A STUDY IN INTEGRATING PARATRANSIT AS A FEEDER SYSTEM INTO URBAN TRANSPORTATION AND ITS EFFECTS ON MODE CHOICE BEHAVIOR: A STUDY IN BANGKOK, THAILAND

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ABSTRACT

Motorized paratransit has continued their dominant function as a feeder in several developing cities due to their services satisfying captive riders in terms of mobility. However, the dissatisfaction with their services especially in the aspects of traffic safety and service images hinder patronage of paratransit and this transport mode has not been systematically considered in the transportation plans. Therefore, more efforts are required in order to promote the solution of integrating paratransit as a feeder into urban transportation, particularly, on the rider side. Personal behavior and attitudes towards the services provided by paratransit and public transport will be important keys for the future development of this solution. This study investigated present choice consideration, influences of personal behavior, and attitudes towards the services of paratransit and public transport on the commuter choice selection. Empirical results revealed that car users prefer to continue driving, while patronage of paratransit combination is decreasing. Car preference and dissatisfaction with comfort and convenience of public transport and paratransit also significantly influence the choice to drive. The pessimism about difficulties and images of the combination of paratransit and public transport modes potentially discourage usage of public transit and paratransit. Moreover, risks of using the combination between paratransit and public transport, especially on traffic accidents and crimes, were found to be a driving factor of selecting public-transport-only and private vehicle alternatives.

Keywords: paratransit, integrating, feeder, mode choice, developing countries

BACKGROUND AND MOTIVATION

Over the last two decades, motorized paratransit, uncontrolled and unrestrained, small to medium sized motorized vehicles e.g. motorcycle-taxi in Bangkok, jeepney in Manila, and van in Indonesia and Rio de Janeiro have emerged as one of the transportation modes in the developing countries. They have gradually become an outperforming mode of transportation. Paratransit modes provide a variety of services from door-to-door collectors to intermediate line-haul due to the advantages of vehicle size and unrestrained operation that make paratransit effectively response to the fluctuated demand. According to the growth of motorization and public transit deficiency, people in urban areas are discouraged to use public transport and car users have become more car-dependent riders, notwithstanding the fact that mass rapid transits, such as BRT, and rail transit have been implemented. Inefficient land use plans and low service coverage have caused difficulties in accessing public transports. In addition, there are only few feeder systems provided. In the areas left by public transport modes, paratransit have shown outstanding performance of shuttling people up and down the narrow alley areas off the main streets especially from their residents to main streets and public transits, which reflects the capability of feeder function. At present, a combination of paratransit as a feeder and public transports has become one of typical choices for commuters in major developing cities and this will continue into the future. Therefore, an idea of integrating paratransit as a feeder system to urban transportation should not be overlooked in order to effectively utilize existing resources, advantages and performances of paratransit for urban transportation planning. This approach aims to improve the performance of the existing transport modes that seem more feasible in terms of financial and economic aspects for the developing countries.

In recent years, studies and researches that focused on paratransit in the developing world have become popular. Paratransit characteristics, service function, performance and effects on urban traffic flow were reveled (Shimazaki and Rahman, 1996; Regidor, 1999; Cervero, 2000). Market structures, regulations and their impacts on controlling paratransit in developing cities had been deliberated (Leopairojna and Hanaoka, 2005; Diaz and Cal, 2005). The ability of paratransit in terms of feeder and enhancing urban transportation performance have been gradually investigated and discussed (Okada et al., 2003; Satiennam et al., 2006; Loo, 2007; Cervero and Golub, 2007). Moreover, user's perception on paratransit services including safety and security was examined for the future of paratransit and providing improvement solutions (Joewono and Kubota, 2006; Joewono and Kubota, 2007). The previous researches could provide valuable information and insight of paratransit performance in the present situation and the ability for planning and improving urban transportation.

At present, as varieties of paratransit have been operated in most developing cities, their performance and capability in terms of feeder in urban transportation have been revealed and recommended. Paratransit services, nevertheless, have not been systematically considered or included in the urban transportation systems and planning. Since present operating paratransit is partially controlled, the services provided by paratransit modes are regarded as unsafe, uncomfortable, inconvenient and unreliable services. These

shortcomings might discourage use of paratransit and affect choice consideration of overall commuters especially in terms of attitudes towards paratransit services. In addition, there are varieties of commuters and alternative travel modes in developing countries. Commuter behavior and preferences will be important keys not only for their travel choice decisions but also for the future development of integrating paratransit into urban transportation policy. Understanding of effects of paratransit on commuter's choice consideration should be enriched with the previous research findings to fulfill the strategy of integrating paratransit to urban transportation. However, effects of paratransit on commuter's choice consideration have rarely been scrutinized. Therefore, this study covers the prospects of integrating paratransit as a feeder system into urban transportation. The primary objective is to investigate the influences of the integration of paratransit and public transport on commuter's travel choice consideration based on personal attitudes and behavior.

The 3-kilometer catchment areas along mass transit corridors in Bangkok, Thailand, were selected to conduct this study. The reason is that varieties of paratransit are functioning, and various transportation plans in particular mass transits are under the process of development. Commuter demographics, present travel patterns, the most preferable travel choice for specific trips and the attitudes towards the combination of paratransit and public transport as well as personal behaviours were collected by questionnaire survey. Descriptive statistical analysis and Structural Equation Model were applied to achieve the objectives of this study. The results of this study, optimistically, provide informative value and insights for the policies of development and planning of the integrating paratransit as a feeder into urban transportation system.

PARATRANSIT IN DEVELOPING COUNTRIES

Paratransit provides a variety of services from door-to-door collectors (flexible for hired services i.e. Ojek in Jakarta and Motorcycle-taxi in Bangkok and Rio de Janeiro) to intermediate line-haul (fixed route services i.e. Minibus in Jakarta and Vans in Bangkok, and Rio de Janeiro). Around 20 to more than 50 percent of travel demand from captive riders and car dependent users are handled by motorized paratransit (Shimazaki and Rahman, 1996; Joewono and Kubota, 2007; Cervero and Golub, 2007; Vuchic, 2007). Taking advantage of vehicle size and unrestrained operation, paratransit can admirably respond to fluctuated markets, fill voids of areas left by public transports at relatively low fares, and substitute for public transit without subsidies. Besides, they were recognized as efficient road-utilizing carriers, low cost service, fleet-footedness, and users' gratifying mode (Cervero and Golub, 2007). Paratransit appears to be popular modes and seems to satisfy captive rider's needs in terms of mobility especially in feeder function by shuttling people up and down the narrow alley areas off the main streets specially from their residences to main streets and public transits.

