natural rubber exported to areas such as South East Asia, Europe and others. These represent the most important customer groups and main trade partners. The majority of export is handled through the Bangkok port, Laem Chabang port and the ports in Malaysia. Of these, the Penang and Klang ports in Malaysia have been used most extensively for direct and transship vessel.

Malaysia is the country that is located the most close to the Southern Part of Thailand. With its long coastline, the country has seen rapid infrastructure development in terms of maritime transport. The Malaysian Government has been a primary driver in this development, with as aim to become the center of collection and distribution of cargo through their Penang and Klang ports. This is also achieved by utilizing feeder vessels through or via the ports of Tanjung Pelapas or Singapore.

The main ports in Malaysia are included Port Klang, Port of Tanjung Pelepas (PTP), Johor Port, Penang Port and Kuantan Port. As the resulted of higher container volumes generate in Asia. Malaysian ports have extremely invested in the infrastructure and port capacity expansion in expectation of increasing the containers volume to their country. Consequently, the rubber exporters in Thailand have exported their cargo via Penang port. The reasons of mainly loaded at Penang port regarding of the freight cost is quite cheap if compared with Songkhla port, Laem Chabang or Bangkok port.

Including with the distances between Trang and Penang port is close than ship via Bangkok port. There is also having many alternative routes from Trang province to Penang port that can make the rubber exporters save cost. For Klang port, even the freight cost is also cheap but the distances are quite far from border of Thailand. That makes the transport cost is high. Thus, most of rubber exporters in Southern Part of Thailand prefer to load the cargo at Penang port.

Port Klang is the largest port in Malaysia. Many shipping lines have service via Port Klang, they providing cheap freight cost but the inland cost is quite high due to long distances. Thus, most of the rubber exporters in the Southern Part of Thailand decided to export the cargo via Penang port.

Recently, the natural rubber exports have changed from bulk loaded to container loaded cargo. Last year an estimated 180,000 TEUs were exported. Thailand's rubber is exported through the Bangkok, Laem Chabang and Songkhla ports, some exported over Thailand border to the Penang port in Malaysia and the remaining containers volume was exported via some Thailand ports (Table 5).

The majority of Thailand's rubbers producers can be found in the Southern Part of the Country, with their products were loaded by barge vessel via Kantang Trang, trucked or railed via Multimodal Freight Padang Besar border, Songkhla Thailand.

Nevertheless, research shows that Thailand's domestic transport between the South East Coast and the Eastern areas are most efficiently done by using coastal vessels. This method offer lower overall costs when compared to other modes of transport (Suthiwartnarueput, 2000). This has been greatly supported by the improvement and development of coastal vessels and ports, and has resulted in greater efficiency between related countries.

1.2 Research question

What are the most influential factors when choosing a mode of transport to export rubber through the Penang port in Malaysia? This will serve as guideline to improvements that will lead to better service and support for rubber exporters.

1.3 Research objectives

1.3.1 To assess the factors those affect decision support system of rubber exporting in Trang Province of Thailand by using the Analytic Hierarchy Process.

1.3.2 To analyze the factors weights of each route in order to support the selected decision and assist in developing the border's performance.

1.3.3 To develop a Cost-Model for multimodal transport using each of the selected routes.

1.3.4 To elaborate on the appropriate mode for each situations of rubber exporting.

1.4 Scope of study

1.4.1 This research focuses on the rubber factories in the Trang Province by selecting 7 factories to be the respondents which are about 30% of all factories in Trang. The criteria are the factories that have shipments exporting via the Penang port, and being the highest top 7 in production volume by month. All factories in Trang are listed in Table 2.

1.4.2 This research consider only 20 TEUs which exported via 3 routes; Kantang port, Sadao border and Padang Besar border.

Table 2 Rubber Factories in Trang Province, Thailand.

Order	Company	Address	Authorized Capital	Products	Volume (tons/month)
1	Sri Trang Agro Industry PLC. (Sikao Branch)	139 Moo 2, Trang-Sikao Road, Na Muangphet Subdistrict, Sikao District	84,000,000	Standard Thai Rubber	10,000
2	Sri Trang Agro Industry PLC. (Trang Branch)	13/1 Jingjit Road, Tabtiang Subdistrict, Muang District	123,200,000	Ribbed Smoked Sheet	8,500
3	Thaitech Rubber Corporation Co., Ltd.	198 Moo 4, Trang-Sikao Road, Namuengpech Subdistrict, Sikao District	37,000,000	Standard Thai Rubber	6,000
4	Sri Trang Agro Industry PLC. (Trang Branch)	13/1 Jingjit Road, Tabtiang Subdistrict, Muang District	123,200,000	Field Latex	5,000
5	Unimac Rubber Co., Ltd.	112/1 Moo 1, Trang-Sikao Road, Natohming Subdistrict, Muang District	45,000,000	Ribbed Smoked Sheet	5,000
6	Sri Trang Agro Industry PLC. (Huaynang Branch)	399 Moo 7, Huay Nang Subdistrict, Huay Yod District	1,560,000	Standard Thai Rubber	4,500
7	Trang Latex Co., Ltd.	227 Moo 1, Phetkasem Road, Khaokao Subdistrict, Huay Yod District	45,000,000	Field Latex	3,500
8	Kwang Ken Rubber Co., Ltd.	164 Moo 1, Trang-Sikao Road, Natohming Subdistrict, Muang District	91,692,000	Field Latex	-
9	Num Rubber and Latex Co., Ltd.	173/4 Moo 3, Trang-Palian Road, Tapaya Subdistrict, Palian District	25,000,000	Field Latex	2,000
10	Para Rubber Co., Ltd.	55/5 Moo 2, Sikao-Kuankun Road, Kalase Subdistrict, Sikao District	17,900,000	Field Latex	-
11	Unimac Rubber Co., Ltd.	112/1 Moo 1, Trang-Sikao Road, Natohming Subdistrict, Muang District	33,270,000	Ribbed Smoked Sheet	-
12	Platinum Rubber Co., Ltd.	109-109/1 Moo 1, Namuengpech Subdistrict, Sikao District	194,500,000	Field Latex	2,500
13	Thawisap Rubber Co., Ltd.	155 Bangrak Road, Tubtiang Subdistrict, Muang District	38,000,000	Ribbed Smoked Sheet	1,000
14	Thai Union Rubber Co., Ltd.	59 Ploenpitak Road, Tubtiang Subdistrict, Muang District	6,000,000	Ribbed Smoked Sheet	700
15	Thungsong Sisawad Co., Ltd.	252/2 Moo 9, Trang-Palian Road, Tapaya Subdistrict, Palian District	110,000,000	Standard Thai Rubber	-
16	Thai Lam Heng Rubber Industry Co., Ltd.	31 Moo 5, Pak Khom Subdistrict, Huai Yot District	37,350,000	Field Latex	-
17	V.A. Rubber Co., Ltd.	80/2 Moo 5, Bang Pao Subdistrict, Kantang District	926,000,000	Field Latex	1,500
18	Ratsada Rubbertex Co., Ltd.	211, Moo 5, Pak Khom Subdistrict, Huai Yot District,	28,000,000	Field Latex	-
19	S.P.Latex Co., Ltd.	35 Trang-Palian Road, Tapaya Subdistrict, Palian District	23,000,000	Field Latex	-
20	Kwang Ken Rubber Co., Ltd.	164 Moo 1, Trang-Sikao Road, Natohming Subdistrict, Muang District	91,692,000	Crepe Latex	-
21	Thungsong Sisawad Co., Ltd.	252/2 Moo 9, Trang-Palian Road, Tapaya Subdistrict, Palian District	110,000,000	Crepe Latex	-
22	S.P.Latex Co., Ltd.	Moo 1, Yantakao-Nayong Road, Nhongbor Subdistrict, Yantakao District	23,000,000	Crepe Latex	-

1.5 Research procedures

1.5.1 Collecting and gathering the primary data and secondary data from interviewing, documents, and other research in this field.

1.5.2 Using pairwise comparison from AHP to compare the effectiveness of each route.

1.5.3 Weighing the criteria and ranking the criteria according to the weight calculation.

1.5.4 Analyzing and summarizing the mode choice criteria which affect the decision making.

1.6 Definition of terms

1.6.1 **Mode choice selection** is the decision making process by rubber exporters, determining by which route and mode they will ship the cargo to Penang port.

1.6.2 **Rubber** refers to the standard Thai rubber, compound rubber, ribbed smoked sheet rubber and field latex rubber which loaded in the 20 TEUs and export from Thailand to other countries only.

1.6.3 **Trang** is one of the provinces which located in Southern Part of Thailand. This research will focus on the rubber exporters in Trang province.

1.6.4 **Penang port** is one of the main ports in Malaysia. This research will study only the container loaded from Thailand border and was discharged at Butterworth Wharfs, Penang port.

1.7 Conceptual framework

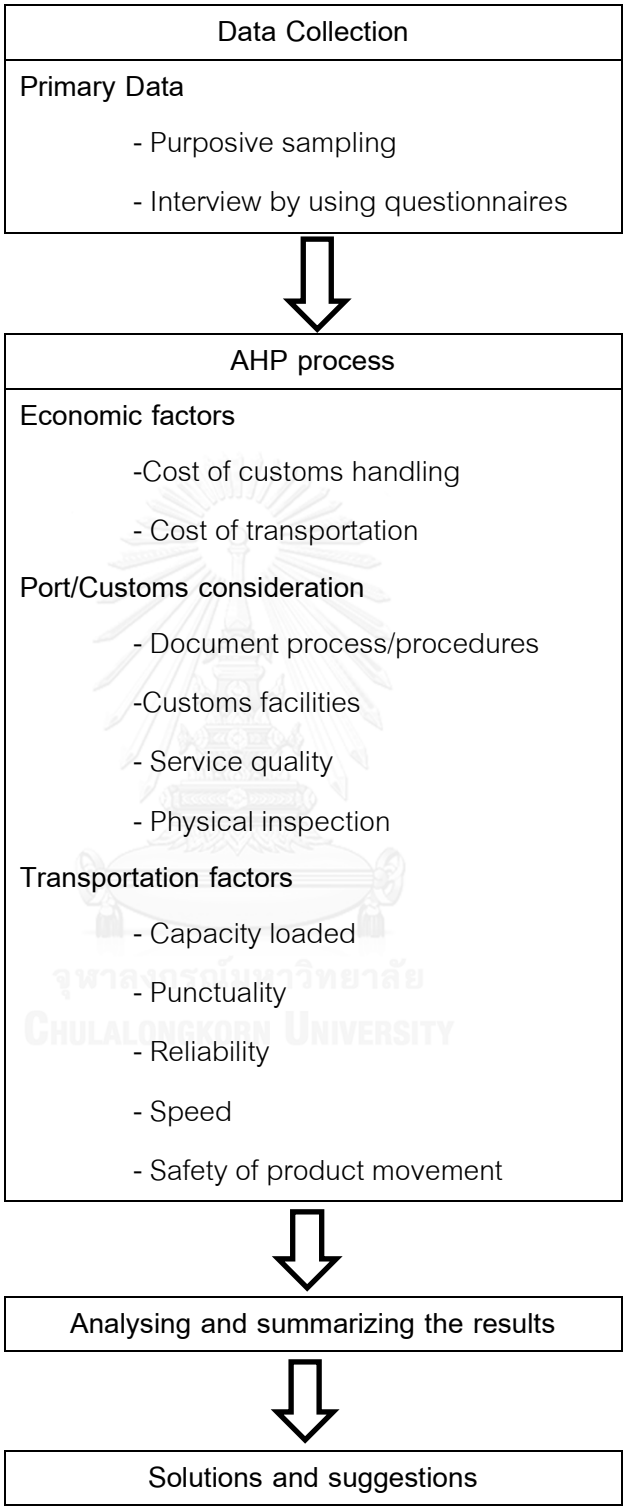

Figure 2 Conceptual Frameworks

1.8 Expectations

1.8.1 Understand the rubber export situation in Southern Part of Thailand.

1.8.2 Understand and able to distinguish the difference of mode performance.

1.8.3 The results of this research can assist:

1.8.3.1 Rubber Suppliers in making a decision on the best mode of transport;

1.8.3.2 Transporters to develop better services to these suppliers; and

1.8.3.3 Government to increase capacity and improve service delivery at borders and ports.

This will lead to Thailand's rubber Industry reaching its high potential and being a competitive player in the global market.

CHAPTER II
LITERATURE REVIEW

In this research emphasizing on the rubber exporting which export via mode choices; Kantang border, Padang Besar border and Sadao Border only. As the review before in 1st chapter, it needed to understand the rubber general details especially rubber export situation, export pattern, problem and threats of suppliers in each mode which will be described as follow:

2.1 Natural rubber

Rubber tree has to plant around 5-6 years growing before become mature rubber and can start tapping. The rubber yield will be come out almost every month unless the rainy day or fall season. The rubber has much around the end of the year until February regarding of the raining season which completely with nutrition in soil. After that the rubber will be reduced in March to April regarding the fall season, it will leave the leaf and the rubber will come only less. The weather is one of the important factors that affect the rubber yield. So, the farmer will stop tapping during that period in order to restore the rubber and they will return the tapping on May to September.

The tap latex can be estimated around 90 percent to transform to be ribbed smoke sheet, Thai standard rubber, crepe and the last 10 percent turns to the concentrated latex (FAO, 2015).

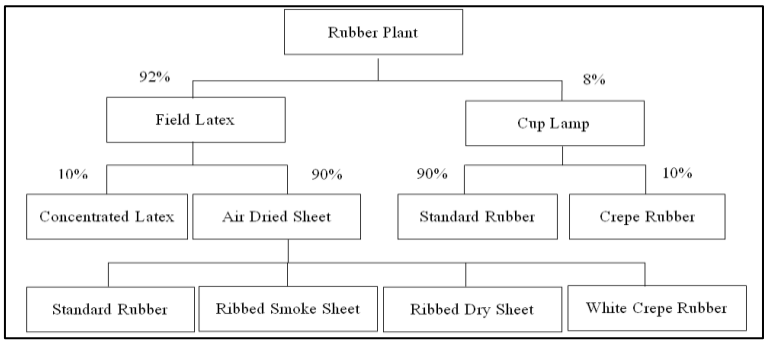

Figure 3 The rubber plant productivity.

2.2 Rubber export situation

The production volume in 2013 has been reached 4 million tons; it was a first round in many years after the production has reduced regarding the drought season, the political issue, the protesting, or even the rubber price in the down trend which not persuade the farmer. However, the rubber price in past 10 years is in the high level and government policy that support the cultivated area expansion especially in the Northeast of Thailand (Table 3).

Table 3 Production of Thailand natural rubber in 2007-2013 (Unit/Tons).

Year	Production	Export	Domestic Consumption	Stock
2007	3,056,005	2,703,762	373,659	230,390
2008	3,089,751	2,675,283	397,595	251,721
2009	3,164,379	2,726,193	399,415	293,659
2010	3,252,135	2,866,447	458,637	227,252
2011	3,569,033	2,952,381	486,745	361,557
2012	3,778,010	3,121,332	505,052	516,675
2013	4,170,428	3,664,941	520,628	502,855
2014	4,323,975	3,770,649	541,003	516,576

Source: Rubber Research Institute Department of Agriculture, 2014.

In the same time, some countries have expanding their cultivated area particular in the China. China has expanded around 2.6 hundred thousand Rai a year and also investing in Cambodia, Laos, Myanmar and Vietnam. It affects the world rubber production is getting higher in 2014.

Table 4 Rubber exporting by country of destination in 2014. (Unit/ Tons)

Year	China	Malaysia	Japan	Europe	U.S.A	South Korea	Others	Total
2007	827,369	413,049	405,599	262,182	213,080	151,824	430,659	2,703,762
2008	824,833	398,043	394,742	249,509	219,986	154,340	433,830	2,675,283
2009	1,160,339	480,313	256,984	245,589	156,069	133,079	293,820	2,726,193
2010	1,128,553	443,000	346,302	268,693	177,859	171,530	330,510	2,866,447
2011	1,274,188	344,589	333,669	223,938	205,410	186,634	383,953	2,952,381
2012	1,630,322	353,501	269,418	179,302	172,577	181,403	334,809	3,121,332
2013	2,075,776	421,408	281,091	205,498	145,638	183,466	352,064	3,664,941
2014	2,142,199	406,025	256,578	231,053	146,794	188,675	399,325	3,770,649

Source: Rubber Research Institute Department of Agriculture, 2014.

