Issues Regarding Bus Rapid Transit Introduction to Small and Medium-Size Cities of Developing Countries in East Asian Region

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Abstract: Transport is very essential in developing countries march toward economic development. It is clear that major advances have been made over the past few decades in the provision of transport services in the region. There are, however, indications that further improvements are required to sustain development and to ensure a more equitable distribution of the benefits of globalization. With the growing number of population of developing countries in East Asian Region and insufficient integration of transit systems, the number of private vehicles operating on road is increasing every year. Traffic management alone is limited in solving the problems of urban transportation, and introduction of guided transit systems separate from ground-level transport is essential in solving these problems. This paper presents issues regarding bus rapid transit introduction to small and medium-size cities in the said region. A survey was given to transportation experts to evaluate the different important issues about BRT.

Keywords: Bus Rapid Transit (BRT), Transportation, Transportation Experts, East Asian Region

1. INTRODUCTION

Economic development in East Asia has followed a remarkable pattern, unlike any other developing regions in the world. East Asia faces not only the old problems of poverty and political strife but also the new challenges posed by economic growth such as emerging income gaps, environmental degradation, urbanization and congestion, and various social problems. Furthermore, the countries in the region are under pressure to enhance domestic capabilities in order to avoid crises associated with globalization and to sustain growth into the next stages of development. East Asia Region is functionally, as those economies that are already taking part in Asian dynamism, or the regional production network linked by trade and investment. This includes Japan, China (including Hong Kong), Taiwan, Korea (ROK), Singapore, Malaysia, Thailand, Philippines, Indonesia, and Vietnam. Some countries such as Laos, Cambodia, and Myanmar are also part of this network.

Large cities in Asia have unique transport problems. Traffic management alone is limited in solving the problems of urban transportation, and introduction of guided transit systems separate from ground-level transport is essential in solving these problems. This article describes some of the recent measures, which is the introduction of the BRT System, taken to solve Asian urban transportation problems.

Various traffic management means have been introduced in some countries to solve the problem of surface congestion. Consequently, many countries want to introduce guided transport that is separate from surface traffic. However, in reality, such a solution is not easy because of different issues. A survey was answered by transportation experts to evaluate the said issues regarding the BRT System introduction to small and medium-size cities of developing countries in East Asian Region.

2. REVIEW OF RELATED LITERATURE

2.1 Defining Bus Rapid Transit

The study focused on knowing the different issues about a BRT system and its introduction to small and medium-size cities of developing countries in East Asian Region. Introduction of new transit systems is needed in the said region to improve urban transportation. Bus Rapid Transit (BRT) is *a bus-based mass transit system that delivers fast, comfortable, and cost-effective urban mobility.* Through the provision of exclusive right-of-way lanes and excellence in customer service, BRT essentially emulates the performance and amenity characteristics of a modern rail-based transit system but at a fraction of the cost.

The term "BRT" has emerged from its application in North America and Europe. However, the same concept is also conveyed around the world through different names. These terms include:

- High-Capacity Bus Systems,
- High-Quality Bus Systems,
- Metro-Bus,
- Surface Subway,
- Express Bus Systems, and
- Busway Systems.

While the terms may vary from country to country, the same basic premise is followed: A high quality, car-competitive transit service at an affordable cost. For simplicity, the term "BRT" will be utilized in this module to generically describe these types of systems. However, it is recognized that the concept and the term will undoubtedly continue to evolve

Perhaps the most telling difference between BRT and other transit services is BRT's central focus on the customer. BRT systems are designed around the customer based needs of speed, comfort, convenience, cost, and safety rather than around a specific technology. In fact, BRT is really just a collection of best practice traits from a range of mass transit options. For this reason, this module will include examples from various mass transit applications in order to present a package of system characteristics that best satisfy customer aspirations. While BRT utilizes rubber-tired vehicles, it has little else in common with conventional urban bus systems. The following is a list of features found on some of the most successful BRT systems implemented to date:

- Exclusive right-of-way lanes
- Rapid boarding and alighting
- Free transfers between lines
- Pre-board fare collection and fare verification
- Enclosed stations that are safe and comfortable

- Clear route maps, signage, and real-time information displays
- Automatic vehicle location technology to manage vehicle movements
- Modal integration at stations and terminals
- Clean vehicle technologies
- Excellence in marketing and customer service

Local circumstances will dictate the extent to which the above characteristics are actually utilized within a system m. Small- and medium-sized cities may find that not all of these features are feasible to achieve within cost and capacity constraints. Nevertheless, serving customer needs first is a premise that all cities, regardless of local circumstances, should follow in developing a successful transit service (Wright 2005).

