

Comparison of Route Changing Behaviors Associated with Perception and Potential Use of Advanced Traveler Information System (ATIS) in Southeast Asian Cities

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Abstract: The Advanced Traveler Information System (ATIS) has been applied in many countries because it has been proved as one of potential solutions to solve congestion problem and to improve the quality of driving. Providing drivers with additional traffic information, it is expected to influence their travel decision on route and destination selection, or even on cancellation of the trip. A number of studies have been conducted in order to improve the performance of ATIS in various ways, such as the setting of the system, the content of information, the accuracy of the information, etc. Yet the effectiveness of the system is heavily dependent on the driver's behavior and response to the given information. The behaviors are somewhat unique for specific individuals (cities).

The primary objective of this study was to analyze the behavior of drivers in different Southeast Asian major cities; Bangkok (Thailand), Kuala Lumpur (Malaysia), and Singapore (Singapore), pertaining to changing route under influence of traffic information availability and travel situation. Users' characteristics including socio-economic and trip characteristic as well as the responses to traffic information were investigated through Revealed Preference. The results illustrate that the behavior of drivers in the three cities are different pertaining to the factors that affect them to change the route. Their socio-economic and trip characteristics play a role in determining their route changing behavior.

Key Words: *Route Changing behaviors, Traveler Information System, Southeast Asian*

1. INTRODUCTION

Advanced Traveler Information System (ATIS) is an Intelligent Transport System (ITS) service which aims at providing reliable and accurate information to users for their better travel decisions. The success of ATIS requires that it could be able to provide additional and sufficient information that is useful, used, and influences motorists to merge this traffic (travel) information into their driving decision so that they could make more efficient driving options (e.g. route choice). Not only ATIS could give more efficiency of the current travel, it could also improve individuals' travel experience. However, the reality does not speak the same facts. Some of previous research results stated that ATIS sometimes was not as effective as it should be. The keys for ATIS success are twofold;

- the quality of the information itself. The given information must be timely and accurate, otherwise drivers will be misleading and have faulty experience on the information, and
- the motorists' route changing habits and the degree that they incorporate the updated

traffic information to make proper decision (i.e. how they make decision based on both ATIS traffic information and their travel experience),
Therefore, the success of ATIS depended on behaviors of drivers and the quality of displayed information.

Even ATIS services are proved by existing users to be successful, the benefits may not appear to attract non-customers (travelers who do not presently buy or use the system) to motivate them seek out ATIS for their use. Drivers normally have their own interpretations for all traffic information based on their own experiences. They generally rate their own ability to predict traffic as reliable, and traffic information generated by radio broadcast (or other media) as unreliable. So, it is impossible for them to get “more” accurate and “more” useful traffic information. As a result, there is little reason for them to buy or use any traffic information services. So, recently ATIS services need to compete against drivers’ local traffic personal knowledge (experience).

By experiment, the extent of benefits and risks of ATIS are still unclear because it all depends on how individual understands and uses the given information and thus assessing the worthiness of ATIS basically depends on anticipating the behavioral responses to such technologies. As a result from an experiment about drivers’ actual responses to message activation in London, it comes that only one third of drivers who noticed the information displayed by Visual Message Sign (VMS) and few of them were diverted, although many found the information useful. And only one-fifth of the drivers diverted compared to the expected results comes from stated questionnaire (Chaterjee, et. al., 2002).

This paper attempted to reveal two conclusions. One is to explain existing travel characteristics and route changing behaviors of drivers associated with travel information. The other is to describe the level of provision of traveler information system and perception by travelers. This could lead to the potential use of ATIS applications. The study was conducted using samples from cities in three countries with different states of development in South East Asia region, namely Bangkok (Thailand), Kuala Lumpur (Malaysia), and Singapore.

2. THEORETICAL BACKGROUND

2.1 Advanced Traveler Information System (ATIS)

ATIS is the system that provides real-time information to travelers about traffic conditions, delays, transit schedules, parking availability, roadwork, and route guidance from origin to destination. Real time information allows travelers to make informed decisions and to have the potential to improve the network efficiency, reduce congestion, and enhance environmental quality as well (Dia, et. al., 2001). In fact, these systems are proved to be useful for users in disseminating such beneficial traffic information. But this information should be provided far enough in advance of critical decisions point for drivers so they have enough time to evaluate their alternate actions, to make proper travel decisions, and to perform some actions to help reduce their individual travel time.

The framework of ATIS system is simple. First of all, situations are gathered from the field using various high-technology equipment located along selected corridors such as traffic sensors and cameras or even equipment attached on vehicles such as Global Positioning

System (GPS). Then, the data are sent to the traffic center. Using powerful software, the collected data are processed into beneficial traffic information in real-time and then are disseminated to the commuting public via accessible channels such as television or radio reports, telephone, newspapers, websites, Variable Message Sign (VMS), or even in-vehicle devices. Receiving the information, commuters are expected to respond by altering their travel behavior, especially the route alteration. Toppen, *et. al.* (2002) stated that ATIS has the potential to benefit drivers in reduce travel time, reduce stress level caused by traffic congestion, and it can lead to cancellation of trips as well.

