# High-Speed-Rail as a New Mode Choice in ASEAN: A Case Study of Southern Corridor in Thailand

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**Abstract**: This paper describes an ASEAN perspective of HSR connection from Kunming to Singapore lines and a study of passengers' behavior of O-D pairs in southern corridor of Thailand. The O-D surveys were conducted for the 2 sections of the southern corridor: Surat Thani-Bangkok (ST-BKK) and Hat-Yai –Bangkok (HY-BKK). The Willing-to-pay for the HSR fare was analyzed, and factors determined by the regression logit model. The result of the Willingness to pay for the HSR fare showed the fare for O-D pairs between ST-BKK and HY-BKK at 1.8 THB/km[1] (US$ 0.06 per km) and 1.5 THB/km (US$ 0.05 per km), respectively. The average HSR fare was 1.65 THB/km (US$ 0.055 per km). In comparison to the HSR fare proposed in the Chinese study of Thai HSR of 2.10 THB/km (US$ 0.07/km) for speed of 250 km/h, and 2.50 THB/km (US$ 0.08/km) for 300 km/h, it is clear that the present study gives a significant lower fare.

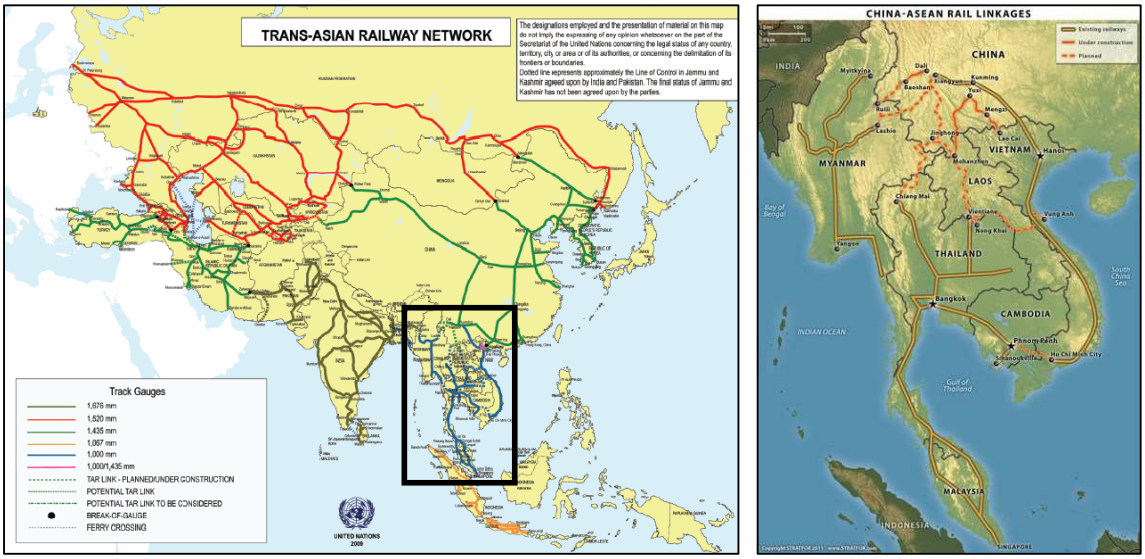
*Keywords*: High Speed Rail, Willingness-to-pay, Regression logit model

## 1. INTRODUCTION

Thailand is one member of the 10-country-member Association of Southeast Asian Nations (ASEAN). In 2015, ASEAN will become a single market and production base with the establishment of the ASEAN Economic Community (AEC). ASEAN connectivity aims to enhance competitiveness of ASEAN countries and for ASEAN to integrate with the global economy (ASEAN Economic Community Knowledge Center, 2012). The improved connectivity, in turn will increase opportunities and quality of life of the Thai and neighbouring ASEAN nations. Better transport can help close the time gap between Bangkok and the regions and between regions. High Speed Rail (HSR) is becoming a new mode choice for passenger travel in middle and long distance. The economic growth of China has been expanding to ASEAN and HSR networks can become the transport linkages for promoting the seamless movement of people and goods. China has plans to connect with ASEAN through HSR network linking to the southern region and passing through Vietnam, Laos, Cambodia, Thailand, Malaysia and Singapore. These routes are the southeastern part of the Trans-Asian Railway network or called CHINA-ASEAN High Speed Rail which connect to the Kunming

[1] Exchange rate: 1 USD = 30 THB

– Singapore (Neala, 2012) (see figure 1).




(a) (b)

Figure 1. (a) Trans-Asian railway network and (b) Kunming – Singapore line.
Source: (a) UNESCAP 2011 and (b) STRATFOR 2011

On December 2012, Transport Minister Mr. Chatchart Sitthipun showed the result of the feasibility study by a Chinese team that the initial line of HSR should start construction in 2014 - 2016 from Bangkok to Ban Pachi, Ayutthaya province and running at top speed 250 km/h on standard track (width 1.435 m.) with total length 54 km and construction budget about THB 25 billion (US$ 843 million) or about 468 million THB/km (US$ 15.6 million per km). The report recommended a fare for both maximum speed of 250 km/h and 300 km/h at 2.1 THB/km (US$ 0.07 per km) and 2.5 THB/km (US$ 0.08 per km), respectively. Furthermore, the study showed that investment in the construction of the Northern corridor between Bangkok –Chiang Mai with a total length 677 km would be about THB 30 billion (US$ 1 billion) and in the Northeast corridor between Bangkok – Nong Kai with a total length 615 km, about THB 29.8 billion (US$ 0.99 billion) (Bangkok Post, 2012). However, the competitive advantage of HSR over air is in the medium distance while for the short distance road transportation would be more efficient. Factors affecting the competitiveness of HSR with other modes are not only the difference of travel time, and frequency but also the differences of fare and convenience. The objectives of this paper are to review HSR in ASEAN perspective, to study factors determining the choice of public and private transport modes of O-D pairs in southern corridor and the Willingness-to-pay for HSR fare.