2.2 Historical development of BRT in the world

The first wide-scale development of the BRTs started in Curitiba (Brazil) in 1974, although there were several smaller-scale projects prior to its development. Since then, Curitiba's experience has inspired other cities to develop similar systems. In the 1970s, development of BRT systems was limited to the North and South American continent. In the late 1990s, the replication of the BRT concept gained momentum and BRT systems were opened in Quito, Equador (1996), Los Angeles, USA (1999) and Bogotá, Columbia (2000). Especially, the TransMilenio project in Bogotá started operation in 2000 and its success drew attention from the world community as an example of the state of the art in BRT systems. By 2005, there may be up to 70 systems around the world, depending on one's definition of BRT (Levinson et al. 2003; Ernst 2005; Wright 2005).

There are about 68 BRT systems throughout the world, not all of which are full BRT. There are 11 in the United States and Canada, 15 in Latin America, 20 in Europe, 2 in Africa, 16 in Asia, and 4 in Australia/New Zealand. BRT's history resides in a variety of previous efforts to improve the transit experience for the customer.

2.3 BRT Introduction in Asia

BRT cities in Asia can be divided into two categories– cities with a bus rapid transit (BRT) system and cities that want to have a BRT system. Currently, there are over 80 BRT systems in development in Asia. In Asia, prior to 2000, the experience of BRTs was very limited in number and scope. The systems in Nagoya, Japan and Taipei were regarded as relatively complete systems in the Asian region (Wright 2005). The spread of BRT in Asia has become more conspicuous since 2004. In 2004, the TransJakarta busway was started along through the city centre (Hook and Ernst 2005). On 1 July 2004, three BRT corridors totaling about 37 km were installed as a part of Seoul's reform of its public transport system (Pucher et al. 2005). On 25 December 2004, the first stage commercial operation of BRT was started in Beijing as a pilot line for 5 km (Chang 2005). In Bangkok, the plan for BRT was declared in 2004 by the newly elected governor of Bangkok Metropolitan Administration (BMA) indicating that the first BRT lines would be opened in October 2005. Although there was some confusion in Indonesia and Seoul when those lines were first introduced, the BRTs in Jakarta, Seoul, and Beijing have shown some success and those systems are under the process of expansion and upgrading. Information on evaluation and expansion of those systems is summarized in Chapter 4. In contrast, the plan for BRT in Bangkok has been delayed and has not been introduced yet, although rail and light rail expansion is underway. The number of cities

looking into BRT is rapidly increasing. In China, a BRT longer than that in Beijing was officially opened in Hangzou in April 2006 (CAI-Asia 2006b). According to a Website by CAI-Asia (2006a), BRTs are now planned or under construction in 18 cities and under consideration in 5 cities in Asia. It is noteworthy that, in the new BRT systems in Asia, some similarities can be observed with existing BRT systems such as Curitiba and Bogotá. In fact, there are records that there were communications between those Asian cities and Latin American cities, such as the visit of Jakarta's Governor to Bogotá in May 2003 (Institute for Transportation and Development Policy 2003a).

With respect to the Philippines, there is a feasibility study on the introduction of BRT in Quezon City. This city is located in National Capital Region of the Philippines. It has a land area of 161 square kilometers and is considered as one of the biggest cities in the country.

3. RESEARCH METHODOLOGY

A survey questionnaire was formulated and was distributed to different transportation experts throughout East Asian Regions. The overall objective of this research is to gain insight in BRT system functioning in the said region and identify how the knowledge from these system operations can be applied on the current/future BRT system planning/implementation process with an intension to make these BRT systems more successful from environmental, social and economic perspectives.

The contents of the survey form were some personal informations of the transportation experts, their personal understanding about the BRT System and their professional opinion about the BRT System.

3.1 Personal Information

The name of the survey expert was an optional. Some wrote their names and some were not. Additional personal information were gathered as data from the survey form. Figure 1 as shown below depicted the age bracket of the transportation experts who answered the survey. It is shown that majority who answered this survey was under the age bracket of 36 – 40 who were considered as middle-aged people. Figure 2 shown below stated that most of the respondents were male. While Figure 3 shown the different developing countries in East Asian Region and accordingly, the country of residence of the transportation experts were also known.

