Transportation Demand Management: a Solution to Reduce Congestion and Towards a Sustainable Transportation in Hanoi

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Abstract: Traffic volume has been rapidly increased recently within the past decade, especially in large cities like Hanoi, Ho Chi Minh City…As a consequence, traffic congestion has become the horrendous problem to cause a low quality of life and economic burden. To solve this problem, a Transportation Demand Management (TDM) scheme addresses a variety of issues such as mitigation of traffic congestions, reduction of energy consumption and exhaust gas emission in the transport sector. The TDM measure does not require too much change on transport infrastructure, but it considers applying the policies and measures. This paper presents the study to apply TDM measure in Hanoi and introduce a case study as Park &Ride measure. The findings may help city agencies in applying the right TDM solution and thus result in reducing the traffic congestion towards a sustainable transportation in Hanoi as well in other similar cities in Vietnam and Asian countries.

Keywords: Hanoi, Transportation Demand Management, Sustainable Transportation, Park and Pide (P&R)

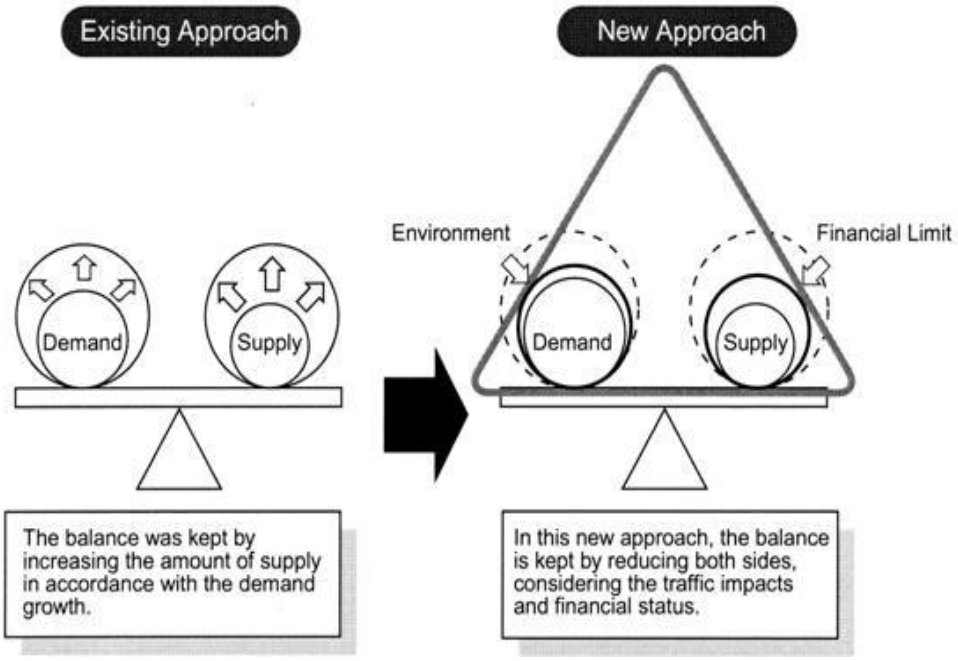
1. TDM – A NEW APPROACH FOR MITIGATE TRAFFIC

Traffic Demand Management (TDM) is a new concept that began to gain wide recognition in the later 1990s. It focuses on the suppression of the traffic demand and does not require too much change on transport infrastructure (Fig. 1). The purpose of TDM is mitigation of traffic congestions, reduction of energy consumption and exhaust gas emission in the transport sector and so forth, which involve changes in people's attitudes towards mobility.

Traffic congestion occurs when traffic demand exceeds the capacity of the road network. According to statistics of Hanoi Department of Transportation, in Hanoi City, the average annual growth rate of vehicle ownership is very high at 15.2% from 2008 to 2010. The rapid increase in the number of vehicles in Hanoi in recent years suggests that the congestion will become heavier every year as the expansion of the capacity of road network, in particular at central area of Hanoi, is very limited. Under such circumstances, management of traffic demand is inevitable to keep the traffic condition at an acceptable level.

