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Bus Rapid Transit in Hanoi

A Case Study of Applying a New Model of Public Transportation

Quang Huy Duong

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Abstract

One of the greatest problems that every Hanoi citizen is facing is traffic congestion. With an already high population density and the ever-increasing rate of urbanization, the problem is also more threatening to both the city dwellers and the government. In the face of that, the government has introduced a new public transport system called Bus Rapid Transit, or BRT. The system has proved to be a success in some cities, while it has failed in some others. In this context, BRT was viewed in Hanoi, as the system came into operation less than three years ago.

The Hanoi BRT system was compared to other systems in the populated cities of developing countries to see how different its applications were by conducting a secondary study. However, it was also examined as participant observation by the user of the system, in this case, the author of the study.

Viewing a transportation system without looking at transportation planning is inadequate. Hence, a solution to encourage the use of BRT and generally the use of public transport by the Hanoi citizens was provided, together with solutions to improve the BRT system itself.

Keywords/tags (subjects)

Bus Rapid Transit, BRT, Transportation planning

Miscellaneous (Confidential information)

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1 Introduction

1.1 Preface

Hanoi, capital of Vietnam, is one of the two most developed cities in Vietnam. Being developed attracts immigrants from the countryside, which is a potential source for workforce and further strengthens Hanoi's economy. However, it also comes with downside of overpopulation, which weighs heavily on Hanoi's transportation system. Hence, in order to keep up with the population growth, the transportation system must continuously evolve to satisfy the increasing demand for travel and transporting passengers and goods.

The Bus Rapid Transit (BRT) is one of the projects which was implemented in order to relieve the weight on transportation system in Hanoi. As of 2019, BRT has been present in 171 cities around the globe (BRTdata) which has proved its efficiency. However, in Hanoi, it was not warmly welcomed because the disadvantages offset the advantages. Hence, this thesis discusses why the BRT system does not perform well enough in Hanoi in comparison to the BRT systems from some cities over the world and provides some proposals on what could be done to make BRT system more viable.

1.2 Objectives

This thesis was made to analyze why the BRT system proved ineffective to the point of being wasteful. The focus of the thesis was on the assessment of BRT system in Hanoi, Vietnam. Based on the analysis, several directions were looked into and suggestions were made and discussed to determine how the BRT could be relatable in the future of transportation to Hanoi as well as other large cities in Vietnam. Hence, this thesis answered the following questions:

- What is Bus Rapid Transit system or Bus Rapid Transit (BRT) and how was it implemented in other countries?

- How was the idea of Bus Rapid Transit executed in Hanoi, Vietnam?

- What are the main differences between BRT system and general bus system in Hanoi and how it is performing in comparison to general bus system?

- What direction can the BRT system follow in order to succeed in Vietnam?

1.3 Research Scopes and Limitations

Despite having various modes of transportation to serve a populous city as Hanoi, this thesis will only focus on the bus system and BRT system. More specifically, the BRT 01 project, first BRT project in Vietnam which will be introduced further into the thesis, will be the subject of this study. Due to being in different field of study, this thesis will not focus too deep on how routes and stops are located compare to each other, for example distance between stops, which belong to city planning. Information regarding the planning process of the BRT project, for example which department, which corporation took part in which with package of the project will not be mentioned as project planning is not considered in the study.

1.4 Research Methods

This research was mostly based on secondary research (desk research) when not related to Hanoi, as data on the BRT system in other countries was retrieved and summarized from previous case studies in many cities. As the BRT system was new in most part of the world, many case studies on the system were done recently, which made the data more reliable. Field study was not an option because it would have included several developing countries and traveling to all destinations would not have been possible at the current level of study.

However, studying the case in Hanoi could be considered participant observation research, defined as the researcher “observe and learn about the group under study in nature environment by participating in those activities” (Kawulich 2005). In this case, the author was a frequent user of Hanoi’s conventional bus system. During the research process, the researcher was able to use Hanoi BRT system in order to learn what its strengths and weaknesses are. Ultimately, participant observation proved to generate greater accuracy when the subject was a culture group. Henceforth, the

methodology for the whole thesis should be mixed research, with most parts are either secondary research or participant observation research.

2 Theoretical Framework

2.1 Urban Public Transportation

Mass transit, also known as urban public transportation (UPT), is defined as ”the movement of people within urban areas using group travel technologies such as buses and trains” (Schofer 1998). UPT is included in urban transportation, which can satisfy a large number of citizens from every demographic frequently. UPT is available at a fixed time, travel in a fixed direction and along a fixed route. Passengers will also have to agree to pay a fixed amount of fee for use of the system. UPT is responsible for moving millions of people daily, while also produces far less pollution per person than other modes of private transportation, especially in urban areas. With the development of technology, urban public transport comes in all shapes and sizes, including metros, trams and buses.

As living quality is continuously improving, most people prefer private to public transportation for privacy and convenience. A computerized questionaire study in the Netherland in 2001 among 1803 people shows that ”women, younger people, low-income groups and singles use their car relatively less often than do men, older age groups, higher income groups and couples and families” (Steg 2003). The study also indicates that traveling by cars is considered superior to traveling by public transports in most of the fields, except traffic safety. In the scale from 1 to 10, cars are on average 2 to 2.5 points higher than public transport on some important aspects such as convenience, independence, flexibility, speed and reliability. Traveling by cars is also believed to have a higher status, which explains the different demographics mentioned above. Furthermore, even those who hardly travel by cars also lean toward using cars instead of public transport according to the study (see Figure 1 and 2).

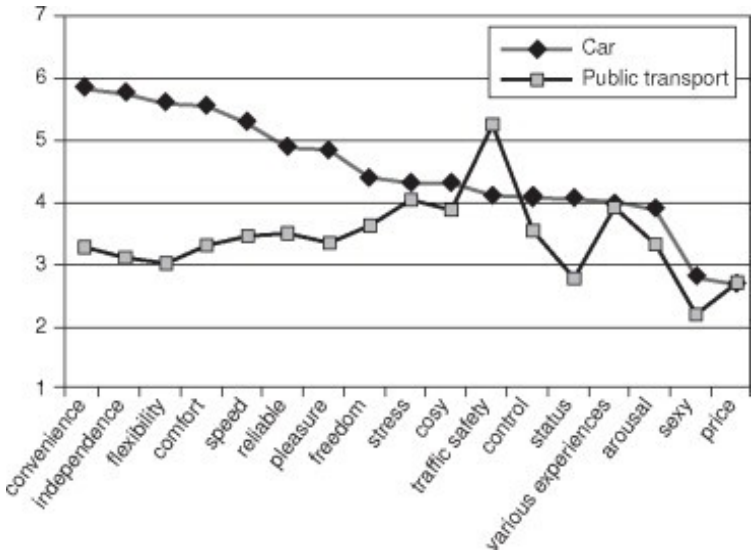

Figure 1: Attractiveness of car use and the use of public transportation (Steg 2003)

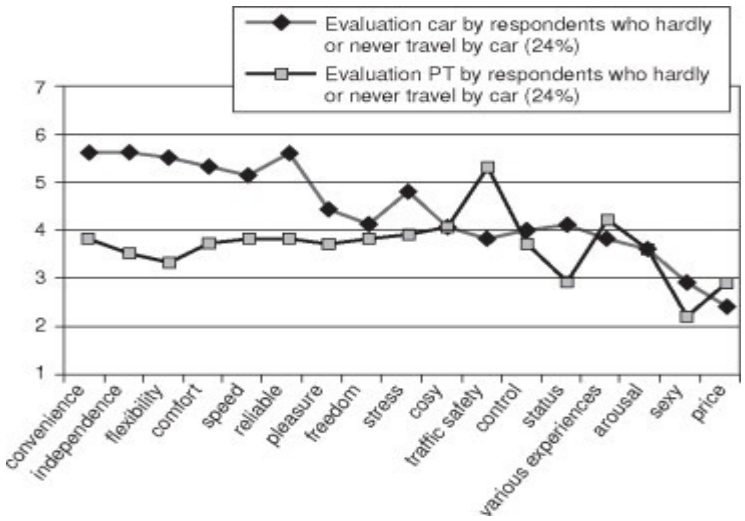

Figure 2: Evaluation of attractiveness of car use and the use of public transportation by infrequent car users (Steg 2003)

However, as mentioned above, since public transports come in varieties of tram, metro and bus, the mentioned study by Steg can be inadequate at defining passengers' preference of different modes of transportation. Since the focus of this thesis was the transportation of passengers by bus, opinions on the bus system will be decisive factor. Another questionaire study conducted in Jeddah, Saudi Arabia shows a great difference between the number of people prefer traveling by bus and those preferring metro (Aljoufie 2015). Six options were given as the future prefered mode of transportation including walking, bicycle, metro, bus, taxi and car. 34.6% of

those took part in the survey preferred traveling by car, while 11.2% preferred the bus and 43.1% chose the metro. However, at the time of the study, there was no metro system in Jedda, so it is possible that people overlooked the negative characteristics of metro.

This is not to say that it is only in the developed, high income countries that private transports are prefered. In the developing countries, people also rely on private transport because of the negative characteristics of a slow, uncomfortable and unsafe UPT system (Wright and Fulton 2005).