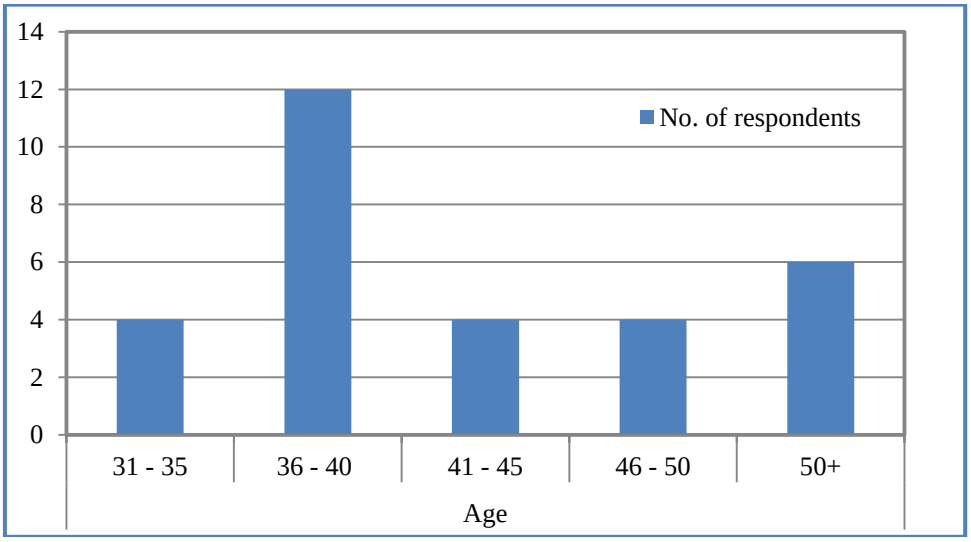

Figure 1. Age Bracket of the Transportation Experts

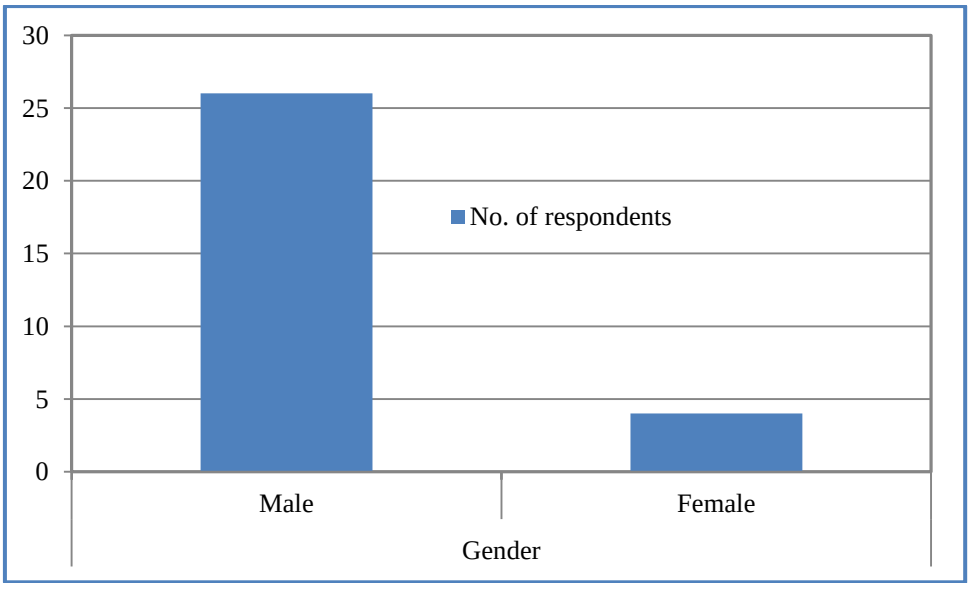

Figure 2. Gender of the Transportation Experts

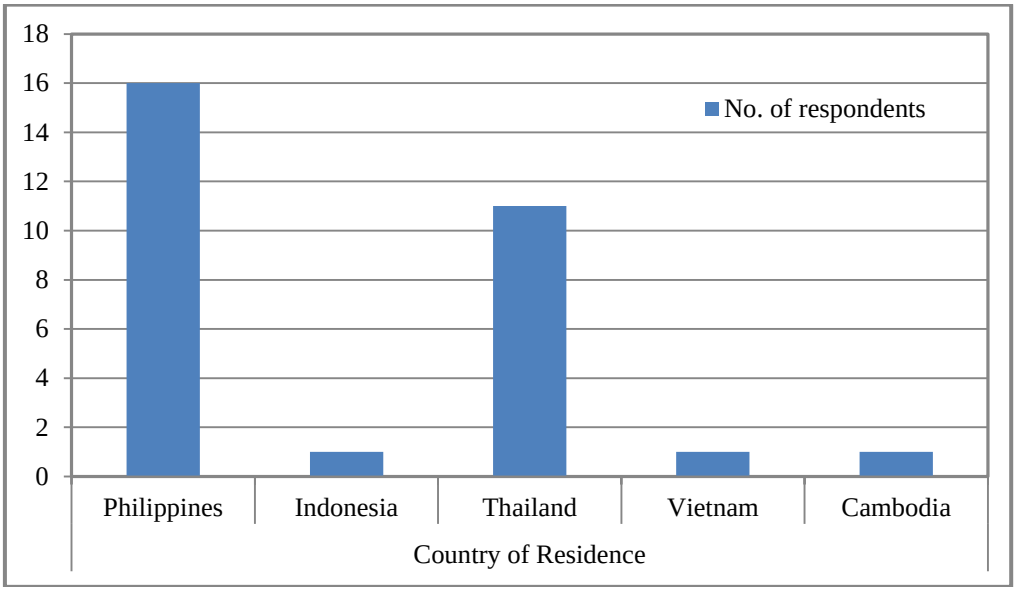

Figure 3. Country of Residence of the Transportation Experts

Figure 4 displayed the work affiliation of the transportation experts such academe, national/local government or industry. Since the authors of this paper belonged to academe, this is the reason why most of the transportation experts were also from the same profession. In relation to this information was the number of years of experience. Figure 5 shown that majority were under the bracket of having 11 – 20 years of experience.