## 2. HIGH SPEED RAIL IN ASEAN PERSPECTIVE

Although Japan has long experience with the HSR technology of over 48 years since 1964, but until recently and in terms of route length, China has emerged as a new player with the longest HSR network in the world. In 2012, China has about 13,000 km of HSR route length which comprises 8,000 km for a maximum speed of 350 km/h and 5,000 km for a maximum of speed 250 km/h. In 2008, the first route of HSR was opened between Beijing – Tianjin for

the Olympic games with a maximum speed of 250 km/h. China achieved the initial agreement for construction the CHINA - ASEAN HSR lines with Vietnam, Laos, Cambodia, Thailand, Malaysia and Singapore. Kunming is starting point of the Kunming – Singapore Economic Corridor and ending in Singapore with total length covering 3,900 km. This line was planned to open for service in 2020 (Bullock, Salzberg and Jin, 2012). In this section, the perspective of each country that would be affected by the construction of the CHINA-ASEAN HSR lines, due to the route configuration are presented.

According to the study by Montlake and Simon (Montlake and Simon, 2011), Laos is the first country which HSR would be connected from China at Boten in Laos and ending in Vientiane. This line has a total length of 420 km of standard gauge and use for passenger and commodity movement with a maximum speed of 200 km/h and 120 km/h, respectively. The estimated cost of this line is about THB 21 billion (US$ 7 billion). In 2010, China and Laos signed an agreement for construction of the rail segment from Kunming to Laos and the strategy plan of HSR showed that the Boten – Vientiane corridor line would be connected to Thailand at Nong Kai province. The construction was to be completed in 4 years from 2011-2014. However, the project Kunming –Vientiane corridor has been postponed due to problems of land expropriation, environmental impact and difficult terrain condition such as rough mountains. This project could start again in 2013 if agreement was reached between the two countries. Furthermore, China and Laos have an investment plan for the second HSR route connecting the south of Laos from Tha- Kaek to the border of Vietnam with a total length of 220 km in the future. The Laotian Deputy Prime Minister expressed confidence in this project as it should not only be beneficial to the socioeconomic development in Laos but also countries in this region (Manager Online, 2012).

Vietnam has a plan to construct an HSR line connecting between north and south region from Hanoi to Ho Chi Minh City in 2009. The project plan showed 1,630 km of railway track length which was capable of a maximum speed of 250 km/h to 300 km/h. The result of a feasibility study by the Japan International Cooperation Agency showed that an investment cost for construction of this line is about THB 1,680 billion (US$ 56 billion). Although HSR between Hanoi and Ho Chi Minh City can cut travel time from 30 hours to 5 hours, but the government was concerned about the huge budget and trying to reduce the budget from THB 1,680 billion (US$ 56 billion) to THB 642 billion (US$ 21.4 billion). However, the government decided to delay this project and to consider the country's competence and financing capability before proceed with the construction plan (Maierbrugger, 2012).

Although Cambodia is the important connecting point of China – Asean rail route between northeastern to south, but there have been unclear discussions among countries which are involved in connecting to this rail network, and the problem of Cambodia –Thai border dispute around Preah Vihear Temple has marred the discussions.

Malaysia and Singapore have agreed to build a 300 km HSR line connecting Kuala Lumpur – Singapore. The estimate total cost for construction is THB 282 billion (US$ 9.4 billion) for a top speed of 250 km/h. This project can reduce travel time by existing train from 9 hours to 90 minutes. However, this project is under going a feasibility study before a final decision (Rahman, 2011).

In Thailand, the strategic plan of HSR was studied by the Office of Transport and Traffic Policy and Planning (OTP) in 2010, which proposed four HSR corridors and investment plans over the 18-year project duration from 2015 to 2032. The HSR corridors cover all the regions of Thailand and starting from Bangkok to Chiang Mai (745 km) in the north, to Nong Kai (615 km) and Ubon Ratchathani (570 km) in the northeast, to Aranyaprathet (250 km) and Chanta Buri (330 km) in the east and to Pradang Besar (982 km) in the south (OTP, 2010) (see figure 2). The former government of Prime Minister, Abhisit Vejjajiva had approved in

principle a framework for negotiations with China on the HSR Kunming - Singapore project from Nong Kai to Bangkok and Rayong in the east, and from Bangkok to Padang Besar, which was estimated at almost THB 560 billion (US$ 19 billion). However, after the general election in 2011, the new Prime Minister, Yingluck Shinawatra decided to delay HSR project on routes connecting Bangkok, Nong Kai, Rayong and Padang Besar due to the impact of the problem of HSR route in Laos. On April 2012, under the joint collaboration, the Chinese government has proposed a feasibility study of the two lines from Bangkok to Chiang Mai and Bangkok to Nong Kai. The result of the study suggested that for Bangkok – Chiang Mai line, train running with the maximum speed of 300 km/h should be selected and the maximum speed at 250 km/h would be appropriate for Bangkok to Nong Kai. Furthermore, the study suggested that the government should construction the pilot line from Bangkok to Ban Pachi as mentioned in the Introduction.