2.2 Urban Public Transportation in Vietnam

2.2.1 History of Urban public transportation in Vietnam

The earliest form of urban public transportation can be traced back to horse-drawn omnibus used in France in 1828, which could carry up to 50 people. In Vietnam, or more specifically in Hanoi, the first form of public transportation was the tram system, set up by French engineers of the Compagnie des tramways électriques d'Hanoï et extensions (CTEH) during the colonization perriod in 1900. The first test ride took place on 13th September 1900. At its peak, the tram network consisted of a 30 km railway system with 5 lines, and Hoan Kiem lake was the main stop (Doling 2013). The tram system was capable of transporting up to 40 millions passengers a year despite the fact that Hanoi's population was only 1 million. In the end, the whole system, including the railway was removed completely in 1993 as a result of deterioration and underdevelopment.

A Hanoi Line 2 tram (1927 stock) picture in the 1980s. (Doling 2013)

2.2.2 Concept of Urban transportation in Vietnam

In Vietnam, according to ministry of transportation (2016), the urban transportation infrastructure system is defined as the collection of infrastructure and mean of transportation which serve to maintain the connection among the urban areas. It includes the urban transportation system and the transportation infrastructure system. The transportation infrastructure consists of road network, conjunctions, tunnels, bridges, stops, parking areas, terminals, depot, and other related structures.

The urban transportation system branch is also divided into three types, passengers transportation, cargo transportation and specialized transportation. The passengers transportation includes private passengers transportation and public passengers transportation (see Figure 3).

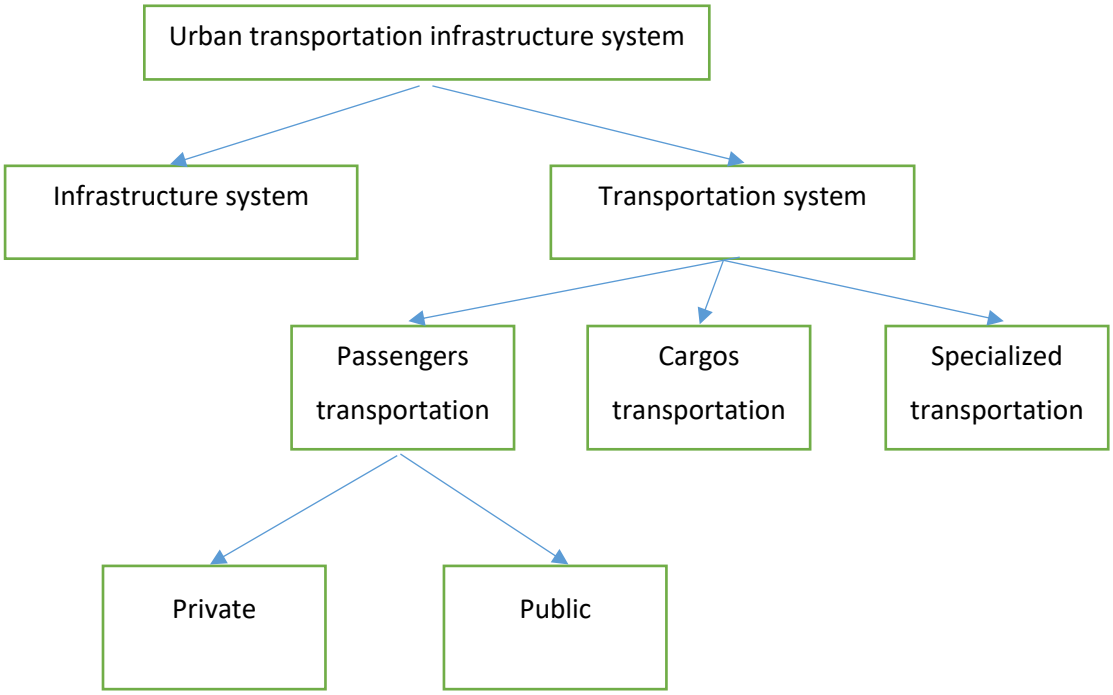

Figure 3: Urban transportation infrastructure system in Vietnam (Ministry of Transportation 2016)

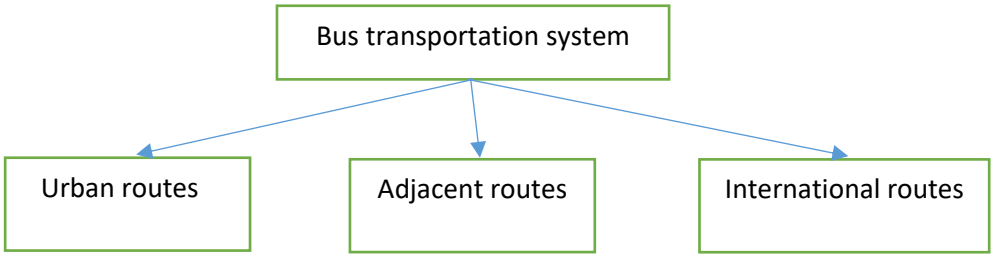

Figure 4: Bus transportation system in Vietnam (Ministry of Transportation 2016)

Based on the location of bus routes (the end point of the route), the bus transportation system (see Figure 4) is divided into three types including:

- Urban routes which have both starting and ending points inside cities, with length in accordance with the size of the urban areas.

- Adjacent routes, also called suburban routes, have either starting points or ending points inside cities and the other points are outside cities. These routes are relatively long (from 20 to 50km).

- International routes: routes with starting and ending points located in two different countries.

Another way to structure the UPT system is shown below in Figure 5:

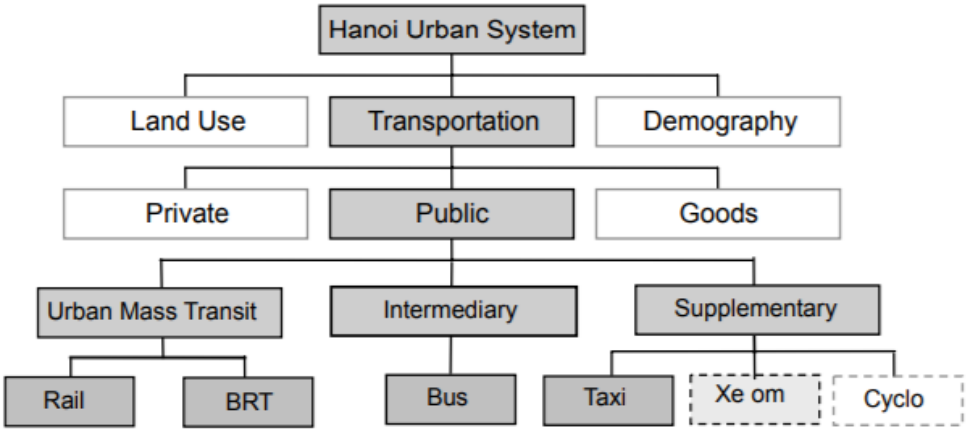

Figure 5: The Hanoi Urban System (Ministry of Transportation 2016)

Base on this structure, the UPT system consists of three basic components, a high-capacity urban mass transit system composed of rail and BRT; an intermediary bus system composed of primary and secondary bus routes and a supplementary system with small vehicles operated by the private sector. In Vietnam, the most dominant form of UPT is bus. UPT by buses is defined as the act of transportation of passengers in a fixed route by bus, with bus stops. Buses also travel in according to an operation map.

The infrastructure system serves UPT by buses including bus lanes, first stops, last stops, other bus stops, sign board/notice board, transshipment stops, parking lots. There are also two bus types, clean energy bus and general bus. General buses use normal gas while clean energy buses consume other type of gases liquefied gas, natural gas and electricity replacing gasoline.

UPT by bus can fit in almost all types of cities or urban areas. In comparison to other modes of UPT, bus transportation has certain advantages as well as disadvantages. The advantages of UPT by bus including high versatility, as buses can operates in poor road and weather condition and able to access underdeveloped areas. Additionally, it can be operated easily, can change course, change bus within a short period of time without affecting the whole bus route. The bus is also economic for medium and small size of passenger number, and it can change frequency to adapt

with changes of passenger number. Furthermore, buses can also run on steep terrains which is not possible for railway. UPT by bus allows the division of travel needs to different routes on the basis of actual road network to regulate general travel. Last but not least, the investment costs are less because they can take advantage of existing roads and have lower operating costs than other types, which brings bringing socio-economic efficiency.

However, UPT by bus also comes with several disadvantages including low maximum transport capacity (seats and standing lane) during peak hours. Moreover, buses do not often meet the needs of passengers in term of comfort and reliability. Due to high mobility and flexibility, bus transportation often leads to arbitrary and difficult to manage. In addition, safety of UPT by bus is not high, as it depends heavily on vehicle quality.

2.2.3 Role of Urban public transportation by bus in Vietnam

Public passenger transport by bus has great significance in the city in general and in urban transport, due to the following key roles:

UPT in general and UPT by bus in particular meet the travel needs of the people in the city best. The demand for travel is increasing in cities because the population is growing fast and life is improving. On the other hand, the city is increasingly expanded with high urbanization rate, so the travel distances are getting bigger and bigger. On the streets, the capacity of passenger flows is very large, and using personal vehicles will not be able to meet the limit. The bus system, however, can provide large transport capacity, which can reach 6000- 8000 passengers/ hour.

