CHARACTERISTICS AND QUALITY OF CANAL BOAT SERVICE : A POTENTIAL TRAVEL ALTERNATIVE IN VERY CONGESTED AREA IN THAILAND

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Abstract

For the past few years, van transit has become a popular mode of transit users traveling between residential areas and activity centers of Bangkok, Thailand. We, therefore, wanted to investigate reasons for its success operation. Finding from this research could provide guideline for decision-makers to establish proper policies in promoting transit usage in very congested areas like BMA. We first established seven major criteria for evaluation of service quality using expert opinion process. The criteria are travel time, safety, accessibility, comfort, crew manner, fare, and reliability. We then asked users of van transit and public air-conditioned bus to rate their level of satisfaction associated with the criteria. We also ask the users to rate the relative importance of the criteria. Finally, the information from the transit users was used to determine factors affecting travel decisions and the quality of service provided by the two transit modes. The results show that van transit currently provides a better service because the service can give better response to what transit users consider important: travel time, safety, comfort and reliability.

Keywords: Public transport; Canal boat; Travel alternative; Very congested area; Quality of service
Topic area: B1 Public Transport and Intermodality

1. Introduction

Waterways have always played a vital role in Thai society, especially in urban development, agricultural development, and communication of the areas. In addition, some canals were used as defense lines to protect enemies coming to the city. Waterways have always been used to facilitate travel needs and link city capital with neighboring towns. As a result, transportation service in the past had relied heavily on rivers and canals. One obvious consequence was that many houses and business centers were constructed along the waterfront of rivers and canals.
The above roles of waterways, especially canals, have changed to comply with changes in social situations and urban development from time to time. As in Bangkok, a great deal of road development was taking place with very few interests in agricultural development of the area. Therefore, the importance of the canals was decreasing. Currently, most canals in Bangkok are located at the backyard of the houses and business centers. Many canals were filled up with wasted water or converted to roadways.

In 1990, the situation of canals was changed again. Thai government developed the first canal boat service in Central Business District (CBD) of Bangkok to help release serious traffic

congestion problem in CBD. From then until now, travelers in Bangkok have had the canal boat as an alternative mode that can travel as fast as Light-Rail-Transit (LRT) and as cheap as BUS service for their travel needs in CBD of Bangkok. In 1996, the service was so popular that about 110,498 riders used the canal boat system every working days, which was at the same level of LRT riders (about 100,000 riders) in its first year of operation (1999).

This paper investigates the canal boat service in Bangkok, Thailand. The purpose of this investigation is to learn about its characteristics and factors affecting decisions of canal boat users. Finding from this research would provide information for decision-makers to establish proper policies in promoting transit usage in very congested areas in the future.

2. Methodology

2.1 The study approach

In this study, we investigated the characteristics and the quality of service (QOS) of canal boat service (BOAT) in very congested areas of Bangkok. We, then, compared the results with those of transit modes normally available in very congested areas worldwide; namely, air-conditioned bus (BUS) and Light-Rail-Transit (LRT) that have their services on routes paralleled to the canal route.