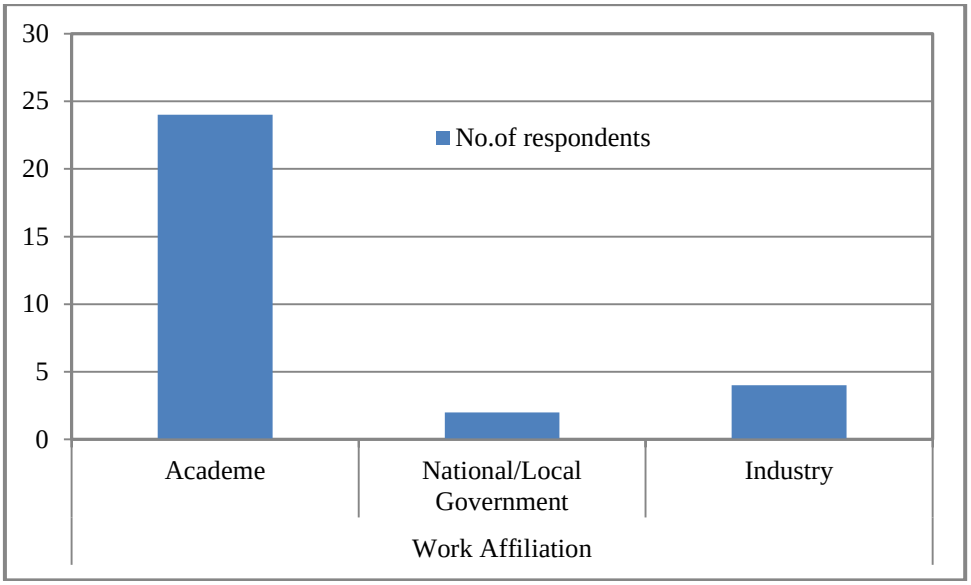

Figure 4. Work Affiliation of the Transportation Experts

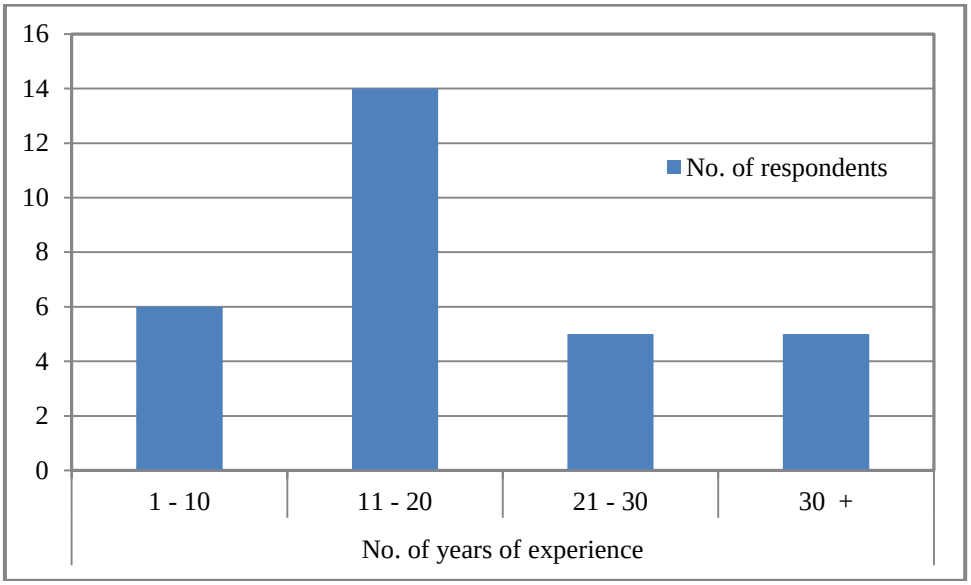

Figure 5. Number of years of experience of the Transportation Experts

Lastly under the personal information was the highest educational attainment. Since, this survey was conducted by transportation experts; it showed from Figure 6 that most of them attained Doctor of Philosophy.

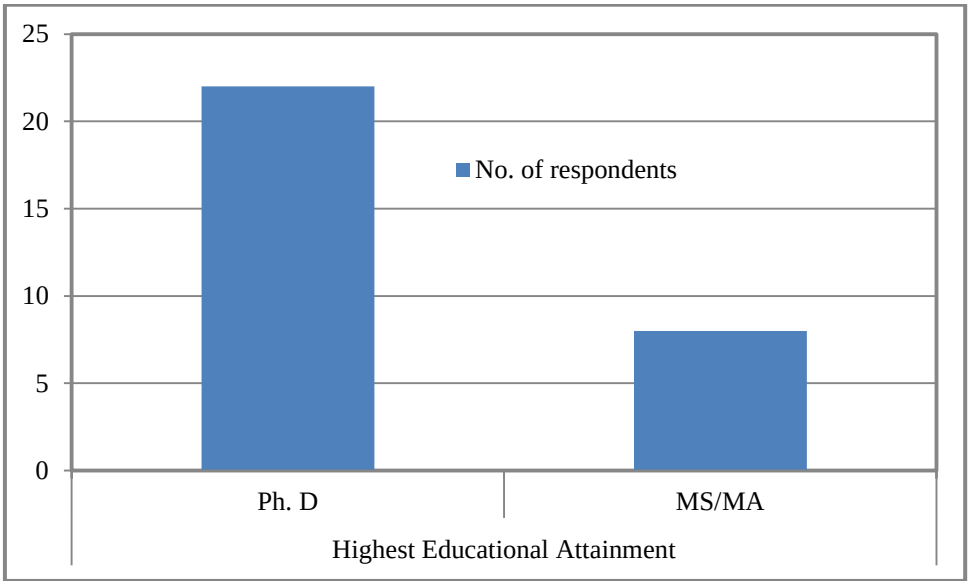

Figure 6. Highest educational attainment of the Transportation Experts

3.2 Personal Understanding about the BRT System

Under this category, the first question was "*Are you familiar with the Bus Rapid Transit System?"* All of the respondents answered yes. Meaning to say, Bus Rapid Transit (BRT) is growing in popularity and gaining more attention as more cities look to develop new means of rapid transit. Figure 7 shown the answer to the question *"Since when have you been aware of the existence of the BRT System?"* Most of the respondents answered 2000 up to present. Despite the growing popularity of BRT systems in developing countries, there is a relative lack of detailed research on the successfulness of these systems that would reveal at which circumstances BRT systems show high performance and at which circumstances these

systems has to be improved/changed in order to ensure their better functioning. And this can be the reason why most of the respondents answered only 2000 up where in fact the BRT System started theoretically by year 1974.