Bus transportation plays a major role in UPT in medium and small cities, which are appropriately used in newly built areas, during the first phase of construction of the city when the number of passengers is low. In remodeled cities, the use of buses is also very suitable because it is possible to change routes easily when there is a change in the flow of passengers.

Bus UPT is an effective measure to reduce the density of vehicles on the road. In urban areas the expansion of the roadway is limited, in fact it is difficult to be

implemented immediately, while the demand for travel is increasing, the density of vehicles on the road is getting bigger and bigger, which leads to low speed circulation.

Bus UPT is the main solution to improve the efficiency of the use of transportation infrastructure. In transportation, in addition to the system of bridges and roads, there are yards and garages for vehicles to stop (static traffic systems). The area occupied by static traffic of private vehicles is also bigger than that required by UPT by bus.

Bus UPT is a solution for reducing accidents and reduce environmental pollution. The widespread use of UPT vehicles by bus not only reduces traffic density and traffic congestion on the roads, it also reduces the type of vehicles on the road, especially reducing the types of outdated vehicles, thus limiting the number of traffic accidents. On the other hand, when the number of vehicles on the road decreases, the environmental pollution caused by vehicle emissions will be limited.

UPT by bus contributes to overall cost savings for the whole society. This includes the cost of purchasing personal vehicles, saving the city's land fund, saving the cost of construction expansion, improving the road network in the city and saving the amount of fuel consumed for traveling within when this energy source is limited.

2.3 Bus Rapid Transit

Bus Rapid Transit, BRT, is a traffic system with cost and infrastructure requirement as low as with conventional bus system while also aim for speed and reliability as high as the metro and other UPT railway systems. While first operated in developing, low income city of Curitiba, Brazil, BRT can now be found in many developed countries. The term BRT originated from it use in North America and Europe. BRT has been evolving through time; hence, the definitions of BRT vary a lot. Cost-wise, the BRT system can be anywhere from four to 20 times cheaper than a light railway system, and from ten to 100 times cheaper compared to a metro (Wright and Fulton 2005). In comparison to conventional bus, BRT has some defining features:

A separated, dedicated lane, usually in the middle of the road (left side), to prevent BRT from being hindered by traffic congestion by mixed types of vehicles. In certain

cities, the BRT lane is separated by elevations, that are either bridges or tunnels. Additionally, the bus fare is collected at the stops instead of on the bus to prevent any delay, for example change of money. The features also include prohibiting turns, a practice where turning across the bus way is prohibited. There are also other ways to maintain BRT's priority at intersections, such as increasing green light phase. Moreover, the BRT buses have same-level boarding, where waiting platform is elevated so that it is at the same height with the bus floor, which helps people on wheelchair or those with suitcases. Finally, other qualities such as cleanliness, frequency is also improved in comparison to conventional bus.

One of BRT's important features is the busway system. A busway is defined as a road, or section of a road set apart exclusively for buses, typically with tracks or grooves for guiding them. A busway helps enhance bus's speed and performance. The busway term is not restricted to only BRT, and non-BRT busways usually do not meet the performance standards of BRT. However, these simple busways can be upgraded into the BRT corridor.

Across the world, BRT systems currently serve more than 33 million passengers daily. The system is present in 170 countries, with a total length of 5,055 km. In comparison to the conventional bus system, BRT systems have certain upsides. While conventional buses are unreliable and suffer from traffic jams just like other private cars and motorbikes, with its own lane BRT is exempted from all these problems in daily traffic. The time required to divide lanes and construct bus stops for BRT systems means that the route will most likely be fixed, permanent like the metro. They also resemble metros in many ways, only without station platforms and railways. BRT systems also require lower investment both in money and infrastructure than metro and tram systems.

However, these comparisons also bring out some inevitable problems and downsides of the BRT systems. Their operating effectiveness when compared to rail decreases when a high capacity is required. Additionally, in overpopulated cities where space is of crucial importance, allocating one lane for the BRT systems while roads only have from three to four lanes on average, is an unaffordable luxury. Furthermore, transiting by bus, including BRT is also viewed as associating with a lower status.

Being in the middle between the more convenient and independent on other traffic, but costlier, railway system and the inexpensive, but unsatisfying, conventional bus system, BRT faces the problem of leaning too much on either of those two. The most usual problem is with reducing costs. BRT lanes are separated at certain parts instead of the whole route, so that space is utilized by other vehicles and so that there are no more prohibitions of turns or simplified stops. In the end, as with cost and space, all the upsides of BRT are cut away as well, which reduces it to the mere conventional bus system. Without completely separated lane or prohibiting turn, BRT will be hindered in traveling on the street as much as normal bus, and passengers will have to pay more for nothing.

Applying the BRT system in a populous city seems attracting, as, for example, in the cities of Curitiba and Bogota. However, it requires follow-up policies, and a certain level of dedication and priority. Simply replicating the BRT and putting it in the middle of a city without regarding other aspects, such as the infrastructure, corridor positions or people's preferences, will be ineffective at best and counterproductive at worst (Wright and Fulton 2005).

3 Current Traffic Status in Hanoi, Vietnam

3.1 Traffic and Public Transportation in Hanoi, Vietnam

Transportation has been one of the most concerned issue for citizens of Hanoi as well as the government of Vietnam. With a population of 7,739,400 persons, and the most dense district of Dong Da has a density of 42,302 person/km^2, transportation and traffic system of Hanoi is bent under the weight of overpopulation (Hanoi Statistics Office, 2017).

According to Mr. Dao Viet Long, Chief Deputy of Hanoi Traffic Police Department, managing and operating traffic proves to be a challenge for various reasons. Traffic jam is still a daily problem for the people. Until the first quarter of 2019, Hanoi Traffic Police Department have to manage 6,649,596 private vehicles in total, including 739,731 cars, 5,761,436 motorcycles and 148,429 electric bikes. Additionally, the number of vehicles in 2018 have increased by 4.8% in comparison to 2017 (Minh Duc

2019). Statistics from 2018 also show an enormous increase of traffic of 27,000 vehicles monthly on average.

With such amount of vehicles, traffic jam during rush hours is inevitable. The risk of congestion is likely to increase in densely populated areas, key traffic routes, main roads entering urban areas, etc., causing great impacts on urban traffic. According to a study by Vietnamese People's Police Academy, from 2008 to 2014 there were 1379 cases of traffic jam nation-wide which lasted over 1 hour. Among them there were 336 cases took place in Hanoi, accounted for 24.4%. The roots of the problems are the underdevelopment of transportation infrastructure. The urban road network has many junctions which are same level intersections (junctions where roads cross each other at the same vertical level) in contrast to only a few interchanges (junctions where roads are grade-seperated, for example tunnels or bridges). In Hanoi, there are 3888 junctions, with only 6 interchanges, 207 junctions have signal lights. Additionally, unbalanced between modes of transportation with a lot of motorcycles as mentioned above is also a contribution as lanes are usually divided to match cars' size. (Du, 2014)

Traffic jam during rush hours in Hanoi.

With such high demand for transportation, the Government of Vietnam has shown interest in developing and supporting the public transportation system. The decision

No. 280 / QD-TTg of the Prime Minister: Approving the Scheme on development of public passenger transportation by buses in the period from 2012 to 2020 includes the following objectives:

Development of public transportation network by bus, together with other modes of urban transportation(metro, inland water transportation, railway), from city center to other districts in the city, from special class urban areas to other satelites urban areas, industrial areas. Additionally, developing public passenger transportation by bus to be convenient, suitable for the need of the majorities (including the number of bus runs in the day, the time of opening and closing routes, arranging the appropriate stop and pick-up points, issuing convenient bus tickets for use) to encourage people to use buses, thereby reducing the use of private vehicles, contributing to solving traffic congestion when urban areas are growing are needed. A rational route network should be built to ensure convenience for people to travel with the orientation to developing bus routes to centers of districts, towns and industrial areas in provinces and cities. Investment in buses using environmentally friendly fuels is also encouraged. Furthermore, new technology in managing and operating bus operations, ensuring reasonable and monitoring of bus services will be applied.

Several option was proposed such as: bus price support for citizens, reduced loans interest for bus company, reduced importing tax for buses,... However, most of these policies only focus on enlarging the public transportation network and increasing the number of public vehicles participate in transportation. At the same time, one of the key factors to encourage people to use buses which is the quality of public transportation by bus is not considered appropriately. In most cities for example Hanoi, Ho Chi Minh City, a part of potential customers such as office workers still have not used buses as a daily mode of transportation due to many shortcomings in service quality, inaccurcy in time and the amount of passengers in rush hour is too great.

Actions also have been taken, as Hanoi have been focusing on developing the Urban mass transit system. One example is the metro system, which is still under construction. However, since it’s commence of construction in 2010, the project has been receving a large amount of disapproval from the citizens due to being behind

schedule a number of time as a result of lack of fund, construction accidents, including fatal ones. The project was approved in 2009 with a total investment of $552.86 million and adjusted in 2016 with a total investment of $868.04 million. Ministry of Transport belived that Chinesse EPC contractor is not professional and inexperience is the main cause of delay. (Tuan Phung 2019; Tatarski 2017)

Traffic jam during rush hour in Hanoi not only interferes with people' timetable, it also poses serious threat toward the health of citizens. As Hanoians' love for private vehicle, especially automobile is evergrowing, Hanoi has become one of the world's most polluted capital city, ranked at 12th, and 2nd among South East Asia cities (IQAIR). One of the main cause for air pollution in South East Asia cities is caused by vehicular emission and transportation, which can be applied to Hanoi air status as well.