From the table above can see that China is the biggest rubber consumer in the world which demand is getting higher every year. Even the overall image of the rubber consumption in the world seems slightly down regarding the economic and rubber price drop down for many years but the rubber market still sustainable. The tyres manufacturing still be in uptrend even it might dropped some time when the rubber price is down (Kristanee Pisitsupakul, 2014).

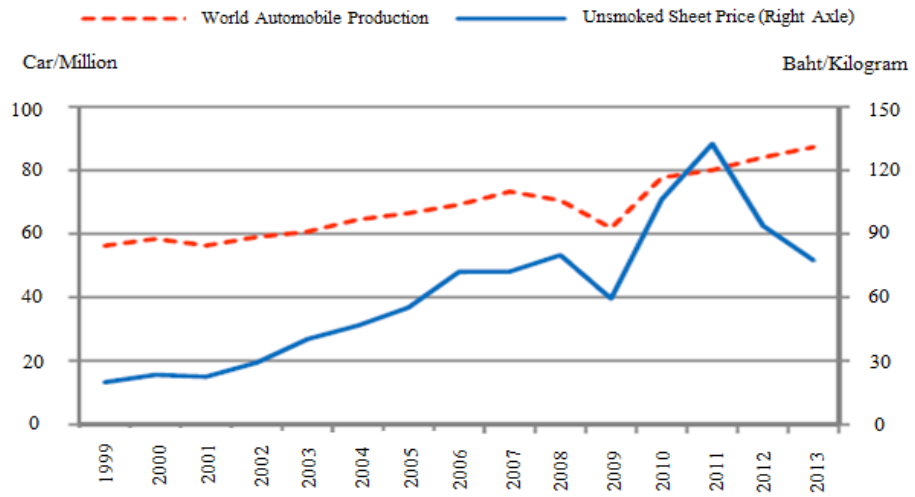

Figure 4 The car manufacturing volume comparing with Thailand Rubber Market Price.

2.3 Border and port of Thailand for exporting the rubber

Thailand has many borders and ports which represent the export and import volumes of Thailand. The export and import volume can represent the Thailand economy. As table 5 has shown the rubber export volume via Thailand port or borders which can represent the rubber export situation TRA (2014).

This research will impose the borders which relevant to Penang port comprising 3 of the borders; Kantang border, Sadao border and Padang Besar border only. Another borders showing in above table have not delivered the cargo via Penang port. The vessels will transship or via any other ports or direct to the destination ports.

Table 5 The rubber export volume via ports/borders of Thailand (Unit: Tons).

Year	Laem Chabang	Padang Besar	Sadao Border	Bangkok Port	Songkhla Port	Phuket Port	Others	Total
2007	362,044	1,141,981	384,305	233,832	275,366	88,366	217,868	2,703,762
2008	492,384	1,101,117	373,574	173,295	290,888	92,585	151,440	2,675,283
2009	586,087	1,065,990	385,916	156,739	240,138	97,781	223,542	2,756,193
2010	701,371	1,128,393	394,967	168,599	171,400	62,151	239,566	2,866,447
2011	754,365	1,140,848	385,016	164,515	203,225	75,527	228,885	2,952,381
2012	742,961	1,140,591	399,274	271,313	256,232	69,223	241,738	3,121,332
2013	896,033	1,117,164	663,031	477,906	250,177	43,157	327,473	3,774,941
2014	1,101,050	1,054,480	554,042	507,513	156,121	36,973	360,470	3,770,649

Source: Rubber Authority of Thailand, 2014.

2.3.1 Kantang pot

Kantang porder is the customs border located near the coastal of Andaman Sea in Trang province of Thailand. In the past, there was only customhouse in charge by the Revenue Department, Ministry of Interior. In 1918, the Kantang customhouse was established to be Kantang Customs Border and there is a chief immigration officer was assigned to conduct the customs border. The Kantang Customs Border can be counted as the one of the oldest customs in Thailand about 82 years.

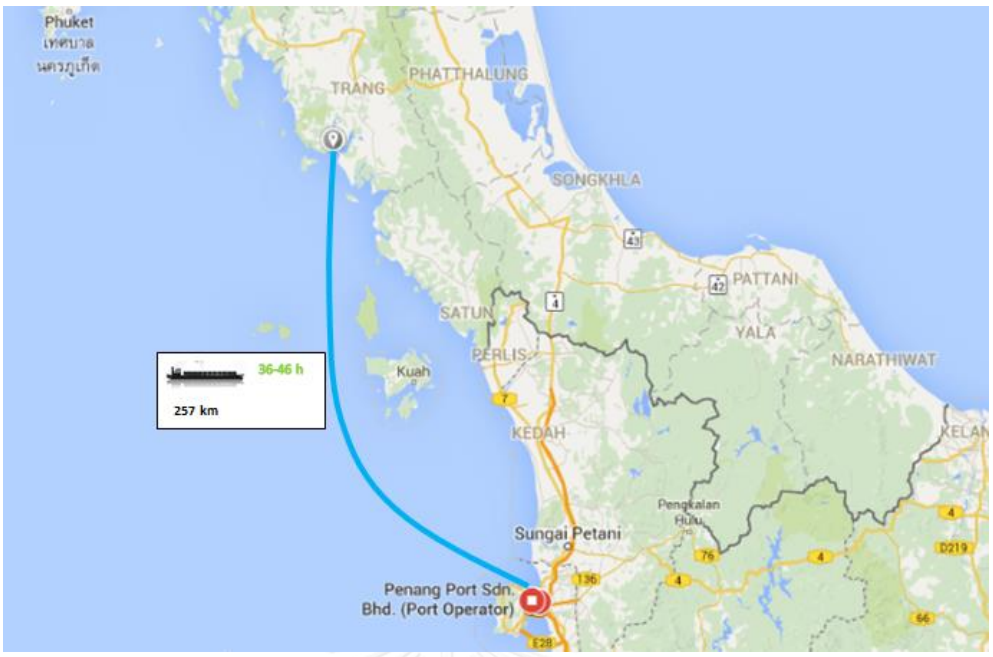

Figure 5 The transportation route from Kantang border to Penang port by barge vessel.

2.3.2 Sadao border

Sadao customs was established on 1919. This is one of the oldest customs which located in Thailand border. There is closed to Bukit Kayu Hitam in Malaysia. The Sadao customs missions comprising the import and export duties, investigating he immigration both people and transportation, protecting the goods import bring into the kingdom with any unpaid tax, supporting and being as consultant for the exporters.

Furthermore, Sadao customs is the main division which has authorized to negotiate with Malaysian customs in order to support the import and export activities and the tourism for both countries.

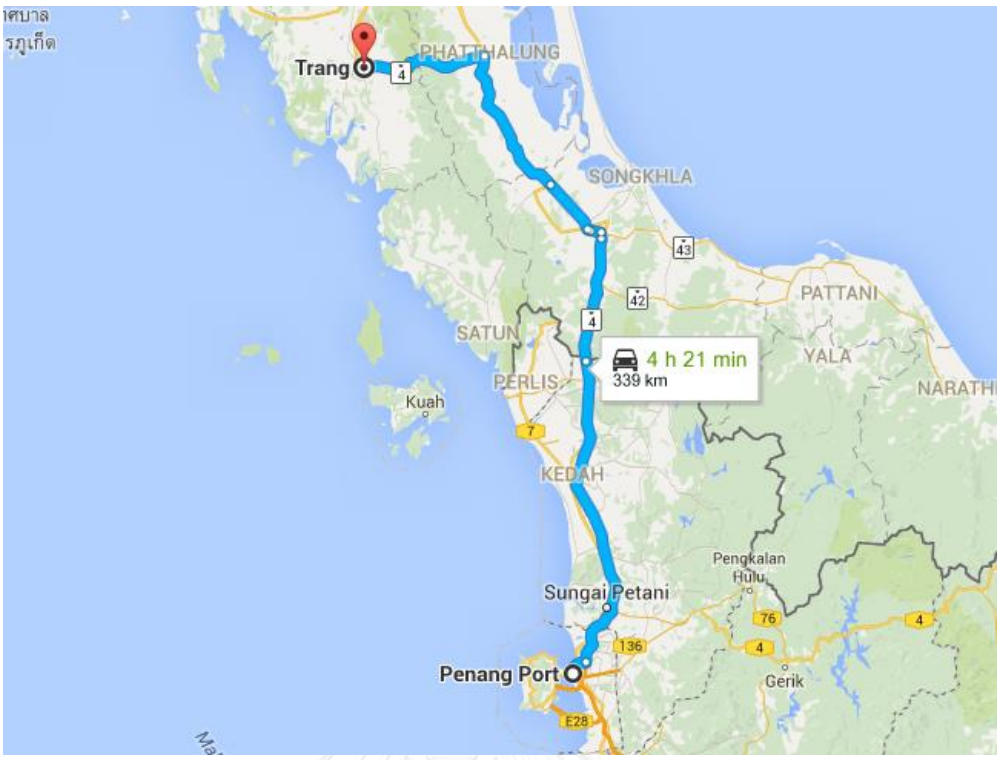

Figure 6 The transportation route from Trang to Penang port via Sadao border by truck.

2.3.3 Padang Besar border

Padang Besar is the land-border located in the Northern part Perlis in Malaysia and Songkhla province in Thailand. This border was found on July 1, 1918. In 1938, they were established to be Padang Besar border by developing the joined area around the train stations in both countries according to the Ministry of Finance, Thailand. This corporates between Thailand and Malaysia Government has the main purpose for supporting the rail transportation among Siam and Kelantan, Kedah, Perlis and Federation of Malaysia.

Padang Besar has the direct rail link between Malaysia and Thailand. The majority of cargos were held by the trucks and trans loaded to rail in order to deliver to Penang port, Malaysia. Even they have the rail-to-rail facilities but it does not famous as truck-to-rail. The rail container yard and operational inside the border was operated by Malaysia Railway. So, Thai shipper can pick up empty containers and return containers at the gate by conducting the customs clearance and after that Malaysia railway will be the responsible person to handle the laden containers.

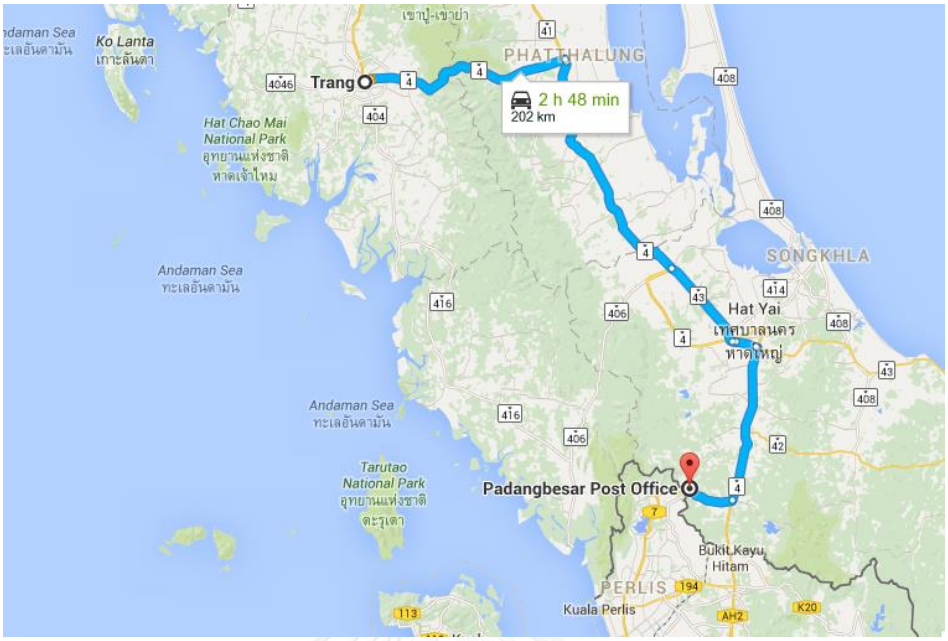

Figure 7 The transportation route from Trang province to Padang Besar border by truck.

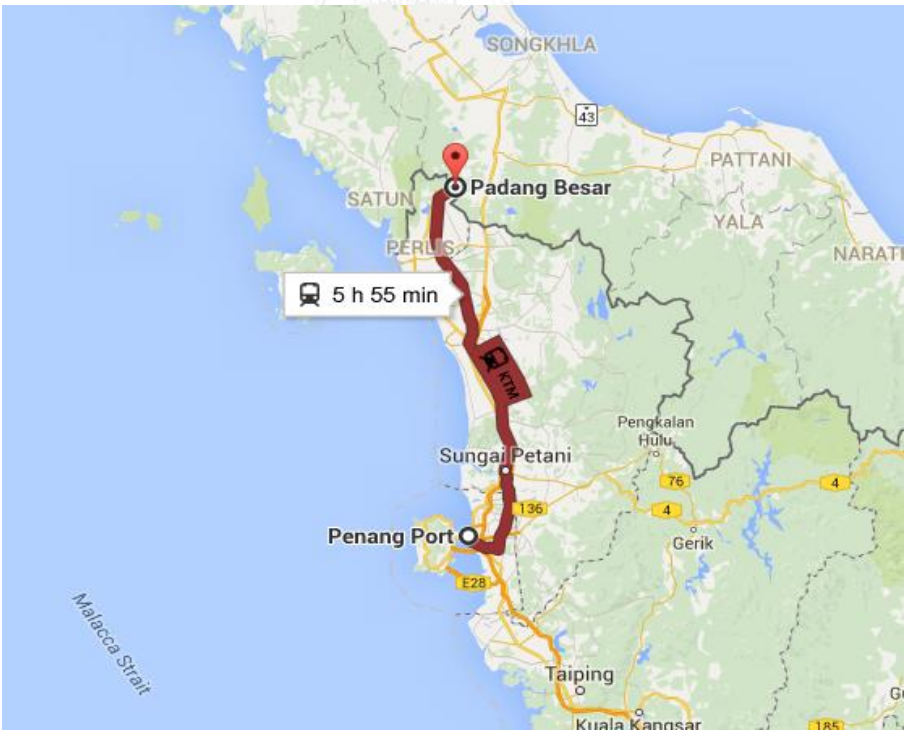

Figure 8 The transportation route from Padang Besar border to Penang port by rail.

2.4 Mode choice decision

The alternative of transport mode or coalition of transport modes has a direct influence on the efficiency of logistics system and channels. Beresford and Dubey has studied and adapted the cost model, which represents in the Figure 9. The figures comprise many transport modes; road, rail, inland waterway, sea and intermodal transfer (ports, rail-freight a terminal, inland clearance depots) as a cost component (Beresford & Dubey, 1990).

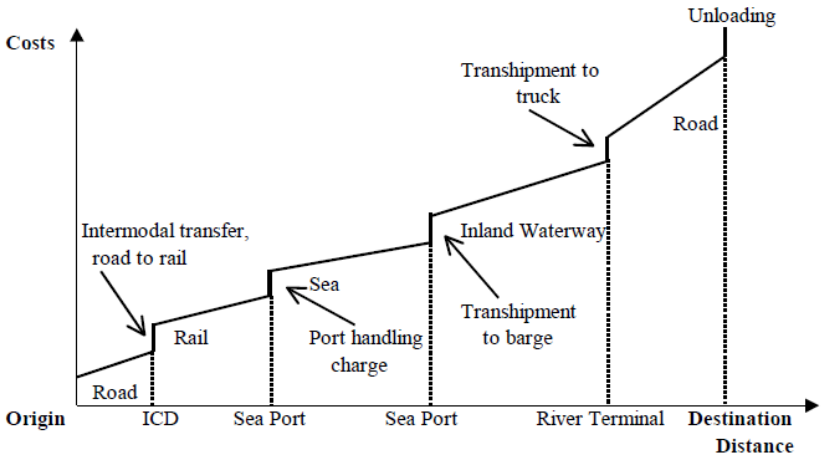

Figure 9 Cost-model for multimodal transport

The figure 9 is based on the assumption that unit costs of transport alter between modes, with the steepness of the cost bends indicating the fact that, for volume movements, sea transport should be the route that represents the cheapest cost per ton-km, road transport should generally be the most expensive, waterway and rail costs should be in the intermediate range. At inland terminals and ports of loading, a freight handling charge is imposed without any progresses being made together with the supply chain; a vertical “step” in the cost bend hence represents the costs encountered there.