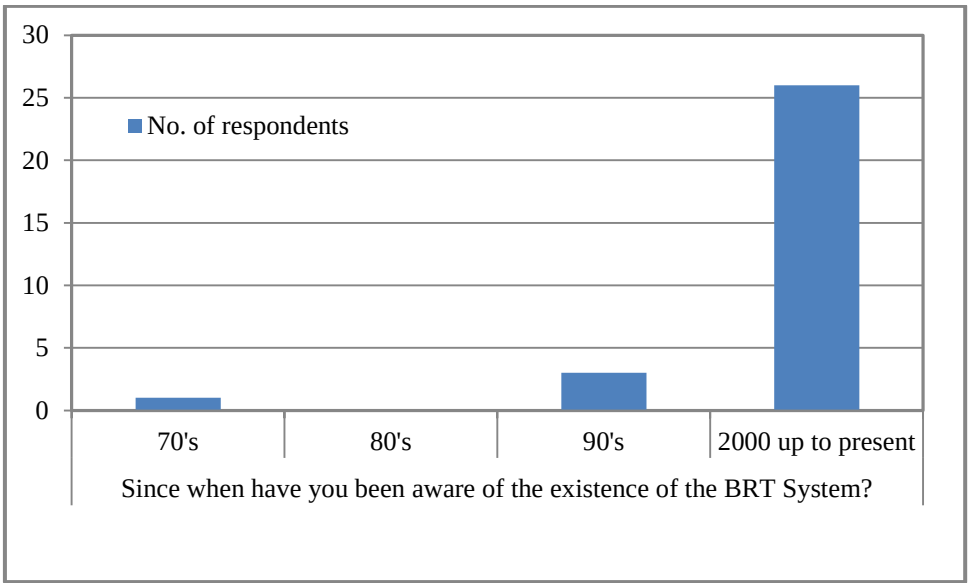

Figure 7. Existence of the BRT System

Next to the survey was the question "*Where did you first hear/read/see the information about BRT?"*. Mostly, they answered through Journal Articles followed by Internet and Newspaper as shown in Figure 8.

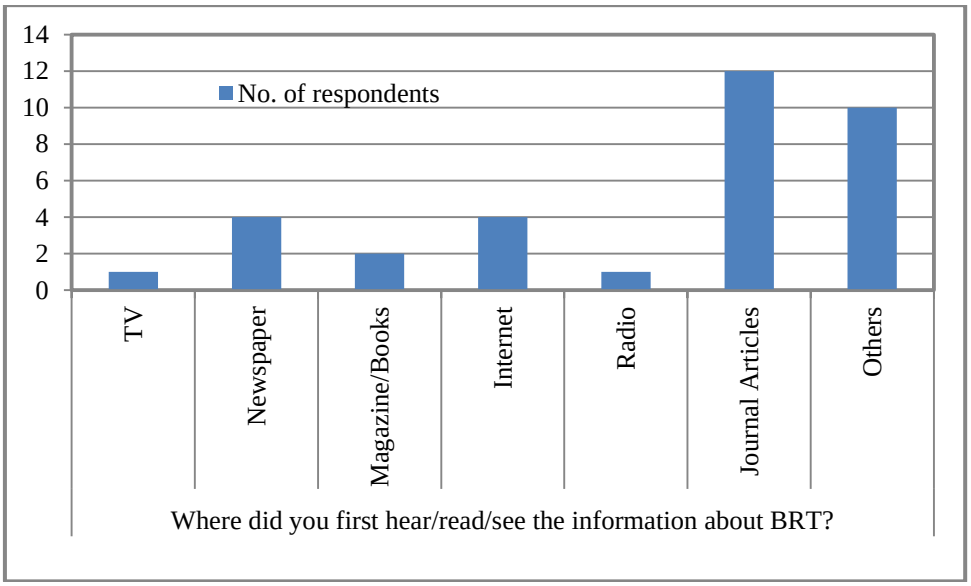

Figure 8. Source of Information about BRT System

Information on the introduction processes of BRT in the said region was obtained from TV, newspaper articles review, magazines/books, through internet, radio, journal articles and others. Some of the respondents answered that they have been aware of the BRT System by attending conferences and seminars, documentation by local governments, and reports by international institutions.

Next was the question "*Have you already ridden a BRT System*?" More than half of the respondents answered yes as shown in Figure 9.