3.2 Current Situation of BRT in Hanoi, Vietnam

Hanoi BRT corridor 1, or Hanoi BRT 1, started operating in 2017, is the first BRT system in Vietnam. BRT 1, together with the major of bus corridors in Hanoi are operated by stated-owned Transportation Corporation Hanoi, or TRANSERCO. BRT 1 includes 23 stations of international standard, which consists of same level platform, ticket post at stations, automatic station doors. The first stop is Kim Ma station, and the last stop is Yen Nghia station (see Figure 6). Total length of BRT 1 route is 14,77 km. Daily time of operation is from 5 a.m to 10 p.m, and 14 buses operate per hour at peak frequency. Operating speed is 22 km/hour. Average distance between stations in the system, or station spacing, is 630,4 mettres.

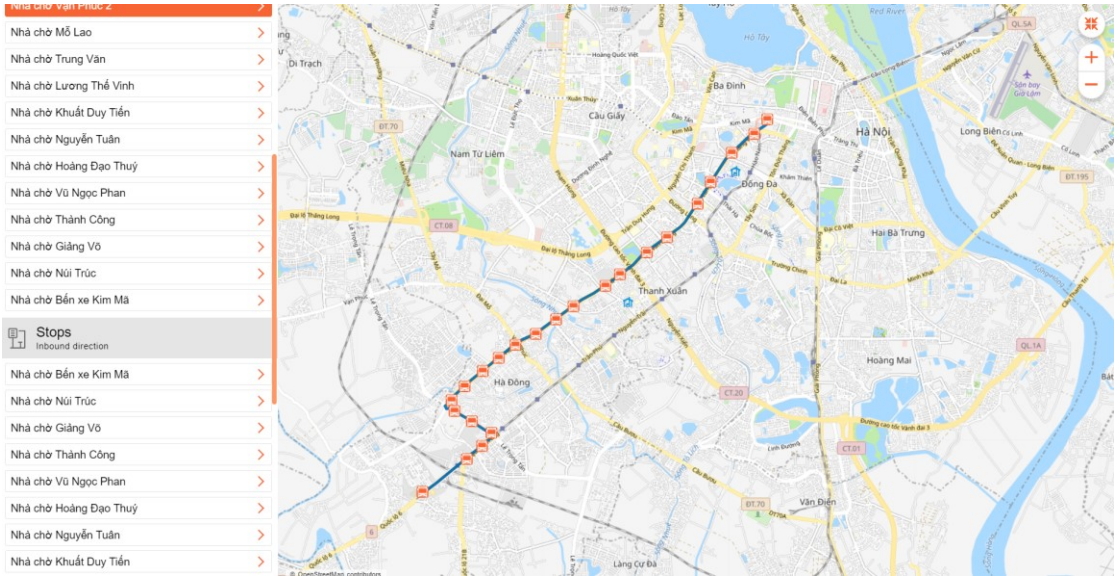

Figure 6: BRT stops and routes

In comparison with other conventional bus routes, Hanoi BRT 1 system has some similarity. BRT 1 has one-time ticket of 7,000 VND, or 0.25 EUR per passenger which is the same as ticket price of conventional bus to encourage the public to use it. Moreover, in January 2017, during the first month BRT 1 went into operation, it was completely free to introduce people to try out and get familiar with the system. In term of bus, each BRT TB120 bus costs roughly $216,000, while the latest, most up-to-date model of normal bus, Huyndai Universe - Noble costs only $180,000. However, BRT TB120 uses engine from Japan and most other parts are from Germany, while Huyndai Universe is from Korea. BRT 120 also have 26 seats, 1 specialized seat for the disabled and 63 standing spots, while Hyundai Universe has 45 seats. BRT 120 also achieved EURO III vehicle emission level. In short, the prices of these 2 models are not comparable due to having different origins, different designs and different specifications.

The BRT project was proposed in 2006, along with road development project, which aimed to “increase urban mobility in targeted areas in Hanoi by increasing the use of public transport in two existing and one new corridors [thereby increasing corridor capacity]; and reducing travel times by all modes between the city center and the west and northwest sections of the city (west of West Lake)” (World Bank, November 2006). Expected total investment for both project was $305 million, with $150 million was funded by International Development Association of World Bank.

Investment on BRT composed of $99.88 million. It was expected to mitigate 30-50% of motorbikes user to using UPT together with other transportation infrastructure development in 2020. However with current demand of only only 8,000 passengers per day, it seems that BRT Hanoi will not be very helpful to reach the objective.

3.3 Other BRT systems globally

In order to have a deeper understanding on how effective Hanoi BRT 1 was, this chapter analyzed BRT system from different cities around the world, mostly cities of developing countries with high population density. Cities were taken into consideration including Beijing of China, Istanbul of Turkey, Delhi and Ahmedabad of India and Bogota of Colombia. Selection of cities was based on availablity of information, as well as resemblance of these cities toward Hanoi. Transmilenio of Bogota was included since it was a beacon of success, even a miracle cure agreed by many researchers (Heres, Jack, Salon 2014; Cain et al 2006; Gilbert 2008). Delhi's BRT was in the list due to some interesting factor which would be discussed later. Information was retrieved from other case studies of these individual cities, as well as from sites specialized in providing data of BRT system around the world such as BRTdata. Limitation will be that most BRT systems had gone through a period of service with either improvement or deterioration, while Hanoi BRT had not been improved due to just started operating in 2017. However, since it is unlikely that Hanoi BRT system will be developed with new corridor, it is safe to say that Hanoi BRT 01 is already at its peak performance. Information of Hanoi BRT system as well as other cities were shown below in Table 1.

Table 1: General information of other BRT system over the world

System, city	Country	City population	Opening year	Length, km	Number of corridors	Capital cost per US$ millions
Janmarg, Ahmedabad	India	7,869,000	2009	82.00	1	2,4
BRT, Beijing	China	20,035,000	2004	74.50	4	4.8
Metrobus, Istanbul	Turkey	14,968,000	2007	52.00	1	6.0
TransJakarta, Jakarta	Indonesia	10,639,000	2004	206.75	12	1.4
Transmilenio, Bogota	Colombia	10,779,000	2000	112.90	11	12.5
BRT, Delhi*	India	29,399,000	2008	5.60	1	3.0
BRT, Hanoi	Vietnam	7,782,000	2017	14.50	1	3.7

Note:population is not collected from BRTdata due to outdated data. population of Hanoi is collected from local data since the difference is too great.

*Delhi BRT's information is retrieved from various sources.

Source: BRT data (https://brtdata.org); World population review (http://worldpopulationreview.com); Carrigan et al. (2013)

Among mentioned cities, most of them have BRT system implemented for at least 10 years or more except Hanoi. As a result, system lengths of these cities are between 3 to 15 times greater than Hanoi BRT. While most other countries have an acceptable time period from planning to full operation, for example BRT Beijing took less than 3 years from 2003 to 2005, partially operated in 2004 (Deng and Nelson 2012; Lu, Chang, Yu 2012), Hanoi BRT dawdling foward with it steps. The plan was conceptualized in 2003, and granted fund by World Bank in 2007, but only went into operation in the begining of 2017 (Nguyen, Hoi-Chan 2007), which is one of the reason Hanoians are hesitant to place trust upon the project. Good planning time usually ties with dedication and clear vision toward the project from city mayor and political leaders, as with the case of Bogota, Jakarta, Seoul, Beijing and other cities according to Hidalgo and Carrigan (2010) and Matsumoto (2006), which does not apply to Hanoi. One particular example of lack of dedication is that during the implementation period of BRT, Vietnam has sent 3 research, study team in 2004; 2009 and 2014 to Brazil, Colombia, Ecuador and Indonesia. However one team did not have resut, while the other teams reported but the content was not relatable to

the goal of the study trip (Dung 2018). With the current result being not very successful, BRT Hanoi is likely to end up with only one corridor, or to be converted to conventional bus route according to some Vietnamese transportation planning specialists.