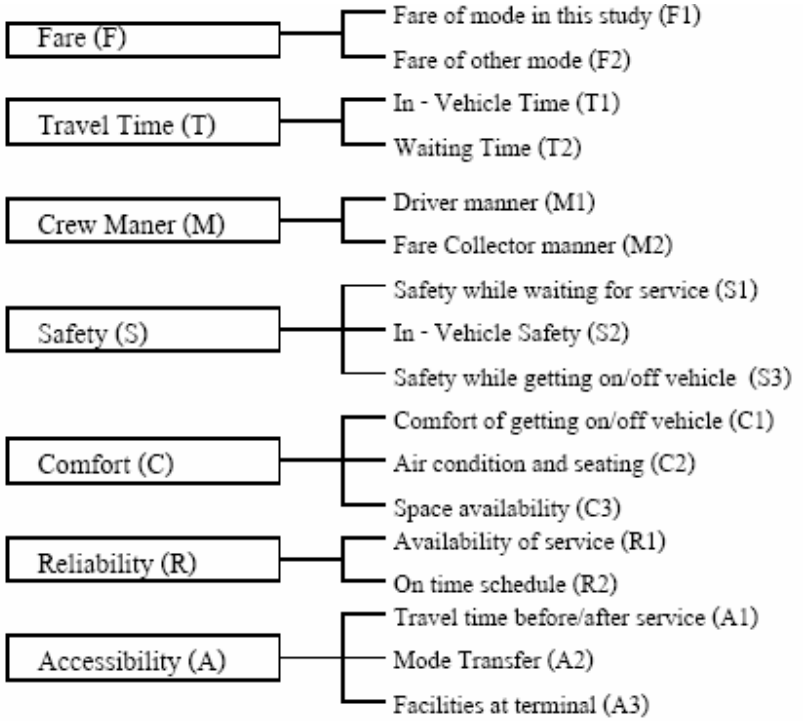


Figure 1. A Hierarchical Structure of Aspects and Attributes of Service Quality

We asked users of BOAT, BUS, and LRT to rate their levels of satisfaction associated with the aspects and attributes. We also asked the users to rate the relative importance of the attributes. The information from transit users was then used to determine factors affecting travel decisions and to estimate the QOS provided by the 3 completing modes: BOAT, BUS, and LRT. Finally, findings from this research were analyzed together to obtain information that would help decision-makers to establish proper policies in promoting transit usage in very congested areas in the future.

Note that this study is not concerned with the level of service actually provided by the transit operators but with the level of service perceived by the transit users. In addition, we assumed that transit users decided to use a particular transit service based on their level of satisfaction of services provided by the transit operators.

2.2 Data collection

We elicited judgments towards level of satisfaction of services and the relative importance of the attributes affecting mode choices from 500 users of BOAT as well as 221 users of BUS and 300 users of LRT on paralleled routes in Bangkok. The data were collectedthrough personal interviews during August-September, 2001, using a questionnairedeveloped in this study. The questionnaire contained questions regarding the profile of the transit users, the importance of the evaluation criteria (weights) for the aspects (Wj) and attributes (Wij), and the level of users' satisfaction according with the service attributes (Sij).

We used a method of quantification of subjective aspects of decisions as developed by Miller (1970). In this case, the relative importance of aspects (Wj) and attributes (Wij) was measured on a scale ranging from "the least (1)" to "the most (5)". However, the level of users' satisfaction was measured on a scale ranging from "the least (1)" to "the most (10)" in order to obtain a more detailed response from transit users.

2.3 Estimating quality of service index

We used a scoring function of Shin, Y., H. Yamakawa and T. Akiyama (1997) for QOS index. The function was designed so that "complete satisfaction" equals 100 and "complete lack of satisfaction" equals zero. In this function, weighted-scores for each attribute werecombined to create a QOS index for the service provider. The function can be represented as follows:

$$Qk = \Sigma \text{all } j \; Wjk * Qjk \,, \quad (1)$$

$$Qjk = \Sigma \text{all } i \; Wijk * Sijk \,, \quad (2)$$

Where: Qk = QOS index for service provider "k", which are BOAT, BUS, and LRT; Qjk = QOS index of Aspect "j" for service provider "k"; Wjk = The relative importance of aspect "j" to QOS for service provider k; Wijk = The relative importance of attribute "i" to aspect "j" for service provider "k"; andSijk = The Quality Score for attribute "i", under to aspect "j",for service provider "k".

The scoring functions were designed so that " Σall i Wijk " for each aspect j sum to ten (10), and the " Σall j Wjk " also sum to ten. The quality score for attributes (Sijk) are assigned values from zero to one. As a result, index of quality of service (Qk) can take on values from zero to 100, where 100 represents a level of perfect satisfaction for every attribute.

3. Characteristics of canal boat service

3.1 Overview of urban public transport in Bangkok

For the purpose of this study, we classified urban public transport system in Bangkok into three major types; namely, Urban Public Transport Modes on Road Network (See Figure 2), Urban Public Transport Modes on Special Networks (See Figure 3), and Personal Public Transport Modes (See Figure 4). Table 1 and 2 show general characteristics of urban public transport system available in very congested areas of Bangkok, Thailand.