On the other hand, paratransit contributes to traffic congestion, air and noise pollution, traffic accidents, and poor images. The reason is that paratransit was started from informal, unplanned and uncontrolled operations (Shimazaki and Rahman, 1996; Cervero, 2000; Joewono and Kubota, 2007). Even though paratransit service qualities are only acceptable

but do not satisfy user's needs, users/passengers are still willing to use paratransit. In the last decades, several regulations were implemented by many governments in order to control and adjust their shortcomings; however, paratransit is just partially controlled and the regulations have not been successfully implemented (Cervero, 2000; Cervero and Golub, 2007). Thus, paratransit has become a popular topic for many researchers to reveal their operating performances, service qualities, and their futures. Recently, the user's satisfaction and performance to be integrated into urban transportation in developing cities have been gradually revealed and suggested. The study of Joewono and Kubota (2007) reviewed that the future of paratransit depends on its service quality and passenger satisfaction as shown by the case study in Bundung, Indonesia. The capabilities for integration of paratransit as a feeder into urban transportation were revealed and investigated in the case study of MRT3 in Manila, BRT project in Bangkok, and residence's coach services in Hong Kong (Okada et al., 2003; Satiennam et al., 2006; Loo, 2007).

As have been reviewed, the dominant roles of paratransit especially in terms of feeder can be proposed as a low capital intensive strategy for urban transport planning that is presumably fit for developing countries. The integration of paratransit as a feeder into urban transportation is not only possibly improve ease of accessibility, but also hopefully enlarge public transit catchment areas, and offer potential latent demands to public transits and mass transit in the future.

EFFECTS OF ATTITUDE AND BEHAVIOR

The future of public transits is based on their performances and how the people perceive their service qualities. Operational outcomes and measurement of public perceptions can attentively assess quality of service, reveal problems that need to be considered, and support transportation plans. As witnessed in mode choice models, most of empirical travel choice models use modal attributes (e.g. travel time and cost) and commuter demographics (e.g. income and household cars) to explain choice. Nevertheless, those variables have not clearly explained the commuter's travel choice decision process that was affected by other unobserved factors driving commuter's travel choice decision process. In recent years, many researchers have introduced commuter's preferences as latent variables to explain the consumer's black box in the empirical travel choice models. The preferences are measured and modelled mostly in terms of attitudinal and behavioral indicators towards all alternatives e.g. modal comfort, convenience, safety and security, car preference and pro-environment (Morikawa and Sasaki, 1998; Ben-Akiva et al., 1999; Ben-Akiva et al., 2002; Nilsson and Kuller, 2000; Morikawa et al., 2002; Johansson et al., 2005; Temme et al., 2008). The inclusion of latent variables outperformed the empirical choice model, and increased explanatory power and understanding of decision making process resulting from commuter's preferences.

STUDY APPROACH AND SCOPE

Study area

The 3-kilometer catchment areas along mass transit corridors in Bangkok, Thailand, were selected to conduct this study. Bangkok is a mega city comprising 50 districts with the total area of 1568.74 km2 and registered population of 10.162 million (BMA, 2009). It is also the centre of many activities that generate many travel demands in the urban areas. At present, there are varieties of public transportation modes provided in Bangkok; however, the two main public transits are (1) bus and passenger van, and (2) rail transit systems. Bus and passenger van are operated by Bangkok Mass Transit Authority (BMTA) that could handle around 6.228 million passenger-trip/day (OTP, 2009). Rail transits consist of 23-km elevated rail system, namely BTS, and 20-km subway line, called MRT. From the data of Office of Transport and Traffic Policy and Planning in 2009, these two rail systems handled around 0.548 million passenger-trip/day. As a result of traffic congestion, low level of bus service, and small coverage areas of rail transits, a share of private car and motorcycle is around 8 million passenger-trip/day. Currently, the number of bus users is decreasing; however, passengers of 2 rail transits are increasing and extension plans of rail transit are under the process.

Unlike developed countries, there are several ways to access from residential areas to main streets or public transport rather than walking and using the existing public transport i.e. motorcycle-taxi, Tuk-tuk, Songtaew, Silor-lek, and taxi. This has been resulted from the unique characteristics of Bangkok's Soi Superblocks, numerous narrow alleys off the main streets, with poor connectivity of roads. Previous studies showed that walking, bus, and motorcycle-taxi are most popular access modes to BTS and MRT stations within a radius of 2 kilometers from stations (Chalermpong and Wibowo, 2007). Also, motorcycle-taxi becomes the predominant access mode in the distance beyond 900 meters. Other motorized modes such as Songtaew (a converted pick-up truck), Silor-lek (a small 4 wheel vehicle), bus, car dependent, also become more preferable than walking beyond the distance of 1 kilometer (Chalermpong and Wibowo, 2007). In present, there are 2 main operating paratransit which are served in the urban areas of Bangkok. These are (1) flexible for-hire service - motorcycle-taxi, and (2) fixed-route service - Songtaew.

Motorcycle-taxi service: There are more than 73,000 motorcycle-taxis by 2007. Their main role is to shuttle people up and down the Sois. They are managed by private associations. Motorcycle-taxi fares are more expensive than other paratransit on short trips and cannot be controlled by government. Nonetheless, they offer the fastest service. Motorcycle-taxi enjoyed the lion's share among access modes. This is because of their ability to beat traffic jams due to its advantages of flexibility, taxi-like service, compact size, and speed. Therefore, motorcycle-taxi is tailored for operating in high density areas of traffic. However, a trade-off between safety and less travel time is generally made by the travelers. The BMA has finally stepped into cleaning up the motorcycle-taxi business in 2003 which required operators to register motorcycle-taxi with the police. They must attend training sessions

before official licenses are given and different colored vests are assigned to indicate areas where they work.