Table 2: Integration to city developing plans, policies and transport infrastructure

System, city	Integration into urban and transport plans	Notable problem/ challenge	Compliment measures
Janmarg, Ahmedabad	Part of comprehensive urban development	Lack of integration with conventional bus system	n/a
BRT, Beijing	Converted from a planned urban light rail corridor project for Olympic 2008	No notable problem/challenge	n/a
Metrobus, Istanbul	Not a part of transport or urban planning	Does not meet capacity need during peak hours	No car restriction scheme
TransJakarta, Jakarta	Part of Transport Master Plan	Lack of feeder bus routes	No car restriction scheme
Transmilenio, Bogota	Replace rail corridor project		Car-free weekdays, parking restrictions, developed walking/cycleway.
BRT, Delhi	Measure to reduce pollution and congestion	Total opposition due to various factors	No car restriction scheme

Table 2 showed the level of integration to city urban and transport developing plans, and the level of integration to existing transport infrastructure, challenge toward the BRT systems as well as follow up measure to promote use of BRT. Ahmedabad's Janmarg BRT and Jakarta's TransJakarta BRT shared some similarity in the planning phrase as both are part of comprehensive urban development plans, which included transport development plans (Hidalgo & Carrigan 2010; Mahadevis, Joshi, Datey 2013; Alvinsyah & Zulkati 2005). While causing inconvience toward some poor households and slum residents along the corridors for eviction and demolition, Janmarg still received high customers satisfaction levels for its speed, comfort and overall service. However with the developing of the high quality BRT system, the already-deteriorated Ahmedaba conventional bus system was even less favorable

than before since Janmarg did not integrate well with it. Nonetheless, with the thinking of ”designing a network and not a corridor”, Janmarg was an successful application of BRT model in India, which promoted the initiation of several BRT plans in other urban areas of India.

Similar to Janmarg, Transjakarta of Jakarta was also conceived with dedication from the goverment. Before BRT, Jakarta’s public transport system was deemed inadequate, as 90% of buses operated in Jakarta was overload with 30% higher than capacity (Kogdenko 2011). With Transport Master Plan in 2004, the goverment of Jakarta ambitiously planned out 7 BRT Corridors by 2007 and 15 BRT corridors by 2010 in order to tackle the congestion problem of the capital of Indonesia (Alvinsyah, Zulkati 2005). However, lack of feeder bus routes was one major problem that Transjakarta has to face, which makes it less competitive toward other private buses.

Beijing’s BRT first corridor operation planning was a unique case as it was not a result of any urban or transport plan. The Nanzhongzhou Line was initially saved for a light rail corridor, which was planned to go into operation in 2012, but the Beijing Goverment subsequently found it was crucial to have an ready public transport system in preparation for the coming Olympic Game 2008 (Masumoto 2007; Lu, Chang, Yu 2012). Prior to BRT, Beijing already had a metro system dated back to 1971 which was not able to keep up with the increase in demand from the citizens. Beijing’s BRT, even though went into operation after a short amount of time, face no notable problem, with the exception of overload vehicles (Kogdenko 2011).

According to Babalik-Sutcliffe and Cengiz (2015) the planning of Istanbul’s MetroBus was poor, as there were both an urban development plan and a transport development plan, but the BRT system cordinated with neither of them. In performance, Metrobus face the problem of high demand exceeding capacity during peak hours, as 85% of the surveyed users are discontent with crowded stations. Overcrowding was expected as Alpkokin and Ergun (2012) stated that some of Istanbul’s city planners criticized the choice of route through a high demanding corridor. Nonetheless Metrobus recieved a high customer satisfaction due to its speed as 85% of costumers considered speed to be the main factor to decide their pleasure toward the BRT system. (Yazici et al 2013).

TransMilenio of Bogota came out as a replacement for the planned implementation of heavy rail. According to Cain (2006) while having the ability to offer the same level of ridership, estimatedly 800,000 passengers, total capital cost for TransMilenio phase 1 only accounted for $340M versus the capital cost of $3,041M of the planned railway system. Additionally, TransMilenio can offer more transitway, 25.6 miles in comparison to 18.0 miles of the railway system. TransMilenio was well known for being one of the moss success BRT projects, if not the most success one, as it promoted economic development in various aspects. Study by Heres, Jack and Salon (2014) have shown the statistical link between income and BRT system for households nearby. However the BRT system alone cannot created that significant change of income if the goverment of Bogota did not provide compliment measures in order to promote the use of BRT system, including a new cycleway, car-free weekday campaign, car-restriction through parking restriction (Wright, Hook 2007). With those promotions, ridership of TransMilenio reached over one million passengers per day, and inspired the expansion of TransMilenio to other parts of Bogota, as well as BRT systems in other cities of Colombia.

In contrast to the success of TransMilenio of Bogogta, Delhi's BRT did not share the same lucky fate. Capital of India, second largest country in term of population, it was unsurprising that Delhi suffers from heavily overpopulation, reaching nearly 30 millions in 2019. Accompanied with overpopulation is a deteriorating traffic condition, which includes bad air quality, traffic congestion and traffic accidents. BRT system was considered as a viable transportation option for Delhi instead of the planned Metro system (Mahadevis, Joshi, Datey 2013). Delhi's BRT 1st corridor, while improved travel time for bus users, had hindered travel for non-bus users, which lead to criticism of the system by the media (Kogdenko 2011). Kogdenko also pointed out the lack of research in BRT system planning phase as one of the impeding factor for Delhi's BRT system. Another detering factor was the lack of supporting infrastructure and technology, for example lack of feeder system, bad junction management. Delhi's BRT system was also deemed a standalone policy, without any supplement policy. Hence, Kogdenko's study considered the system "cannot be considered as a successful system" but still "a big step towards sustainable transportation system". Ultimately though, Delhi's BRT system was scrapped in 2016 due to opposition from

the mass media, private vehicle users, and even bus users were hesitant to use it (Misra 2016).

4 Analysis

In this part of the thesis, the Hanoi BRT system was analyzed in depth as a part of the city development plan and a means of transportation. Moreover, the analysis also focused on why the system was not well received by the mass media.

4.1 Corridor Selection

One of the most important factors when planning a BRT system is the choice of a corridor, which not only affects the utilization of the system itself but also has great impact on the future city development. According to the guidelines for planning a BRT system by Wright and Hook (2007), certain factors should be taken into consideration when making plan for a BRTS's corridor, such as the number of beneficiaries, impact on general traffic, cost and social benefits.

Hanoi BRT line 1 starts from the city center at the Kim Ma stops and then heads to the Yen Nghia stops in south-west direction. However, the corridor is also parallel with the metro corridor, which will go into operation in 2020. With the parallel corridors, Hanoi BRT1's ridership will be reduced to an even lower level in the near future. Moreover, the western part of the corridor also goes through areas with low residential density, such as farmland and graveyards. On the contrary, the metro corridor, 1.3 km south of the BRTS corridor, passes right through residential areas with much higher density as shown in Figures 7 and 8.

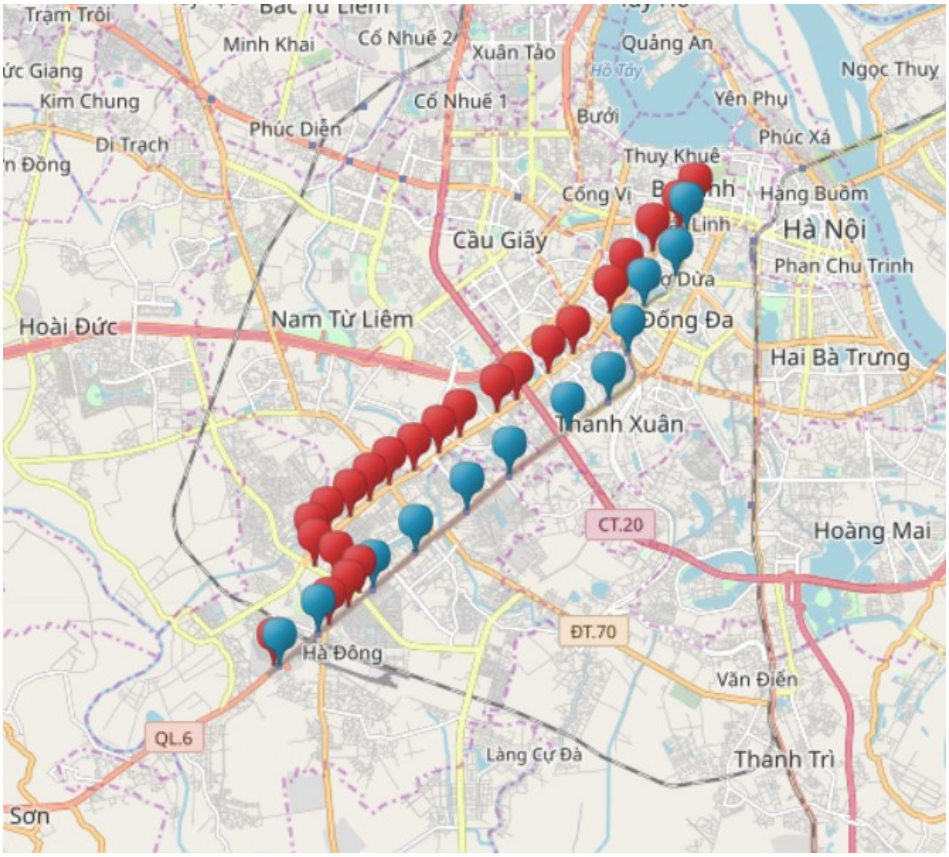

Figure 7: Map of Hanoi BRT1 stations in red and Hanoi Metro stations in blue

Figure 8: Aerial view of the Hanoi BRT1 line in white and the Hanoi Metro in yellow. North west of the white line has many non-populated green area.

Hence, in accordance with the factors mentioned above, Hanoi's choice of corridor for the BRTS is not good as it will not help with maximizing the number of users. It can be argued that having the BRTS corridor going through the low-density area will help developing it in the future. However, this approach requires a specific condition, the willingness to use the system of passengers, which is discussed further in the thesis.