The vehicle of this system is a boat (as shown in Figure 3(c)) with seating capacity of 80seats. The average fare of the boat service (1.67 Baht/Km.) is about the same level as the fare of the air-conditioned bus service (1.53 Baht/Km.) and about half of the fare of Light-Rail-Transit (LRT) service (3.28 Baht/Km.). Canal boat service is operated on a canal which separates itself

from the other types of traffic. The route of boat service is fixed and link between CBD, business centers, schools, service centers, and residential areas of very congested areas of Bangkok. The service generally makes stops at places where the canal crossed with major streets so that the users can change travel mode or walk to their destinations. Table 1 and 2 show the differences between canal boat service and other urban public transport modes.

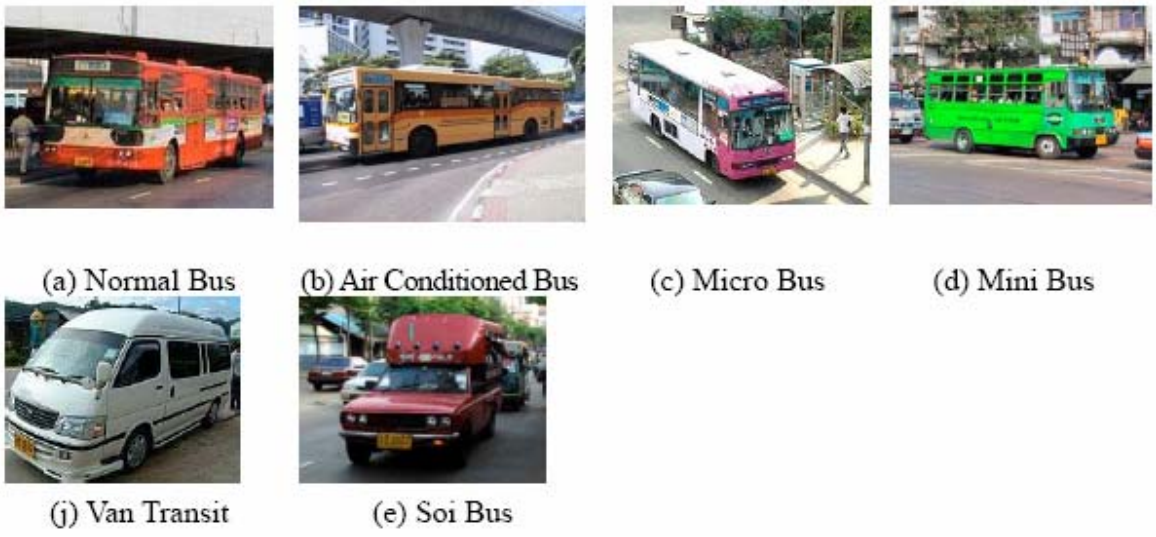


Figure 2. Urban Public Transport Modes on Road Network in Bangkok

Figure 3. Urban Public Transport Modes on Special Networks in Bangkok

Figure 4. Personal Public Transport Modes in Bangkok

Ridership of San Saep canal boat service had been increasing every year from the beginning of service in 1990 until the economic crisis hit Thailand in 1996 (see Figure 10). Normally, travelers use the service to get into the CBD in the morning and to get out from the CBD in the afternoon (see Figure 11). The data surveyed in 2001 shows that the systemhas boats running 246-368 trips to service average riders of 52,670 per day. Although, many users of canal boat service feel that the service has Safety and Comfort problems, canal boat service is still having a lot of captive

riders and appeal to many travelers when traveling in CBD, especially to some destinations nearby the canal.

Table 1. General Characteristics of Urban Public Transportation Modes in Bangkok

Transport Mode	Fare (Baht/ride)	Fleet	Service Routes	Seat Capacity
A. Urban Public Transport Modes on Road Network in Bangkok				
1. Normal Bus	3.50 (flat)	1,594	84	32-35
2. Air Conditioned Bus	8-16	1,981	82	46-63
3. Micro Bus	20	600	16	30
4. Mini Bus	3.50 (flat)	1,179	56	26
5. Soi Bus	3.00 (flat)	2,208	125	14
6. Van Transit	10-30	4,610	143	10
B. Urban Public Transport Modes on Special Networks in Bangkok				
7. Light Rail Transit	10-40	40	1	1,000
8. Commuter Train	5-30	4	4	>1,000
9. River Boat	6-25	47	1	100
10. Canal Boat	5-15	107	1	80
C. Personal Public Transport Modes in Bangkok				
11. Taxi (Meter)	35+	53,000	N.A.	4
12. Soi Taxi	5-20	N.A.	N.A.	9
13. Tuk-Tuk Taxi	20-70[a]	7,400[1]	N.A.	3
14. Motorcycle Taxi	3-15[a]	50,000[1]	N.A.	1