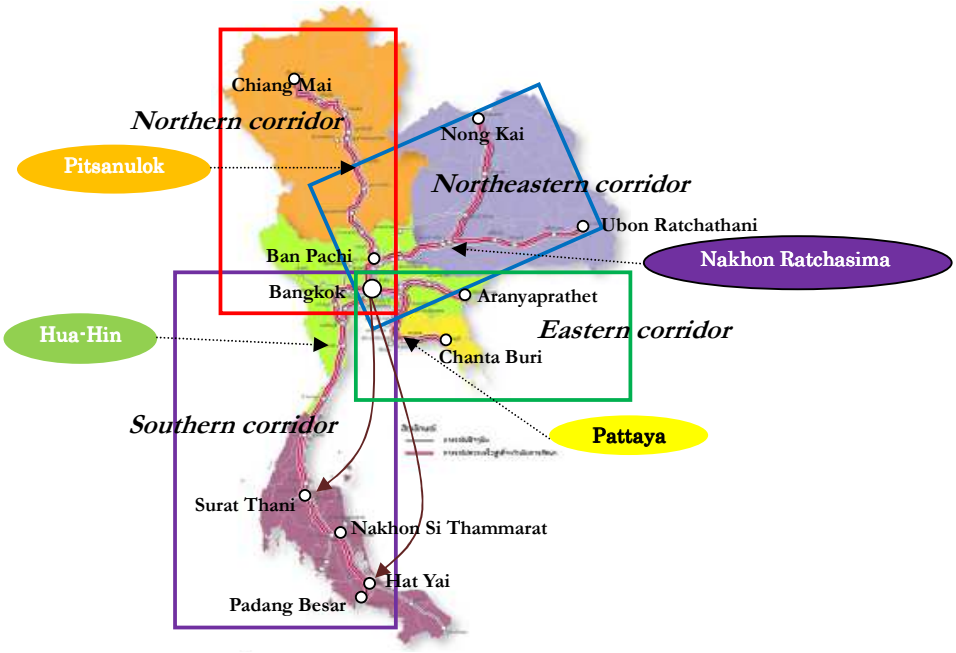



Figure 2. High Speed Rail Routes on four corridors
Source: OTP, 2012

On 19th March 2013, the cabinet approved a special plan to borrow THB 2 trillion (US$ 68 billion) for investment in the logistics and transport infrastructure projects over the seven years (2014-2020) period. The total of THB 2 trillion for infrastructure investment includes: THB 1.65 trillion for double track railway and the four high speed rail projects, THB 307 billion for water transport projects, THB 243 billion for road transport projects and the highway checkpoint THB 12.2 billion. The government has a plan for construction bidding in 2014, the first phase high speed rail covers four routes – Bangkok - Pitsanulok, Bangkok - Nakhon Ratchasima, Bangkok - Pattaya and Bangkok - Hua Hin and will be completed in 2018; and plans for the continuation of the routes are to be completed in the second-phase construction by 2022. The cost estimates for high speed rail vary according to the geographical areas from about 300 million baht/km (US$ 10 million per km) to 600 million baht/km (US$ 20 million per km) (Bangkok Post, March 30th, 2013).

The government was confident that the high speed rail system would increase options

for the people on transportation connectivity, reduce transportation cost, spread prosperity to the rural areas and less disparity among the people.

## 3. INTERCITY TRANSPORT SITUATION IN THAILAND

### 3.1 Intercity Passenger Travel Demand

During 2005-2009, travel volumes on public transport showed an average of 460 million passenger-trips /year. The proportion of passengers choosing to travel by intercity buses was a predominant 87%, followed by the rail and air modes, at 10 % and 3% respectively. Intercity bus and airline ridership showed an average increase of 7.9% and 5.8 % per year respectively, while the rail ridership showed an average drop of 2.1% per year (see table 1).

The result of OTP's study showed that intercity passenger travel volume for 2009 grew to 1.20 billion passenger-trips /year with private-car and public-transport modes taking up 59% and 41% of the volume respectively. The public transport mode comprise intercity bus, train and commercial airline, catered to the demand at 36%, 4% and 1%, respectively. Because practically all sections of Thailand's national highways are built to high international standards, the demand for highway use has been increasing at the rate of 3.6 % per year.

Table 1. Intercity passenger travel demand for public transport during 2005-2009

| Modes | Years (million passenger-trips) | | | | | Average | % Avg. diff. / year |
|---|---|---|---|---|---|---|---|
| | 2005 | 2006 | 2007 | 2008 | 2009 | | |
| Rail | 49 (13.7) | 48 (12.2) | 45 (8.2) | 48 (9.4) | 45 (9.2) | 47 (10.5) | -2.1 |
| Air | 11 (3.0) | 12 (3.0) | 14 (2.5) | 14 (2.7) | 14 (2.9) | 13 (2.9) | 5.8 |
| Intercity Bus | 299 (83.3) | 334 (84.8) | 493 (89.3) | 451 (87.9) | 427 (87.9) | 401 (86.6) | 7.9 |
| Total | 359 (100) | 394 (100) | 552 (100) | 513 (100) | 486 (100) | 461 (100) | -2.1 |

Remark: (%)

### 3.2 Modal Competition

The intercity travel modes under investigation include: Private Car, Bus, Train and Airline. Origin-Destination Surveys (O-D) were conducted in order to analyze the relationship between travel time and distance in each mode. The destinations were selected for trips originating from Bangkok to all twenty one provinces for airline, train and bus and three hundred questionnaires for car respondents in the southern corridor (see figure 3).