4.2 Attractiveness of BRTS for public transport users

The development of another mode of public transportation will certainly gain support from the current public transport users, who in this case in Hanoi are the bus users. With proper organization into a lobbying group, they can help tremendously in pushing the development and implementation of the new system of public transport as with the case of Los Angeles Bus Riders Union (Duran 1995). Unlike many other developing countries where private transport users only make 15% of the population, in Hanoi the largest part of the population travels by motorbike, and public transportation users represent a meager 12%.

Unfortunately, the Vietnamese government has also failed to gather support from this small part of the population. This is the case in Hanoi, since the BRT line 1 acts more as just another bus route together with all the existing conventional bus routes in Hanoi, instead of a system which it should have been. Such limited scope can be explained that Hanoi BRT1 is the first BRT system in Vietnam, which is a test experience for both the government and the citizens. Additionally, both BRT1 and conventional buses are also under the jurisdiction of Transerco. Most bus users, hence, consider BRTS an additional route.

As mentioned, the Hanoi BRT has some upsides in comparison to conventional busses. One of the most important aspect is speed, in which BRT has a slight edge of 22 km/h in comparison to its counterpart with the speed lower than 20 km/h. Theoretically, the advantage will be higher especially in rush hours, since it has a segregated lane. Additionally, as mentioned above, both the ticket prices of the conventional busses and BRT follow the same price support system from the government of 0.25 EUR per passenger. Moreover, since 2018 Hanoi is piloting electronic tickets at the

BRT bus stops in contrast to the conventional busses with ticket checkers/seller personnel on each bus. This measure not only eliminates misconduct, such as ticket dodge, it also removes the need for separate on-bus ticket sellers for each bus.

One important point to be noted is that the Hanoi BRT stops are superior when compared with those of the conventional buses. While the conventional buses have stops with proper seats, roofs and bus timetable boards, on many streets with inadequate areas of sidewalk, there are only bus poles with information regarding what bus will be available, and the passengers are expected to wait nearby them whether in rainy or sunny weather as shown in the pictures below. Furthermore, passengers waiting for bus in such areas are sometimes also chased away by nearby stores for blocking their entrances. During rush hours, with stores occupy sidewalks as parking areas, the passengers do sometimes not have enough space to wait for a bus.

Conventional bus waiting area with shelter

Conventional bus with only the waiting board

On the contrary, with the great investment, Hanoi BRT stops are well constructed with full functions of an express bus terminal according to international standards. With a width of 5m and a total area of 129m2, wall is tempered with glass panels, BRT stops are spacious, clean to meet the flow of passenger. Access roads are also built with reasonable slope for people with disabilities and wheelchairs can enter. The floors of the waiting shelters are elevated to create a level with the floor of the bus, giving bus users much easier access than traditional buses. The doors from the waiting shelters to get on the bus are the automatic sliding glass system. Only when the bus arrives at the sliding door will the door open automatically to stay safe and make a habit of queuing when entering the car. The shelters are equipped with ticket machines, automatic card / ticketing machines, as well as a concierge desk with on-site staff. Passenger travel time is maximized thanks to automatic systems and the process of buying tickets, checking tickets, sweeping cards is all done right when entering the waiting room. Some differences of the two system were shown in Table 3.

	Conventional bus	*BRT*
Ticket price	0.25 EUR/passenger/ride	0.25 EUR/passenger/ride
Speed	<20km/h	~22km/h
Operating hours	5am to 10pm	5am to 10pm
Stops	Some with shelter, some without shelter.	International standard for BRT system.
Operating area	All region in Hanoi and connecting with other regions	One route

Table 3: General in formation of Hanoi conventional bus system and Hanoi BRT system

However, one of the most heavily criticized aspects about the BRT stops is their accessibility. Currently, many stops challenge the passengers with inexplicably long detours to reach.

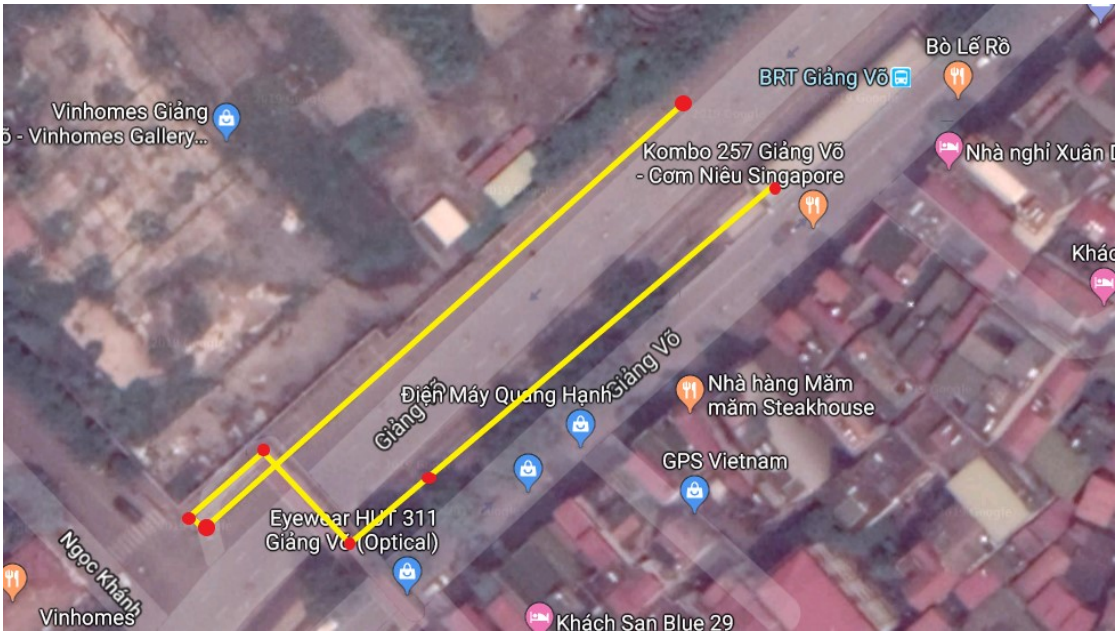

Figure 9: Path from the conventional bus stop on the right side to the BRT stop on the left side

In the figure 9 above, the total walking distance from the right side of the street to the left side of the street where the BRT stop at is almost 200m. The first 80m is from the starting point to the overpass bridge. After that, the passenger will have to climb up and down another 40m and 10m on the bridge. However, the next 60m of walking between the bridge and the stop is inexplicably and inexcusably of bad design. Additionally, even though the stops are made to support wheelchairs, the overpass bridges are not. One approach to this is that the bridge can be stretched out to replace the walking distance, while at the same time being less steep so that wheelchair users can benefit from BRT. Moreover, one element that can make traveling to the BRT platforms even less appealing is the weather, accompanied by the pollution of environment in Hanoi. The distance is increased yet again since most of the overpass bridges in Hanoi are accessible from one side, meaning that the passengers who come from the other side of the bridge must walk an extra distance. With such design, it is questionable whether public transport users plan spending time to walk an unnecessary length to try out the international standard BRT platforms when conventional buses arrive in every 10 minutes.

Unnecessary travel distance toward BRT stop from conventional bus stop.

One sided overpass bridge.

4.3 Attractiveness of BRTS for private transport users

Naturally, private transport users are not likely to support a public transportation model like BRT, as prioritizing a road lane for public transport are against their interest. This can lead to powerful political opposition toward newly developed public transport model. However, private transport users can also benefit from development of a public transport system, providing that these systems can lift the burden of traffic congestion. Examples were mentioned above, in the case of Bogota's Transmilenio where proper follow up measures to encourage citizens to switch from private transport to BRT. However, this is not applicable for Hanoi as long as BRT is not even appealing to other public transport users, which can irritate motorists further with both BRT's segregated lane and mix traffic conventional buses in their sight (see Figure 10). This leads to some motorists invade the lane designed for BRT, which hindering BRT from performing at its best and consequently even less people considering using BRT in daily lives.