Songtaew service: A pick-up truck specially adapted to take passengers on the back with an overhead cage, two row seats, and stepped up the back that can move up to 14 passengers or more (Cervero, 2000). It operates as a fixed route service. Each route concession is awarded to the operators from Bangkok Mass Transit Authority, BMTA. All operating vehicles have to register for a license also and fares are controlled by BMTA. The services are managed by the concessionaires however. Though, Songtaew is a cost-effective mode, and has advantages over motorcycle-taxi on lower fares, longer service range, and more carrier capacity. Nonetheless, it offers long travel time and unreliable waiting because of its size, frequent stops for loading and unloading and suffering from traffic congestion.

Approach and Methodology

In developing cities, car riders seem to rely on commuting by their own cars and dissatisfactions of public transportation discourage use of commuters. Moreover, inadequate public transportation and poor land use plan posed difficulties in using public transport services especially on accessibility. There are only few feeder systems provided. At present, paratransit shows their dominant role in shuttling people between their houses and main streets. This reflects their capabilities in terms of feeder function. In addition, past studies provided useful information regarding paratransit performances, their perceptions in passenger's point of views, and the future of paratransit in developing countries. The perspective of integrating paratransit as a feeder into urban transportation is very interesting. However, paratransit quality of services is only acceptable or unsatisfactory to commuters especially in the terms of unreliability, safety, and bad image that might discourage use of their services. In Bangkok, past studies found that attitudes towards rambling, fast, and door-to-door services of the motorcycle-taxi showed positive influences on high and middle income commuters who lived in the ranges of 1 to 2 kilometers from the stations in increasing satisfaction of trip accessing mass transit stations and willing to use motorcycle-taxi and mass transits (Tangphaisankun et al., 2009a, 2009b). However, motorcycle-taxi's pessimism of dangerous operation made those people dissatisfied accessing the stations. In contrast, attitudes to safer operation offered by Songtaew demonstrated positive influence on all commuters; however its reliability, especially waiting time, could not attract the high and middle income groups (Tangphaisankun et al., 2009a, 2009b) Therefore, careful consideration should be done while planning to integrate paratransit into urban transportation.

To achieve this perspective, commuter's attitudes and their interrelations on travel choice consideration must be clearly understood. The integration of paratransit as a feeder might impact commuter's choice consideration to the overall commuters, both public transit users and car riders. However, effects of the paratransit combination on commuter's choice consideration have rarely been discussed. As mentioned above, the combination of paratransit as a feeder affects commuters not only on comfort and convenience but also on reliability, traffic safety, and image of using public transit.

In this research, the focus then will be to investigate the effects and interrelations of commuter's attitudes and behaviors considering the integration of paratransit into urban transportation based on their choice consideration. In addition, the areas along the rail transit lines in Bangkok are intentionally selected as a case study. Since the extension plans of rail transits are under the process, the results of this study could provide valuable information for the future urban transportation plans. Descriptive statistics is introduced to explained differences of attitudinal and behavioral variables among choice groups, and Structural Equation Model (SEM) is applied to obtain the estimated influences of commuter's attitudes on their choice consideration. However, the travel choice model is not considered in this study.

Survey and Data

Both direct interview and pick-up & drop-off questionnaire surveys were conducted along BTS and MRT lines. The target groups were commuters, public transport users as well as private vehicle users, who regularly traveled for work, studied, and lived within the catchment areas of 3 kilometers from mass transit stations. It was intended to grasp use of motorcycle-taxi and Songtaew services. The surveys focused on how commuters considered their choice options. Individual attitudes and preferences on available alternatives as well as present travel patterns of all travelers were also collected.

The questionnaire contained 4 main sections, specifically (1) present travel patterns, (2) travel choice consideration, (3) individual attitudes and preferences, and (4) general information. In the present travel pattern section, respondents were required to explain their daily trips to work or education (mode and frequency), travel time and cost, and public transit usage in the last two months. In the section 2, respondents were required to state the most preferable travel choice for their regular trips from thirteen choice options. These options consisted of all possible alternatives such as private vehicle, bus and van, mass transits, and combinations of paratransit and public transits. In the section 3, the preferences for car use, safety and security, risk assessment, and environmental concern were measured by using level of agreement. Individual attitudes to public transits and paratransit were also assessed by respondents. The attitudinal questions were set in terms of reasons that discourage usage of public transit services. All respondents were requested to rate their attitudes on a four-point scale, ranging from "1 = strongly disagree" to "4 = strongly agree" with the purpose of avoiding the "no opinion" answer. In addition, they had to provide demographic details in the last section, which were used to prepare the demographic profile.

According to the limited budget, survey duration and difficulties in approaching commuters' residences, only 318 effective samples were obtained. Because geographically stratified random sampling was adopted, however, the maximum standard deviation of related variables carried the estimated margin of error within 10% for a 95% confidence level. This consequently satisfied the small and medium size constraints for SEM estimation reliability (Goodhue et al., 2006) Moreover, coefficient estimates obtained from the samples are statistically consistent and significant.

FINDINGS

Respondent backgrounds and demographics

The 318 effective samples from 113 returned samples and 292 interviewed samples were used in the analysis. The main gender of respondents is female (73 percent). Ages of respondents are between 15 and58 years old, which approximately 82 percent of them completed bachelor degree at least. Most of respondents are private company staffs (31 percent), workers/laborers (30 percent), and students (24 percent). Around 35 percent of respondents earn monthly salaries less than 10,000 baht, while 53 percent of them earned 10,000 – 20,000 baht. In addition, only 22 percent and 8 percent of them are able to use private cars and motorcycles, respectively. Other respondent's demographics are shown in Table 1.