2.5 The factors influence decision making

In the antecedent, the process facilitated for cargo movement can be either in break bulk or in container, and transport by road or rail (Ravibabu, 2013). The alternatives of transport mode or coalition of transport modes has a direct influence on the efficiency of logistic systems and channels. Beresford & Dubey have studied and adapted the cost model, which is represented in Figure 9. This comprises many transport modes: road, rail, inland waterway, sea and intermodal transfer (ports, rail-freight a terminal, inland clearance depots) as a cost component.

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To carry goods by using at least two different modes of transport is called multimodal transport (UNCTAD, 2001). There is study of Laotian garment exporters, which compares the cost in each kind of multimodal transport from Vientiane in Lao PDR to Singapore. 4 routes were analyzed; “Road-Sea” via Danang (Vietnam), “All-Road” via Bangkok (Thailand), “Road-Sea” via Bangkok Port and “Road-Rail-Road” via Lad Krabang (Thailand). The research result showed that the “Road-Sea” via Bangkok Port is the most competitive in terms of cost whereas the “All-Road” is the best option for the fastest transit time (Banomyong & Beresford, 2001). Whereas another studied of the feasibility of exporting natural rubber via coastal shipping by focus only the exporting from Songkhla Seaport through Laem Chabang Seaport. The factors examine influencing the shippers’ decisions on route choices and the obstacles encountered.

The result reveals that this route has not possessed sufficient competitive advantage (Ahuwari, 2004).

Obviously, each of the transport modes have different of strengths and weaknesses, at the mean time will effect with the effective of logistics channel directly (Liberatore & Miller, 1995). The allotment of freight amongst transport modes, frequently called modal split, has been one of the most contentious topics in the field of transport logistics because the decision making cannot be made base on principles or the ideology only, but it depends on other factors that influence the trade (Mckinnon, 1989).

The decision making in mode choice and transportation routes depend on many factors. Many researches revealed that logistics cost, operations, customer relationship, quality, response, company image, transit times, reliability, flexibility, pilfered and damaged goods, shipper market consideration and carrier considerations are the factors that are commonly concerned by the exporters (Banomyong, 2001; Chinrungroht, 2006; Mcginnis, 1989; Snaddon, 2000). Moreover, the environment trend was also considered (Chanpuypetch & Kritchanchai, 2009b).

Apart from that, the topography, the density of transport network, the size of country, the community dispersion, the economic infrastructure, the investment, the tax and the environment safety were also considered as factors that influence the decision. In the meantime, the service level would be the main concern for choosing the truck carrier (Soontronwut, 2010). Despite those factors were considered but it cannot refer to the optimal route or best choice of the decision regarding of the selection may be changed upon the different circumstances (Chanpuypetch & Kritchanchai, 2009a).

Furthermore, next to the transportation route of cargo export, there is also the choice of port. The factors that influence the port choice from the Southeast Asian Freight Forwarder's perspective are considered the following: frequency of ship visits, operational efficiency, adequacy of port infrastructure, location, competitive port charges, quick responsiveness to port users' needs and port's reputation for cargo damage (Tongzon, 2009).

2.6 The Analytical Hierarchy Process

The Analytic Hierarchy Process (AHP) is a multi-criteria decision making approach. The AHP has attracted the attention of many researchers mainly caused the good mathematical properties of the techniques and the fact that the required input data are not too hard to be gathered. AHP comprises a multi-level hierarchical structure of objectives, criteria, sub-criteria, and alternatives. The elementary principle of AHP is a simplification of a complicated issue that is not structured, dynamic and strategic to be parts and arranged in a hierarchy.

The relevant information is obtained by using a pairwise comparisons set. These comparisons are conducted by weighing of importance of the decision criteria, and the relative performance and structure measures of the alternatives in terms of each individual decision criterion. The weighing must obtained from a few expert respondents.

AHP can measure the consistency of judgement in case the deviation is too incomparably from the value of complete consistency, which shows the hierarchy of assessment needs to be repaired or must be re-structured (Saaty & Vargas, 1994).

Table 6 Factors affecting the selection of mode choice reviewed.

	Author/Year / Factors	2001 Banomyoung, R.	2009 Jose L. Tongzon	2013 M.Ravibabu	2000 D.R. Snaddon	2009 Kritchanchai and Chanpuypetch	2014 Korndnejad B.	2014 Reis V.	2014 Shi et al.	1979 McGinnis	1974 Farouk A.	1998 Eirik	2003 Vannieuwenhuyse	2014 Hyun-Chan Kim	2006 Krongkwan
1	Adequate infrastructure		x												
2	Average of vehicle speed								x						
3	Capacity loaded					x									
4	CO2 emissions						x								
5	Container volume								x						
6	Cost of shipping agent														
7	Cost of terminal handling						x								
8	Cost of transportation												x	x	
9	Logistics cost	x		x	x	x		x		x		x			x
10	Customs procedures					x									
11	Customs facilities														
12	Document process at customs														
13	Customs leading time														
14	Distance	x													
15	Efficiency		x												
16	Flexibility				x			x					x		
17	Frequency of transport		x												
18	Insurance policy					x									
19	Loading space utiliztion						x								
20	Location		x												
21	Long haul costs														
22	Punctaulity					x					x				
23	Quality of service				x						x	x			x
24	Quality of transport route					x									
25	Reliability	x				x		x		x	x		x		
26	Respositiong charges				x										
27	Response														
28	Rule of international trade					x									
29	Security of products movement					x				x		x	x	x	
30	Short haul costs														
31	Transit time	x		x				x		x	x	x	x	x	x
32	Transportation distance								x						
33	Transportation time					x									
34	Waiting time to be loaded								x						
35	Customs accessibility					x									
36	Service level													x	
37	Monitoring														
38	Legth of haul														
39	Physical inspection at customs														
40	Speed									x	x				
41	Company policy									x					
42	Extermal market influences									x					
43	Accesicility													x	
44	Suitability													x	

CHAPTER III
METHODOLOGY

Refer to Chapter 2 has mentioned to the theory of the Analytical Hierarchy Process (AHP). There will represent the procedures and method as the follow diagram:

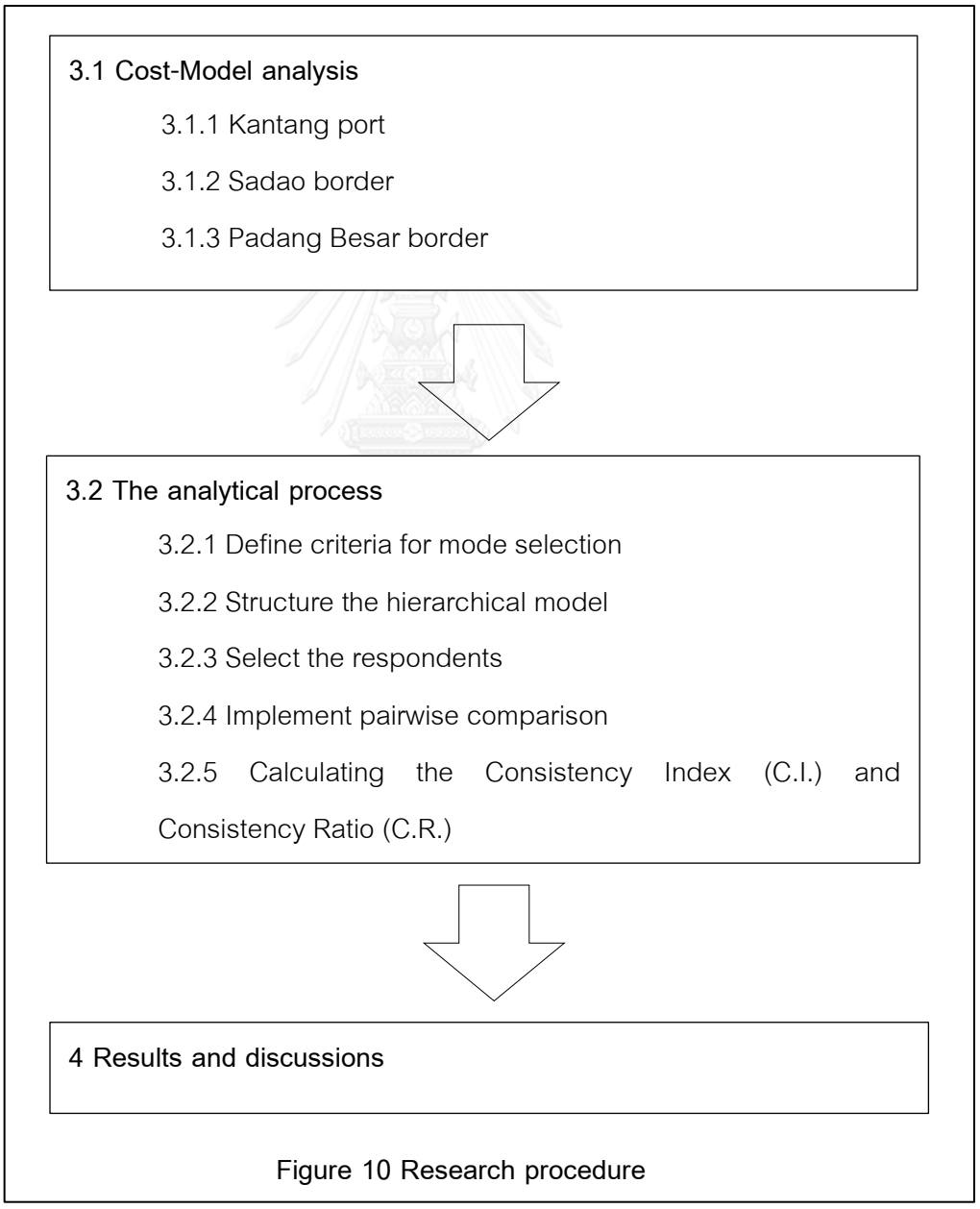

Figure 10 Research procedure

3.1 Cost-Model analysis

This research focuses on the decision making process for rubber exporting as container loaded from the Southern Part of Thailand to Penang port by determining the factors that influence this process. Routes options considered were shown as Figure 11.

- Kantang port, Thailand
- Sadao border, Thailand
- Padang Besar border, Thailand

The problems encountered can be analyzed to provide a framework to improve and develop Thailand's border exports. In determining these factors, the less weight factor should be concerned and improved the capability and performance in each mode.

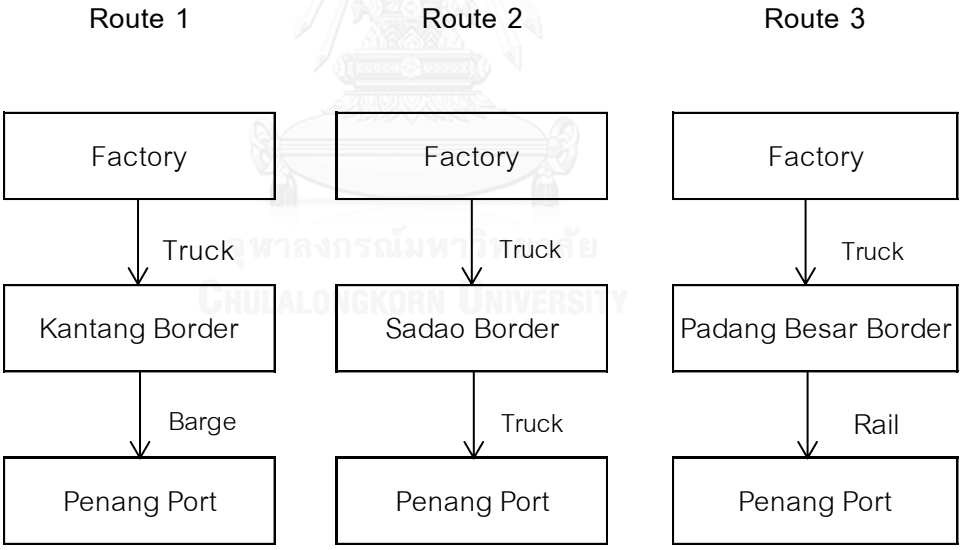

Figure 11 Mode routing choice

Moreover, this research has also analyzed the Cost-Model in each three routes to be the supporting evidences for the exporters. Distances, transit time, and cost were analyzed together.

Figure 12 Kantang Border, Sadao Border, Padang Besar and Penang Port map

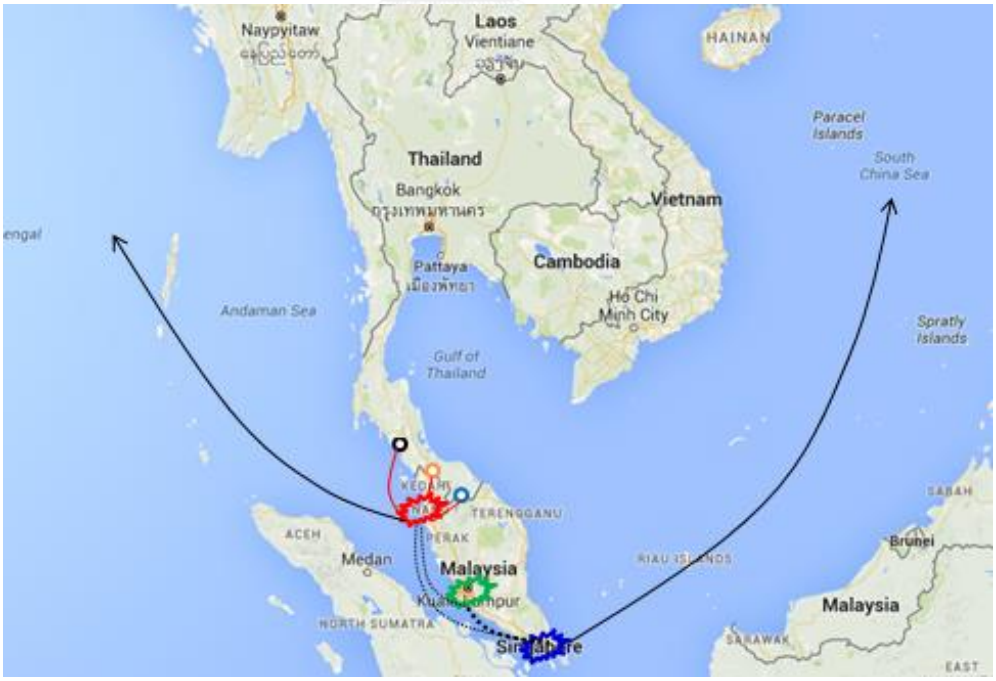

Figure 13 Kantang border, Padang Besar border, Sadao Border, and Penang Port routes

In this analysis, we collected the total cost and break into transportation cost, customs charge and other charge in order to analyze the details as in table 7-9. Moreover, the distance was bringing to analyze together with the transportation cost, so we can figure the cost per kilometer for each route. Then we bring this value to plot the graph and see how the steepness of the curve is.

Table 7 show clearly that the transportation cost from the factory to Kantang port is cheaper than other mode but regard the distance in this mode is near to the factory in Trang that make this mode has highest cost per kilometer with 167.57 Baht/km. The cost per kilometer of Sadao border and Padang Besar border has slightly difference.

Comparing the cost per kilometer from the border to Penang port, we can see that Sadao border represent the most expensive mode regarding all of the containers were delivered by truck whereas Kantang port using barge vessel and Padang Besar border using rail.

Table 7 The transportation cost from origin to destination.