2.2 ATIS and traveler's behaviors

The performance of ATIS is highly dependent on driver behaviors. This phenomenon comes up in consequence of the main goal of ATIS to maximize the network performance (by reallocating or shifting travel demands in proper proportion). Therefore, to achieve the desiring shifting of travel demands, the solid (and accurate) system and positive driver's responses to ATIS information are highly required. Thus, to build an effective ATIS, it is important to provide good quality of data accumulation. The characteristics of ATIS, information, communication, and integration are key features of ATIS. Then, it is critical to study and understand driver's behavior since all of ATIS benefits cannot be realized without driver's actions. Numbers of research conducted on traveler's behaviors corresponding to ATIS usage. Most recent methodologies for the evaluation and management of ATIS are based on travelers' behavioral model, predicting the response of users to the ATIS systems. One example of the past study is done by Mahmassani, Hani and Yu-Hsin Liu (1999) which was concerned about drivers' response in commuting behavior under influence of ATIS.

Commuters tended to switch their route both pre-trip and en-route in response to differences between predicted arrival time and their own predicted arrival time. Furthermore, they tended to switch their route if they experienced late arrival by following the current route.

The belief and following traffic information (suggestion) from ATIS is highly dependent on driver's behaviors. Many have believed their personal experience more than the suggestion by the ATIS information. Many past studies show that drivers still proceed on the regular route even the in-vehicle device suggests an alternative route. This behavior is individual's unique characters. The degree of route changing depends on several personal factors, such as experience on ATIS data reliability, familiarity with the alternative route, travel time constraint, current traffic condition, etc.

2.3 Existing ATIS information channels

Information from ATIS can be provided to travelers in several ways. Focusing on the drivers, main channels to communicate with drivers are Variable Message Sign (VMS), In-vehicle device (IVD) or "navigator", Intelligent Sign Board (ISB), Mobile phone, etc. Here, VMS and IVD are described in details:

- Variable Message Sign (VMS)

VMS is one of the most common deployed ATIS devices, which are usually installed on the side or over the roads to display the real-time traffic information such as congestion ahead, incident report, or existence of construction work. Typically, VMS messages are only beneficial in abnormal or unique situations. Furthermore, VMS impacts on diversion rates are often modest since the information is openly disseminated to all drivers who share the same

routes. The VMS studies generally focus on how drivers react while they receive shared information on display. A driver will make a travel decision based on his own decision, and consideration of other drivers' responses as well.

- *In-vehicle Devices*

In-vehicle devices are another type of channel for information dissemination and are gaining popularity in giving drivers personal en-route traffic information. Several services and features have been promoted by traffic information providers with various packages and with various prices as well. This kind of devices is quite popular in developed countries such as European countries or Japan. This device can provide personalized and necessary information to drivers, and thus has a high potential that the decision of individual can be optimized and the goal of overall traffic congestion solution can be easily realized.

The most popular feature is in-vehicle navigation which gives drivers route navigation or route guidance. Another popular feature is urban traffic flow information, which informs drivers the distribution of traffic in the city so they can easily know which roads are suffered from congestion and which roads are vacant so they can divert themselves accordingly. Besides, in-vehicle traffic information device also offers features as incident information, route guidance, weather report, etc.



a) VMS



b) In-vehicle device (or navigator) (www.dash.net)

Figure 1 Some Traveler Information devices

Studies regarding ATIS are mostly concerned with one or two different point-of-views. Some studies are concerned about the system, and the other emphasized in users' behavior regarding the information. For users' behavior studies, many researchers attempted to ensure whether in-vehicle devices could provide information that was relevant with drivers' needs in usable format. Many of these studies focused on analyzing drivers' preferences of the information (Mannering, et. al., 1995), the value of traveler information for drivers (Levinson, 2002), or even the impact of the device to drivers (Shiaw-Tsyr Uang and Sheue-Ling Hwang, 2002).

Bierlaire, et. al. (2006) studied about drivers' responses to VMS in Switzerland and came up with a behavioral model using discrete choice approach for pre-trip and en-route type of information. Chatterjee, et. al (2002) focused on building a drivers response model to VMS in London area. Cited from Lappin (2000), Schofer et. al. (1997) studied about Dynamic Route Guidance (DRG) and found that there were a variety of perceptions by drivers on DRG. First, women drivers preferred DRG while men drivers preferred delay advisory feature. Moreover, most drivers believed that, in their local area, they could find an alternate route by themselves better than any device suggestion. The rest believed that they had their own delay (tolerance)

limit, and received and believed any suggestion from DRG whenever the traffic (delay) condition exceeded the limit. Finally, drivers had a greater acceptance on DRG information when they reckoned that the system provided good advice.

Beside the type of information, drivers also want reliable, accurate and relevant traffic information while driving. For many trips, traffic information provided information which already out-dated at the moment they reached the potential route diversion decision point. This is where the greatest demand of ATIS lies.

3. RESEARCH DESIGN AND DATA

3.1 Questionnaire Design

The questionnaire was designed to capture the real-world driver's behavior pertaining to availability of travel information. The choice and rating questions were devised with 5 points semantic scale for opinion regarding availability of travel information. After completing pilot survey, the final questionnaire included:

Socioeconomic characteristics, such as gender, age, and income.

Normal trip characteristics, such as distance from home to school/work place, flexibility of working hours, which may influence the travel behaviors.

Responses to certain travel information devices, whether they were ever noticed the information, and the level of understanding to the information. The feedback for the service also gathered through the survey.

This survey also tried to get the opinion pertaining travel information services, such as the quality of the information, and the preferable information.