Various transport demand management measures are being implemented in other cities. They adopt different technologies with slightly different objectives and effects. The experience of the TDM measures in other cities will be a good reference in studying the possibility of the TDM measures in Hanoi. From the year of 2012, Government of Vietnam has launched or started to examine some TDM measures, such as staggered working time and changes of the school time as well as road pricing measures, etc. However the measures have not been worked effectively sufficient enough to mitigate exiting serious traffic congestions. This study, a component under TRAHUD II project (the Project for Improving Public

Transportation in Hanoi), therefore, will focus on the current efforts on the TDM measures to encourage the smooth implementation of the measures.



Source: "Jutai-kanwa no Chie Bukuro", Japna Society of Traffic Engineers

Figure 1. Mechanism of Transport Demand and Supply

2. TDM MEASURES – FOUR MAIN GROUPS OF SOLUTION

In recent years, many measures were studied and applied in several cities in the world. Japan, America, Canada have good examples of applying TDM measures in miligating of traffic volume. Based on a study of JICA (The Japan International Cooperation Agency), TDM measures are classified into four categories in term of the intended effects: promotion of modal shift, suppression on demand, dispersal of demand and efficient utilization of available road space.

2.1 Promotion of Modal Shift

This group focuses on changing travelling method of transport participants through upgrading infrastructure for public transport, development of pedestrian and cycling facilities. The purpose of this solution is make more attraction for the new transport models, since then to persuade passengers to change from private vehicles to new transport models. Infrastructure upgrade on public vehicles often concentrates on improvement of transit station, designing the public transit routes form the suburbs to the central business district, and also building parking space near transit station to meet travelling demand of people to urban area by public transport.

Another method is development of pedestrian facilities such as sidewalks, crosswalks, universal designs, car-free malls… to create convenient environment for pedestrians and a safe, comfortable feeling for them also. Development of cycling facility attracts bicycle users by focusing on developing on lanes and bicycle parking space.

This solution brings huge effectiveness: demand dispersal by many different forms of transportation, attracting passengers using public transport and non-polluting vehicles, thereby significantly reduce private means and vision to a sustainable transportation. However, these solutions are usually applied in middle-income or developed countries because these countries have convenient and consistent plan on traffic and construction, land reserve fund for traffic development, and financial capacity for those changes.

2.2 Demand Suppression

This group focuses on travelling demand suppression of passengers by: increase on tax and private vehicle charge, congestion charge in peak hours and in downtown, higher parking charge in urban area, in addition, banning on lorry and encouraging tele-working measures. These solutions do not require infrastructure upgrade which does not cost too much. But, this needs to develop the suitable policies, a model toll system and consensus from car users, logistic sector and public. Particularly, tele-working solution needs development of information technology infrastructure and an appropriate change of working method.

2.3 Demand Dispersal

This group redistributes the demand in space or in time by concrete methods: congestion charge in region and hour by using Intelligent Traffic Information System (ITS) to transfer information to vehicles. This solution makes drivers drive on another route or run in another time to keep away from being tolled and congested. Another measure to redistribute traffic demand by time is to stagger commuting to offices and schools so that they can avoid a large amount of traffic demand accruing together at the same time. Meanwhile congestion charging and ITS require a developing and consistent information technology infrastructure, alternative work schedules need consensus form public and coordination between the management agencies and schools.