Mode Choice	Origin	Destination	Distance	Cost	Cost (Baht)/KM
Kantang port	Trang	Kantang	23	3,808	165.57
	Kantang	Penang	257	9,300	36.19
Sadao border	Trang	Sadao	203	10,053	49.52
	Sadao	Penang	139	9,500	68.35
Padang Besar border	Trang	Padang Besar	213	10,087	47.36
	Padang Besar	Penang	171	5,410	31.64

In table 8, the other charges refer to following cost;

- The administrative cost
- Shipping and forwarding cost

The customs charge including with;

- Customs clearance at border
- EDI fee & Seal fee
- Lift on-Lift off charge (LOLO)

Table 8 The other charges and customs charges.

Mode Choice	Other charge	Customs charge
Kantang port	3,200	1,980
Sadao border	2,065	4,935
Padang Besar border	1,500	4,298

Total cost is showing in table 9 as below. Kantang port is the cheapest mode and following with Padang Besar border and Sadao border respectively.

Table 9 The total cost and distances of each alternative.

Mode	Kantang port	Sadao border	Padang Besar border
Total cost (Baht/20'GP)	18,288	26,553	21,295
Distance to Penang Port (km)	257	342	384

3.1.1 Kantang port

This routing was held by intermodal transportation, its delivering began at the factories to the Kantang border by truck and trans loaded to barge vessel. The estimated total lead time to ship via Kantang border is about 8-14 days starting from pick up empty containers and returns the laden containers to Penang port.

In Figure 14, there is a short distance between the factories in Trang and Kantang border. It takes around 2-4 hours for driving. Meanwhile, the routing between Kantang port and Penang port is taking long time due to the speed of the barge vessel.

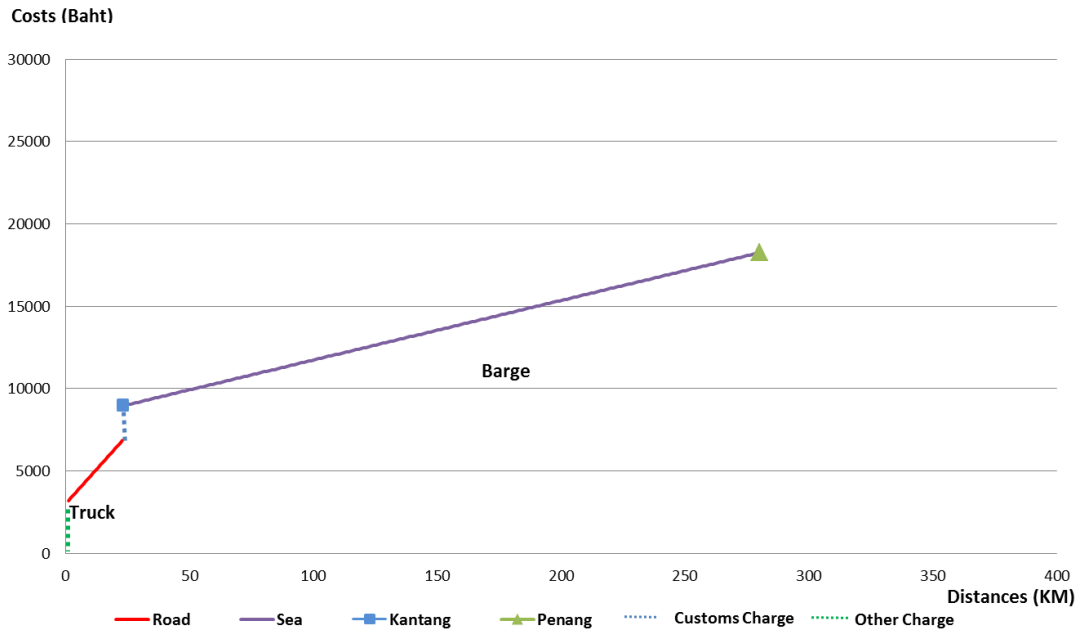

Figure 14 Transportation Cost-Model from Trang to Penang port via Kantang port.

3.1.2 Sadao border

As shown in figure 15, this routing is held by truck only. The starting point is in the factories in Trang, directed to and dropped at Sadao customs house. They need to declare and submit customs documents, change the tractor trailer from Thailand registered number to be Malaysia registered number and then head to Penang port.

The estimate leading time for transport via this route take around 2-4 days for picking up empty containers from Sadao border and returning the laden containers to Penang port.

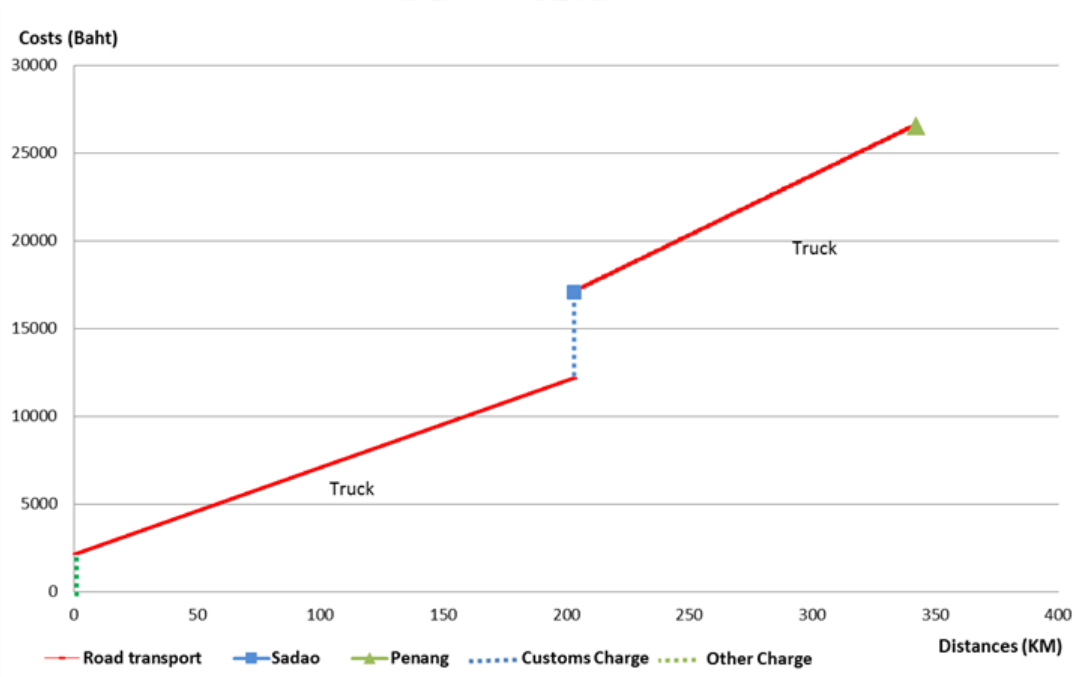

Figure 15 Transportation Cost-Model from Trang to Penang port Sadao border.

3.1.3 Padang Besar border

This routing is held by intermodal transportation, it began with truck and then trans loaded with rail at Padang Besar border in figure 16. At the Padang Besar border, the cargoes were held by Malaysian Railway called Kereta api Tanah Melayu (KTM) to the Penang port.

All the containers handling is managed by Malaysian side. The estimated leading time is about 5-7 days. The empty containers are picked up from a depot in Malaysia and the laden containers are returned to Penang port.

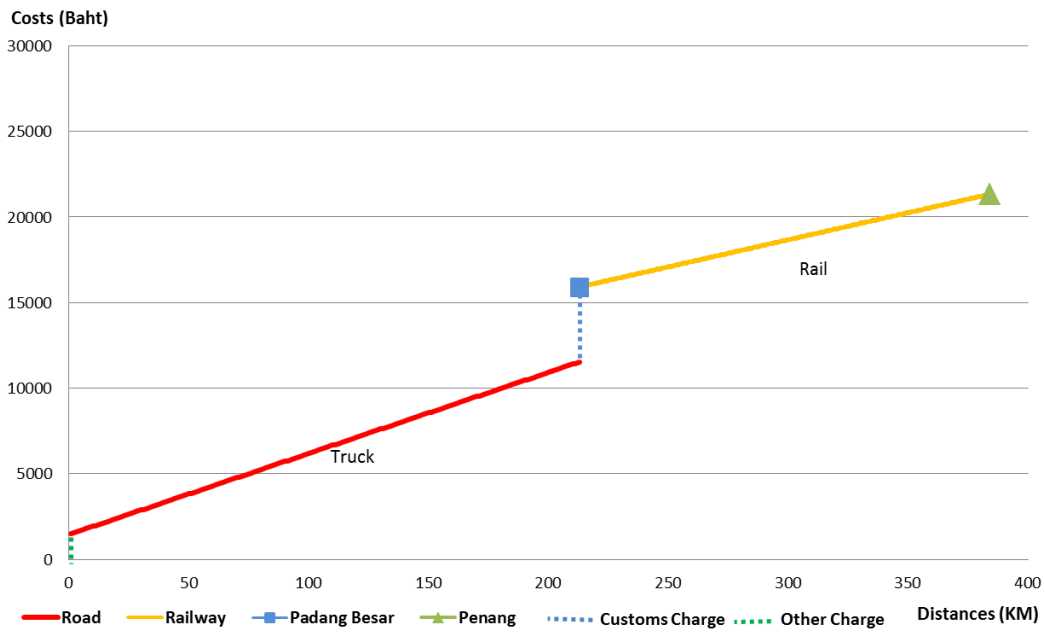

Figure 16 Transportation Cost-Model from Trang to Penang port Padang Besar border.

However, the decision making is not depending on distance or cost only. There are many other factors needed to be assessed for finding the optimal alternatives and control the restriction of this model to be less.

3.2 The Analytical Hierarchy Process (AHP)

3.2.1 Define criteria for mode selection

To define the criteria for this study, it will conducted from the literature review and interviewed by relevant party in the rubber industry in order to generate only the factor that affect in this industry. After the factors were screened and selected, the description of each factor were described as table 10.

Table 10 The factor's description for the mode selection.

Factors	Description
Cost of customs handling	The customs/border handling charge, lifted on-lifted off (LOLO) charges
Cost of transportation	Barge, truck, rail or haulage charge for round trip
Document process/procedures	The time for handling paper or document declaration at customs gate
Customs facilities	The sufficient availability of equipment and infrastructure inside the customs/border. The number of cranes/wagons/labour/barge vessels.
Service quality	Service level, the responsiveness, the efficiency of operation, the flexibility of operation support.
Physical inspection	The checking time of cargo in customs. The process of checking container number and seal numbers.
Capacity loaded	The volume loaded per trip.
Punctuality	The punctuality of the transporter: barge, truck, rail.
Reliability	The reliability of the transporter or the shipping agent.
Speed	Transportation distances, transit time, average of vehicle speed.
Safety of product movement	Quality of transport routes such as the road roughness, the pilferage during delivery

3.2.2 Structure the hierarchical model

This phase needed to build the AHP hierarchy model and calculate the weight of each levels of mode selection. As figure 17, the hierarchy model is developed based on the criteria and alternatives. The goal of this research is identified in first level. The second level identified the criteria which consist: Economic, Port/Customs, and Transportation factors. The third level is sub criteria consists cost of customs handling, cost of transportation, document process and procedures, customs facilities, service quality, physical inspection, capacity loaded, punctuality, reliability, speed and safety of product movement. The lowest level of the hierarchy comprises of three choices as follows; Kantang Port, Sadao border and Padang Besar border.

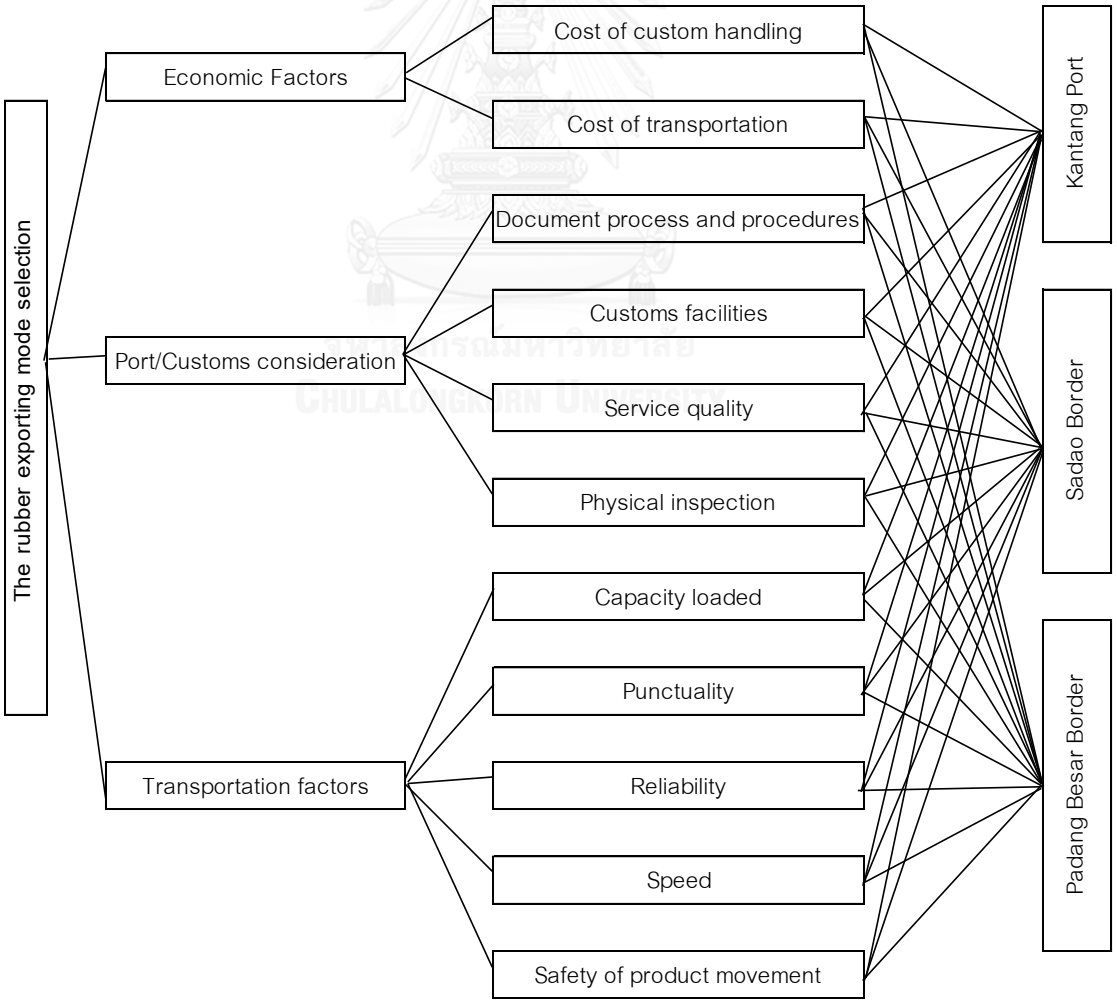

Figure 17 The analytical hierarchy process of mode selection.

3.2.3 Select the respondents

There are total 22 companies of rubber manufacturers in Trang province of which 7 have been selected as the sample because of two reasons: they have the highest production volumes per month and they have shipments loaded at Penang port as table 11.

Table 11 The selective respondents for surveying.

Order	Company	Authorized Capital	Products	Volume (tons/month)
1	Sri Trang Agro Industry PLC. (Sikao Branch)	84,000,000	Standard Thai Rubber	10,000
2	Sri Trang Agro Industry PLC. (Trang Branch)	123,200,000	Ribbed Smoked Sheet	8,500
3	Thaitech Rubber Corporation Co., Ltd.	37,000,000	Standard Thai Rubber	6,000
4	Sri Trang Agro Industry PLC. (Trang Branch)	123,200,000	Field Latex	5,000
5	Unimac Rubber Co., Ltd.	45,000,000	Ribbed Smoked Sheet	5,000
6	Sri Trang Agro Industry PLC. (Huaynang Branch)	1,560,000	Standard Thai Rubber	4,500
7	Kwang Ken Rubber Co., Ltd.	91,692,000	Field Latex	3,500

3.2.4 Implement pairwise comparison

The respondents can weigh the factors in pairwise comparison in the format as table 12. The scales of number were described as the relative importance showing as table 13 which developed by Saaty.

Table 12 The sample of comparing factors table.