3.2 Locations

Three different places with different characteristics were selected in this study. Thailand, Singapore, and Malaysia were chosen as study cases since the three countries were located in the same region (Southeast Asia) but differ in travel information applications and may have different motorists' route changing behaviors

- Singapore

Singapore is known as a small developed country in South East Asia region with population 4.8 million people as of June 2006. It has reached advanced and well managed transportation system compared to nearby countries that offers comfort and easiness for transit and public transport riders in result. With harmony among its public transportation systems (Mass Rapid Transit, Light Rapid Transit, buses, and taxis), people has almost never experienced difficulties in reaching any places in the country. Private car drivers are provided with updated traffic information such as major roadwork, slow traffic, vehicle breakdowns, accidents, or even closed routes by panels which are available on the roadside. VMS in Singapore deployed in its expressway and major roads in the city. Information on incidents as well as travel time to destination can be obtained through these electronic signboards. The content of the message could inform the condition of the traffic ahead, roads closing, or even travel time to particular destinations.

- Kuala Lumpur - Malaysia

Kuala Lumpur, as the capital city of Malaysia is also has a well managed transportation system. The Integrated Transport Information System (ITIS) has provided information to commuters Kuala Lumpur for few years. Information can be sent to drivers through VMS which are deployed in several points in the city. For future long-term deployment, real time data will be obtained through various communication tools such as radio, mobile phones, Multimedia Messaging Services (MMS), Short Messaging Services (SMS), Personal Digital Assistant (PDA), navigators, and others. (www.itis.com.my). Currently 45 surveillance corridors in Kuala Lumpur have been equipped with 255 closed-circuit TVs (CCTV), 728 image-based vehicle detector stations, 140 variable message signs (VMS), 89 communication nodes as well as 150km of cable ducting. (the star on-line, July 21, 2007).

- *Bangkok - Thailand*

Whereas in Bangkok, the intelligent transport system already deployed has not reached the same stage as in Singapore or Kuala Lumpur. Traffic jam always occurs in major urban roads, while the expressway sometimes suffers from the same problem. Interactive travel information devices are installed in some busy areas to inform drivers the traffic condition ahead. Apart from several VMS in the city, Bangkok has introduced a new message board as known as Intelligent Sign Board (ISB), which consists of colorful panels showing the traffic condition of major urban roads. Three colors; red, yellow (or orange) and green represent the traffic condition in associated routes. This kind of board, will be introduced in the others location and gather the public response regarding this device as well. Bangkok has 80 VMS and ISB on urban streets. Car navigation is on-trial to show traffic information on-board. A growing community is to use Personal Navigation Device (PND). The limited number of mobile phone users can access to real-time traffic information.



a) VMS in Singapore



b) VMS in Kuala Lumpur, Malaysia



c) Intelligent Sign Board in Bangkok, Thailand

Figure 2 Example of existing channels to provide traffic information in three cities

3.3 Data Collection

The primary data obtained were divided into two main parts, (1) the socioeconomic attributes of the drivers, and (2) the characteristics of behaviors in interpreting the information, plus the expected actions in specific conditions. A non-random sampling approach is used in this study. Non-random sampling techniques do offer potential way in reducing the cost of data collection and increasing the precision of parameter estimates. However, it requires careful thoughts about how to use the resulting data to represent population's conclusion. A pilot survey was conducted in 2007 with random respondents regarding their socioeconomic characteristics with the main objective to test whether respondents could understand the content of the questionnaire. After that, the main survey was conducted in three different cities. A total 200 questionnaires survey conducted in Kuala Lumpur and Singapore in 2007 and achieved response rate of 40% in Kuala Lumpur and 60% in Singapore. Later the last survey was done in Bangkok with total respondents of 400.

4. RESULTS AND DISCUSSION

4.1 Trip Characteristics

The summaries of key person and trip characteristics are highlighted in Table 1 and 2. It is noted that the study focused on the home-based trips, even though some non-commuter trips were also obtained as these were long-distance trips. Key person characteristic, income, in Table 1 shows that Singapore has the highest income among the three cities. Income may be attributed to value of time and thus affect the decision for route switching. The discernable trip characteristics of three cities are trip distance and trip time. On average Bangkok commuters traveled in the greatest distance and time. Considering the travel time over the similar distance, Bangkok people spent the longest time to travel in a short distance, i.e. in downtown area where congestion is oversaturated. Singapore drivers enjoy easy traffic flow in a short distance, as observed from the shortest travel time in the downtown area.

Table 1 Basic person and travel characteristics of three cities

Characteristics	Unit	Bangkok Survey Sample	Kuala Lumpur Survey Sample	Singapore Survey Sample
Average income	Baht/Ringgit/Sing Dollar	19394	2134	2072
	US Dollar	555	610	1350
Average trip distance	km	16.4	16.3	14.4
Average travel time	min	51.6	41.8	22.6
Average travel time when distance < 10 km	min	41.5	21.6	13.1
Average travel time when distance is 10-30 km	min	52.6	48.4	24.3
Average travel time when distance > 30 km	min	75.7	69.6	50.3

Table 2 shows person and travel characteristics which are related to route changing behaviors. Kuala Lumpur drivers had the most flexible working hour, and Singapore drivers had the least. The distribution of start and end working hour for Kuala Lumpur was more distributed compared to the schedule of Bangkok or Singapore drivers. This situation implies that people who has different work schedule might tolerate different situation of traffic congestion and delay. This condition could result in different perception or different travel behavior. Drivers tend to be more fixed on their schedule in the morning than in the afternoon.