Source: Data from websites of related agencies and from field survey in this study; Except "1" from Furutani, T. and et all.
Note: "a" means "usually depend on negotiation with drivers"

Table 2. General Characteristics of Canal Boat System

Characteristics	Canal Boat	BUS	Conventional Transit	LRT	Taxi	Car Pool	Private Car
1. Direct route (DR) or route deviation (RD)	DR	RD	RD	DR	DR	RD	DR
2. Door-to-Door	No	Maybe	No	No	Yes	Yes	Yes
3. Travel time spent as passenger (P) or driver (D)	P	P	P	P	P	P/D	D
4. Ride shared (S), or personal (P)	S	S	S	S	P	S	P
5. System routes fixed (F), semi fixed (S) or Variable (V)	F	F	F	F	V	S/V	V
6. Access determined by prior arrangement (A), fixed schedule (F), phone (P), street haling (H), or at user's discretion (U)	F	F	F	F	H/P	A	U
7. Vehicle parking required (PR) or not (NP)	NP	NP	NP	NP	NP	PR	PR
8. Convenient for baggage	No	Maybe	No	No	Yes	Maybe	Yes

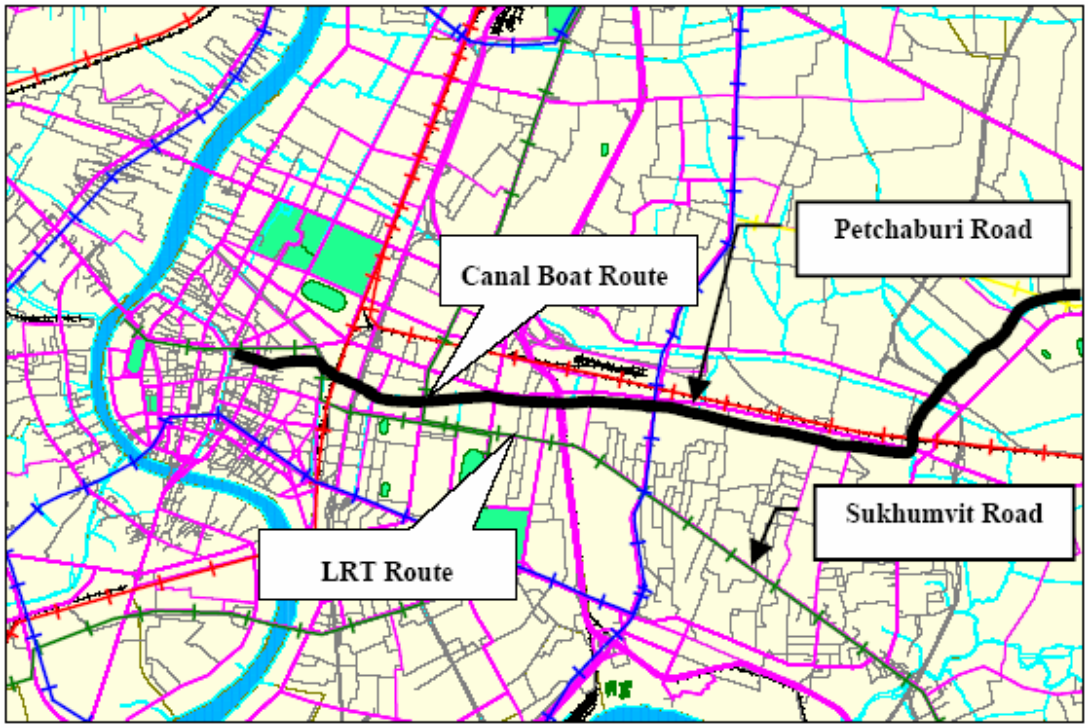


Figure 5. Location of the service route of canal boat system

Table 3. Major characteristics of canal boat users

Characteristics	Description	Percentage of Users
1. Age	Age between 21-40 years	62.0
2. Income	Income less than 11,000 Baht per month	67.0
3. Occupation	Students and Business Employee	63.0
4. Vehicle Ownership	No Private Vehicle in Household	55.5
5. Trip Time	Morning Peak hours	52.1
	Evening Peak Hours	40.0
6. Number of Mode Transfer	None	58.9
7. Trip Purpose	Home Based Work	43.0
	Home Based School	29.0

Source: Data from 500 BOAT Users Directly Interviewed in this Study.