Comparing the factors																		
Factor 1	9	8	7	6	5	4	3	2	(1)	2	3	4	5	6	7	8	9	Factor 2
Factor 1	9	8	7	6	5	4	3	2	1	(2)	3	4	5	6	7	8	9	Factor 3
Factor 2	9	8	7	6	5	4	3	2	1	2	(3)	4	5	6	7	8	9	Factor 3

Table 13 Scale of relative importance (Saaty, 1980).

Intensity of Importance	Definition	Explanations
1	Equally important	Two activities contribute equally to the objective
3	Slightly more important	Experience and judgement slightly favour one activity over another
5	Essential or strongly important	Experience and judgement strongly favour one activity over another
7	Very strongly important	An activity is strongly favoured and its dominance demonstrated in practice
9	Extremely more important	The evidence favouring one activity over another is of the highest possible order of affirmation
2,4,6,8	Intermediate values	When compromise is needed

After the pairwise comparison judges as table 15, then the computation of a vector for priorities or weighing of the elements in the matrix must be process in table 16-17. The comparison of the alternatives and the criteria were paired into the squared matrix in each level and then analysed following the hierarchy structure.

3.2.5 Calculating the Consistency Index (C.I.) and Consistency Ratio (C.R.)

For C.I., referring to the table 14 which collecting by Oak Ridge National Laboratory and team, it depends on the Matrix size from 1x1 to 15x15 as below;

$$C.I. = (\lambda \text{ max} - n) / (n-1)$$

All comparisons need to be completely consistent. So, it need to be checked the comparison results whether it conform to the reason or not by using the following formula;

$$C.R. = C.I./R.I.$$

If the result is C.R. $\leq$ 0.10 (or 10%) can be accepted, but if the result is C.R. $\geq$ 0.10 (or 10%) cannot be accepted. It needed to review the scale comparing again.

Table 14 The random consistency index (R.I.).

N	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
R.I.	0.00	0.00	0.58	0.90	1.12	1.24	1.32	1.41	1.45	1.49	1.52	1.48	1.56	1.57	1.59

Table 15 Pairwise comparison matrix sample

Respondent #1 / Criteria	Factor 1	Factor 2	Factor 3
Factor 1	1	1	1/2
Factor 2	1	1	1/3
Factor 3	2	3	1
	4.000	5.000	1.000

Table 16 Normalized matrix for criteria.

Respondent #1 / Criteria	Factor 1	Factor 2	Factor 3	Total	Eigenvector
Factor 1	0.250	0.200	0.273	0.723	0.241
Factor 2	0.250	0.200	0.182	0.632	0.211
Factor 3	0.500	0.600	0.545	1.645	0.548
	1.000	1.000	1.000	3.000	

Table 17 Priority vector for criteria.

Respondent #1 / Criteria	Factor 1	Factor 2	Factor 3	Sum	Sum/Eigenvector
Factor 1	0.241	0.211	0.274	0.726	3.013
Factor 2	0.241	0.211	0.183	0.634	3.012
Factor 3	0.482	0.632	0.548	1.662	3.030
					9.055

Checking consistency

λ max	=	sum consistency vector / n	=	3.018
C.I.	=	(λ -n) / (n-1)	=	0.009
C.R.	=	C.I. / R.I.	=	0.016

In this sample, C.R. is less than 0.10 which is acceptable. This mean it is consistence. Moreover, the results represent weight of each factor. Factor 3 is the most important factor and following with factor 1 and factor 2 as table 18 below.

Table 18 The weight of each factor.

Factor 1	0.241
Factor 2	0.211
Factor 3	0.548

CHAPTER IV
RESULTS AND DISCUSSIONS

After completed survey 7 respondents by using the Analytical Hierarchy Process (AHP), it can summarize the results follow the hierarchy structure as follows;

4.1The criteria of mode selection

As table 19, the weights of the criteria were averaged and represent the transportation factor is the top priority with 0.426 and following with the economic factor with score 0.384. The port/customs consideration is the fewer score 0.19. In each respondent is might having different idea, some thinking that the economic factor is the most important but anyway when it was averaged, the most weight is going to the transportation factor. The exporters think the transportation factor is more important than economic factor. It represents that cost is not always being as the most important factor when they need to make a decision.

Table 19 The weight of criteria.

Respondents / Criteria	#1	#2	#3	#4	#5	#6	#7	Average
Economic factor	0.297	0.359	**0.499**	0.167	**0.703**	0.142	**0.525**	0.384
Port/Customs consideration	0.164	0.077	0.074	0.167	0.182	0.334	0.334	0.190
Transportation factor	**0.539**	**0.564**	0.427	**0.667**	0.115	**0.525**	0.142	0.426
Consistency ratio	0.008	0.046	0.021	0.000	0.047	0.046	0.046	

4.2 The sub criteria of mode selection

4.2.1 Economic factors

In economic factors, there are 2 sub criteria which comprised the cost of customs handling and the cost of transportation. As table 20 show clearly that the exporters prioritized the cost of transportation in higher level (0.872) than customs handling charge (0.128). Normally, the customs handling charge is not much expensive.

They have the stand cost which generally fixed for their operational. In the same time the transportation factor is depending on the fuel cost so it might be changed more often than the customs handling charge.

Table 20 The weight of sub criteria with respect to the economic factor.

Respondents / Sub-criteria	#1	#2	#3	#4	#5	#6	#7	Average
Cost of customs handling	0.143	0.125	0.111	0.125	0.125	0.143	0.125	0.128
Cost of transportation	**0.857**	**0.875**	**0.889**	**0.875**	**0.875**	**0.857**	**0.875**	0.872
Consistency ratio	0.000	0.000	0.000	0.000	0.000	0.000	0.000	

4.2.2 Port/Customs consideration

There is 4 sub criteria which respect to port/customs consideration, it includes with document process and procedures, customs facilities, service quality and physical inspection as shown in table 21. The service quality has highest score with 0.475, following with customs facilities, document process and procedures and physical inspection with the score of 0.251, 0.141, and 0.132. Apparently, the service quality is the most important and the physical inspection is the least important due to the reason of the inspection, all borders have the standard process. So, the exporters no need to concern much in this process. Normally, the officers will check for both the document paper and random checking the container sometimes followed their policies.

Table 21 The weight of sub criteria with respect to the port/customs consideration.

Respondents / Sub-criteria	#1	#2	#3	#4	#5	#6	#7	Average
Document process and procedures	0.144	0.086	0.045	0.052	0.245	0.065	0.354	0.141
Customs facilities	0.370	0.250	0.402	0.265	0.136	0.258	0.079	0.251
Service quality	**0.442**	**0.587**	**0.434**	**0.627**	**0.543**	**0.518**	0.176	0.475
Physical inspection	0.045	0.077	0.120	0.056	0.076	0.158	**0.392**	0.132
Consistency ratio	0.097	0.013	0.086	0.099	0.076	0.091	0.072	

4.2.3 Transportation factors

As table 22, there are 5 sub criteria with respect to the transportation factors comprising capacity loaded, punctuality, reliability, speed and safety of product movement. The most important factor for the exporters is the safety of product movement with score of 0.343. The safety of product movement refers to the routes condition such as the surface of the road, the rest of the driver and the pilferage. The punctuality and reliability is ranked as the next highest score 0.227 and 0.162. These factors are depending on the schedule or plan in each mode. The exporters concerned on the punctuality because they planned to load the cargo with this schedule but when the truck or the transporters cannot come on time. It will affect their planned which normally will impact their storage and warehouse. However, the speed is the least important with score 0.129. Normally, the exporter will plan the schedule earlier one month so the speed of the transporter might not be affect much.

Table 22 The weight of sub criteria with respect to the transportation factor.

Respondents / Sub-criteria	#1	#2	#3	#4	#5	#6	#7	Average
Capacity loaded	0.079	0.053	0.040	0.032	**0.578**	0.073	0.122	0.140
Punctuality	**0.303**	0.141	0.192	**0.358**	0.204	0.231	0.156	0.227
Reliability	0.272	0.168	0.278	0.122	0.039	0.182	0.073	0.162
Speed	0.044	0.113	0.135	0.159	0.078	0.117	0.256	0.129
Safety of product movement	0.302	**0.525**	**0.354**	0.329	0.101	**0.396**	**0.393**	**0.343**
Consistency ratio	0.083	0.027	0.085	0.099	0.081	0.093	0.092	

4.3 The alternatives of mode selection

As figure 18, the rubber exporters prefer to ship the rubber to Penang port via Kantang port 48.97%. The second mode is Padang Besar border with 27.19% and the last 23.84% is Sadao border. We can see that even Kantang port is the cheapest mode and most nearing the factories but the weight still sharing to another mode which is depending on each factor concerned.

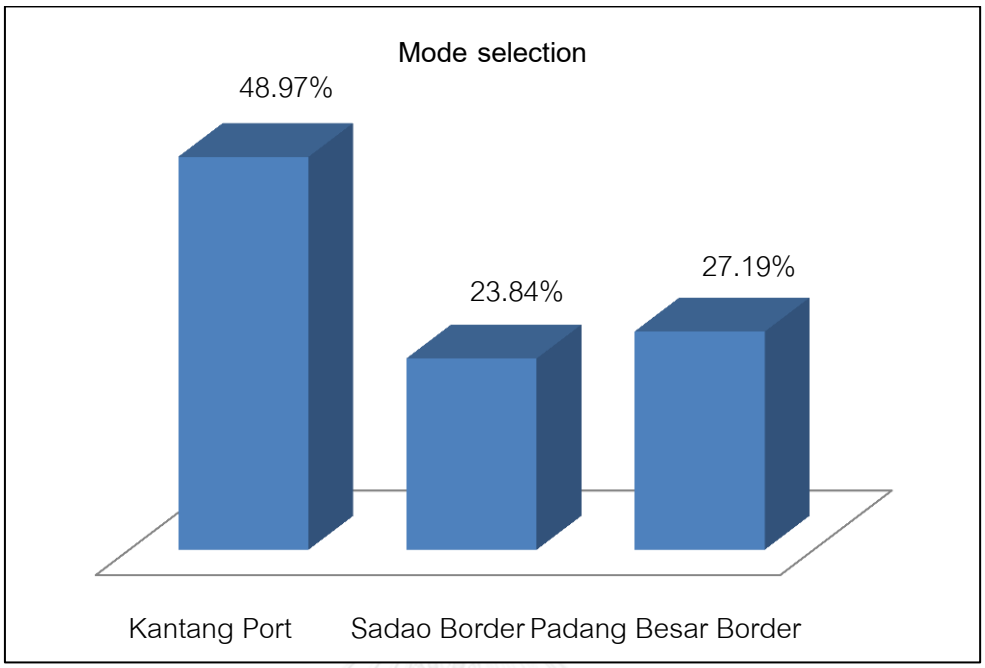

Figure 18 The weight of mode selection.

4.3.1 Cost of customs handling

Refer to table 23, cost of customs handling in Kantang port is the cheapest one. So, we can see the results in table 23 that the exporters prefer to load the cargo via Kantang port with score 0.407. Padang Besar border has score 0.301. Whereas the Sadao border is the mode that has highest customs handling charges. This is the last alternative for the exporters with score 0.292. For consistent ratio, all the weight is completely consistent.

Table 23 The mode alternatives with respect to the cost of customs handling charge.

Respondents / Alternatives	#1	#2	#3	#4	#5	#6	#7	Average
Kantang port	0.161	0.333	0.179	**0.640**	0.074	**0.739**	**0.724**	0.407
Sadao border	**0.765**	0.333	0.082	0.054	**0.643**	0.082	0.083	0.292
Padang Besar border	0.074	0.333	**0.739**	0.306	0.283	0.179	0.193	0.301
Consistency ratio	0.093	0.000	0.088	0.094	0.056	0.088	0.057	

4.3.2 Cost of transportation

According to the cost of transportation, it shows obviously in table 24 that the exporters prefer to load at Kantang port with the score 0.654. Regarding Kantang port is near to factories in Trang, so the transportation cost is quite cheap than other mode. Padang Besar border and Sadao border has score 0.234 and 0.112 respectively. We can see Sadao border is the most expensive mode regarding this route using only truck for transport.

Table 24 The mode alternatives with respect to the cost of transportation.

Respondents / Alternatives	#1	#2	#3	#4	#5	#6	#7	Average
Kantang port	**0.765**	**0.808**	**0.690**	**0.786**	0.102	**0.724**	**0.701**	0.654
Sadao border	0.074	0.074	0.059	0.068	0.366	0.083	0.062	0.112
Padang Besar border	0.161	0.118	0.251	0.146	**0.532**	0.193	0.236	0.234
Consistency ratio	0.093	0.047	0.095	0.096	0.082	0.057	0.062	

4.3.3 Document process and procedures

Normally, the document process and procedures in each mode has its own standardization but the exporters prefer to load the cargo via Kantang port with score 0.477. Regarding the Kantang port is the mode that has less congestion so to implement the document process and the procedures are not complicated. Also, the officers in Kantang port is Thai who easily manage and flexible than other modes. For Sadao border and Padang Besar border show not much different scores with 0.254 and 0.269 (table 25).

Table 25 The mode alternatives with respect to the document process and procedures.

Respondents / Alternatives	#1	#2	#3	#4	#5	#6	#7	Average
Kantang port	0.158	0.333	**0.646**	**0.735**	0.092	**0.665**	**0.707**	0.477
Sadao border	0.187	0.333	0.290	0.065	**0.707**	0.104	0.092	0.254
Padang Besar border	**0.655**	0.333	0.064	0.199	0.201	0.231	0.201	0.269
Consistency ratio	0.025	0.000	0.064	0.062	0.083	0.075	0.083	

4.3.4 Customs facilities

As table 26 showing that the exporters prefer to load the cargo via Kantang port, Padang Besar border and Sadao border with the scores 0.449, 0.305 and 0.247 respectively. Most of their concerned are the sufficient support equipment such as wagons, cranes, folk lift and labours which can support the operation fasten and smoothly.

Table 26 The mode alternatives with respect to the customs facilities.

Respondents / Alternatives	#1	#2	#3	#4	#5	#6	#7	Average
Kantang port	**0.655**	0.170	**0.765**	**0.474**	0.241	0.069	**0.767**	0.449
Sadao border	0.133	**0.443**	0.161	0.053	**0.548**	0.298	0.090	0.247
Padang Besar border	0.211	0.387	0.074	0.474	0.211	**0.632**	0.143	0.305
Consistency ratio	0.047	0.016	0.093	0.000	0.016	0.087	0.047	

4.3.5 Service quality

Refer to table 27, the exporters prefer to load the cargo via Kantang mode with score 0.538 and Sadao border mode with score 0.252. Regarding the officers in Kantang port and Sadao border is Thai, so this is the competitive advantage because they willing to help and something can be easier managed. The exporter said they get fast responsiveness when they coordinate with staffs at Kantang border. For Padang Besar border, most of officers are Malaysian so it might hard for the exporter when they need the flexibility support.

Table 27 The mode alternatives with respect to the service quality.

Respondents / Alternatives	#1	#2	#3	#4	#5	#6	#7	Average
Kantang port	**0.400**	0.360	**0.703**	**0.474**	**0.422**	**0.739**	**0.665**	0.538
Sadao border	**0.400**	**0.512**	0.182	0.053	0.336	0.179	0.104	0.252
Padang Besar border	0.200	0.128	0.115	0.474	0.242	0.082	0.231	0.210
Consistency ratio	0.000	0.094	0.047	0.000	0.093	0.088	0.075	

4.3.6 Physical inspection

As table 28, it is standard for checking container number or seal number for every mode alternatives. So, the results are not much different as table 4.10. The exporters give the priority to Padang Besar border with score 0.379, the Kantang port scoring 0.372 and Sadao border as the last one with score 0.250.

Table 28 The mode alternatives with respect to the physical inspection.