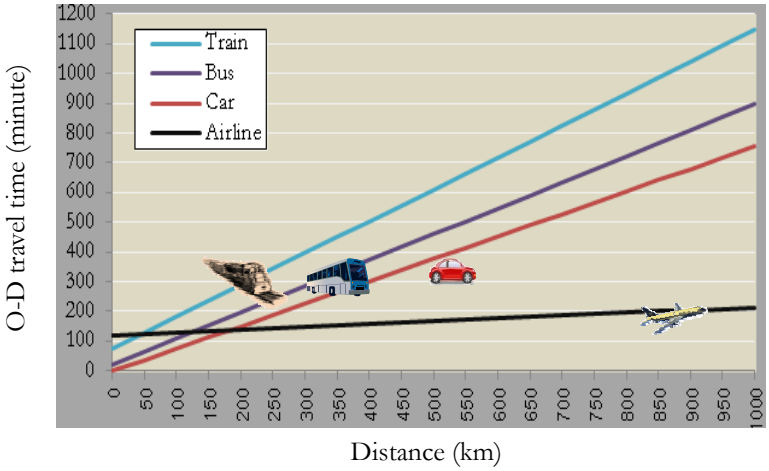



Figure 3. Relationship between O-D travel time and distance in each mode

Figure 3 shows that train travel is not as popular as due to the much longer travelling time when compared with other modes on the same distance travelled. The relationship between O-D pairs travel time and distance showed two service gaps are indicated; the first gap lies between the train and the bus modes, and the second one between the air and other travel modes. The first gap widens with travel distance, an indication that travel time on the train mode expands disproportionately with the time required for the bus mode on the same distance travelled. This reflects the inefficiency of train services which need upgrading. The gap between the air and other modes indicates the need for innovative options in order to fill it; for example, high-speed rail with service speeds of 250 km/h or higher.

However, the State Railway of Thailand (SRT) has the development plans for double track rail project which is planned for nationwide service coverage with a combined route length of 3,039 km, and to be implemented over 15 years. Development is staged in three phases as described below.

- Phase I: From 2010 to 2014, a period of 5 years; total route length 767 km; project investment THB 75 billion (US$2.5 billion).
- Phase II: From 2015 to 2019, total route length 1,025 km; project investment THB 75 billion (US$2.5 billion).
- Phase III: From 2020 to 2024, total route length 1,247 km; project investment THB 99 billion (US$3.3 billion).

Rail infrastructure upgrades are necessary to accommodate the planned Express Train and HSR. Either new or upgraded rail systems as well as E&M will be required to support train operations at higher speeds. It is possible to upgrade a portion of existing rolling stock for use on the new Express track. Existing track (1.00 m gauge) can also be improved to support speeds up to 120 km/h. At the same time, the existing signaling system may be upgraded for compatibility with the express system. For the high-speed train operating at 250 km/h on single track, all-new rolling stock will have to be procured. The track required for HSR will be the standard gauge (1.435 m) dedicated track which cannot be linked with SRT's narrow-gauge lines, with the Airport Rail Link being an exception. Elevated rail will be necessary where a line crosses a traffic intersection. This medium-haul option is expected to

fill the service gap between existing road-rail modes. From the O-D surveys, the average service speed of existing train is found to be as low as 50 km/h. For a long distance such as 900 km, an outdated SRT train requires 18 hours to cover it. In contrast, an express train running at 120 km/h will be able to cover the distance in 8 hours and 30 minutes, thereby cutting current travel time by 9 hours and 30 minutes. Even greater travel time reductions will be possible where an HSR is employed, as shown in Figure 4.