Table 4. Cost-performance of canal boat system

Characteristics		Boat	Bus	LRT
1. Operating Capacity (Persons/Vehicle)		100	100	1000
2. Travel Distance Used in Comparison (Km.)		8.98	9.14	9.14
3. User Cost	Fare (Baht/Person)	15	14	30
	Average Fare (Baht/Person/Km.)	1.67	1.53	3.28
4. Vehicle Operating Cost (Baht/Person/Km.)		0.78	2.21	8.21
5. Average Travel Time	In Vehicle Time(min.)	27	39	24.5
	Waiting Time (min.)	2	7	5
	Total Time (min.)	29	46	29.5
6. Average Travel Speed	Running Speed (Km. / hr.)	20	14	22
	Average Speed (Km. / hr.)	19	12	19

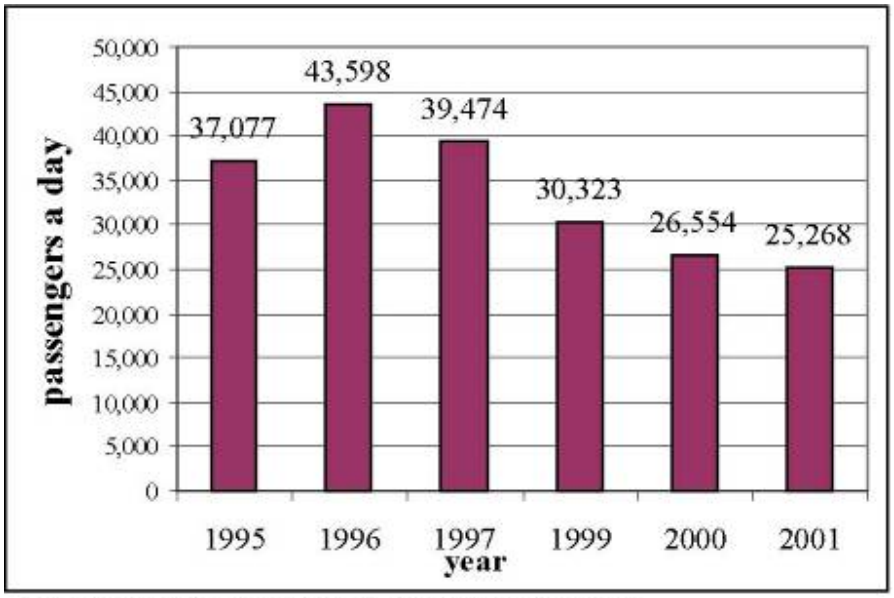
Source: Data from websites of related agencies and from field survey in this study.