Respondents / Alternatives	#1	#2	#3	#4	#5	#6	#7	Average
Kantang port	0.192	0.333	**0.633**	**0.474**	0.096	0.106	**0.767**	0.372
Sadao border	0.131	0.333	0.260	0.053	**0.619**	0.260	0.090	0.250
Padang Besar border	**0.677**	0.333	0.106	**0.474**	0.284	**0.633**	0.143	0.379
Consistency ratio	0.082	0.000	0.330	0.000	0.075	0.033	0.047	

4.3.7 Capacity loaded

The capacity loaded refers to the volume loaded availability per trip. Some exporters focus on the volume loaded due to they have high volume of production. So, the mode that they decided to load the cargo should respond their need. The exporters might load the container 20 or 30 TEUs within a few days, so it is important that the mode alternative can support them to deliver all cargo on time. As table 4.11, Kantang port and Padang Besar border is the most preference with score 0.388 and 0.346 for the exporter because they can load high volume in barge and train. Meanwhile, Sadao border is the least score with 0.266 regarding it transport by truck. So, it can be loaded as a few containers per one truck (table 29).

Table 29 The mode alternatives with respect to the capacity loaded.

Respondents / Alternatives	#1	#2	#3	#4	#5	#6	#7	Average
Kantang port	0.334	0.198	**0.750**	**0.474**	0.115	0.096	**0.751**	0.388
Sadao border	0.142	**0.490**	0.125	0.053	**0.703**	0.284	0.064	0.266
Padang Besar border	**0.525**	0.312	0.125	**0.474**	0.182	**0.619**	0.185	0.346
Consistency ratio	0.046	0.046	0.000	0.000	0.047	0.075	0.095	

4.3.8 Punctuality

As table 30, the exporters prefer to load the cargo via Sadao border with score 0.434, Kantang port with score 0.429 and Padang Besar border with score 0.137. The vehicle for transport via Sadao mode is truck which is faster and more punctual than Kantang port which using barge vessel and Padang Besar border which using rail transport. We can see the Padang Besar border is the last mode choice for the exporter, even they using rail which supposed to transport faster than barge vessel in Kantang port but the fact is rail in Padang Besar border is always late and the exporters need to wait for their operations (lift on or lift off the container) which cannot confirmed the exactly time.

Table 30 The mode alternatives with respect to the punctuality.

Respondents / Alternatives	#1	#2	#3	#4	#5	#6	#7	Average
Kantang port	0.161	0.143	0.370	**0.735**	**0.665**	0.193	**0.735**	0.429
Sadao border	**0.765**	**0.767**	**0.545**	0.065	0.104	**0.724**	0.065	0.434
Padang Besar border	0.074	0.090	0.085	0.199	0.231	0.083	0.199	0.137
Consistency ratio	0.093	0.047	0.075	0.062	0.075	0.057	0.062	

4.3.9 Reliability

For the reliability concerned, it involves the reliable of the border staffs and the shipping agent. The exporters prefer to deliver cargo via Kantang port with score 0.445, Sadao border with score 0.312 and Padang Besar border with score 0.243 (table 31).

Table 31 The mode alternatives with respect to the reliability.

Respondents / Alternatives	#1	#2	#3	#4	#5	#6	#7	Average
Kantang port	**0.589**	**0.400**	**0.455**	**0.649**	0.193	0.078	**0.751**	0.445
Sadao border	0.252	**0.400**	**0.455**	0.057	**0.724**	0.234	0.064	0.312
Padang Besar border	0.159	0.200	0.091	0.295	0.083	**0.688**	0.185	0.243
Consistency ratio	0.046	0.000	0.000	0.070	0.057	0.067	0.095	

4.3.10 Speed

As table 32, it shows obviously that the exporters prefer to load the cargo via Sadao border with highest score 0.477, Padang Besar border with score 0.28 and Kantang port with score 0.243. Regarding, they using truck for transport the cargo via Sadao border, so the lead time via this mode is shorten than other modes. Meanwhile the speed of rail in Padang Besar border and the barge vessel via Kantang mode is longer than Sadao border about a week or maybe 2 weeks.

Table 32 The mode alternatives with respect to the speed.

Respondents / Alternatives	#1	#2	#3	#4	#5	#6	#7	Average
Kantang port	0.090	0.099	0.231	0.236	0.168	0.069	**0.808**	0.243
Sadao border	**0.767**	**0.751**	**0.665**	0.062	**0.719**	0.298	0.074	0.477
Padang Besar border	0.143	0.150	0.104	**0.701**	0.113	**0.632**	0.118	0.280
Consistency ratio	0.047	0.071	0.075	0.062	0.075	0.087	0.047	

4.3.11 Safety of product movement

In table 33, the exporters prefer to load the cargo via Padang Besar border with score 0.428, Kantang port with score 0.343 and Sadao border with score 0.229. They said railing is the most safety mode than barge vessel or truck loaded. For trucking, it has more opportunities to get car accidents.

Table 33 The mode alternatives with respect to the safety of product movement.

Respondents / Alternatives	#1	#2	#3	#4	#5	#6	#7	Average
Kantang port	0.088	0.250	0.252	0.690	0.192	0.159	**0.765**	0.343
Sadao border	0.135	0.250	0.159	0.059	**0.677**	0.252	0.074	0.229
Padang Besar border	**0.777**	**0.500**	**0.589**	**0.251**	0.131	**0.589**	0.161	0.428
Consistency ratio	0.067	0.000	0.046	0.095	0.082	0.046	0.093	

According to all the average weight in each factor, we also can prioritize the mode alternatives with respect to each factor as shown in figure 19-29.

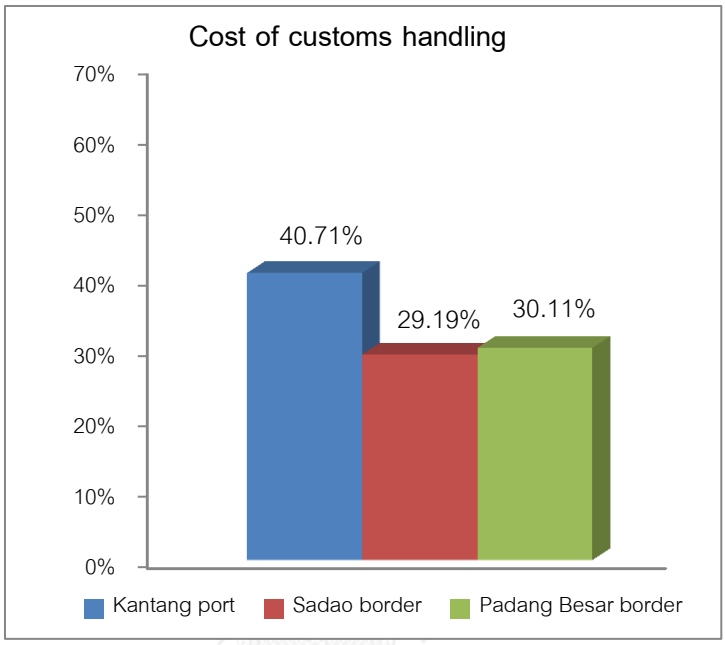

Figure 19 The percentage of mode alternative respect to cost of customs handling.

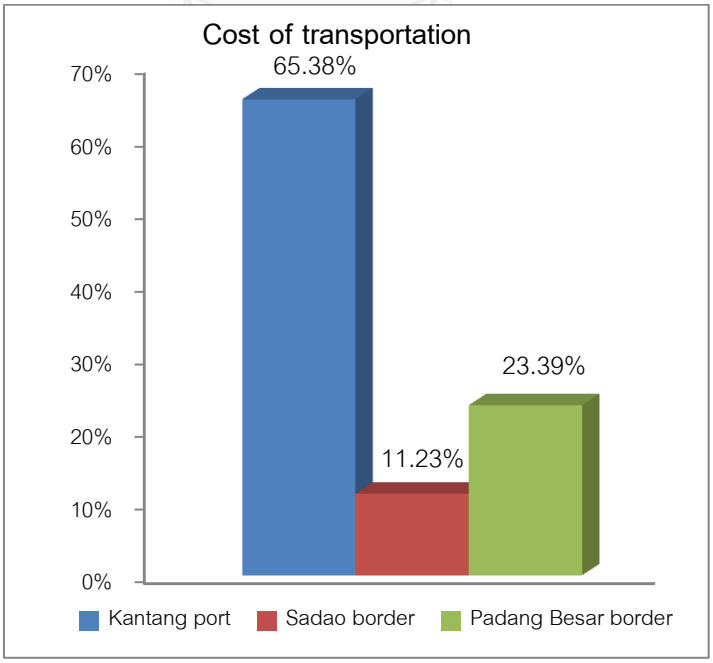

Figure 20 The percentage of mode alternative respect to cost of transportation.

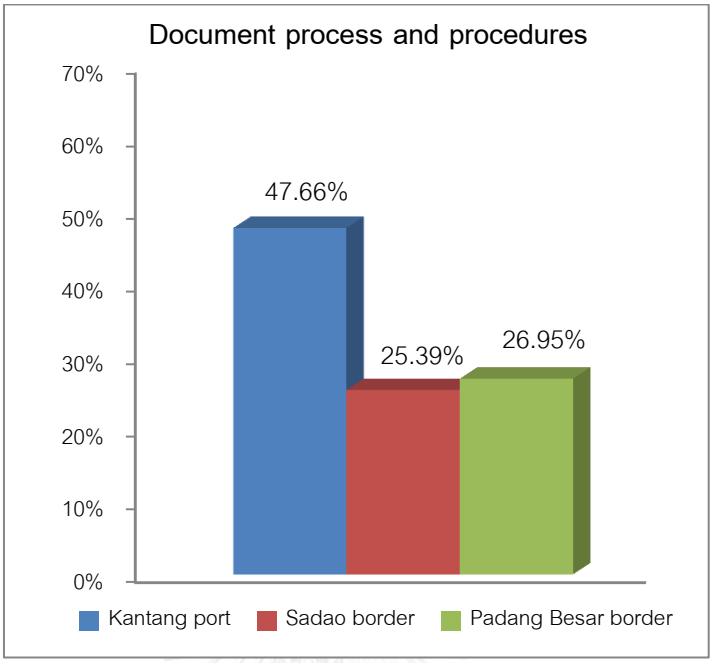

Figure 21 The percentage of mode alternative respect to document process and procedures.

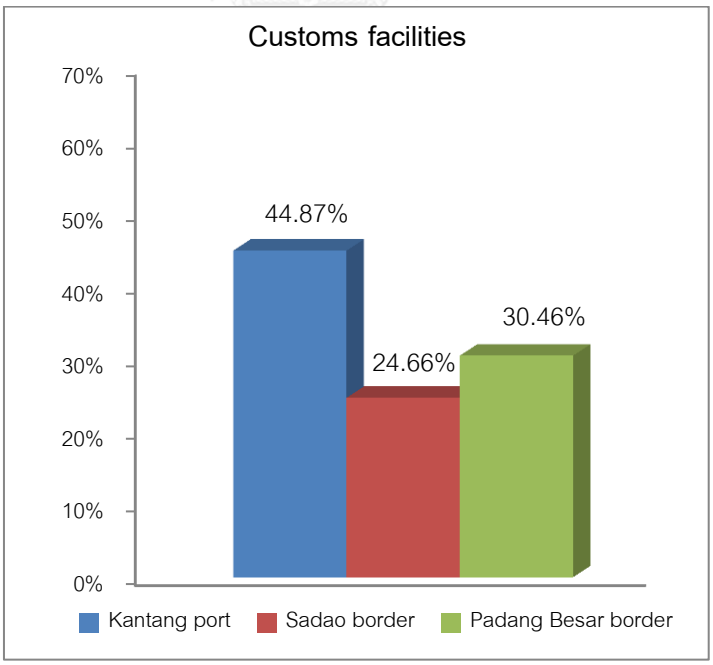

Figure 22 The percentage of mode alternative respect to customs facilities.

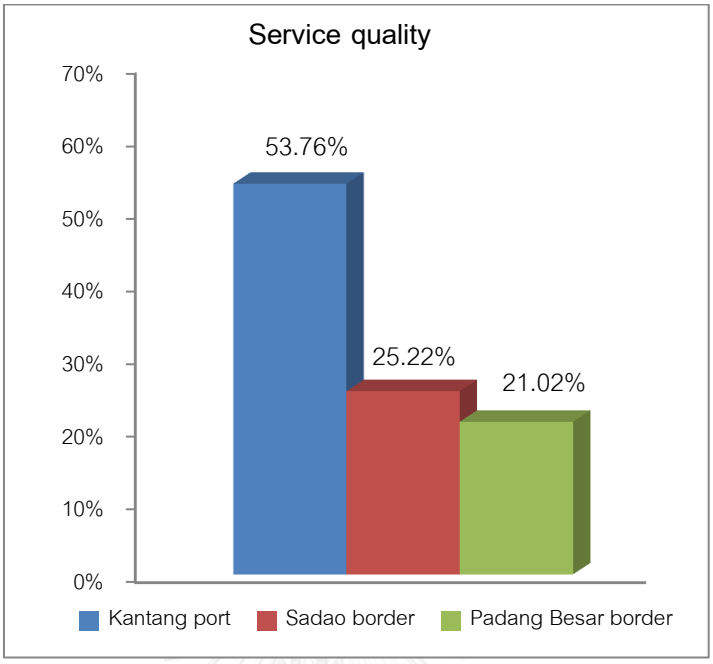

Figure 23 The percentage of mode alternative respect to service quality.

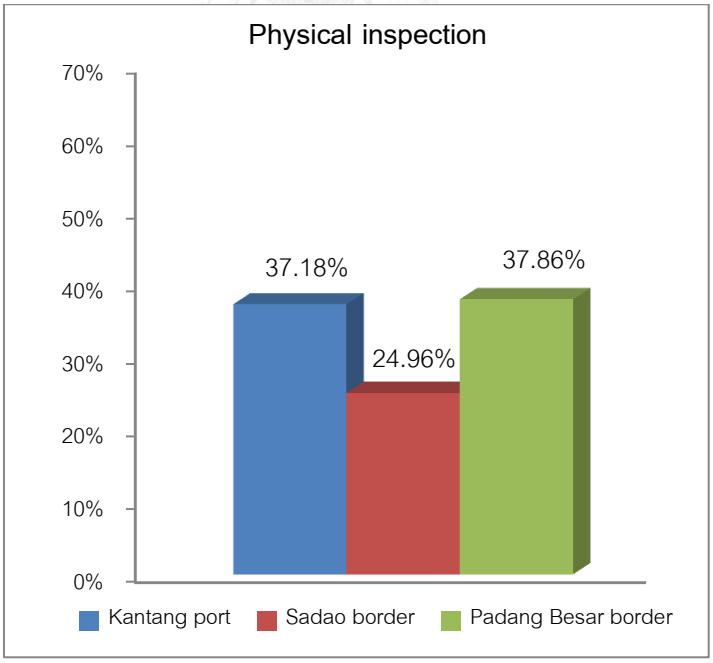

Figure 24 The percentage of mode alternative respect to physical inspection.

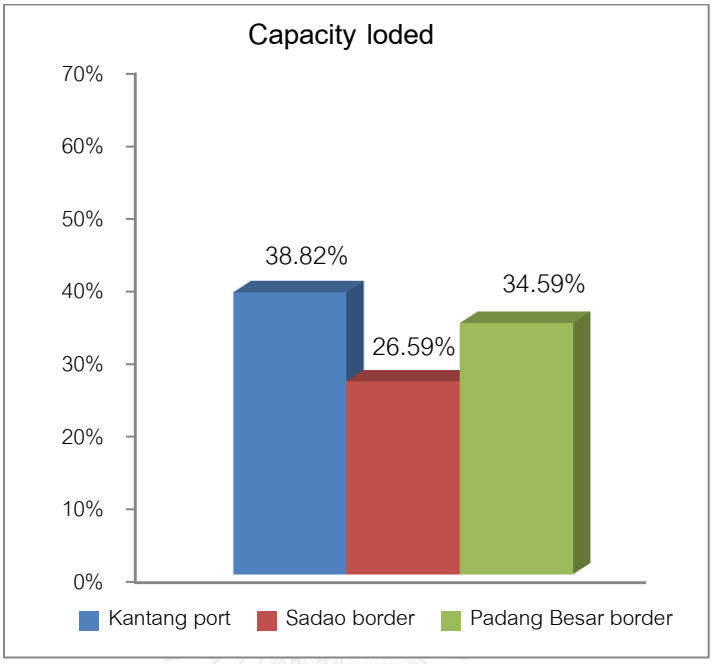

Figure 25 The percentage of mode alternative respect to capacity loaded.