Present travel and travel choice consideration

Among effective samples, 314 respondents commute to work and study for their daily trips, and the remaining 4 respondents work at their residences. The present travel patterns of respondents were classified as follows; (1) car-dependent riders (8.60 percent) – commuters who used only car or motorcycle and rarely used public transport, (2) choice riders (6.69 percent) – commuters who used both car/motorcycle and public transport, (3) public transport-only users (42.99 percent) – bus, passenger van, BTS and MRT users, and (4) combination of paratransit and public transport users (41.72 percent) – commuters who used paratransit, motorcycle-taxi and Songtaew, as a feeder and public transport as a main mode. Men had higher proportion of car users, car-dependent riders and choice riders. In contrast, women seemed to rely on public transports including the combination of paratransit feeder alternatives as presented in Table 2.

Table 1 – Respondent demographics

Individual characteristics	Category range	Respondent		Individual characteristics	Category range	Respondent	
		No.	percent			No.	percent
Gender	Male	85	26.73%	Ability to use car	unable to use	250	78.62%
	Female	233	73.27%		able to use	68	21.38%
Age	15 - 25	126	39.62%	Ability to use	unable to use	294	92.45%
	25-60	192	60.38%	motorcycle	able to use	24	7.55%
Education	Lower than bachelor	57	17.92%	Household	0	283	88.99%
	Bachelor or higher	261	82.08%	motorcycle	1	29	9.12%
Occupation	Gov Officer	16	5.03%		2	5	1.57%
	Private company	98	30.82%		more than 2	1	0.31%
	Own business	20	6.29%	Household car	0	238	74.84%
	student	79	24.84%		1	62	19.50%
	worker/laborer	97	30.50%		2	13	4.09%
	unemployed	8	2.52%		more than 2	5	1.57%
Monthly income	< 10,000	112	35.22%	Household type	Private house	53	16.67%
	10,000 – 20,000	167	52.52%		Apartment	265	83.33%
	> 20,000	39	12.26%				

In the present travel choice consideration, this study could not classify commuter choice options into car-dependent riders and choice riders due to the limitation of questionnaire instruments. As a result, the commuter choice considerations were observed and categorized as (1) private vehicle (12.74 percent) – car and motorcycle, (2) public transport-only (67.83 percent) - bus, passenger van, BTS and MRT, and (3) combination of paratransit and public transport (19.43 percent). Men still had higher proportion of using car or motorcycle. Women tended to use combination of paratransit and public transport more than men did. However, public transport-only choice was increasing while choice of paratransit combination was decreasing for both male and female as illustrated in Table 2.

Table 2 – Present travel pattern and choice consideration

Present travel pattern				**Present choice consideration**			
Travel choice	**Overall**	**Male**	**Female**	**Travel choice**	**Overall**	**Male**	**Female**
Car-dependent	8.60%	15.48%	6.09%	**Private vehicle**	12.74%	21.43%	9.57%
Choice rider	6.69%	10.71%	5.22%				
Public transport-only	42.99%	39.29%	44.35%	**Public transport-only**	67.38%	65.48%	68.70%
Paratransit and Public transport	41.72%	34.52%	44.35%	**Paratransit and Public transport**	19.43%	13.10%	21.74%

How each type of commuters considers their most preferable choice for daily trips is shown in Table 3. Car-dependent riders strongly relied on driving. Also, 63 percent of choice riders chose car or motorcycle; however, 32 percent chose public transport-only and 5 percent selected a combination of paratransit and public transport. Most of the public-transport-only users (90 percent) chose the same travel pattern. It was interesting that 63 percent of combination of paratransit and public transport group shifted to the public-transport-only alternative. These results highlighted the assumptions that car riders tended to rely on driving and paratransit services affected commuter's choice consideration.

Table 3 – Present choice consideration of each commuter group

		Present choice consideration		
		Private vehicle	**Public-transport-only**	**Paratransit and public transit**
Present travel pattern	**Car-dependent**	100%	-	-
	Choice rider	63.16%	31.58%	5.26%
	Public transport-only	0.74%	90.44%	8.82%
	Paratransit and public transport	-	63.64%	36.36%

RESULTS

Attitudinal and behavioural measures

Factor analysis and latent variables

From the assumptions of this study, different commuter's attitudes and behaviors on available alternatives have some effects on travel choice consideration especially from paratransit services. This section aims to categorize the observed attributes in terms of attitudinal and behavioral measures. This process not only classifies the observed data into main measures, but also facilitates the model development and accuracy (Kaplan, 2009; Shrestha et al., 2007). Confirmatory factor analysis (CFA) based on the significant criteria of 5% significance was conducted to perform in the categorizing process by the analysis of moment structures, AMOS5.0 (Arbuckle, 2003; Blunch, 2008). The model was assessed by multiple fit indices including chi-square (χ^2), goodness of fit index (GFI), adjusted goodness of fit index (AGFI), root mean square residual (RMR), and root mean square error of approximation (RMSEA). The χ^2/df value is 1.82, which is less than 3. The fit indices of the established model can be explained by the RMR, 0.047, and RMSEA, 0.051, that satisfy the assessed criteria of less than 0.10 and 0.08, respectively. The GFI and AGFI values were 0.865 and 0.791 respectively that means around 80 percent of the co-variation in the data could be represented by the given CFA. The recommended values of GFI and AGFI are 0.90 and 0.80. Even though the indices obtained from CFA could not reach the recommended values, the model, however, could be concluded as reasonably good fit. The 12 factors were made based upon the variables that load on each factor. The factors obtained from CFA were classified into 8 main factors of attitudinal measure and 4 factors of behavioral measure as shown in Table 4. The standardized factor loadings were listed in Table 5. The factor lodgings, the values greater than 0.4, were selected to construct the latent variables of attitudinal measure and behavioral measure.

Table 4 – Latent variables of attitudinal measure and behavioural measure from factor analysis

Attitudinal Measure' s latent variables				**Behavioral Measure's latent variables**	
Items	**description**	**Items**	**description**	**Items**	**description**
ATT 1	Access to public transit	ATT 5	Risks of the combination alternative	BEH 1	Car preference
ATT 2	Personal convenience	ATT 6	Using environment of the combination alternative	BEH 2	Environmental concern
ATT 3	Difficulties of the combination alternative	ATT 7	Fare suitability of the combination alternative	BEH 3	Risk assessment
ATT 4	Images of the combination alternative	ATT 8	Comfort of the combination alternative	BEH 4	Safety and security

Descriptive statistics

Table 5a, 5b and 5c showed descriptive statistical analysis of differences in attitudinal and behavioral ratings assessed by three choice consideration groups. The private vehicle selecting and public transit selecting groups were compared with the group of commuters choosing combination of paratransit and public transit. This comparison revealed different attitudes and preferences among the three groups of travel choice selection that might support our hypotheses.