2.4 Efficient use of road space

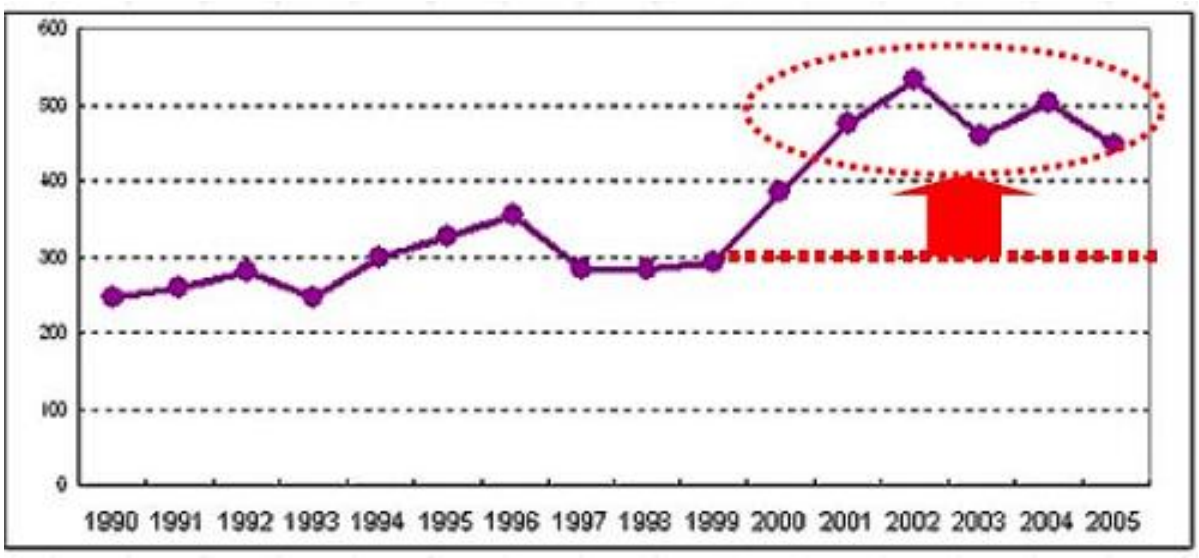
Solutions here are designing of Lanes or roads for High Occupancy Vehicles (HOV), developing form of car sharing and pooling, using traffic calming measures, and restriction on para-transit vehicles. Solution “Lanes for HOV” is usually applied in developed countries which have good infrastructure plan, law system on fining non-HOV running on HOV lane. Car sharing and pooling means the people who have the same destination will share their journey; however an organization or company will be in charge of gathering the same demands for their routes. Another solution is Traffic calming. It refers to various design features and strategies intended to reduce vehicle traffic speeds and volumes on a particular roadway.

3. STUDY TO APPLY THE TDM MEASURES IN HANOI

3.1 Review on current Transport situation in Hanoi, Vietnam

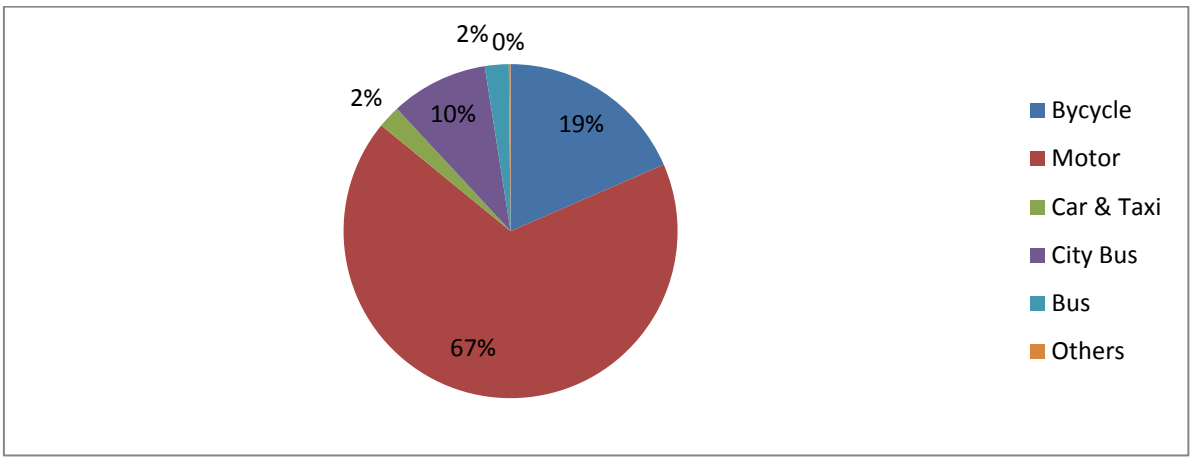
Vietnam, a country in Southeast Asia, has seen a fast growth of economy in the latest decade. Hanoi city is one of the two biggest cities of Vietnam with trends upward also. The rapid urbanization leads to fast growth of private vehicles. Up to now, according to the statistics of