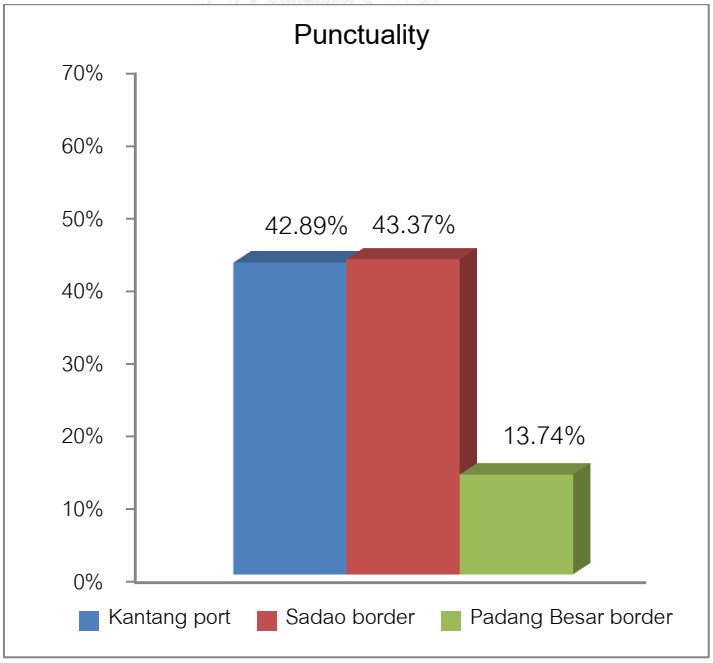

Figure 26 The percentage of mode alternative respect to punctuality.

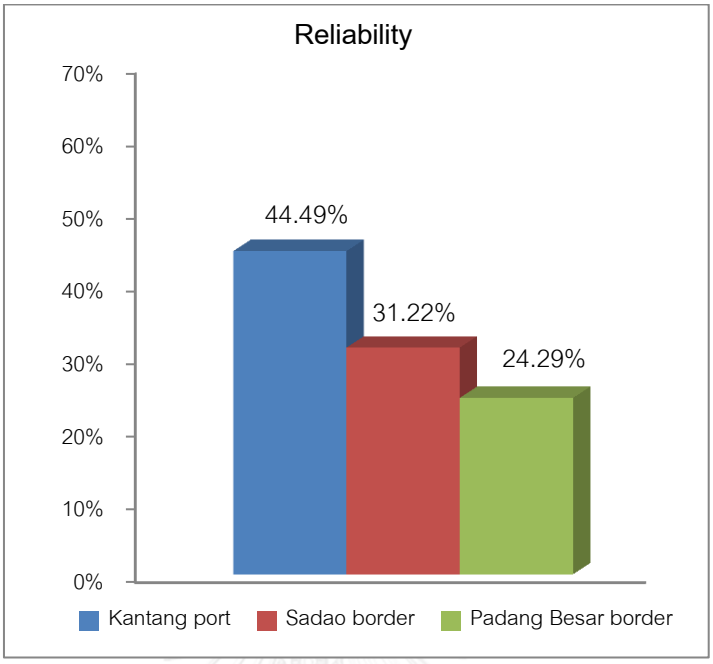

Figure 27 The percentage of mode alternative respect to reliability.

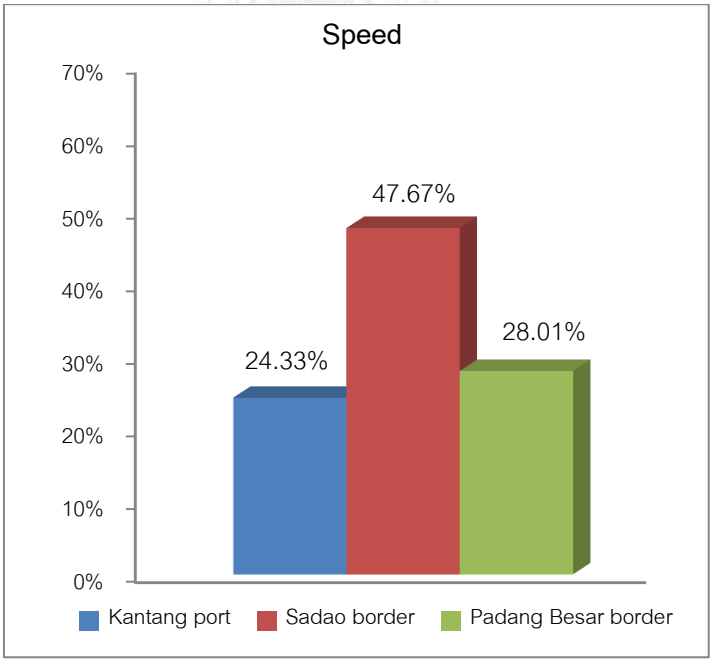

Figure 28 The percentage of mode alternative respect to speed.

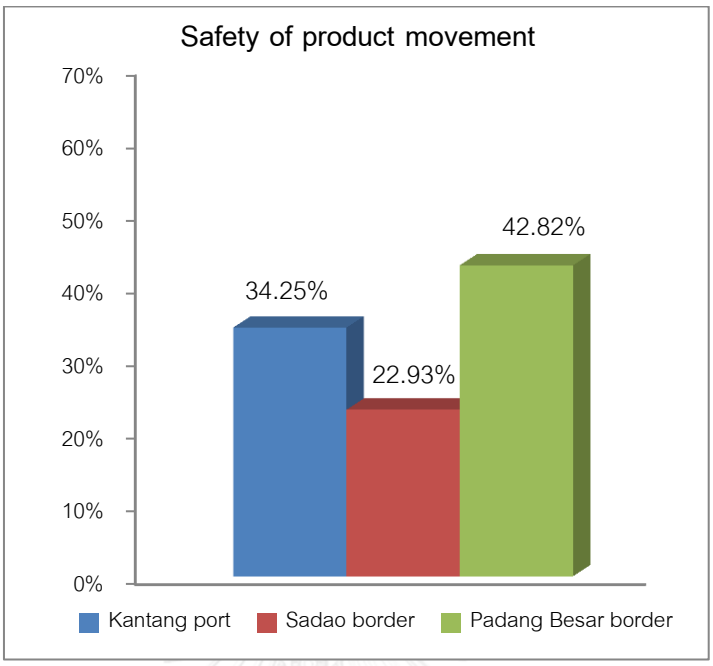

Figure 29 The percentage of mode alternative respect to safety of product movement.

4.4 Mode choice analysis

In term of the alternatives, we can analyse the weight of each factor respect to each alternative as follow;

4.4.1 Kantang port choice

Kantang port is a primary mode for cargo export with regards to cost efficiency. It is the cheapest mode and the inland route is more close to the factories in Trang province than others. The exporters who focus on cost would consider this mode the best choice. In addition to the document process and procedures which is also performed well along with the service make this port being as the major mode for exporting the cargo from Trang to Penang port (table 34).

Only the transit time is around 14 days which need to be improved. This mode cannot support urgent shipments and there are also many shipping agents who provide free time detention and demurrage only for 5 or 7 days which cannot cover the lead time for export via this mode. Thus, they should increase the barge vessels and trips.

Table 34 The weight and rank of all factors respect to Kantang port.

Factors	Weight	Rank
Cost of customs handling	0.407	
Cost of transportation	0.654	1
Document process and procedures	0.477	3
Customs facilities	0.449	
Service quality	0.538	2
Physical inspection	0.372	
Capacity loaded	0.388	
Punctuality	0.429	
Reliability	0.445	
Speed	0.243	
Safety of product movement	0.343	

4.4.2 Sadao border choice

Sadao border is a worthwhile choice for exporters concerned about short transit time. According to lead time for arranging the container regularly about 4-7 days, so there would be no problem about free time detention and demurrage allowed when transport occurs via this mode. Furthermore, this mode has been the entire transportation by truck that has a better punctual than other modes.

The study revealed this mode is the most expensive mode. It is also more risky than others. Normally, the truck must stop at the Sadao border to change the trucking plate from Thailand to Malaysia. Some trucks will park one night after entering to Malaysia and that has a high risk of robbery (table 35).

There are fewer possibilities to reduce the cost due to many factors such as fuels, operational and administrative cost. The improvement should focus to the security of transportation such as providing a rest area for drivers. It is possible to reduce the robbery problem and can make the exporter feel safe to export cargo via this mode.

Table 35 The weight and rank of all factors respect to Sadao border.

Factors	Weight	Rank
Cost of customs handling	0.292	
Cost of transportation	0.112	
Document process and procedures	0.254	
Customs facilities	0.247	
Service quality	0.252	
Physical inspection	0.249	
Capacity loaded	0.266	
Punctuality	0.434	2
Reliability	0.312	3
Speed	0.477	1
Safety of product movement	0.229	

4.4.3 Padang Besar border choice

Padang Besar border is determined as the safest mode for exporting cargo from Trang to Penang port. For rubber shipments, most of the cargoes packing with shrink wrapped pallet loaded in twenty and forty-foot equivalent unit but they also have some latex shipment in Flexi-bag packing which is very sensitive when delivering. It is too risky for exporting the Flexi-bag shipment via truck or barge vessel. It could cause the containers to swell up.

Service quality and punctuality are two main criteria that the exporter concerned when export via Padang Besar border. They work very slow compared to other modes. It is also very congesting when many exporters are queuing for returning the laden containers. Sometimes, they will suddenly close the gates for a few days to clear all laden containers. They also have problems about wagon shortage or rack maintenance. It affects the exporters directly because they cannot get the empty containers to load the cargo on time (table 36).

Table 36 The weight and rank of all factors respect to Padang Besar border.

Factors	Weight	Rank
Cost of customs handling	0.301	
Cost of transportation	0.234	
Document process and procedures	0.269	
Customs facilities	0.304	
Service quality	0.210	
Physical inspection	0.379	2
Capacity loaded	0.346	3
Punctuality	0.137	
Reliability	0.243	
Speed	0.280	
Safety of product movement	0.428	1

In general, most of the activities in this mode are mainly operated by Malaysian staff. They should improve the service by training the staff especially for the operational working. Moreover, investing in equipment is important in order to support the high volumes of containers going in and out every day.

4.5 Factors summary

In figure 30, we have summarized the sub criteria with respect to the 3 main criteria; economic factors, port/custom consideration and transportation factors. We found that for the exporters, cost of transportation, the safety of product movement and punctuality are the most 3 important factors with scores of 33.52%, 14.59% and 9.64% respectively.

The 3 least important factors are customs facilities, document process and procedures and physical inspection with scores of 4.78%, 2.69% and 2.51% respectively. The cost of transportation is higher outstanding than other factors.

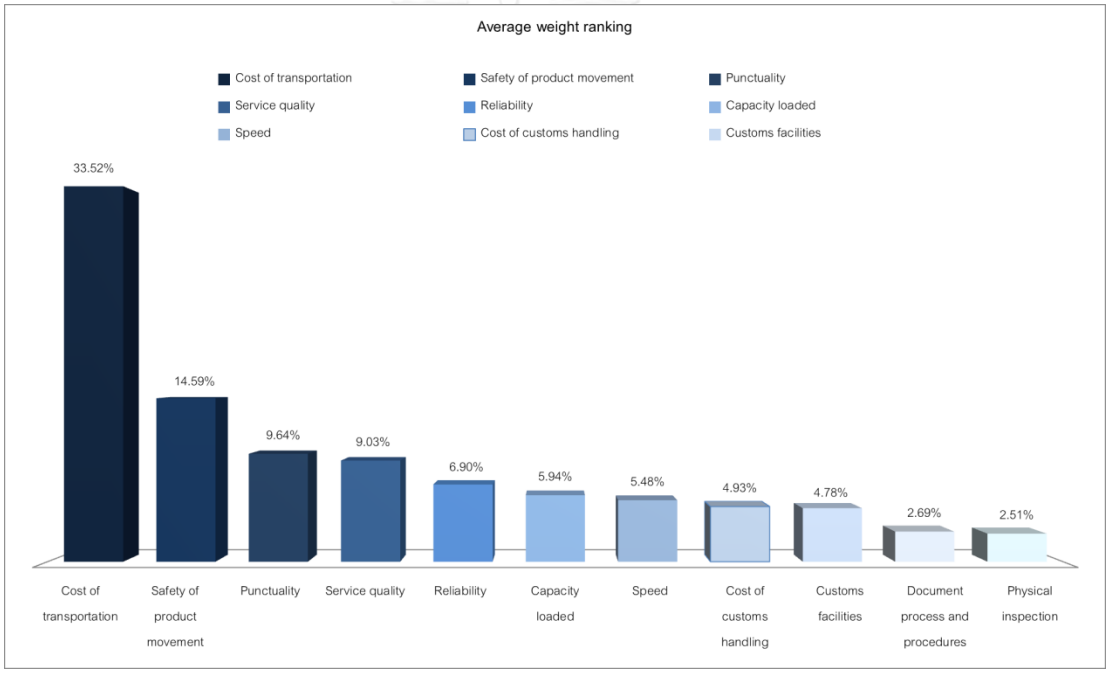

Figure 30 Sub criteria weight ranking

We can see that cost of transportation is the main factor that affects the decision. The exporters prefer to load via Kantang port because this is the cheapest mode. However, although the fuel price is the main element in cost of transportation with about 60%, there are other elements such as driver's salary, overtime, waiting times that add to the cost about 40% (Pholyiem, 2009).

Table 37 Distances and transportation cost from factory to border

Alternative Choices	Distances (Km)	Transportation cost (Baht)
Kantang port	27.7	3,808
Sadao border	202	10,053
Padang Besar border	198	10,087

Table 37 indicates the distances from factory to each border and the related transportation cost. We analyzed the scenarios in which the fuel price would drop to see if there would be a significant impact in the exporter's decision. As shown in figure 31, a fuel price drop from 23.54 to 20.74 and 18.34 does not change the exporter's decision. Kantang port still represents the cheapest mode, followed by Padang Besar border and Sadao border accordingly (See appendices E-G).

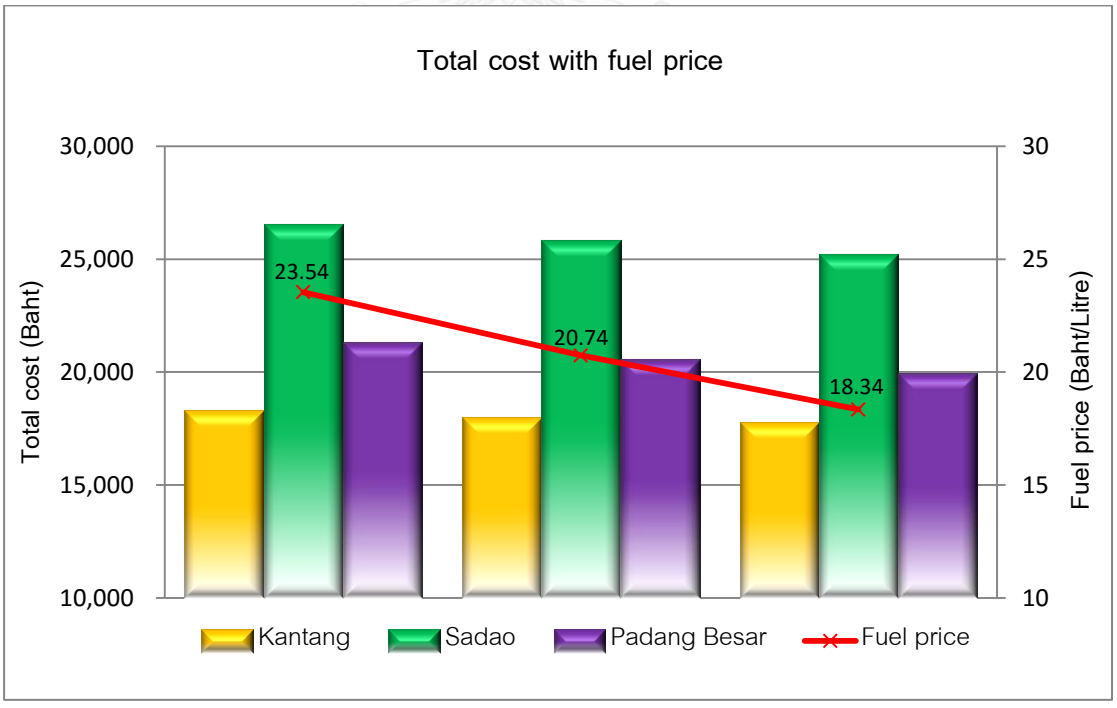

Figure 31 Total cost according to the fuel price

CHAPTER V
CONCLUSIONS

In this study, we proposed a mode choice selection using the AHP method. We considered three main criteria including Economic, Port/Customs, and Transportation factors.