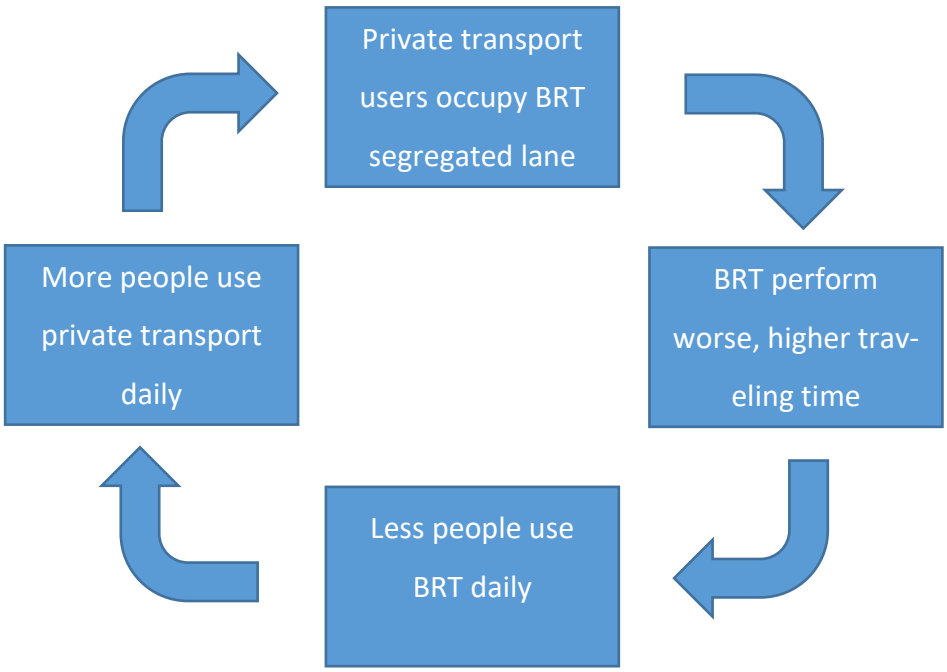

Figure 10: Current trends of using BRT in comparison to using private vehicles

In the case of BRT Hanoi, this effect is amplified since BRT segregated lane pass through some streets with heavy traffic while have only 3 lanes. In the figure 11 below, the width of one side of the road is 11.25m excluding BRT stations on road divider and sidewalk. BRT lane is 3.5m in width, which is almost one third of the road. Theoretically, this roadway configuration for BRT corridor is acceptable with 2 lanes for other traffic. In practice however, this is not suitable for Hanoi yet considering how heavy traffic it is in the capital of one among word top 20 countries with highest population. This is result of lack of practical consideration when applying a new public transport model from transportation professionals and city planner.

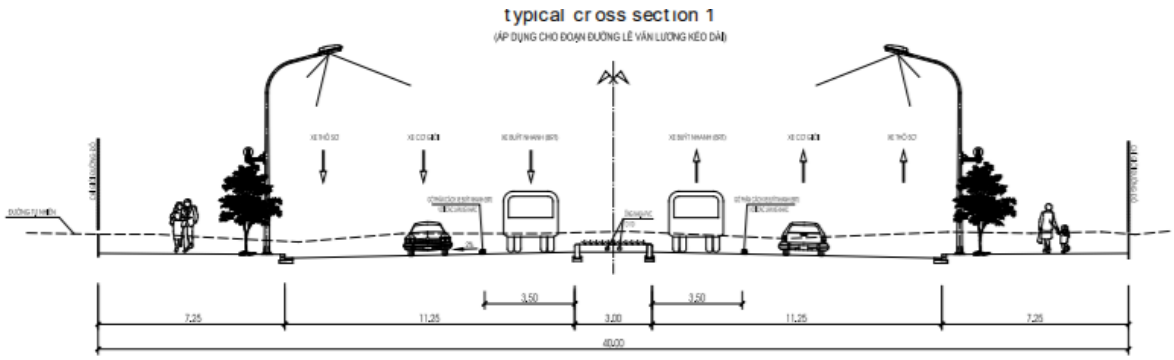

Figure 11: Typical cross section of road with BRT lane in Hanoi

Recently, the government has provided a countermeasure toward occupation of BRT segregated lane for private users by make it fineable. This indeed serve the purpose of keeping BRT performance at high level, however, will not attain affection from private transport users in the near future.

BRT lane before fine on lane occupying was enforced

BRT lane after fine on lane occupying was enforced

4.4 Opinion of public mass

Reputation of a system can be ahead of the system in case of a BRT system. With some level of transparency as well as promotion, it can affect the sentiment of the public mass toward the system enormously. Unluckily, BRT Hanoi was not in that position to please the Hanoians, as it was delayed several times until it went into operation in December of 2016, and in the meantime, many built BRT stops went into deterioration.

Furthermore, it was noticed that not only the implement of Hanoi BRT was behind schedule, it also caused waste to the state budget for various reasons related to bypass or violation of laws. For example, at package CP4a (constructing a bus stop from the Ministry of Health to Khuat Duy Tien); Package CP4b (Construction of bus station road from Khuat Duy Tien - Yen Nghia bus station), the investor and the consulting unit, when planning the road design step, replaced asphalt concrete pavement with cement concrete pavement. In particular, it is worth noting that the replacement of road surface has wasted the budget more than VND 15 billion, or 586,000 EUR.

Additionally, BRT Hanoi lacks any kind of promotion except a few advertisement boards. Knowledge of people toward BRT is only limited in it speed and segregated

lane. Lack of outreach for the system, together with the visibly deterioration of platforms is the main cause for the poor start of Hanoi BRT.

5 Solution

The government has come up with some solutions regarding the underuse of BRT in order to both improving the condition of BRT and promoting the use of BRT. Segregated lane occupants are fined on-site by traffic police officers.

BRT causing inconvenient toward private transport users is an expected trend, as it indirectly forces them to switch to BRT. In Hanoi case, the former was achieved but the latter was not, which cause even further disruption toward traffic. The BRT system is a good idea, however the problem came from Hanoi city planning, as on some of the most congested roads with BRT system more skyscrapers are under constructions, which will clearly lead to even a greater amount of traffic in the future. Hence, further development with accessibility to make the BRT system more user-friendly, more attractive is a must to encourage the use of BRT.

In large scale, Hanoi are also planning to prohibit motorcycle in 2030 (Vu Diep 2019) which requires he public transportation system and alternative means to meet at least 65% of the travel needs of the people. The plan will restrict motorbikes by ring roads which is applied in many places such as Singapore, London, Guangzhou. Of the five ring roads built by Hanoi by 2030, ring roads number 3 will meet all criteria to apply the motorcycle restriction policy. Prohibited motorbikes are implemented hourly and by day of the week according to the selected route. In addition, Hanoi may ban motorcycles based on the organization of walking spaces. Other areas should only be banned from 6am to 10pm every day and must be replaced by public transportation. However, Hanoi should proceed to restrict motorcycles step by step, not in a hurry to avoid causing social disturbance. The restriction of motorbikes will directly affect the daily life of a part of people in restricted areas and those wishing to come and go through this area. Therefore, it is necessary to develop the public transport system for buses, which including BRT, and urban railways. In the immediate future, if it is a narrow area, there must be a bus system with frequency and operating time to meet the travel needs of people; minimize the impact on people's

travel needs as well as gradually creating habit for people to use public transport. For people to give up motorbikes, Hanoi must be determined to invest in public passenger transport in accordance with the approved plans and at the same time, coordinate with the competent authorities with city planning.

6 Conclusion

From the prospect of transportation planning, Hanoi BRT line 1 showed that simply applying a system which had been already proved to be successful in other cases would not guarantee another favorable outcome. It required practical understanding of the population habits and mindset as well as city planning. Aside from some of its downsides such as station position, BRT Hanoi satisfied passengers well. However, promoting people to switch model is what lack to make Hanoi BRT succeed. Hanoi BRT case shared the most resemblance with Delhi's BRT, which was doomed after only a few years of operation due to the opposition from the mass. It was not a coincidence, since the two cities had many factors in common, from heavily overpopulated to mainly using motorcycles. Luckily though, Hanoi will plan to prohibit motorcycles in 2030, and if BRT can survive until then it will bear fruit. That also lead to another approach, whether BRT Hanoi was given birth too early. If it goes into operation in one or two years prior to 2030, it will not be blamed for congestion as much as it did. Another factor hindered BRT project in Hanoi is its transparence, being behind schedule and causing waste of state budget, which damaged its reputation.

In conclusion, the case provided an example of applying a new system of transportation does not lead to solving the problem of traffic congestion. However, the solution for the current case does not only require the government to design the system with better optimization, it also need the dedication of the citizens to switch to using public transportation. Without proper consideration as well as dedication to change from both the government and the citizens' mindset, it may worsen the current situation to the point of being scrapped.

7 References

Bus Rapid Transit Data. Retrieved from https://brtdata.org/

Schofer, J. N. 1998. Mass Transit. Accessed on 16 July 2019. Retrieved from https://www.britannica.com/topic/mass-transit

Steg, L. 2003. Can Public Transport compete with the Private Car. *IATSS Research.* Vol 27(2). pp. 27-35. Accessed on 16 July 2019. Retrieved from https://doi.org/10.1016/S0386-1112(14)60141-2

Aljoufie, M. 2016. Exploring the Determinants of Public Transport System Planning in Car-dependent Cities. *Procedial – Social and Behavioral Sciences.* Vol 216. pp. 535-544. Accessed on 19 July 2019. Retrieved from https://doi.org/10.1016/j.sbspro.2015.12.013

Wright, L. & Fulton, L. 2005. Climate Change Mitigation and Transport in Developing Nations. *Transport Review*. Vol 25(6). pp. 691-717. Accessed on 24 July 2019. Retrieved from https://doi.org/10.1080/01441640500360951

Dolling, T. 2013. Hanoi Tramway Network. *Historic Vietnam.* Accessed on 30 July 2019. Retrieved from http://www.historicvietnam.com/ha-noi-tramway-network/

Ministry of Transportation Vietnam. 2016. Báo cáo đề án: Nâng cao chất lượng vận tải hành khách công cộng bằng xe buýt [Report of project: Improving quality of passenger transportation by bus]. Accessed on 5 August 2019.