To discuss these descriptive statistics results, authors, again, would like to notify that the attributes related to attitudinal measure were assessed based on the reasons that discouraged usage of public transit. Relating to the access to public transit, public transit selecting group, in contrast to the other two groups, stated that accessing distance to public transportation was not far from their residences. As expected, the groups of paratransit combination and private vehicle were more likely to live in the longer distances. Moreover, private vehicle preferred group was considerably dissatisfied with the access cost. There were insignificant differences in the difficulties of paratransit combination alternative for the public transit and the combination of paratransit selecting groups, whereas the private vehicle preferred respondents were significantly dissatisfied, and stated that the paratransit combination alternative caused them inconvenience of transfer, longer time, and expenses. This was because respondents who often used public transportation became familiar with the paratransit services as a feeder mode.

In terms of personal convenience, participants who liked to use public transit were significantly satisfied with public transit for specific trips rather than their regular trips, and also were not reluctant to stay close to other people, while private vehicle selecting respondents were more likely to avoid using public transportation. Also, images of paratransit and public transports, especially bus and passenger van, were more likely to discourage use from the view point of car preferred respondents. Risks of traffic accidents and crimes as well as facing with traffic congestion seriously concerned the private vehicle choosing group, while the direct access to destination was slightly considered as a risk. Only the risk of crime was slightly concerned by public transit selecting group comparing with the group of choosing a combination of paratransit and public transit. The suitability of motorcycle-taxi fare based on the travel time was complained by respondents who did not consider the combination of paratransit alternative, especially the car preferred group. Difficulty in getting seats and uncomfortable seats significantly dissatisfied the car preferred group. Also, using combination of paratransit and public transit on a raining day and difficulty in getting on and off were not preferable.

For personal behavioral measure, car choosing group significantly rated high score on car preference attributes, but provided minor concern on environment as shown in table 5c. However, the group of selecting combination of paratransit alternative was more likely to have more environmental concern compared to the group of choosing public transit alternative. The respondents preferring using public transit were significantly more concerned on their security than the other two groups were.

Table 5a – Standardized factor loading results and t-test results of attitudinal attributes

Attitudinal Attributes	Attitudinal Latent Variables								*t*-test results for Attitudinal attributes		
Description	**ATT 1**	**ATT 2**	**ATT 3**	**ATT 4**	**ATT5**	**ATT 6**	**ATT 7**	**ATT 8**	**Private vehicle**	**Public transit**	**Paratransit combination**
I have to walk to find service more than 5 min	0.718								2.90 (0.78)	2.62 (0.82)	2.69 (0.79)
Distance to bus stop/van terminal is quite far from my home	0.826								2.80 (0.79)	**2.25 (0.87)**	2.56 (0.79)
Distance to BTS /MRT is quite far from my home/ office/ school	0.809								2.75 (0.87)	2.46 (0.86)	2.56 (0.76)
Access cost to bus stop/van terminal/ BTS / MRT is quite expensive	0.688								**2.78 (0.70)**	2.59 (0.83)	2.46 (0.77)
Because of no choice to access bus stop/van terminal/ BTS / MRT making me difficulties	0.695								2.70 (0.79)	2.51 (0.83)	2.48 (0.74)
Ticket and payment systems are complicated and require much time			0.606						2.62 (0.81)	2.31 (0.75)	2.44 (0.79)
Combination of [motorcycle-taxi /Songtaew/Silor-lek] 8 [bus / van/ BTS / MRT] Make my trip inconvenient because of transfer			0.731						**2.85 (0.77)**	2.40 (0.72)	2.43 (0.81)
Combination of [motorcycle-taxi /Songtaew/Silor-lek] 8 [bus / van/ BTS / MRT] Make my trip longer travel time			0.786						**2.98 (0.66)**	2.42 (0.69)	2.31 (0.72)
Combination of [motorcycle-taxi /Songtaew/Silor-lek] 8 [bus / van/ BTS / MRT] Make me pay more money and many times			0.793						**2.98 (0.66)**	2.50 (0.70)	2.49 (0.83)
My image influence my decision on making a trip		0.554							2.35 (0.95)	2.33 (0.88)	2.44 (0.98)
It is not convenient if I have trips other than home-based trip after work or study by using public transport		0.520							2.95 (0.78)*	**2.43 (0.81)**	2.67 (0.75)
I don't like to sit or stay close to other people I don't know while using public transit		0.785							2.68 (0.76)	2.31 (0.70)*	2.49 (0.70)
I feel irritated to do something while staying with other people I don't know		0.743							2.75 (0.78)	2.41 (0.73)	2.52 (0.74)
My image is important to my job or daily life		0.511							2.52 (0.96)	2.33 (0.90)	2.30 (0.78)

Remarks: (1) All factor loading estimates are significant at the 0.05 level

(2) **Bold** and * indicate significance at the 0.05 level, and 0.10 level, respectively, in the *t*-test with the combination of paratransit and public transport travel alternative

Table 5b – Standardized factor loading results and t-test results of attitudinal attributes (cont.)