Table 2 Person and travel characteristics related to route changing behaviors

Characteristics	Range	Bangkok Survey Sample (%)	Kuala Lumpur Survey Sample (%)	Singapore Survey Sample (%)
Morning Flexibility	Yes	47.50	54.88	20.16
	No	52.50	45.12	79.84
Afternoon Flexibility	Yes	52.50	69.51	33.87
	No	47.50	30.49	66.13
Alternate Route Availability	Yes	66.50	57.32	38.71
	No	33.50	42.80	61.29
Familiarity on Alternate Route	Very Strange	1.08	7.32	0.81
	Strange	5.76	10.98	4.84
	Average	42.81	21.95	22.58
	Familiar	43.17	30.49	29.03
	Very Familiar	7.19	29.27	42.74
Frequency Using Alternate Route in the Morning	1-2 times a week	3.00	30.49	12.90
	1-2 times a month	28.00	40.24	28.23
	Less than 5 times per year	38.50	21.95	33.06
	Never	30.50	7.32	25.81
Frequency Using Alternate Route in the Afternoon	1-2 times a week	3.75	36.59	13.71
	1-2 times a month	30.50	37.80	26.61
	Less than 5 times per year	35.25	23.17	36.29
	Never	30.50	2.44	23.39
Using the Same Alternate Route	Yes	59.35	67.07	52.46
	No	40.65	32.93	47.54

The decision to detour was determined by some factors such as the availability of alternate route and the familiarity of the route itself. Only about 39 percent of Singapore drivers stated that they had an alternate route while the other 61 percent just relied on their main route. In comparison, the two groups were evenly distributed in Kuala Lumpur case, and even in Bangkok, more than 66 percent of respondents said that they do have alternate route. On the contrary, the percentages of Singaporean who admitted that he/she was familiar of their alternate route exceeded the numbers of respondents who stated that they had other possible routes. This situation implies that, even Singapore drivers had their own alternate routes, they rather preferred staying on the main route to diverting to alternate route. Moreover, most of drivers in Bangkok admitted that they possessed alternate route, but the frequency of using any other route beside their primary was relatively low. Only about 31 percent of them said that they used it regularly (1-2 times or more per month), while the rest admitted that they used it if it necessary or even never. The same pattern was shown by Singaporean while most Malaysian declared that they used it as a part of regular activities. It can be concluded that for the three cities, they were likely to keep on their major route especially on the morning trip. However, they opened a possibility to change their route if something happened on the major route during evening trip.

From this finding, it can be seen that three cities' citizens differ in their changing route behaviors. Bangkok drivers seemed to be either more tolerate on unfavorable traffic conditions or were not familiar with alternative route, and thus they chose to stay on their route. On the other hand, Singapore drivers showed the same behavior but with different reasons. Singapore drivers might insist to stay in the route because they comparatively had less alternative route availability. Different from the two cities mentioned earlier; drivers in Kuala Lumpur seemed to have a number of alternative routes beside their usual route.

4.2 Experience on Late Arrivals

Figure 3 shows late arrivals experienced in the average number of days/month. From this figure, on average Bangkok drivers experienced up to 15 minutes about 7 days/month and still

experienced more to one-hour delay in about 3 days/month, which proved that Bangkok drivers engaged with a lot of variability on their travel time compared to the others. Bangkok drivers deal with a lot of travel time variability and unexpected condition on their trip, indicated by the numbers of late arrivals in both graphs. Singapore drivers were likely to be punctual in their trip compared to drivers in Bangkok and Kuala Lumpur. This can be seen by the number of days that they had late arrivals for both morning and afternoon were relatively low. On average, Singapore drivers experienced late arrival from their usual arrival time by up to 15 minutes about 2 days in a month with variation of occurrence around 2 until 3 days. For late arrivals up to 30 minutes, it occurred rarely or almost never.

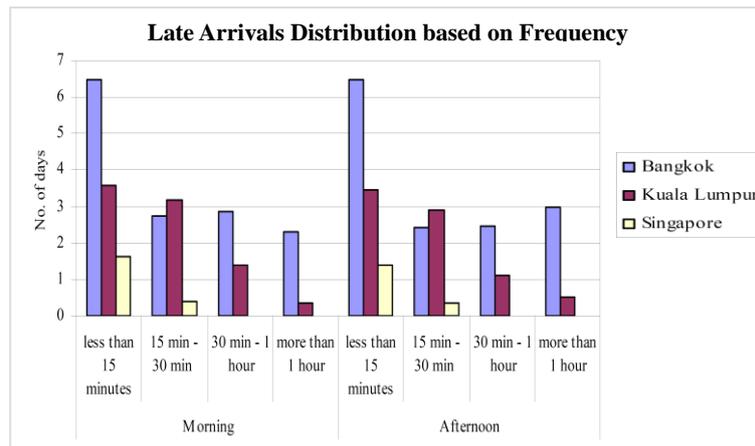


Figure 3 Experience on late arrival (days/month)

4.3 Travel time tolerance by drivers

Figure 4 shows the stated intention to divert to alternate route if the travel time is longer than normal. In the case of shorter trip (Figure 4a), Kuala Lumpur drivers tended to be more sensitive to additional travel time, as the number of drivers who claimed that they would divert was higher than the other two cities for additional 5 to 10 minutes to their usual travel time. However, as the additional time increased to 20 minutes and more, the number of diverted drivers was not as significant as before. Bangkok drivers showed a significant number of diverting drivers after experienced 15 minutes of delay. About 70 percent of drivers decided to detour after experiencing 15 minutes delay. After 20 minutes of delay, the numbers of additional diverting drivers were not as significant as before. Then, it can be seen that even they experienced delay for 20 minutes or more, there were still a number of drivers insisted to stay on their route. This may indicate that these drivers were unfamiliar on the alternate route and they would like to stay than divert to unfamiliar route. On the contrary, Singapore drivers yielded different and unique behavior from Kuala Lumpur and Bangkok drivers. Although the number of drivers that aware of delay of 5 to 10 minutes time was higher than Bangkok case, the no drivers would divert. For delay greater or equal to 15 minutes, the diversion increased significantly about 80 percent of total number of drivers. This indicates that for short distance trips, Singapore drivers were more likely to be tolerant than drivers in the other cities.