Figure 6. Vehicle of Cannal Boat System

Figure 7. Terminal of Canal Boat System

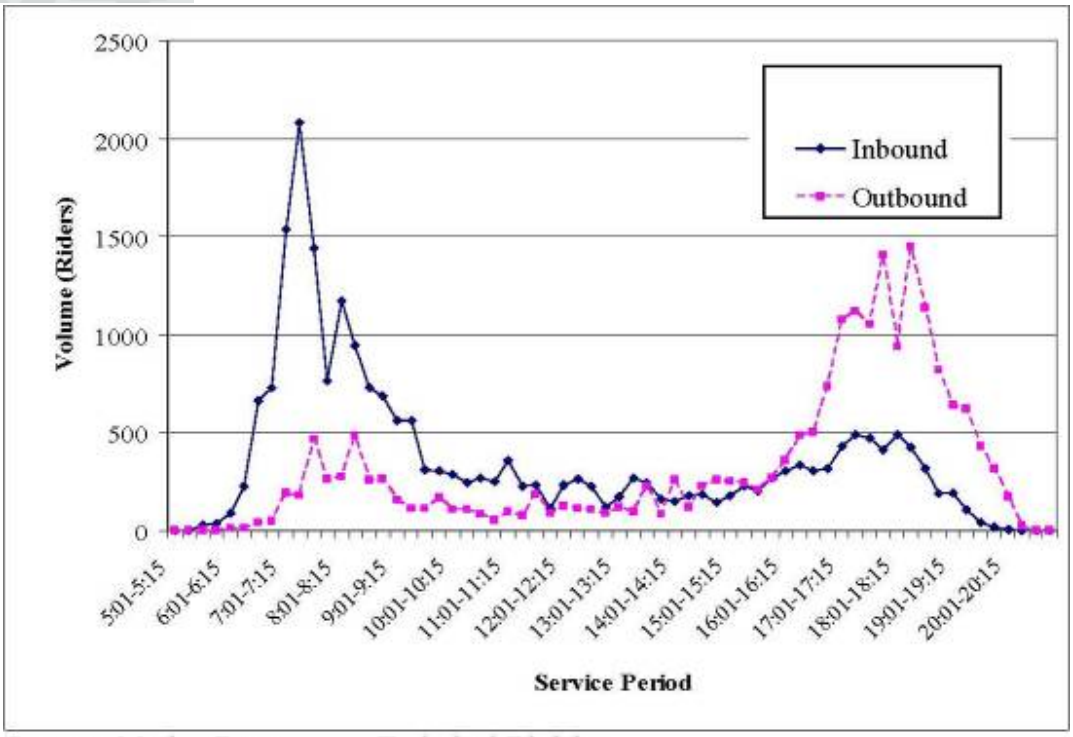
Figure 8. Fare Collection Manner

Figure 9. Cross Section of the Canal



Source: Marine Department, Technical Division.
Note: Data from 15 major boat stops but the system have 25 boat stops.

Figure 10. Average Daily Ridership of Canal Boat System



Source: Marine Department, Technical Division.

Figure 11. Distribution of Ridership of Canal Boat System

4. Quality of canal boat service

Table 5 and 6 show results of QOS analysis of canal boat service (BOAT) in comparison with BUS and LRT. The results show that transit users of this study weight travel time and safety clearly higher than the other aspects. For example, users of BOAT weight Safety most importantly at 1.73 followed by Travel Time (1.70), Accessibility (1.43), Reliability (1.39), Comfort (1.38), Crew Manner (1.24) and Fare (1.12). The similar pattern is seen for the users of BUS and LRT. Table 5 shows the comparison of the relative importance ofaspects (Wj) as rated by the users of BOAT, BUS and LRT. As for the level of satisfaction analysis (see Figure 12), BOAT users gave the highest level of satisfaction for Reliabilityat 6.10, and followed by Travel Time (5.90). BUS users, on the other hand, gave the lowestlevel of satisfaction for travel time (4.12), and followed by Reliability (4.76). Finally, thesimilar pattern is also seen among various demographic characteristics and income of transit users under this study.

Looking at the weights and level of satisfaction simultaneously (see Table 5), we can seethat LRT clearly provides the better service as measured by QOS index (Qk) which rated at80.09 in comparison with that of BOAT at 51.63 and BUS at 51.25 from the perfect scoreof 100. This is because LRT could provided services that response to what users considerimportant better than BOAT and BUS. However, the QOS index of LRT is still low and the system still need a lot of service improvements to keep old customers and attract the new ones, especially in the aspects of Fare and Accessibility.

Table 6 shows detailed QOS analysis of BOAT. Looking at Table 4, 6, and Figure 6, wecan see that BOAT is a potential travel alternative in very congested areas of Bangkok.Unlike, LRT which is very expensive to build and maintain, the main strength of BOAT is the free usage of available public space (canal) for its exclusive transportation network.As a result, BOAT could

travel as fast as LRT and BOAT service can be charged as cheapas BUS service. Besides, BOAT have its exclusive lane like LRT, BOAT could provideexcellent Reliability with Safety if proper policies implemented.

In addition to strengths of BOAT mentioned above, BOAT currently has 5 seriousweaknesses. First, our survey of BOAT users revealed that Safety was the most significantaspect but scored almost the lowest points. It is clear that the priority to improve Safety ishigh. Second, they survey also revealed that vehicle and terminal of the system has serious Comfort (see Figure 1 for description) problems and needed to be redesigned. Third,BOAT service creates environmental adverse effects on areas along the canal in terms of noise disturbing and erosion from canal waves. Forth, there is need for regularly dredgingresidues out of the canal or service lane. Finally, travel environment of the canal is not good when compared to other modes. This is because the water in canal is quite polluted.This study makes suggestions on improvement measures in the next section.