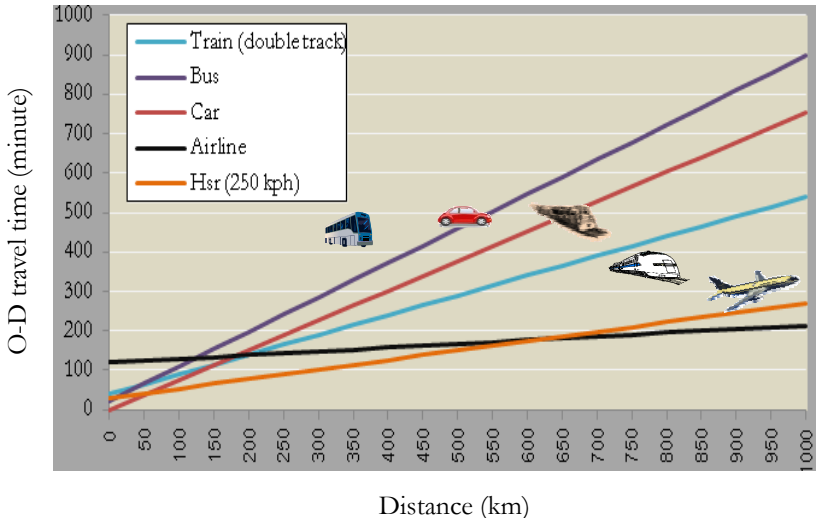



Figure 4. Express train and HSR to fill in service gap between modes

### 3.3 O-D Surveys Case Study in Southern Corridor

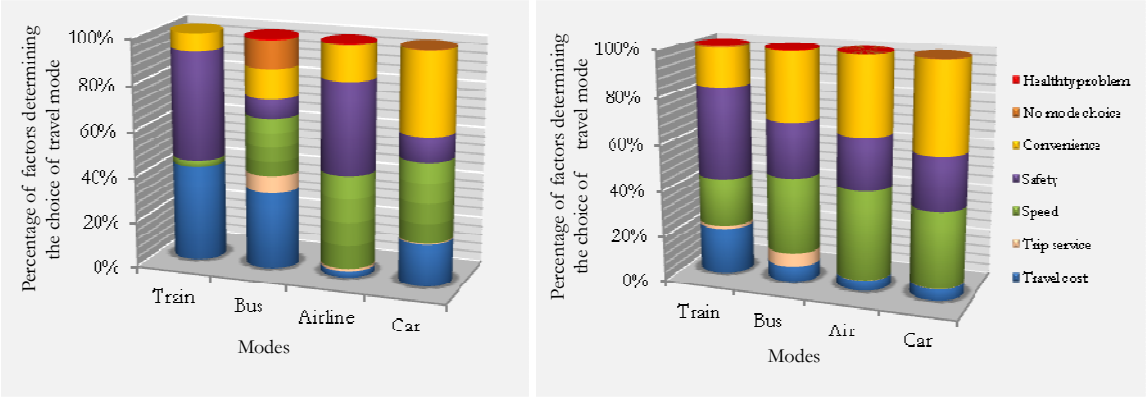
Surat Thani (ST) and Hat-Yai city (HY) were selected for trips originating of O-D case study to destination in Bangkok because of their locations being situated on HSR route plan of southern corridor. Distance between Bangkok to Surat Thani is 644 km and distance between Bangkok to Hat-Yai city is 933 km as shown in Figure 2. O-D surveys were conducted in order to analyze the behaviors of intercity passengers, modes under investigation include: private car, bus, train and airline. Travel behaviors are grouped according travel modes in each province. The study used primary data which were collected with the use of structured questionnaires. Table 2 shows the characteristic of respondents and covers the data of socioeconomic and trip purpose of each mode for a sample of 1,268 respondents of Surat Thani and a sample of 1,385 respondents of Hat-Yai. The result can be summarized as follows:

Table 2. The characteristics of respondents: socioeconomic and trip purpose

| Characteristics | Percentage characteristics of respondents in each O-D pairs by modes | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | Surat Thani-BKK | | | | Hat-Yai-BKK | | | |
| | Train | Bus | Air | Car | Train | Bus | Air | Car |
| Number of pax/day (one-way trip) in 2010 | 1,154 | 1,087 | 513 | 1,664 | 1,070 | 998 | 1,740 | 1,538 |
| Number of respondents | 300 | 309 | 344 | 315 | 349 | 350 | 351 | 335 |
| Gender | | | | | | | | |
| Male | 42.3 | 46.3 | 47.7 | 41.3 | 40.1 | 59.1 | 49.6 | 75.8 |
| Female | 57.7 | 53.7 | 52.3 | 58.7 | 59.9 | 40.9 | 50.4 | 24.2 |
| Marital status | | | | | | | | |
| Single | 46.7 | 22.3 | 25.9 | 43.2 | 50.1 | 36.9 | 44.4 | 20.0 |
| Married | 53.0 | 76.1 | 71.8 | 56.8 | 46.4 | 51.2 | 46.2 | 69.3 |
| Divorced/Widowed | .3 | 1.6 | 1.7 | 0 | 3.4 | 12.0 | 9.4 | 10.7 |
| Age (Year) | | | | | | | | |
| Average | 34 | 40 | 38 | 36 | 33 | 32 | 34 | 34 |
| Occupation | | | | | | | | |
| None | 4.3 | 2.3 | 1.5 | 3.8 | 2.0 | 8.0 | 4.3 | 2.1 |
| Housewife | 16.0 | 4.5 | 4.9 | 15.6 | 15.5 | 6.9 | 26.2 | 9.9 |
| Student | 41.7 | 13.3 | 12.5 | 34.6 | 28.9 | 23.1 | 31.6 | 17.6 |
| Government official | 14.7 | 39.5 | 38.1 | 23.5 | 4.9 | 33.7 | 6.6 | 30.7 |
| Employee | 12.7 | 7.1 | 16.3 | 6.0 | 23.8 | 18.9 | 21.1 | 4.2 |
| Owner | 6.7 | 21.4 | 20.9 | 13.3 | 16.6 | 7.4 | 8.8 | 20.0 |
| Agriculturist | 4.0 | 12.0 | 4.9 | 2.9 | 4.6 | 1.4 | 1.4 | 15.2 |
| Other | 4.3 | 2.3 | .9 | .3 | 3.7 | .6 | 0 | .3 |
| Education level | | | | | | | | |
| Below bachelor degree | 33.3 | 28.8 | 22.1 | 28.6 | 57.3 | 31.1 | 23.4 | 37.0 |
| Bachelor degree | 60.3 | 61.8 | 65.4 | 54.0 | 40.1 | 59.4 | 66.4 | 55.5 |
| Master degree | 6.0 | 8.1 | 10.2 | 16.5 | 2.3 | 8.9 | 10.0 | 7.5 |
| Ph.D. | .3 | 1.3 | .3 | .3 | .3 | .6 | .3 | 0 |
| Others | 33.3 | 28.8 | 2.0 | .6 | 0 | 0 | 0 | 0 |
| Personal income (THB) | | | | | | | | |
| Min. | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Max. | 35,000 | 80,000 | 80,000 | 80,000 | 70,000 | 70,000 | 35,000 | 35,000 |
| Average | 6,808 | 21,610 | 24,104 | 11,794 | 9,757 | 11,064 | 14,993 | 13,500 |
| Household income (THB) | | | | | | | | |
| Min. | 5,000 | 4,500 | 5,000 | 7,500 | 5,000 | 7,500 | 12,500 | 12,500 |
| Max. | 45,000 | 100,000 | 100,000 | 100,000 | 100,000 | 75,000 | 55,000 | 75,000 |
| Average | 22,400 | 37,190 | 42,289 | 34,333 | 19,019 | 32,021 | 33,412 | 33,500 |
| Trip purpose | | | | | | | | |
| Work | 19.7 | 12.3 | 11.0 | 27.3 | 18.1 | 15.4 | 14.8 | 15.2 |
| Business | 27.3 | 47.6 | 36.3 | 25.1 | 25.8 | 25.4 | 25.4 | 28.1 |
| Visiting family | 14.3 | 7.4 | 11.3 | 13.0 | 16.0 | 15.4 | 10.5 | 11.9 |
| Home | 26.3 | 1.9 | 4.4 | 16.5 | 7.7 | 33.1 | 34.2 | 38.5 |
| Touring | 12.0 | 27.2 | 32.0 | 13.0 | 8.3 | 10.6 | 13.4 | 6.3 |
| Study | .3 | 3.6 | 2.9 | 5.1 | 23.8 | 0 | 1.7 | 0 |
| Other | 0 | 0 | 2.0 | 0 | .3 | 0 | 0 | 0 |

- Number of passengers travelled by public modes, most of the passengers chose to travel by train followed by bus and air between ST-BKK while airlines was the mode chosen by most passengers travelled between HY-BKK.
- Number of travellers by private car were estimated by using an occupancy rate at 2.3 persons/car.
- Female travellers formed a higher percentage than male travellers in all travel modes between ST-BKK, whilst they made up a high percentage in train and air mode between HY-BKK.