For medium-distance (10 to 30 km) (Figure 4b), the drivers yielded a slightly different behavior than previous Figure 4a. The critical delay for the three cities was about 10 to 15 minutes longer from normal travel time, unless for Singapore drivers who altered from critical

threshold 15 to 20 minutes delay. Kuala Lumpur drivers seemed to be less sensitive for the shorter distance trip, so did Bangkok drivers in terms of incremental diverting drivers.

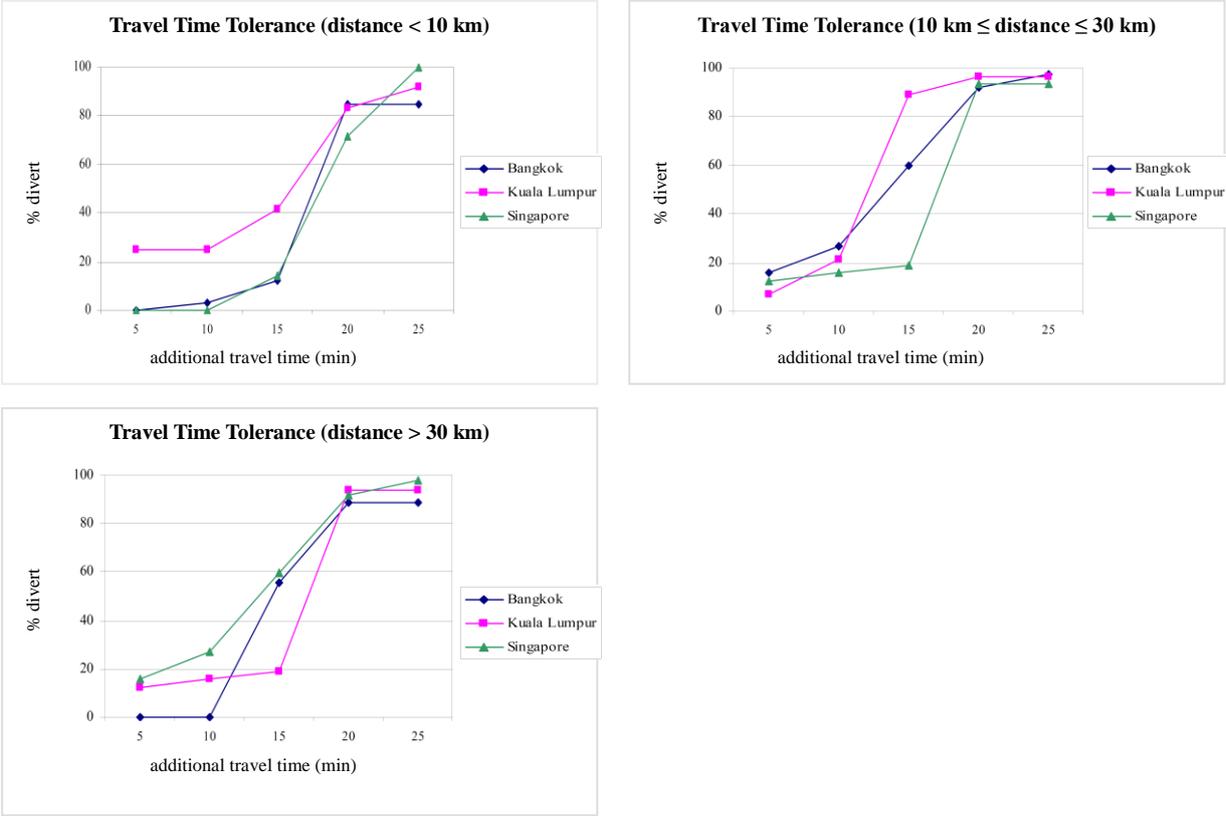


Figure 4 Travel time tolerance

Singapore drivers showed more logic behavior, but still there were a number of drivers who did not choose to divert after 20 minutes or more delay.

For long distance travel drivers (drivers with trip distance more than 30 km) in the three cities (Figure 4c), all the drivers in three cities showed different behavior compared to Figure 4a and 4b. Non-commuter drivers in Singapore tended to be more sensitive to additional travel time to commuter drivers. For additional 10 to 15 minutes delay, the number of drivers who diverted rose more steeply than two previous graphs. For Kuala Lumpur case, the number of diverting drivers increased sharply when they experiencing more than 15 minutes travel time. All Bangkok drivers decided to stay on their route even they experienced additional 5 to 10 minutes on their travel time. After 15 minutes delay, about 55 percent of drivers decided to divert. Bangkok non-commuter drivers tended to be more tolerant than commuter drivers were. This phenomenon shown by the critical delay for diversion were around 10 to 15 minutes from normal travel time. For Bangkok case, even the significant percentage of diverting drivers was generally the same with previous cases. Nonetheless, for additional 15 minutes travel time, the drivers who claimed that he/she would divert from their usual route just about 40 percent of total sample compared to 70 percent drivers in previous cases. The same situation occurred to Kuala Lumpur drivers. The significant increment of diverting drivers altered from 10 to 15 minutes delay into 15 to 20 minutes of delay. Obviously, about 70 percent drivers would detour when they experienced 15 until 20 minutes delay. It differed from earlier cases while about 60 percent of drivers chose to change their route when experienced 10 to 15 minutes of delay.