Attitudinal Attributes	Attitudinal Latent Variables								*t*-test results for Attitudinal attributes		
Description	ATT 1	ATT 2	ATT 3	ATT 4	ATT5	ATT 6	ATT 7	ATT 8	Private vehicle	Public transit	Paratransit combination
Vehicle condition is old, dirty and unsafe. It discourage me to use public transit				0.653					2.55 (0.85)*	2.23 (0.75)	2.26 (0.81)
BTS and MRT images discourage me to use				0.611					1.82 (0.81)	1.88 (0.82)	2.00 (0.91)
Motorcycle-taxi /Songtaew/Silor-lek images discourage me to use				0.802					2.68 (0.92)*	2.18 (0.81)	2.36 (0.73)
Bus and van images discourage me to use				0.741					**2.75 (0.87)**	2.25 (0.77)	2.26 (0.75)
Public transit can not directly access close to my destination and I have to use other vehicle for the distance more than 1 km					0.404				2.75 (1.01)*	2.27 (0.93)	2.34 (1.09)
I do not like to use public transit service while the traffic is congested					0.475				**2.95 (0.71)**	2.50 (0.70)	2.62 (0.73)
It makes me more chance to face traffic accident if I use public transit every day					0.830				**3.25 (0.71)**	3.00 (0.79)	2.89 (0.84)
It makes me more chance to face crime if I use public transit every day					0.788				**3.38 (0.74)**	3.19 (0.78)*	2.98 (0.83)
Combination of [motorcycle-taxi /Songtaew/Silor-lek] 8 [bus / van/ BTS / MRT] Make my trip inconvenient on the raining day						0.583			**3.60 (0.55)**	3.29 (0.65)	3.30 (0.74)
It is not safe while getting on/off on the street						0.654			**3.25 (0.63)**	3.09 (0.66)	2.97 (0.71)
Hot weather and rain make me inconvenient to use public transport						0.731			**3.20 (0.65)**	3.06 (0.7)	3.07 (0.73)
Motorcycle-taxi fare is suitable for travel time							0.818		**2.91 (0.82)**	2.58 (0.77)	2.30 (0.81)
Motorcycle-taxi fare is suitable for travel distance							0.786		2.50 (0.88)	2.50 (0.79)	2.46 (0.77)
It is difficult to get seat and I do not like crowd								0.759	**3.08 (0.76)**	2.62 (0.66)	2.67 (0.63)
Uncomfortable and inconvenient seat								0.807	**3.15 (0.70)**	2.77 (0.60)	2.79 (0.71)

Remarks: (1) All factor loading estimates are significant at the 0.05 level

(2) **Bold** and * indicate significance at the 0.05 level, and 0.10 level, respectively, in the *t*-test with the combination of paratransit and public transport travel alternative

Table 5c – Standardized factor loading results and t-test results of behavioral attributes

Behavioral Attributes	Behavioral Latent Variables				*t*-test results for Behavioral attributes		
Description	**BEH 1**	**BEH 2**	**BEH 3**	**BEH 4**	**Private vehicle**	**Public transit**	**Paratransit combination**
Using car increase my work efficiency	0.928				**2.55 (0.96)**	1.83 (0.97)	2.00 (1.02)
Private car or motorcycle is necessary for my trip	0.912				**2.52 (1.11)**	1.85 (0.97)	2.05 (1.01)
I feel more confident when I use my car	0.911				2.45 (1.06)*	1.87 (1.02)	2.07 (1.09)
For me using public transit instead of car for everyday route would be impossible	0.902				2.22 (1.00)*	1.69 (0.84)	1.89 (0.97)
I prefer to use car although other modes offer faster travel time	0.801				**2.20 (0.88)**	1.76 (0.85)	1.82 (0.79)
I think that separating garbage save environment and I am ready to do		0.786			**2.75 (0.81)**	3.00 (0.78)	3.11 (0.69)
I think that I can preserve environment by reducing car use and I am ready to do		0.758			**2.90 (0.81)**	3.08 (0.84)*	3.28 (0.76)
I have a habit if recycling paper, plastic in order to preserve environment		0.747			2.78 (0.80)	2.79 (0.77)	2.90 (0.79)
I am not afraid to stay with other persons I do not know or unpredictable			0.752		2.20 (0.82)	2.17 (0.80)	2.30 (0.86)
I always accept a dare/ I like to challenge everything			0.659		2.05 (0.93)	2.14 (0.79)	2.20 (0.96)
It disturb me if I am forced to change in my routine			0.637		2.22 (0.95)	2.28 (0.84)	2.21 (0.86)
I like to live in secure surrounding				0.786	3.40 (0.87)	**3.53 (0.66)**	3.31 (0.83)
I selects mode that can protect me from traffic accident for the 1st reason				0.712	3.10 (0.84)	3.08 (0.87)	3.18 (0.81)
I always drive or travel adhering to prevailing speed limit				0.541	2.58 (0.98)*	2.74 (0.89)	2.93 (0.95)

Remarks: (1) All factor loading estimates are significant at the 0.05 level

(2) **Bold** and * indicate significance at the 0.05 level, and 0.10 level, respectively, in the *t*-test with the combination of paratransit and public

Attitudinal and behavioral Influence investigation

Structural models

The primary objective is to investigate influences of the combination of paratransit and public transit alternatives on commuter's choice consideration based on personal attitudes and behavior. Three investigation models were constructed using the same latent variables of attitudinal and behavioral measures for each choice consideration. The 8 latent variables of attitudinal measure and 4 latent variables of behavioral measure listed in Table 4 were constructed based on the results of CFA. Structural Equation Model (SEM) was applied to examine the influences as illustrated in Figure 1. The 8 latent variables of attitudinal measure and 4 latent variables of behavioral measure listed in Table 4 were constructed based on the results of CFA.