General Statistics Office of Vietnam (GSOV), there are 3.7 million motorcycles in Hanoi accounting for 1/8 of motors, and 380.000 cars accounting for 1/6 of cars over the country. The number of newly registered vehicle is constantly increasing each year, 12-13% of motorcycles and 9-13% cars. The amount of personal vehicles puts a lot of pressure on urban transport infrastructure and is one of the major causes of congestion.



Source: General Statistics Office of Vietnam

Figure 2. Traffic accident in Hanoi



(Source TEDI, 2012)

Figure 3. Modal share in Hanoi in 2012

People living in Hanoi are so acquainted with congestion in peak hours: long line of vehicles queuing and slowly moving on each centimeter. Traffic congestion not only raises the travel time, fuel consumption, and emission but also reduces economic growth and convenience when joining traffic and disturbs social activities.

Though the large amount of vehicles is one of the main causes, during a long time of development, Hanoi authority has not paid attention to planning transportation and construction while the travelling demand is growing up quickly. This is shown in inappropriate distribution of manufactures, schools, hospitals… excessive land use in restricted developing areas for building commercial centers, apartments and offices... In 2010,

land for traffic is only 6.4% meanwhile the standard is 20% (Hanoi Department of Transport, 2010). Hanoi authority also delayed the implementation of public transport which has large carrier such as Metropolitan Rapid Transit, Light Rapid Transit and Bus Rapid Transit. Up to 2015, there is no urban railway going into operation and from now on to that time, private motorcycles and cars are still main vehicles.

3.2 Select TDM measures by screening method

As analyzed, Hanoi has very complex and sensitive traffic condition. A small adjust in traffic management policies can be calling a big influence on the circulation and got heavy criticism from public opinion. In fact, the traffic in every city has different condition, so we cannot bring the solutions and the experiences from other cities into Hanoi. Based on that, to apply TDM measures in Hanoi, it is necessary to study, analyze and evaluate to select the suitable measures.

The method to apply the TDM measures into Hanoi is descripted as diagram below. A long list of best practices of TDM measure will be created. After that, the first screening will be applied by focusing on time and cost; approval; local applicability. The second screening use multi-criteria evaluation matrix method and selected by collected ideas from expert and State management agencies. The last measures will be put into feasibility phase.