- For marital status, the 'married status' made up the highest percentage The respondents' average ages in ST are higher than those in HY when compared between mode. Average ages are about 34 - 40 years old in ST and about 32 – 34 years old in HY.
- In ST, the percentage of students travelled by train (41.7%) and car (34.6%) were the highest compared to other occupations whilst most of government officials selected to travel by bus (39.5%) and air mode 38.1%). For HY, the highest percentage of occupation was the students who chose to travel by train (28.9%) and airline (31.6%). Most of government officials chose to travel by bus (33.7%) and car (30.7%).
- Most of the respondents' education level was bachelor degree (>50%) except train passengers in HY where the percentage of below bachelor level was the highest (57.3%).
- Similarly, the average of personal income and household income of respondents in both ST and HY show train passengers have the lowest income and air passengers the highest income.
- The main travel purpose of respondents by mode were to do business and go home by train, to do business and touring by bus and airline and go to work and business by car in ST. In HY the main travel purposes by mode were to do business and study by train, to do business and go home by bus, air and car.




Surat Thani Hat-Yai

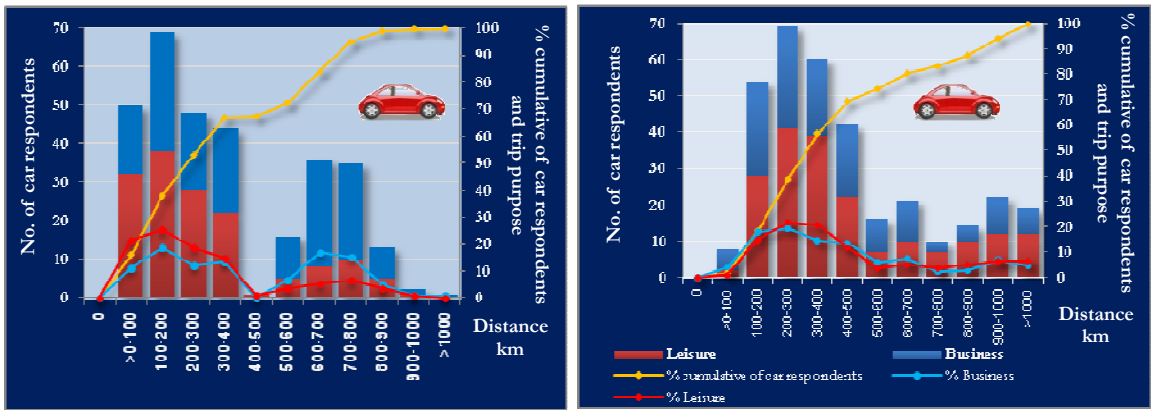
Figure 5. The percentage of factors determining the choice of travel modes in ST and HY

The results of this study showed the percentage of respondents' decision in choosing factors that determine their travel mode choice. In ST, main factors determining the choice of each mode were travel cost (40%) and safety (40%) for train. For bus, the dominant factors were travel cost (20%), speed (20%), convenience (12%) and others (12%). The dominant factors for air mode choice were speed (38%), safety (40%) and convenience (20%). The factors influencing passengers travel by car were travel cost (12%), speed (36%) and convenience (40%).

In HY, the results showed the dominant factors for train respondents were travel cost (18%), speed (20%), safety (38%) and convenience (18%). For bus, the dominant factors were speed (36%), safety (24%) and convenience (32%). Air passengers' chosen factors which determined their mode choice were speed (36%), safety (28%) and convenience (36%). For car mode, the main factors were speed (28%), safety (20%) and convenience (44%).

However, for health reasons, a small percentage of passengers chose to travel by bus and air mode in ST and train, bus and airplane in HY (see figure 5).

Notwithstanding, in this study intercity travel can be separated into two modes: 1/public transport: train, bus and airplane where data on distance can be obtained for each pair of origin to destination and 2/ private mode: which includes cars and other passenger vehicles, e.g. pickups and vans whose destination depends on the travel purpose of respondents. Figure 6 showed relationship between number of car users and trip purpose classified by distance.




Surat Thani Hat-Yai

Figure 6. Relationship between number of car respondents and trip purpose classified by distance

Most car users selected to travel short distance about 100 - 300 km (Over 50%) from the origin and the number of car users gradually decrease after distance 300 km and increasing again at distance about 600 – 800 km in ST and 900 – 1,000 km in HY. Figure 6 showed distance which the number of car users increase again, in the range of 600 – 800 km and distance 900 – 1,000 km which is the distance between ST to Bangkok and HY to Bangkok, respectively. Consideration of the relationship between trip purposes and distance of ST show that for short distance, the main purpose of respondents was travelling for leisure and for long distance was travel for business. In HY, similarly for short distance but for long distance number of respondents selected same purpose about 10% of respondents in each purpose.