Hanoi Statistics Office. 2017. Niên giám Hà Nội [Hanoi Yearbook 2017]. Accessed on 6 August 2019. Retrieved from http://thongkehanoi.gov.vn/uploads/files/source/2018/Nien%20giam%20Ha%20Noi%202017.pdf

Minh Duc, 2019. Xe máy đang chiếm 86% lượng phương tiện giao thông đang tham gia tại Hà Nội [Motorcycles are responsible for 86% of all vehicles in Hanoi]. *Elecctronic newspaper of Vietnam television stations.* Accessed on 9 August 2019. Retrieved from https://vtv.vn/trong-nuoc/xe-may-dang-chiem-86-luong-phuong-tien-giao-thong-dang-tham-gia-tai-ha-noi-20190404142702196.htm

Nguyen Van Du, 2014. Vấn đề ùn tắc giao thông tại các đô thị lớn ở Việt Nam hiện nay [Traffic congestion in major urban areas in Vietnam nowadays]. *Vietnamese People's Police Academy.* Accessed on 10 August 2019. Retrieved from http://www.canhsatnhandan.vn/Home/MagazineStory?ID=51

Prime Minister of Vietnam, 2012. QUYẾT ĐỊNH Phê duyệt Đề án phát triển vận tải hành khách công cộng bằng xe buýt giai đoạn từ năm 2012 đến năm 2020 [DECISION: Approving the scheme on development of public passenger transport by bus from 2012 to 2020]. *Socialist Republic of Vietnam Goverment Portal.* Accessed on 16 August 2019.

IQAir,2018. 2018 World Air Quality Report. Accessed on 25 August 2019. Retrieved from https://www.airvisual.com/world-most-polluted-cities/world-air-quality-report-2018-en.pdf

World Bank. 2006. Vietnam-Hanoi Urban Transport Development Project (English). p. 3. *Washington, DC: World Bank*. Accessed on 1 September 2019. Retrieved from http://documents.worldbank.org/curated/en/861141468141594238/Vietnam-Hanoi-Urban-Transport-Development-Project

Cain, A. et al. 2006. Applicability of Bogotá's TransMilenio BRT System to the United States. Accessed on 11 September 2019. Retrieved from https://www.researchgate.net/publication/254609627_Applicability_of_Bogota's_TransMilenio_BRT_System_to_the_United_States

Gilbert, A. Bus Rapid Transit: Is Transmilenio a Miracle Cure. *Transport Review.* Vol 28(4). pp. 439-467. Accessed on 13 September 2019. Retrieved from https://doi.org/10.1080/01441640701785733

Lu, Y., Chang, S. K. J., and Yu, M. 2012. Comparison of BRT system in Four Chinese Cities: Beijing, Changzhou, Xiamen and Jinan. *Sustainable Transportation Systems: Plan, Design, Build, Manage and Maintain.* pp. 234-247. Accessed on 16 September 2019. Retrieved from https://doi.org/10.1061/9780784412299.0029

Deng, T., Nelson, J. D. 2012. The perception of Bus Rapid Transit: A passenger survey from Beijing Southern Axis BRT Line 1. *Transportation Planning and Technology.* Vol 35(2). pp. 201-219. Accessed on 17 September 2019. Retrieved from https://doi.org/10.1080/03081060.2011.651885

Nguyen, Hoi-Chan. 2007. Financial Aggreement for Credit 4347-VN Conformed (English). *Washington, DC: World Bank*. Accessed on 1 September 2019. Retrieved

from http://documents.worldbank.org/curated/en/893481468317675030/Financing-Agreement-for-Credit-4347-VN-Conformed

Hidalgo, D., Carrigan, A., 2010. Modernizing Public Transportation: Lessons Learned From Major Bus Improvements in Latin America and Asia. Accessed on 19 September 2019. Retrieved from https://pdf.wri.org/modernizing_public_transportation.pdf

Matsumoto, N. 2006. Analysis of policy processes to introduce Bus Rapid Transit systems in Asian cities from the perspective of lesson-drawing: cases of Jakarta, Seoul, and Beijing. Accessed on 20 September 2019. Retrieved from https://www.researchgate.net/publication/228380644_Analysis_of_policy_processes_to_introduce_Bus_Rapid_Transit_systems_in_Asian_cities_from_the_perspective_of_lesson-drawing_cases_of_Jakarta_Seoul_and_Beijing

Phuong-Dung, 2018. Tuyến buýt nhanh BRT: Kỳ lạ chuyện cử đoàn nghiên cứu đi nước ngoài học hỏi kinh nghiệm [BRT rapid bus: Strange story about sending research teams abroad to learn from experience]. Accessed on 22 September 2019. Retrieved from https://dantri.com.vn/kinh-doanh/tuyen-buyt-nhanh-brt-ky-la-chuyen-cu-doan-nghien-cuu-di-nuoc-ngoai-hoc-hoi-kinh-nghiem-20181013161642 47.htm

Mahadevia, D., Joshi, R., Datey, Abhijit. 2013. Promoting low carbon transport in india and the challenges of social inclusion: The bus rapid transit (BRT) case studies in India. Accessed on 26 September 2019. Retrieved from https://www.researchgate.net/publication/258807014_Promoting_low_carbon_transport_in_india_and_the_challenges_of_social_inclusion_The_bus_rapid_transit_BRT_case_studies_in_India

Alvinsyah, Zulkati, A. 2005. Impact of the Existing Corridor due to the Implementation of new Public Transport Corridor (Case Study: Jakarta BRT System). *Journal of the East Asia Society for Transportation Studies.* Vol. 6. pp. 467-479. Accessed on 30 September 2019. Retrieved from https://doi.org/10.11175/easts.6.467

Kogdenko, N. 2011. Successful of bus rapid transit system in Asia. Ex-post evaluation. Accessed on 2 October 2019. Retrieved from https://publicaties.ecn.nl/PdfFetch.aspx?nr=ECN-O--11-013

Yazici, M. A., et al 2013. A Bus Rapid Transit Line Case Study: Istanbul's Metrobus System. *Journal of Public Transportation.* Vol 16(1). pp. 153-177. Accessed on 6 October 2019. Retrieved from https://doi.org/10.5038/2375-0901.16.1.8

Alpkokin, P., Ergun, M. 2012. Istanbul Metrobüs: First intercontinental bus rapid transit. *Journal of Transport Geography*. Vol 24 Accessed on 7 October 2019. Retrieved from https://doi.org/10.1016/j.jtrangeo.2012.05.009

Babalik-Sutcliffe, E., Cengiz, E. C. 2015. Bus Rapid Transit System in Istanbul: A Success Story or Flawed Planning Decision? *Transport Review.* Vol 35(6). pp.792-813. Accessed on 9 October 2019. Retrieved from https://doi.org/10.1080/01441647.2015.1059381

Heres, D.R., Jack, D., & Salon, D. 2014. Do public transport investments promote urban economic development? Evidence from bus rapid transit in Bogota, Colombia.

Transportation. Vol 41(1). pp. 57-74. Accessed on 11 October 2019. Retrieved from https://doi.org/10.1007/s11116-013-9471-8

Wright, L., Hook, W. 2007. Bus Rapid Transit Planning Guide. Accessed on 2 October 2019. Retrieved from https://nacto.org/docs/usdg/brt_guide_itdp.pdf

Misra, T. 2016. Why Did Bus Rapid Transit go Bust in Delhi. Accessed on 13 October 2019. Retrieved from https://www.citylab.com/solutions/2016/12/why-did-bus-rapid-transit-go-bust-in-delhi/510431/

Duran, L. 1995. Bus Riders Union in L.A. *Race Poverty and the Environment.* Vol 6(1). pp. 8-9. Accessed on 14 October 2019. Retrieved from https://www.jstor.org/stable/41554212

Tatarski, M. 2017. Vietnam's tale of two metros, one built by the Japanese and the other by the Chinese. *South China Morning Post*. Accessed on 15 August 2019. Retrieved from https://www.scmp.com/week-asia/business/article/2104149/vietnams-tale-two-metros-one-built-japanese-and-other-chinese

Tuan Phung,. 2019. Nguyên nhân đường sắt Cát Linh - Hà Đông chậm hầu hết do phía Trung Quốc [The cause of Cat Linh - Ha Dong railway is slow mostly due to China]. *Tuoi Tre journal.* Accessed on 15 August 2019. Retrieved from https://tuoitre.vn/nguyen-nhan-duong-sat-cat-linh-ha-dong-cham-hau-het-do-phia-trung-quoc-20190810114454564.htm

Vu Diep,. 2019 Hà Nội sẽ cấm xe máy, thu phí ô tô nội đô năm 2030 [Hanoi will ban motorbikes and collect urban cars fee by 2030]. *Vietnamnet.* Accessed on 25 October 2019. Retrieved from https://vietnamnet.vn/vn/thoi-su/an-toan-giao-thong/ha-noi-se-cam-xe-may-thu-phi-o-to-noi-do-nam-2030-581970.html

Kawulich, B. B. 2005. Participant Observation as a Data Collection Method. *Forum Qualitative Sozialforschung / Forum: Qualitative Social Research.* Vol 6(2). Art. 43. Accessed on 23 November 2019. Retrieved from http://nbn-resolving.de/urn:nbn:de:0114-fqs0502430.