Table 38, it shows obviously that exporters prefer to load cargo via Kantang port when they concerned on cost, document process and procedures, customs facilities, service quality, capacity loaded and reliability. The exporters prefer to load via Sadao border when they are concerned about punctuality and speed. Finally, Padang Besar border would be considered as the best choice when they are concerned on physical inspection and safety of product movement.

Table 38 Mode choice decision

Factors	Mode selection
Cost of customs handling	Kantang port
Cost of transportation	Kantang port
Document process and procedures	Kantang port
Customs facilities	Kantang port
Service quality	Kantang port
Physical inspection	Padang Besar border
Capacity loaded	Kantang port
Punctuality	Sadao border
Reliability	Kantang port
Speed	Sadao border
Safety of product movement	Padang Besar border

To summarize, Kantang port is the best choice for loading common shipments which means the exporter has planned the shipment one month in advance. For urgent shipments, they should be loaded via Sadao border because the transit time is shorter than for other modes. Padang Besar border is the most preferable mode for the latex cargo which is packed with Flexi-bag which is very sensitive packaging. So, railway is the better choice for safety of product movement and shorter transit time than barge vessel.

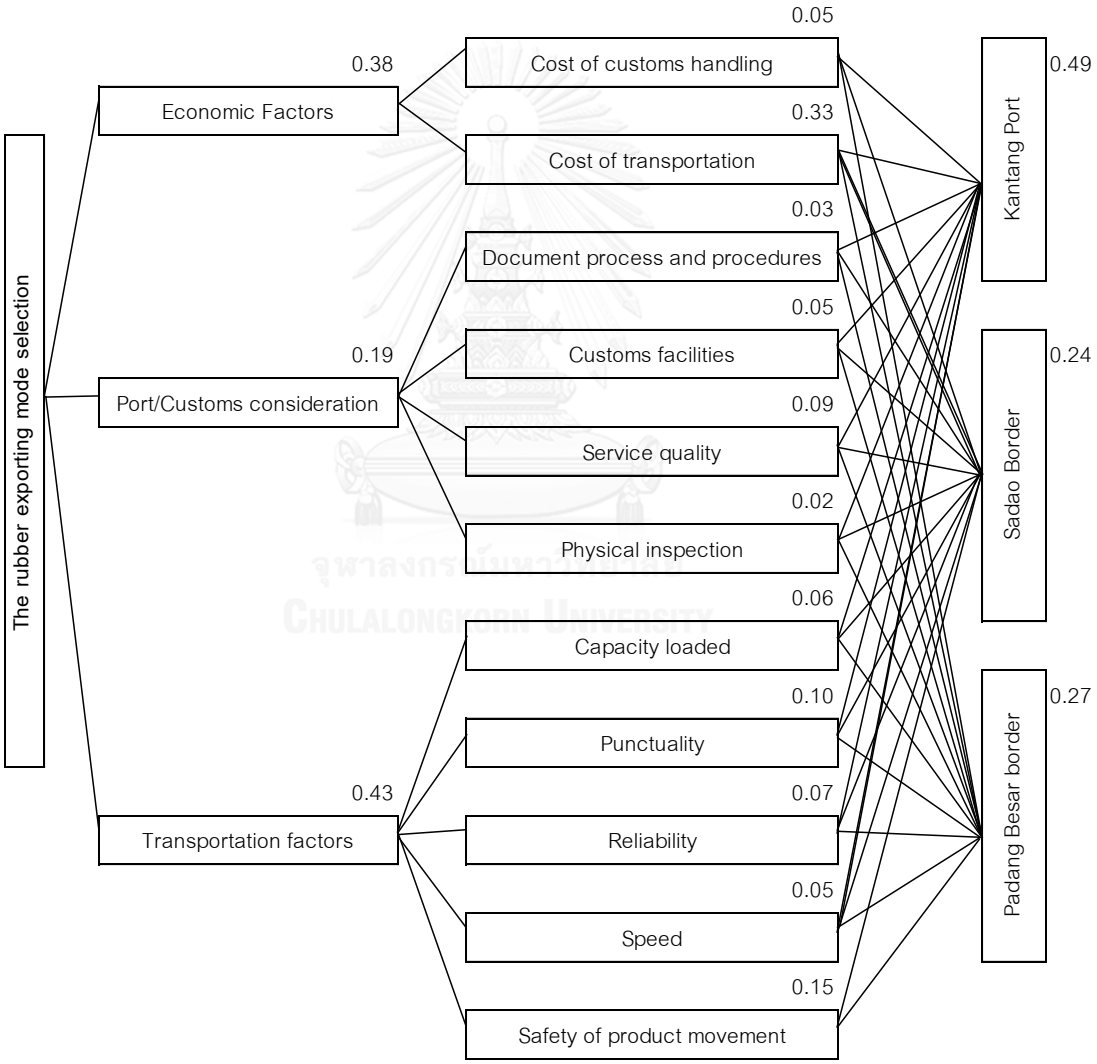

Figure 32 The weights of all factors and alternatives hierarchy.

The finding of this study was shown in figure 32. It reveals that the exporters are highly concerned about the cost of transportation, safety of products movement and the punctuality. The exporters decided to export via Kantang port when they consider on cost. Sadao border will be considered as first choice when they emphasized on time. Padang Besar border will be considered when they are focusing on safety of products movement.

According to the obtained results, Kantang port is the first mode choice to export the rubber from Trang to Penang port. Nevertheless, the study reveals that cost is not always important under many circumstances. Another mode choice can be chosen depending on the different factors. It cannot be decided totally that which mode is the best mode to deliver cargo from Trang to Penang port because each mode can be chosen upon the factor that the exporter concerned.

Despite the fact that survey has been limited to a sample of rubber exporters in Trang, the results provide a useful empirical data in order to increase the border performances and the transport routes. Further research might also analyze the perspective of rubber exporters in Northeast of Thailand in order to export rubber to different mode choice.

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APPENDICIES

Appendix A The questionnaires survey form.

QUESTIONAIRE SURVEY FORM

For each following table, please marked O on the number in side that you agree those criteria is important than another side.

Part 1 Pairwise comparison of the criteria

Table 1 Paired comparison matrix with respect to the goal

F1	Comparing and weight the factors between F1 and F2																	F2
Economic Factors	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	Port/Customs consideration
Economic Factors	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	Transportation Factors
Port/Customs consideration	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	Transportation Factors

Part 2 Pairwise comparison of the sub criteria

Table 1 Paired comparison matrix with respect to the Economic factor

F1	Comparing and weight the factors between F1 and F2																	F2
Economic Factors	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	Port/Customs consideration

Table 2 Paired comparison matrix with respect to the Port/Customs consideration

F1	Comparing and weight the factors between F1 and F2																	F2
Document process and procedures	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	customs facilities
Document process and procedures	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	Service quality
Document process and procedures	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	Physical inspection
customs facilities	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	Service quality
customs facilities	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	Physical inspection
Service quality	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	Physical inspection

Table 3 Paired comparison matrix with respect to the transportation factor

F1	Comparing and weight the factors between F1 and F2																	F2
Capacity loaded	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	Punctuality
Capacity loaded	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	Reliability
Capacity loaded	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	speed
Capacity loaded	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	safety of product movement
Punctuality	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	Reliability
Punctuality	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	speed
Punctuality	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	safety of product movement
Reliability	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	speed
Reliability	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	safety of product movement
speed	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	safety of product movement

Part 3 Pairwise comparison of the mode alternatives

Table 1 Paired comparison matrix of the mode alternatives with respect to the cost of customs handling charge

F1	Comparing and weight the factors between F1 and F2																F2
Kantang Port	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	Sadao Border
Kantang Port	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	Padang Besar border
Sadao Border	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	Padang Besar border

Table 2 Paired comparison matrix of the mode alternatives with respect to the cost of transportation

F1	Comparing and weight the factors between F1 and F2																F2
Kantang Port	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	Sadao Border
Kantang Port	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	Padang Besar border
Sadao Border	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	Padang Besar border

Table 3 Paired comparison matrix of the mode alternatives with respect to the document process and procedures

F1	Comparing and weight the factors between F1 and F2																F2
Kantang Port	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	Sadao Border
Kantang Port	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	Padang Besar border
Sadao Border	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	Padang Besar border

Table 4 Paired comparison matrix of the mode alternatives with respect to the customs facilities

F1	Comparing and weight the factors between F1 and F2																F2
Kantang Port	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	Sadao Border
Kantang Port	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	Padang Besar border
Sadao Border	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	Padang Besar border

Table 5 Paired comparison matrix of the mode alternatives with respect to the service quality

F1	Comparing and weight the factors between F1 and F2																F2
Kantang Port	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	Sadao Border
Kantang Port	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	Padang Besar border
Sadao Border	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	Padang Besar border

Table 6 Paired comparison matrix of the mode alternatives with respect to the physical inspection

F1	Comparing and weight the factors between F1 and F2																F2
Kantang Port	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	Sadao Border
Kantang Port	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	Padang Besar border
Sadao Border	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	Padang Besar border

Table 7 Paired comparison matrix of the mode alternatives with respect to the capacity loaded

F1	Comparing and weight the factors between F1 and F2																F2
Kantang Port	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	Sadao Border
Kantang Port	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	Padang Besar border
Sadao Border	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	Padang Besar border

Table 8 Paired comparison matrix of the mode alternatives with respect to the punctuality

F1	Comparing and weight the factors between F1 and F2																	F2
Kantang Port	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	Sadao Border
Kantang Port	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	Padang Besar border
Sadao Border	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	Padang Besar border

Table 9 Paired comparison matrix of the mode alternatives with respect to the reliability

F1	Comparing and weight the factors between F1 and F2																	F2
Kantang Port	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	Sadao Border
Kantang Port	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	Padang Besar border
Sadao Border	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	Padang Besar border

Table 10 Paired comparison matrix of the mode alternatives with respect to the speed

F1	Comparing and weight the factors between F1 and F2																	F2
Kantang Port	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	Sadao Border
Kantang Port	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	Padang Besar border
Sadao Border	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	Padang Besar border

Table 11 Paired comparison matrix of the mode alternatives with respect to the safety of product movement

F1	Comparing and weight the factors between F1 and F2																	F2
Kantang Port	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	Sadao Border
Kantang Port	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	Padang Besar border
Sadao Border	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	Padang Besar border

Appendix B The transportation cost from the origin to destination place

Origin	Destination	Cost (Baht)
Trang	Kantang Port	3,000
Trang	Sadao	10,000
Trang	Padang Besar	9,700
Sikao	Kantang Port	4,500
Sikao	Sadao	10,000
Sikao	Padang Besar	9,800
Huaynang	Kantang Port	5,300
Huaynang	Sadao	10,500
Huaynang	Padang Besar	13,000

Appendix C The production volume of 7 respondents.

Factory	Location	Volume (Tons)	Percentage	Total Percentage	Average		
					Kantang port	Sadao border	Padang Besar border
Fac#1	TG	8500	20%	52%	3,000	10,000	9,700
Fac#2	TG	5000	12%				
Fac#3	TG	5000	12%				
Fac#4	TG	3500	8%				
Fac#5	SK	10000	24%	38%	4,500	10,000	9,800
Fac#6	SK	6000	14%				
Fac#7	HN	4500	11%	11%	5,300	10,500	13,000
	Sum	42500					

Appendix D The average transportation cost.

Factory	Location	Volume (Tons)	Percentage	Container volume	Probability (Container Volume)		
					Kantang port	Sadao border	Padang Besar border
Fac#1	TG	8500	20%	425	1,275,000	4,250,000	4,122,500
Fac#2	TG	5000	12%	250	750,000	2,500,000	2,425,000
Fac#3	TG	5000	12%	250	750,000	2,500,000	2,425,000
Fac#4	TG	3500	8%	175	525,000	1,750,000	1,697,500
Fac#5	SK	10000	24%	500	2,250,000	5,000,000	4,900,000
Fac#6	SK	6000	14%	300	1,350,000	3,000,000	2,940,000
Fac#7	HN	4500	11%	225	1,192,500	2,362,500	2,925,000
Sum		42500		2125	8,092,500	21,362,500	21,435,000
Average transportation cost					3,808	10,053	10,087

Appendix E Total fuel consumption cost in different fuel rate

Fuel consumption rate (Truck/Haulage) 3 Kilometre/Litre

Diesel price as on 11/05/16 23.54 Baht/Litre

Alternative choices	Kantang	Sadao	Padang Besar
Distance from Factory to border (Km)	28	202	198
Fuel consume (L)	9.23	67.33	66.00
Fuel consume*Fuel price (Baht)	217.35	1,585.03	1,553.64

Diesel price as on 01/03/16 20.74 Baht/Litre

Alternative choices	Kantang	Sadao	Padang Besar
Distance from Factory to border (Km)	28	202	198
Fuel consume (L)	9.23	67.33	66.00
Fuel consume*Fuel price (Baht)	191.50	1,396.49	1,368.84

Diesel price as on 31/12/08 18.34 Baht/Litre

Alternative choices	Kantang	Sadao	Padang Besar
Distance from Factory to border (Km)	28	202	198
Fuel consume (L)	9.23	67.33	66.00
Fuel consume*Fuel price (Baht)	169.34	1,234.89	1,210.44

Appendix F Total transportation cost in different fuel rate

Diesel price as on 11/05/16 23.54 Baht/Litre

Cost (Baht/20'GP)	Kantang	Sadao	Padang Besar
60% Fuel cost	2,284.94	6,031.76	6,052.24
40% Other cost	1,523.29	4,021.18	4,034.82
Total transportation cost	3,808.24	10,052.94	10,087.06

Diesel price as on 01/03/16 20.74 Baht/Litre

Cost (Baht/20'GP)	Kantang	Sadao	Padang Besar
60% Fuel cost	2,013.16	5,314.31	5,332.34
40% Other cost	1,523.29	4,021.18	4,034.82
Total transportation cost	3,536.45	9,335.48	9,367.17

Diesel price as on 31/12/08 18.34 Baht/Litre

Cost (Baht/20'GP)	Kantang	Sadao	Padang Besar
60% Fuel cost	1,780.20	4,699.34	4,715.29
40% Other cost	1,523.29	4,021.18	4,034.82
Total transportation cost	3,303.49	8,720.52	8,750.12

Appendix G Total cost in different fuel rate

Diesel as on 11/05/16	23.54	Baht/Litre	
Cost (Baht/20'GP)	Kantang	Sadao	Padang Besar
Transportation cost	3,808	10,053	10,087
Port/Border charge	1,980	4,935	4,298
Barge/Rail/Haulage freight	9,300	9,500	5,410
Shipping and Forwarding	3,200	2,065	1,500
Total cost	18,288	26,553	21,295

Diesel as on 01/03/16	20.74	Baht/Litre	
Cost (Baht/20'GP)	Kantang	Sadao	Padang Besar
Transportation cost	3,536	9,335	9,367
Port/Border charge	1,980	4,935	4,298
Barge/Rail/Haulage freight	9,300	9,500	5,410
Shipping and Forwarding	3,200	2,065	1,500
Total cost	18,016	25,835	20,575

Diesel as on 31/12/08	18.34	Baht/Litre	
Cost (Baht/20'GP)	Kantang	Sadao	Padang Besar
Transportation cost	3,303	8,721	8,750
Port/Border charge	1,980	4,935	4,298
Barge/Rail/Haulage freight	9,300	9,500	5,410
Shipping and Forwarding	3,200	2,065	1,500
Total cost	17,783	25,221	19,958

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