From Figure 4, it can be concluded that the behavior of commuter drivers was different with non-commuter drivers. Non-commuter drivers tend to be more tolerant than commuter drivers were when experienced delay in their travel. This situation could be, as compared to their travel time (which is about 40 into 120 minutes in total), that the 5 to 10 minutes additional travel time seemed to be nothing for them. For Singapore drivers, they were more sensitive to delay in order to avoid severe traffic congestion on the next route. If they were late for even 5 minutes, they had to bear longer delay caused by the traffic congestion.

4.4 Reasons for changing route (detouring)

The reasons of detouring are depicted in Figure 5. Most respondent stated the avoidance of accident and congestion, which was related to the traffic condition as their best answer. For other options related to personal matters such as pick/drop off people and stop at other destinations, the result was not so significant in numbers, but it seemed that people answered these options differently for morning and afternoon trips. Most of drivers considered personal reasons in a greater degree for diverting their route during afternoon trip instead of the morning trip. This might occur because the afternoon trip was not as tight as morning trip, hence they had the chance to slot in their personal matters on it.

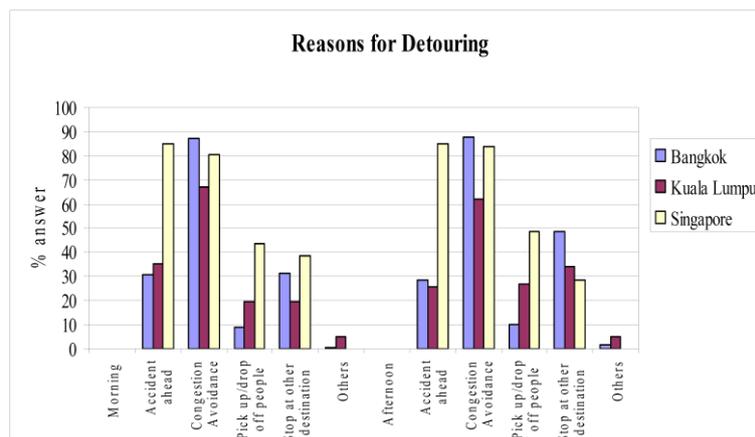


Figure 5 Reasons for detouring

4.5 Source of receiving traffic information

Figure 6 illustrates that the majority of existing traffic information relayed by radio broadcast had been the primary source of traffic information for drivers in Bangkok and Kuala Lumpur while Singapore drivers relied more on traffic information broadcast on television or getting information from newspaper. Personal knowledge also stood out as one of important traffic information sources. For ATIS devices, VMS and Intelligent Sign-Board were traffic information sources for many drivers while the other services such as internet, in-vehicle device, or phone call service are less popular due to several reasons.

One interesting point is the number of drivers who said that VMS being one of their traffic information sources varied for the three cities. This occurrence might happen due to the accuracy of the given information. The perceptions from drivers towards the quality of ATIS devices in traffic information, including Variable Message Service (VMS), In-vehicle Device (IVD) and Intelligent Sign-Board (ISB), were investigated. The results are shown in the following sections (Figure 7-10).

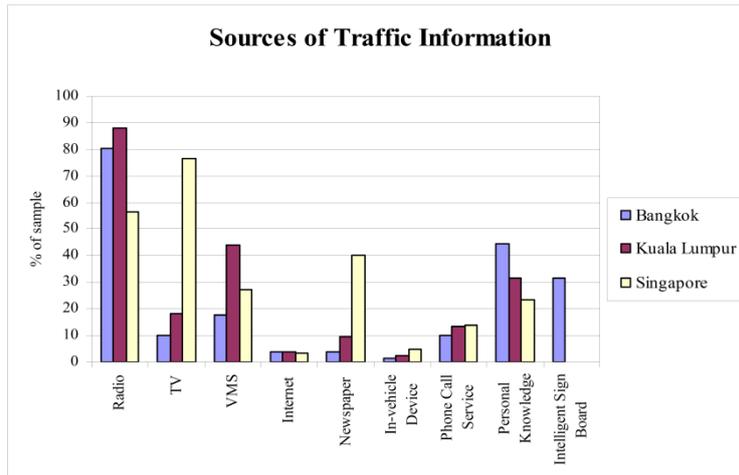


Figure 6 Sources of traffic information

4.6 Variable Message Sign (VMS)

Figure 7 shows the percentage of drivers who notice the VMS. For Singapore and Kuala Lumpur, the driver's awareness of ATIS devices was quite high as shown by the percentage of total drivers who admitted that they were notice about VMS application in the city was beyond 70 percent of total sample. This can be understandable since in both cities VMS devices already installed in most vital spots inside the city. Bangkok drivers were moderately split into two groups between drivers who did notice VMS messages during their daily trip and those who did not. This situation could be a result of various reasons. First, those who admitted that they were unable to notice any VMS device were non-commuters who resided outside the city. Second, the deployment of the device have not reached all the crucial spots within the city, and the last prejudgment is, in fact the drivers noticed the existence of the device but since the information are non-beneficial then they practically chose ignoring it.