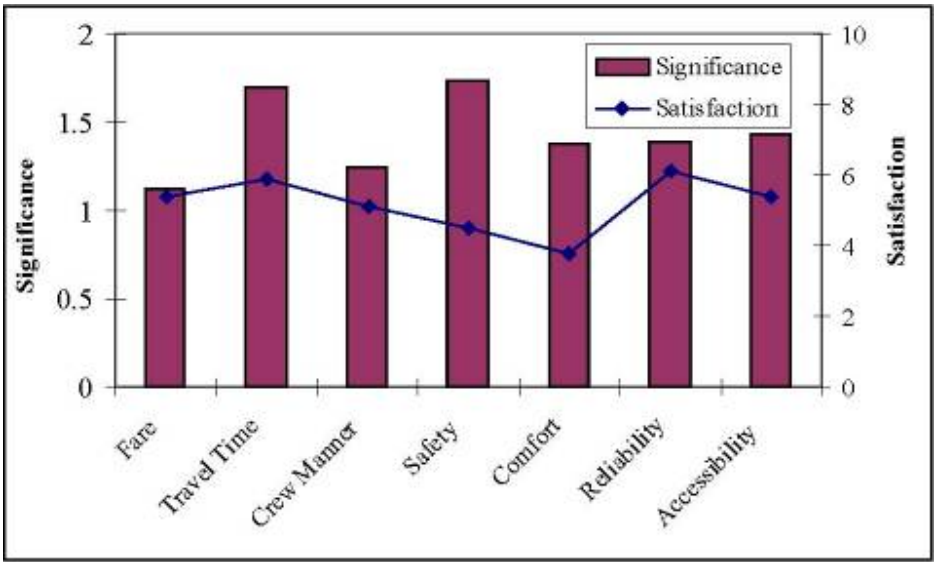


Figure 12. Overall Quality of Canal Boat Service

Table 5. Overall Quality of Transit Service

Quality Aspects (j)	Important of Aspect "j" (Wjk)			QOS Index for Aspect "j" (Qjk)			QOS Index for service provider (Qk)		
	BOAT	BUS	LRT	BOAT	BUS	LRT	BOAT	BUS	LRT
1. Fare	1.12	1.09	1.50	5.38	5.51	5.85	6.05	6.01	8.76
2. Travel Time	1.70	1.55	1.69	5.93	4.12	8.75	10.03	6.39	14.81
3. Crew Manner	1.24	1.25	0.98	5.13	5.60	8.94	6.32	7.00	8.76
4. Safety	1.73	1.70	1.43	4.49	5.80	8.07	7.79	9.86	11.58
5. Comfort	1.38	1.50	1.64	3.83	4.87	7.53	5.24	7.31	12.37
6. Reliability	1.39	1.44	1.55	6.05	4.76	8.12	8.48	6.85	12.55
7. Accessibility	1.43	1.47	1.54	5.35	5.33	7.31	7.72	7.84	11.26
QOS Index (Qk = Σall j Wjk*Qjk)							**51.63**	**51.25**	**80.09**

Table 6. Detailed analysis of quality of canal boat service

Aspests	Importance of Aspects (Wi)	Attributes[1]	Importance of Attributes (Wij)	Quality Score (Sij)
Fare	1.12	F1	5.09	0.54
		F2	4.91	0.54
Travel Time	1.70	T1	5.05	0.68
		T2	4.93	0.50
Crew	1.24	M1	5.27	0.53
Manner		M2	4.52	0.51
Safety	1.73	S1	3.03	0.52
		S2	3.49	0.46
		S3	3.48	0.38
Comfort	1.38	C1	3.82	0.39
		C2	2.74	0.46
		C3	3.27	0.32
Reliability	1.39	R1	5.03	0.57
		R2	5.05	0.64
Accessibility	1.43	A1	3.48	0.56
		A2	3.41	0.58
		A3	3.13	0.47
	Quality of Service index (Q)			**51.63**

Note: "1"See Figure 1 for Description of Attributes.