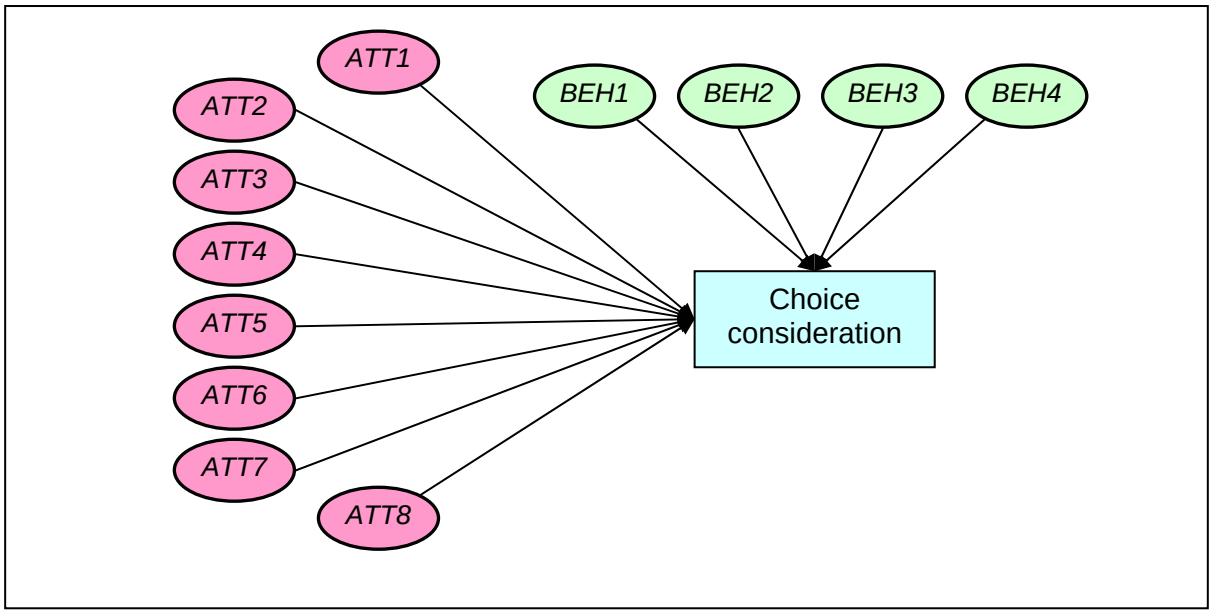

Figure 1 – Structural Equation Model

As presented in Table 6, the three developed SEM models had almost the same goodness of fit indices. This was because all models were constructed based on the same independent variables of attitudinal and behavioral measures and only dependent variables were changed regarding each choice consideration. Therefore, the models developed were statistically significant. The χ^2/df values for all models were around 1.80, which was smaller than 3. These indices showed that the differences between the population covariance matrix and the model implied covariance matrix are small (Bollen, 1989; Kaplan, 2009). The RMR and RMSEA of all models satisfied the recommended value of within 0.10 and 0.08, respectively. The goodness of fit index (GFI) and adjusted goodness of fit index (AGFI) values were around 0.820 and 0.78 respectively. The AGFI indices were found close to the threshold of 0.80, while the GFI values were slightly lower than the recommended value of 0.90. The overall models appeared to be acceptable. The results will be discussed in the following section.

Model results and discussions

The model result of the analysis showed the empirical results supported the assumption that integration of paratransit and public transport alternative affects commuter's choice selection through personal attitudes and behaviors. Additionally, individual attitudes towards the service were found to have more influence compared with personal behaviors.

Table 6 – Standardized parameter estimates of SEM models

	Developed SEM models		
Explanatory variables/ Fit indices	**Private vehicle**	**Public transit-only**	**Combination of paratransit and public transport**
Access to public transit	0.017	-0.029	0.074
Personal convenience	-0.011	-0.036	0.051
Difficulties of the combination	0.211**	-0.110*	-0.047
Pessimism of the combination	0.267**	-0.231**	-0.148*
Risks of the combination	0.172*	0.323**	-0.311**
Using environment of the combination	0.273**	-0.076	-0.026
Fare suitability of the combination	-0.013	0.071	0.062
Comfort of the combination	0.150*	-0.079	-0.022
Car preference	0.319**	-0.208**	0.059
Environmental concern	-0.066	-0.048	0.110*
Risk assessment	-0.026	0.015	0.004
Safety and security	-0.052	0.03	0.008
$\chi 2$	1504.616	1503	1483.35
df	825	825	825
$\chi 2$/df	1.824	1.822	1.798
p	0.000	0.000	0.000
GFI	0.820	0.819	0.820
AGFI	0.782	0.783	0.784
RMR	0.046	0.046	0.046
RMSEA	0.051	0.051	0.050

Remark: ** $p < 0.05$, * $p < 0.10$

For the private car choice consideration model, the car preference behavior was found to be the strongest positive influence on car choice. It meant that those who preferred car advantages would be more likely to choose their cars or motorcycles as their travel choices. It should be noted that the attitudes towards difficulties, images, risks, and using environment of the combination alternative were indicated to be the factors that significantly influenced the choice to drive. In other words, respondents who were dissatisfied with the service qualities of the existing paratransit and public transport modes would prefer the choice of private vehicle to public transports including the combination of paratransit and public transport alternatives. It is noted that the using environment variable was constructed from the

attributes regarding weather condition and places for getting on and off while using the combination alternative. Moreover, the attitudinal variables that drive commuters to choose their cars or motorcycles mostly relate to their travel comfort and convenience as well as images and safety of the travel modes.

Again, the results of public transit only model, in terms of estimated negative parameter, illustrated that the car preference behavior had an influence on commuters in the matter of discouragement to using public transport modes. The negative parameters of attitude on images and difficulties of the combination between paratransit and public transit alternative were found significant in this model as well. It can be interpreted that respondents who encountered difficulties and possessed pessimistic images on using of paratransit combination alternative would potentially refrain from choosing public transport. However, the attitude indicator towards risks of the combination between paratransit and public transport choice, e.g. traffic accidents and crimes, was found to be the driving factor of selecting public-transport-only alternative, as indicated positive estimated parameter.

Conversely, for the model of paratransit combination alternative, the car preference behavior was found not to be significant. It was possibly because of the effects of door-to-door services of paratransit that were functioning in the study areas. However, environmental concern behavior became positively significant. It could be implied that respondent who had more concern on the environment would be likely to choose their travel mode of the combination between paratransit and public transport. The attitudinal indicators towards risks and difficulties of the combination between paratransit and public transport were found negative for the selection of this alternative. These two indicators indicated that commuters who were dissatisfied with images of the combination between paratransit and public transport would potentially feel discouraged in using this alternative. It should be noted that risks, especially on traffic safety and personal security, of this combination alternative possessed the strongest influence on making respondents easily leave from choosing this alternative.