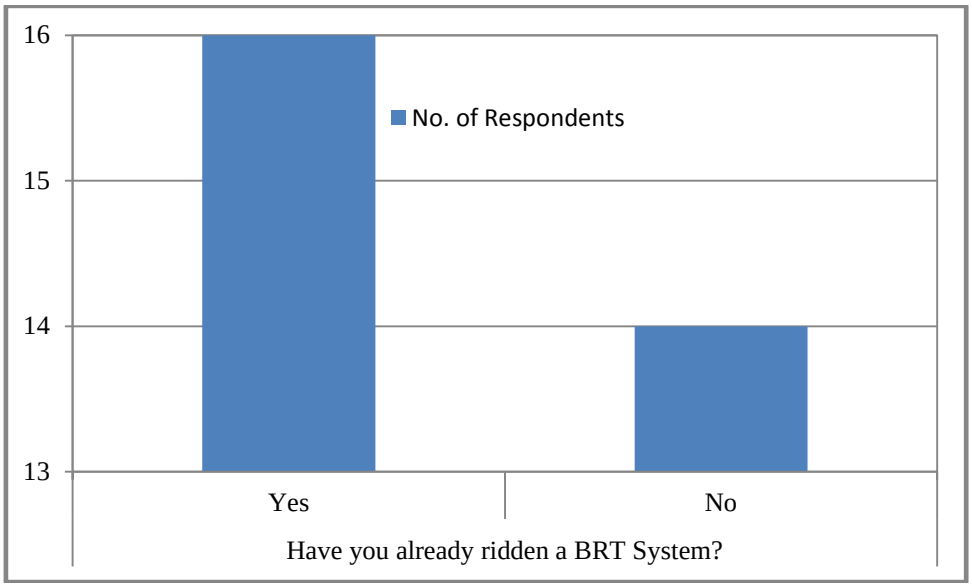

Figure 9. Respondents who have ridden a BRT

For those who answered yes, they were asked to evaluate different descriptions of the BRT System. Table 1 as shown below displayed the ratings given by the transportation experts to each description and its mean was calculated.

Table 1. Impression of the riding experience with the BRT System (with 5 – Highest and 1 – Lowest)

Description of the BRT	Rating					Mean
	5	4	3	2	1	
Cost Effective/Value for Money	7	9				4.4375
Fast	3	7	5	1		3.75
Reliable	2	10	4			3.875
Comfortable/Convenient	6	6	3	1		4.0625
Safe and Secure	4	8	4			4.0

Among the descriptions, it was the cost effectiveness/value for money got the highest mean score. As one of the characteristics of BRT, the customer tariff is related to operational costs and the level of subsidies (if any). Given the lower labour costs in developing cities, BRT can typically deliver relatively low operating costs. Further, the realities of municipal revenues in developing cities also mean that long-term subsidization is not an attractive or viable option. Thus, BRT is often capable of delivering non-subsidized services for fares of less than US$ 0.50 per passenger. In the developing city context, rail-based systems have proven to largely require subsidies and/or higher fare levels.

The next description which got the second highest mean score was comfortability and convenience of using BRT. The level of comfort within a system depends upon many design characteristics that are somewhat independent of mass transit type. Station seating and protection from the elements are dependent on system design. Of course, underground systems have the advantage of a better natural barrier from outside weather conditions. The interior design of the vehicles is again dependent upon design specifications, and can be of equal quality for either rail or BRT services. However, some types of trams may have a more narrow width which may limit design options and in some cases create a more squeezed environment for the customer. Ride comfort is one potential area of difference between BRT vehicles and rail vehicles. Rail is typically credited with a smoother ride performance both during starts and stops as well as during full operation. A smoother ride performance better permits value-added activities, such as reading, for the customer. Low-floor BRT vehicles can be susceptible to surface imperfections on the busway that will result in a "bumpier" ride. High-floor vehicles with ramped entry service can better mitigate this issue through dampening and improved suspension. With this type of BRT vehicle set-up in cities such as Bogotá, Curitiba, and Quito, on-board activities such as reading are quite feasible. However, in general, the ride smoothness of rail vehicles is superior to that of BRT vehicles.

Table 2. Existing and Proposed BRT System in the ASEAN

Location (Country/City)	Existing BRT System		Proposed BRT System
	Budget	Opening	Project Stage
Bangkok BRT, Bangkok	2000 million baht	2010	
TransJakarta, Indonesia		2002	
Montreal, Canada		1989	
Khon Kaen, Bangkok			Feasibility and Engineering Design Stage
Chiang Mai, Bangkok			Feasibility and Engineering Design Stage
Nakhon, Bangkok			Feasibility Stage
Ratchasima, Bangkok			Feasibility Stage
Quezon City, Philippines			Pre – Feasibility Stage
Cebu City, Philippines			Feasibility Stage

A mean score of 4.0 was given to safe and secure. Segregated lanes for rail and BRT vehicles help to reduce the potential for accidents, and thus make such mass transit options relatively safer over more standard services. Grade separated services, such as underground metros, particularly benefit from avoiding such conflicts. Both BRT and LRT systems face potential risks when crossing intersections. The opening of the Houston (USA) LRT system has been met with a higher than expected accident rate between private vehicles and LRT vehicles. Private vehicle owners are often unaccustomed to the presence and operation of segregated transit vehicles and may be unprepared for the implications. Fully grade separated systems do incur other types of risks that may affect safety. The higher maximum speeds reached on underground and elevated systems implies that in the event of a mishap, there is a greater chance for serious injury and fatalities. Further, underground and elevated systems have added difficulty in evacuating customers during a system emergency (Wright 2005).