The study of OTP's 2010 Thailand Master Plan for Transport and Traffic Development has set the target for growth and mode share as follows: intercity public transport is to increase from 41% to 46% over the decade of the plan; reduction in private car use from 59% to 54%; rail ridership is to be increased to 35% over the 12-year span (2007-2018). However, the government's emphasis on developing the rail mode, in particular, the double-track and the high-speed systems can be seen that the planned express train (120 km/h on double track) will have a competitive edge over the bus and private car modes at travel distances of 200 km or longer. The HSR (250 km/h) will rival the flying mode at distances about 600 km. Given the prospects of such improvement, plus appropriate upgrades on the intercity rail systems, passengers will be accorded a better array of travel options which will help to discourage private car use and encourage their switching to the public modes, especially for travel distances over 200 km.

## 4. HIGH SPEED RAIL CASE STUDY

### 4.1 Competitiveness between HSR and Air

As mentioned above in figure 4, travel time of express train with maximum speed 120 km/h would have advantage over car at distance over 200 km. However, for short and medium distance, HSR has advantage over all modes; on the other hand, air mode has advantage for long distance. Given the competition between express train, HSR and car for short distance which showed travel time by car at a disadvantage but most of car users chose to travel by this mode due to more convenient than other mode for short distances, as showed in figure 5 and figure 6. Express train is at a disadvantage in competing with air mode for long distance due to more travel time gap. HSR is a new mode choice which has potential to compete with air mode in medium distance. Factors that influence the passengers' decision in choosing between HSR and air include not only travel time but also differences in fare. If airfare is more expensive, passengers will likely switch to HSR.

### 4.2 Willingness To Pay and Model Results for HSR Fare

Number of domestic passengers by Low Cost Carrier airline (LCC) grew up from 14.37 million to 26.32 million over the 10 year period, 1999-2009. Full Cost Carrier airline market share were significantly reduced on most of all routes due to the cheaper of LCC fares. The data of LCC fares collected from six provinces in the south regions seven days before departure during 18 - 24 May 2012 were shown in Table 3. The data showed the average fares were about 2.7 THB/km (US$ 0.09 per km).

Table 3. Distance, fare/seat and fare/km of six provinces in the south region

| Provinces | Distance | Fare/seat* | | Fare/km | |
|---|---|---|---|---|---|
| | km | THB | US$ | THB/km | US$/km |
| Surat Thai | 520 | 1,580 | 52.7 | 3.04 | 0.10 |
| Nakhon Si Thammarat | 590 | 1,580 | 52.7 | 2.68 | 0.09 |
| Krabi | 645 | 1,830 | 61.0 | 2.84 | 0.10 |
| Trang | 682 | 1,670 | 55.7 | 2.45 | 0.08 |
| Phuket | 684 | 1,670 | 55.7 | 2.44 | 0.08 |
| Hat-Yai | 735 | 1,800 | 60.0 | 2.45 | 0.08 |
| Average | | | | 2.65 | 0.09 |

Remark: *LCC fare is for booking 7 days before departure during 18-24 May 2012

The study of by Chinese team recommended HSR fare for 250 km/h train at 2.1 THB/km (US$0.07 per km) and for 300 km/h at 2.5 THB/km (US$ 0.08 per km), as mentioned in the introduction. The gap between LCC fare and 250 km/h of HSR fare is a difference of 29% and 11 % for 300 km/h with LCC fare higher than HSR fare. However, the O-D case study of willingness-to-pay (WTP) in the southern corridor between ST-BKK and HY-BKK are for analyzing factors which determine the mean WTP comparing between LCC fare and HSR fares and recommended fares.

The sample sizes are the same as in section 3.3. The questionnaires were divided into two sections of the equation: socioeconomic and bid fare amount. WTP was evaluated with Contingent Valuation Methods (CVM) and was estimated using a double bounded dichotomous model. Regression logit model was selected to analyze the influence WTP variables. The regression logit model is specified as

$$Y = \alpha + \beta_1 X_1 + \beta_2 X_2 + .....\beta_i X_i \quad (1)$$

where,

| | | |
|---|---|---|
| $Y$ | = | Logit (WTP) responses of WTP HSR fare which is either 1 for Yes and 0 for No |
| α | = | $Y$ intercept |
| $\beta_i$ | = | the coefficient of independent variables |
| $X_1$ | = | Gender (coded 0 = Female, 1= Male) |
| $X_2$ | = | Marital status (coded 0 = Married, 1= Single) |
| $X_3$ | = | Age (in ranges) |
| $X_4$ | = | Occupation (coded 0 = Otherwise, 1 = Student) |
| $X_5$ | = | Occupation (coded 0 = Otherwise, 1 = Government official) |
| $X_6$ | = | Occupation (coded 0 = Otherwise, 1 = Employee) |
| $X_7$ | = | Occupation (coded 0 = Otherwise, 1 = Owner) |
| $X_8$ | = | Education level (coded 0 = Otherwise, 1 = Bachelor degree) |
| $X_9$ | = | Personal income per month (in ranges) |
| $X_{10}$ | = | Household income per month (in ranges) |
| $X_{11}$ | = | Trip purposes (coded 0 = Leisure, 1 = Business) |
| $X_{12}$ | = | Initial bid amount |

Initial bid amount were determined by pilot test with 30 questionnaires in each modes of each O-D pair. Respondents were free to offer HSR fare by open bid and initial bid amount was selected from the four highest frequencies of respondents. The initial bid amounts of O-D ST-BKK were 500, 600, 950 and 1,500 Baht and the initial bid amounts of O-D HY-BKK were 950, 1,000, 1,200 and 1,500 Baht.

Mean WTP can be calculated using formula derived by and given as (Hanemann M, 1991):

$$Mean\_WTP = \frac{1 * \ln\left(1 + e^{\alpha}\right)}{\left|\beta_{bid}\right|} \quad (2)$$

where,

*ln* is the natural logarithm

$\beta_{bid}$ is absolute coefficient of initial bid amount.