CONCLUSIONS AND IMPLICATIONS

In recent years, performance and capability of integrating paratransit as a feeder into urban transportation system have gradually been revealed and recommended to enhance the performance of public transport. This idea has inspired authors to perform this study. At present, paratransit – e.g. motorcycle-taxi and jeepney - operating in urban areas of developing cities shows a dominant role in shuttling people up and down their residences and main streets including existing public transports – bus, BRT and rail transit. Captive riders are satisfied with paratransit services in terms of mobility. This is emanated from their advantages of vehicle size and unrestrained operation. However, commuters are dissatisfied with the services provided by paratransit in the aspects of traffic safety, personal security and service images. These shortcomings can hinder patronage of paratransit services in the future. Thus, commuter's attitudes towards paratransit will be the important keys for the future development of integrating paratransit into urban transportation policy. Additionally,

paratransit services have not been explicitly included in urban transportation system especially at the planning stage.

The main purpose of this study is to investigate the influences of commuter behaviors and attitudes towards the travel alternative of the combination between paratransit and public transport on the commuter's travel choice consideration. This study, with anticipation, renders one of the important steps to achieve the policy for enhancing public transport performance and urban transportation in developing countries through the ideas of integrating paratransit as a feeder into urban transportation system.

In the case study areas of Bangkok, most of the operating paratransit services consisted of motorcycle-taxi and Songtaew. The travel choice of the combination between paratransit and public transport found in this study owned the patronages of about 42 percent of the respondents or almost the same share of public transport-only mode. This revealed the fact that, presently, commuters considered the combination alternative as their typical travel choices. However, only 20 percent of the respondents considered this combination of paratransit and public transport alternative as their first choice and 63 percent of present users of this alternative decided to shift to public-transport-only travel choice. Most of car riders, especially the car-dependent, preferred to continue driving as expected. Based on this information, further analysis was conducted on respondent's personal behaviors and attitudes towards the combination of paratransit and public transport alternative that might influence their travel choice decision.

The descriptive statistics of behavioral measure revealed that only an attribute of agreement on reduction of car use could preserve the environment and was significantly different between the public transport-only choosing group and the combination of paratransit and public transport choosing group. The later group rated the highest average rating score among three choices; however, all respondent agreed with this attribute. The car preferred group significantly stated the highest average scores for all attributes of car preference, while this group assessed low average scores on the attributes of environmental concern. However, this did not mean that car preferred respondents thought environment preservation was unimportant as able to be seen from the agreement rating of almost 3.0. Also, in the attitudinal measure, there were few statistically significant differences between the public transport-only choosing group and the combination of paratransit and public transport choosing group. The first group seemed satisfied with access distances and using public transport for the trips other than the regular trips. In addition, public transport-only preferred respondents concerned chance of facing with crimes more than the commuters who chose the combination of paratransit and public transport travel mode. It should be noted that car preferred respondents seemed dissatisfied with public transportation services especially on comfort and convenience. They were also significantly dissatisfied with the expenses of access to use public transport services, images of public transit and paratransit, and difficulties and risk of using the paratransit combination alternative.

From the results of developed models in Table 6, the important factors that significantly influence commuter's choice consideration are emphasized. Firstly, car preference strongly

influence an increase of choosing to drive rather than using public transport especially for present car riders. Furthermore, this can be seen from the significant high rating scores on car preference attributes of car riders comparing with the others. Secondly, risks of the combination of paratransit and public transport alternative significantly result in increased potential of selecting private vehicle and public-transport-only travel modes, and refrain from the combination alternative. Thirdly, images and difficulties of using public transit and paratransit show the negative effects on all public transport patronages. Lastly, negative attitudes towards comfort and convenience of using public transport and paratransit possess the potential of choosing car rather than public transport services.

Although the patronage of the combination between paratransit and existing public transport seems to be decreasing, it can be implied from the findings of the present study that paratransit services are still taken into consideration by the commuters in Bangkok and have a potential to continue their dominant function as a feeder in urban transportation system. The reduction in level of patronage is potentially caused by the dissatisfaction with paratransit services qualities as well as deficiency of existing public transportation. Not only commuter demographics and alternative specific attributes but also personal behavior and attitudes towards travel alternatives are found to considerably affect the commuter mode choice. As indicated in the results of this study, car preferences encourage use of private vehicles and discourage public transport patronage as well as the pessimism over services of existing public transport and paratransit. Therefore, it is necessary for transportation planners to focus on the personal behavior and attitudes towards the combination of paratransit and public transportation in order to enhance the performance of public transport and urban transportation by integrating paratransit as a feeder into transportation system. Additionally, the current findings therefore imply that strategies of improving the level of services for existing public transports including paratransit services should be promoted. Improvement on travel time reliability, safety and security, and comfort and convenience, can potentially alleviate the pessimism over a level of services of the existing public transport and paratransit. Probably, these will also make paratransit become one of effective transport modes and elevate the level of public transport patronage of the car riders. Inspired from the results of this study and past studies, authors would like to emphasize the solutions of fading away pessimism over risky and unreliability of paratransit operations in Bangkok. As motorcycle-taxi offers fast and door-to-door service that satisfied the higher income groups, thus, the strategies of providing helmet and controlling riding quality through enforcement and rules from within could minimize the pessimism of risky service that would attract latent demands from high and middle income people who have an ability to use car. For the fixed route Songtaew, though it offers cheaper and safer services, commuters are still dissatisfied with its unreliable waiting time and in-vehicle time. The solution of “Songtaew-express” that offers headway control and limited stops especially in peak hours could debilitate unreliable images of Songtaew and make Songtaew attractive to not only the low-income but the middle-income as well. Moreover, the strategies to attenuate commuter’s car preference by means of mobility management, soft measures, and hard measures, must be stimulated.

This study is only a beginning step of promoting integration of paratransit as a feeder into urban transportation system. Several issues are yet to be addressed in this study. Our case

study was limited to only the areas along the mass transit corridors and focused only on the influences of commuter attitudes and preferences. Further variant samples and commuter demographics are necessary to obtain more accurate conclusion of commuter choice consideration. Moreover, attitudes towards all types of paratransit should be included in future studies. Finally, further studies, that can enrich the validity of our findings and draw the general conclusion to implement this strategy, are being looked forward to in order to enhance urban transportation performance in the developing countries.

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