Reliability is related to the level of confidence one has in the transit system's ability to perform as expected. The concept of reliability is related to the previous discussions of travel time and service frequency, but can also refer to other system characteristics such as comfort and safety. An unreliable service can create a high degree of personal stress if a customer does not know when and/or if a vehicle is going to arrive at a station. Unreliable services ultimately lead to non-captive users seeking more robust travel options, such as private vehicles. Each type of transit system has different characteristics with regard to reliability. The frequency of service breakdowns, the rate at which disabled vehicles can be replaced, and the operational responsiveness to changes in demand all affect overall reliability. Metros, LRT, and BRT all have excellent records of reliability, particularly when compared to more conventional transit services. Segregated right of- ways help to better control service frequencies and headways between vehicles. Systems with complete grade separation, such as underground metros, have a particular advantage in terms of avoiding unforeseen incidents at mixed traffic intersections. The relative flexibility of BRT vehicles to operate inside and outside of the segregated infrastructure allows immediate adjustments to breakdowns. Service can continue while repairs or removal are taking place. The breakdown of a metro or LRT vehicle is another matter. Until the disabled vehicle is cleared from the system, there can be considerable disruption to service. Further, BRT vehicles can be removed utilizing standard tow vehicles. In the case of rail vehicles, more specialized removal equipment is required. Another consideration is the impact of extreme weather considerations on the system. Systems that are completely underground are immune to such affects, although a weather-related failure of the electricity supply can obviously have an impact. Ice on rails and busways can act to slow or even halt services (Wright 2005).

Likewise, additional questions were asked regarding the BRT System. Table 2 summarized the answers gathered from the survey.

3.3 Professional Opinion about the BRT System

The last part of the survey was all about the professional opinion about the BRT System of the transportation experts. Table 3 as shown below summarized the answers gathered from the survey and the mean score of each was calculated. Other issues such as Solution to Congestion, Fare Structure, Station/Stop Planning and Development, and Public Involvement were also cited in the survey.

Table 3. Professional Opinion about the BRT System

Important Issues about BRT	Number of respondents who answered the given rates					Mean
	Very Important				Least Important	
	5	4	3	2	1	
Local technical/professional experts In the country about BRT's	19	6	5			4.47
Support from existing public transport providers	16	8	5	1		4.47
Favorable transport agenda of concerned government agencies	18	8	3	1		4.43
Support from national leaders/decision makers	22	3	4	1		4.53
Budget to construct such a system	10	13	5	1	1	4.0
Information and understanding about the BRT system in the general population for civil society/citizen support	10	14	5	1		4.10
Private sector involvement (finance, construct, operate) to support such a system	12	7	4	5	2	3.73
Concern for sustainable transport and environmental issues	12	13	5			4.23
Others	4	2	1			4.43

4. CONCLUSION

Important issues regarding bus rapid transit introduction to small and medium-size cities of developing countries in East Asian Region were formulated and answered by the transportation experts. The evaluation results of the selected BRT issues revealed the current problems and positive aspects of these BRT systems' operation, creating knowledge, which can be applied for the introduction of these systems's functioning as well as for the planning and implementing stages of the new BRT systems in the said region. In this way, the main goal of this research was achieved. Based on the results obtained from the evaluation of the survey, it can be concluded that these BRTs have contributed to improvement of the transport system in these cities, ensuring a faster transfer of a majority of cities' inhabitants. However, all these systems still have several problems in operation and the most common problem is the lack of the BRT system capacity.

Finally, East Asian Region BRT systems have to fulfill several conditions. These conditions can be summarized as follows:

- There should be a support from government and international organizations in BRT system planning and implementation.
- Local technical/professional experts in the country about BRT's should be provided and be trained.
- A support from existing public transport providers should be there.
- Favorable transport agenda of concerned government agencies should be provided also.
- Concern for sustainable transport and environmental issues such as air pollution should be addressed.
- There should be information and understanding about the BRT system in the general population for civil society/citizen support.
- Others, such as a careful planning of the new BRT system, using up to date informations.

The results obtained from the evaluation are in line with the other researches. Many studies and guidelines on BRT systems have been developed and proposed based on successful BRT experiences in various cities. They may not be applied directly, unless proper modifications and enhancements are done accordingly based on specific backgrounds, conditions and characteristics of each Asian developing city. Therefore, further feasibility studies are required before actual BRT implementation can occur.

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