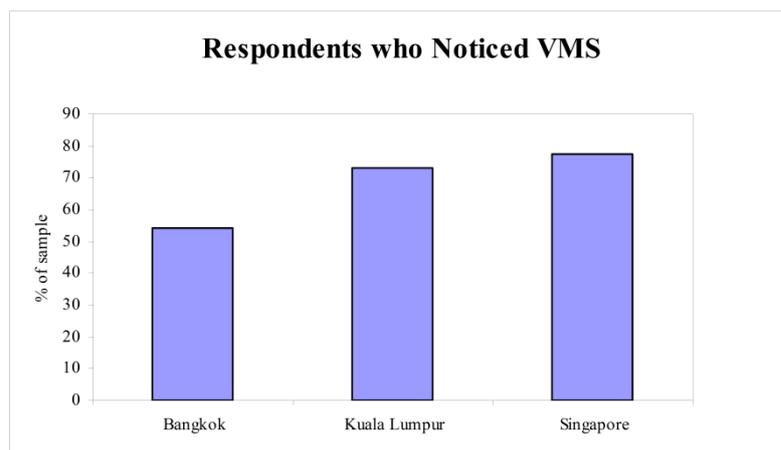


Figure 7 Respondents who noticed VMS

Figure 8 shows the perception of drivers from the three cities towards the content of VMS information. From the graph, it is easy to capture that the content of VMS information were rated as average in its accuracy. This means that the drivers could not completely rely on the given information. Bangkok drivers tend to be pessimistic on VMS information than the other two cities. It can be seen that the number of drivers who said that the accuracy of VMS information was good was lower than the other cities.

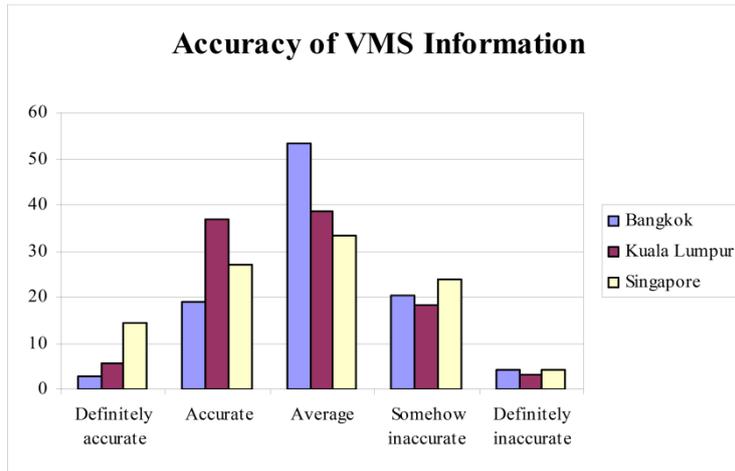


Figure 8 Accuracy of VMS information

Figure 9 presents the relationship between diverting behavior and familiarity on alternate route. It is observed that the number of diverting drivers who are familiar on their alternate routes exceeded the unfamiliar ones, beside for Singapore which the proportion were likely equal. It proved that the more familiar drivers to their alternate route, the more willing for them to change to alternate route.

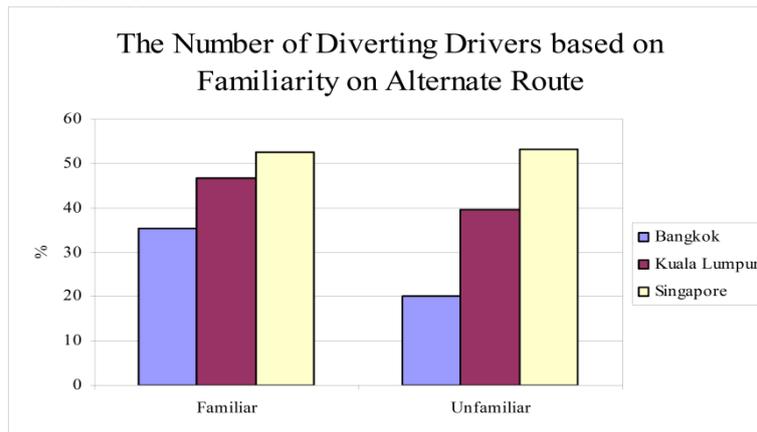


Figure 9 The number of diverting drivers based on familiarity on alternate route

4.7 In-Vehicle Device (IVD)

In-vehicle device is one of newest ATIS systems introduced to the market. In this region, this system are relative uncommon but has enormous users' expectation regarding offered features. It offers privatized, personal, and detailed traffic information to drivers. This is different with the characteristics of VMS information, which gives general information and open for all drivers who travel in the same direction (since the information is free). Moreover, using this device, drivers can select which type of information that they need most. In general, the device expected to has more utilization level for drivers, associated with its prices.

The results on the expectation by users in three cities are shown in Table 3. Most of drivers in Bangkok and Singapore tended to answer 'quite useful' as their highest rate while Malaysian was more optimistic towards the device. Information regarding congestion level was still favored by Bangkok drivers since the city has suffered from severe traffic congestion problem. Other prosperous information would be travel time, route guidance, and alternative route availability. For drivers in Kuala Lumpur, accident information did matter more than

other kind of information. Then (again) congestion level and route guidance was placed as the second rank of the most important information to be put on the device. In opposition, Singapore drivers thought that travel time would be the most important information for them; this can be proved as many variable message boards in the city inform drivers about travel time from one place to another. Moreover, accident information and weather report are the other information, which they thought it would be essential to be provided by the device. This result mainly illustrated the first impression of drivers to the device since this technology is still new and not so many drivers use and are familiar to this technology. The answers were purely prior expectation to the device, so then if they would like to purchase this device, they sure enough the device would give the right information for them.