The model result shows that factors which determine the HSR fare for O-D pair ST-BKK at significant 95% comprise occupation variables, education level, household income and initial bid amount. For O-D pair HY-BKK, the determining factors are education level, household income, trip purposes and initial bid amount (see table 4).

Mean WTP HSR fare of for ST and HY were calculated by equation 2 which gave the results as 1,177 THB (US$ 39.2) or 1.8 THB/km (US$ 0.06 per km) for ST-BKK and 1,402 THB (US$46.7) or 1.5 THB/km (US$ 0.05 per km) for HY-BKK. The average HSR fare in southern corridor then is 1.65 THB/km (US$ 0.06 per km) and this shows that WTP for HSR fare is significantly lower than the recommended fare proposed by the Chinese study team of 2.10 THB/km (US$ 0.07per km). Although the result of this study showed that HSR has an advantage over LCC in terms of fare difference but LCC has advantage over HSR for travel time (see table 5). However, the current strategy of LCC is the promotion of cheap fares in low seasons which can help keep the market share in competition with other modes.

Table 4. Determinants of HSR fare of O-D pairs: ST-BKK and HY-BKK

| Variables | ST-BKK | | | HY-BKK | | |
|---|---|---|---|---|---|---|
| | $\beta_i$ | *p-value* | *Exp($\beta_i$)* | $\beta_i$ | *p-value* | *Exp($\beta_i$)* |
| α | 5.5273 | .0000 | - | 6.4454 | .0000 | - |
| $X_1$ | -.3103 | .0883 | .7332 | -.0926 | .5390 | .9116 |
| $X_2$ | .5929 | .0737 | 1.8092 | - | - | - |
| $X_3$ | - | - | - | - | - | - |
| $X_4$ | -1.0663 | .0116 | .3443 | -.4185 | .0789 | .6580 |
| $X_5$ | -1.0334 | .0011 | .3557 | -.3435 | .2845 | .7093 |
| $X_6$ | -1.1941 | .0019 | .3029 | -.1071 | .7134 | .8984 |
| $X_7$ | -1.3544 | .0002 | .2580 | -.7541 | .0610 | .4704 |
| $X_8$ | .5133 | .0139 | 1.6707 | .4914 | .0118 | 1.6346 |
| $X_9$ | .2650E-05 | .7846 | 1.0000 | -.1730E-04 | .1999 | 1.0000 |
| $X_{10}$ | .1548E-04 | .0188 | 1.0000 | .3557E-04 | .0053 | 1.0000 |
| $X_{11}$ | .0010 | .9957 | 1.0009 | -.2964 | .0441 | .7435 |
| $X_{12}$ | -.0047 | .0000 | .9952 | -.0046 | .0000 | .9954 |
| No. of respondents | 1,268 | | | 1,385 | | |
| Log likelihood | -431.4713 | | | -624.0723 | | |
| $\rho^2$ | .4324 | | | .1768 | | |

Table 5. Comparison of HSR fare among O-D case study, OTP recommendation, Chinese feasibility study and low cost airlines fare

| O-D | WTP | | WTP/km | | Remark |
|---|---|---|---|---|---|
| | THB | US$ | THB | US$ | |
| ST-BKK | 1,177 | 39.2 | 1.80 | 0.06 | From O-D case study |
| HY-BKK | 1,402 | 46.7 | 1.50 | 0.05 | |
| Average | - | - | 1.65 | 0.06 | |
| HSR 250 km/hr | - | - | 1.60 | 0.05 | OTP recommendation |
| HSR 250 km/hr | - | - | 2.10 | 0.07 | From the Chinese study |
| HSR 300 km/hr | - | - | 2.50 | 0.08 | |
| Average of LCC | - | - | 2.65 | 0.09 | LCC fare/km of six provinces in the south region |

## 5. CONCLUSIONS

ASEAN connectivity has a goal for the movement of people and commodity under the strategy of the seamless boundary plan. The economic growth of China has been expanding to ASEAN and HSR networks are the transport linkages for promoting the seamless movement of people and goods. China and ASEAN countries agree to build the railways networks starting from Kunming in China to Laos, Vietnam, Cambodia, Thailand, Malaysia and Singapore. However, the HSR construction in each country has been delayed due to huge investment costs and political impacts.

Thailand has a plan to construct the first HSR link between BKK and Ban Pachi following the recommendations in the study by the Chinese team, the link is 54 km long and

construction budget has been estimated at about THB 25 billion (US$ 843 million) or about 468 million THB/km (US$ 15.6 million per km). The report recommended fare for the case where the maximum speed was 250 km/h and 300 km/h at 2.1 THB/km (US$ 0.07 per km) and 2.5 THB/km (US$ 0.08 per km), respectively.

O-D pairs between ST to BKK and HY to BKK were selected for the study because of the location of the two cities lie on the planned HSR route for southern corridor. The result showed most passengers in ST chose to travel by train and by air for HY. Car respondents chose to travel short distance for leisure purpose and long distance for business purpose. The study showed WTP for HSR fare of O-D ST-BKK is 1,177 THB (US$ 39.2) or 1.8 THB/km (US$ 0.06 per km) and 1,402 THB (US$46.7) or 1.5 THB/km (US$ 0.05 per km) for HY-BKK. The average HSR fare in southern corridor is 1.65 THB/km (US$ 0.06 per km) which is less than the recommended fare of 2.1 THB/km (US$ 0.07per km) as proposed by the Chinese study team. Competitiveness between HSR and air did not depend only on travel time but also on factors such as fare difference, users'occupation, household income, education level and trip purposes.

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