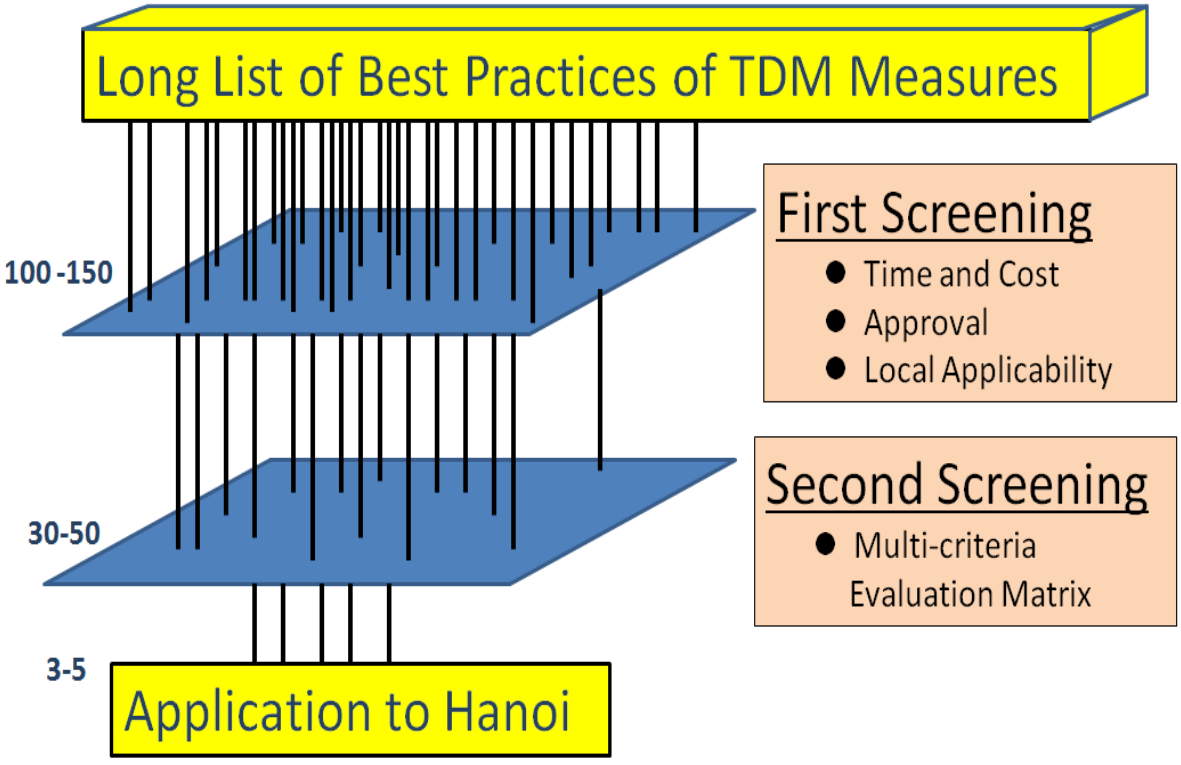


Figure 4. Process of screening TDM measure

The long-list of TDM measures including data on main description, applied place and time, explanation and the current status as below. More than 100 measures were collected and put into long list. Four groups of measure including Promotion of Modal Shift, Demand Suppression, Demand Dispersal and Efficient use of road space were classified.

Table 1. Long-list table form of TDM measures

No	TDM Measure	Description	Place &Time	Explanation	Status	Note
I. Promotion of Modal Shift						
1	Park and Ride	Car parks with connections to public transport that allow commuters and other people wishing to travel into city centre to leave their vehicles and transfer to a bus, rail system (rapid transit, light rail or commuter rail), or carpool for the rest of their trip	Istanbul - Turkey		Proposed in master plan studies 2008	Reports of JICA master plan studies
			Shanghai - China	Set up 37 park-and-ride centers in two years 2009 - 2010	Already in force	http://www.meet-in-shanghai.net/news_detail2008.php?id=157
			Vientiane - Laos		Proposed in master plan studies from 2009 , no information update	Reports of JICA master plan studies
			Singapore	Park and ride scheme, park & ride card, park & ride ticket	Already in force	http://www.transitlink.com.sg/ps-pnr-scheme.html#2
2	Improved coordination	Among modes - buses, trains, ferries and airports.	Bogota - Columbia	BRT network; transit facilities	Already in force	Reports of JICA master plan studies
3	Lower fares and discounts, and more convenient fare payment	Such as electronic "smart cards"	Paris - France	Use only RATP card to access every type of public transport	Already in force	http://www.ratp.fr/
4	Multi-Modal Access Guides	Which includes maps, schedules, contact numbers and other information on how to reach a particular destination by public transit	Paris - France	The site http://www.ratp.fr/ provides the guide for every personnel who want to access the public transport system in Paris. The client can find the itineraire, time and every information of transport system	Already in force	http://www.ratp.fr/

Source: TRAHUD II project

After second screening, three TDM measures including P&R, transit priority and Improvements for transit vehicle, stops and stations were selected and put into feasibility study. These activities will conduct in the scope of the TRAHUD II project.