5. Conclusion and recommendation

The research findings highlight perception factors on which government or transit operators can focus either their marketing or operating effort in order to attract customers to transit modes. We found that Travel Time and Safety are the most important aspects of transit users in very congested areas. Bus, which is a typical transit service, failed toresponse to users' expectation with the QOS index valued at 50 % of the full score (100).

LRT is a promising transit service in congested areas like Bangkok. LRT operates on its exclusive lane. As a result, it can provide excellent Travel Time and Safety. However, LRT is very expensive to build and maintain. LRT system in Thailand has been fully invested and operated by private company. As a result, LRT service is too expensive to most of travelers. Because of its advantage, LRT could be modified to further fit users' expectations. One of LRT major drawback is its Fare. The government should consider LRT system is a public obligation service for travel need in very congested areas. We believe that LRT would be a potential candidate for combating with congestion problems in many urban areas but the system has to be properly managed with clear support from government.

We consider that the canal boat service is another potential travel alternative in very congested areas. The system currently can provide service as fast as LRT and as cheap as BUS. However, the system has Safety and Comfort problems. As a result, its QOS index is valued at 50 % of the full score (100). With proper management and policy, BOAT system should be able to provide

service that response to expectations of transit users. The keys are to promote its strength (S), resolve its weakness (W), and at the same time build their opportunity (O), and reduce threats (T) as described below. The followings are results from SWOT analysis and recommendations for further development of BOAT system as well as other transit services.

Strength (S): BOAT demonstrates the example of how public transportation service can be provided in response to the commuter requirements for traveling in very congested urban areas like Bangkok with cheaper service. The major reason is that BOAT can use available public space (canal) for its transport network. As a result, there is no need to procurecostly land and wait for a long time to have the system in operation. In addition, the system operates on its exclusive lane like LRT so that the system can be arranged to fit users' expectations, especially in Safety and Travel Time aspects which transit users in congested areas considered most importantly.

Weakness (W): The major weaknesses of BOAT are its vehicle, terminal, and operating plan that currently result in Safety and Comfort problems. Energy consumption per passenger of BOAT is also higher than that of BUS. Besides, travel environment is not quite acceptable because the canals in urban areas usually filled up with polluted water. Finally, we have to keep the water level to guarantee BOAT service all year round. We believe that the weaknesses of current BOAT service, especially, Safety and Comfort, can be solved with engineering techniques, management strategies, and good policies from government. For example, we can redesign the vehicle of the system (boat), terminal, and operating plan for safer and cheaper with more comfort and efficient service. The water levels can also be controlled by having a regular dredging of the canal as well as construction and management of water gates using engineering techniques.

Opportunity (O): While operations of BUS and LRT always run at losses or require public resources, BOAT operation demonstrates the possibility of profitable or self-sustaining transit service. BOAT can provide job opportunities for unskilled low-income workers and unemployed persons. Finally, Opportunity is provided from increased tourist activities in areas along the canals because many historical sites usually locate nearby waterways such as canals.

Threat (T): People living nearby the canal may oppose to have BOAT service. This is because BOAT produces environmental adverse effects to areas located close to the canal, in particular noise pollution and erosion of canal bank and bed from waves. The engineering solution for this problem is the construction of bank protections and retaining walls to protect damage of land from canal waves. The government can be the other threat of BOAT system. Without clear and proper policies from related government agencies, BOAT will have problems in providing long term service and extend its service to other potential areas. For example, the current situation of BOAT service has problems about obstacles of road bridges and about clearance of water level when operates the boat along the canal. To solve these problems, cooperation of related agencies is very important.

References

Miller, J. R., 1970. Professional Decisions-Making: A Procedure for Evaluating Complex Alternatives. Praeger Publishers, New York.

Shin, Y., Yamakawa, H., and, Akiyama, T., 1997. An Evaluation of The Quality of Service and Cost-Effectiveness of Special Transport Service in The Tokyo Metropolitan Area. Journal of the Eastern Asia Society for Transportation Studies, 2 (5) 1357-1370.

Dinoo, J. V., and Thomas, R.W., 1977. Mass Transit: Devising a Research Based Marketing Plan, Transport Reseach, 11, 245-253.

Furutani, T., Muromachi, Y., Harata, N., and, Ohta, K., 2003. Mobility for the Poor inBangkok Metropolitan Area, University of tokyo, Graduate School of Engineering, Department of Urban Engineering, Unit of Urban Transportation Planning, Tokyo.