Table 3 Type of In-vehicle device information with rates of usefulness

	Bangkok					Kuala Lumpur					Singapore				
	<i>Very Useless</i>	<i>Quite Useless</i>	<i>Can Not Say</i>	<i>Quite Useful</i>	<i>Very Useful</i>	<i>Very Useless</i>	<i>Quite Useless</i>	<i>Can Not Say</i>	<i>Quite Useful</i>	<i>Very Useful</i>	<i>Very Useless</i>	<i>Quite Useless</i>	<i>Can Not Say</i>	<i>Quite Useful</i>	<i>Very Useful</i>
accident info	0.3	7	33.5	46.8	12.5	0	1.22	9.76	47.56	41.46	0	1.61	32.26	33.87	32.26
travel time	0.3	5	39.5	43.8	11.5	1.22	2.44	26.83	47.56	21.95	1.61	0	30.65	55.65	12.1
congestion	0	2.25	24.5	52.5	20.8	1.22	2.44	14.63	48.78	32.93	0	1.61	33.06	43.55	21.77
route guidance	0	3	34.8	47.3	15	0	2.44	14.63	50	32.93	0	20.16	43.55	22.58	13.71
alternative route	0.3	4.75	33.3	45.3	16.5	0	2.44	19.51	52.44	25.61	0	8.87	59.68	26.61	4.84
parking availability	1	12.8	44	36.3	6	3.66	7.32	26.83	41.46	20.73	2.42	39.52	45.97	7.26	4.84
interesting places	3.5	32.8	39.3	20.8	3.75	2.44	21.95	31.71	30.49	13.41	12.9	23.39	44.35	15.32	4.03
potential alt. destination	0.5	25.3	37.8	31.5	5	0	3.66	37.8	45.12	13.41	0	45.16	41.13	8.06	5.65
weather report	6.8	34	37.3	20.3	1.75	1.22	23.17	35.37	25.61	14.63	11.29	2.42	35.48	46.77	4.03

4.8 ATIS devices versus experience

Figure 10 shows that, for VMS device, Singapore drivers were more likely to trust their experience than the device. Bangkok drivers tended to be neutral, so did Kuala Lumpur drivers. Then, since the users of in-vehicle device were still few, most of drivers in the three cities tended to say they were neutral between the device and experience. The interesting point on the intelligent sign board was that, for drivers in Kuala Lumpur and Singapore who had not experienced this device before, the response was likely neutral to positive. On the contrary, for Bangkok drivers who already experienced the benefit of this device only few of them admit that they believed wholeheartedly on the device. Most of them answered neutral, or even more preferred to their experience. The conclusion from the Figure is that the availability of the information must be supported by the initial knowledge about the traffic information itself. At this time, traffic information still acts as a complement but not as a substitute to the personal experience of traffic conditions on the road. In addition, this situation can be noted as a benchmark in effort to keep improving the quality of traffic information so the level of trust from driver to the ATIS devices can be increased.

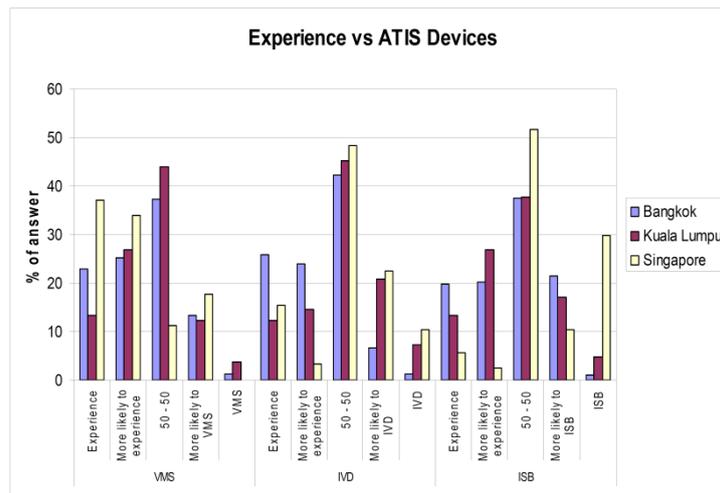


Figure 10 Comparison between experience and ATIS device

5. CONCLUSION

The paper describes the differences in travel behaviors related to route changing in three cities in Southeast Asia. Different trip characteristics are prerequisite to the consideration of propensity to change to alternate route. Normal trip time flexibility, availability of alternate route(s), familiarity of the alternate route, and route changing habit are positively correlated to the probability of route diversion. The influencing traffic condition factor includes the normal travel time variability and perceived traffic condition/incidents. The driver's characteristics include tolerance to delay by travelers. The quality of system and information consist of the notice to the information by drivers, the perceived accuracy of provided information.

Drivers in three cities (Bangkok, Kuala Lumpur, and Singapore) have different trip characteristics and drivers' behaviors. At present, the propensity of diversion depends on mentioned circumstances. In comparison, Singapore drivers have the least time flexibility, do not have much experience on late arrivals, have known their alternate route but are tolerate not to change their route when facing delay. Drivers in Kuala Lumpur comparatively have the least knowledge about alternate route, but they are familiar if they have one. They do not regularly use the alternate route. Bangkok drivers have good knowledge about the alternate routes and do often use their alternate routes. One noticeable point for Bangkok drivers is that normal trip time vary the most, thus they experience late arrival very often. They have the greatest tolerance to the delay.

Existing travel information dissemination in three cities depends on the degree of provision of the ATIS equipment. Drivers receive traffic information and interpret them differently. Considering the dissemination, radio is still the most widely used source of receiving information. The accuracy of the information provided by VMS also plays an important role to the route changing behaviors. Congestion is the most needed information in most countries, and accident is also highly needed information for Singapore drivers. Comparatively, Singapore drivers perceive that they receive the least accurate traffic information from VMS. The accurate information give greater tendency to divert in all three cities. Receiving information by ATIS devices, drivers in three cities are still likely to put the experience over recommended and given information. Drivers tend to believe and follow information from In-vehicle device and Intelligent Sign Board more than Variable Message Sign.

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