Table 2. Selected measures after second screening

No	Measures: TDM Measure	Measures: Explanation	Measures: Typical cities	Evaluation for application: High	Evaluation for application: Medium	Evaluation for application: Low	Note
1	Park and Ride	Car parks with connections to public transport that allow commuters and other people wishing to travel into city centre to leave their vehicles and transfer to a bus, rail system (rapid transit, light rail or commuter rail), or carpool for the rest of their trip	Istanbul - Turkey (2008); Shanghai - China (2009-2010); Vientiane - Laos (in master studies 2009); Singapore (1990's)	**1/6**	**3/6**	**2/6**	
2	Transit Priority	Including bus lanes, queue-jumper lanes, bus-priority traffic signals, and other measures that reduce delay to transit vehicles	Ottawa, Ontario Canada (1994, ongoing)	**4/6**	**2/6**		
3	Improvements for transit vehicle, stops and stations	Reduced crowding, better seats and cleaner vehicles, shelter (enclosed waiting areas, with heating in winter and cooling in summer), seating, Wayfinding and other Navigation Tools, washrooms, refreshments, Internet services, and other convenience and comfort features.	Jakarta - Indonesia (2010)	**3/6**	**2/6**	**1/6**	

Source: TRAHUD II project

4. CASE STUDY ON P&R MEASURE ALONG BUS ROUTE NO.6 IN HANOI

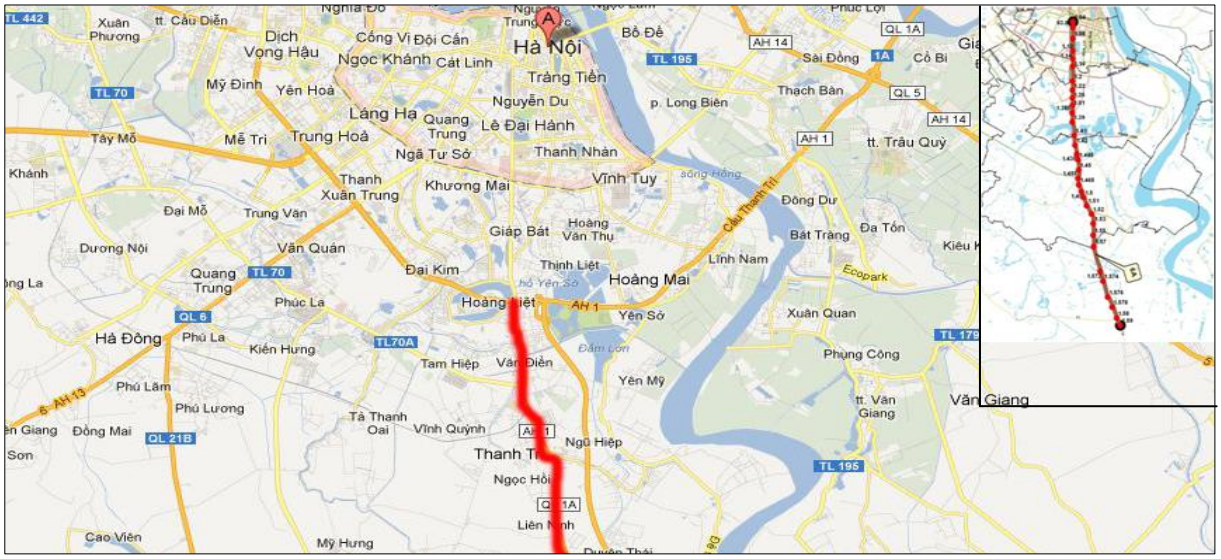
This study including these activities: planning process of P&R project; building the criteria table for P&R facilities; site survey to collect necessary data; estimation the parking demand and consider about the parking fee and management policies.

This study is aim to create the base to build the pilot P&R facilities along bus route No6 in Hanoi. It will provide the comfortable and secure P&R facilities, with the purpose to response parking demand of bus passenger. New P&R facilities will attract a number of private user shifts to use the bus by park their vehicle in P&R facilities and base on that, it will increase effect of bus and reduce congestion in the core city. This activity will introduce and publish the multimodal transportation method, an effect and economy mode of transport.

4.1 Description of bus route no.6

Bus route no.6 locates in the Giai phong, Ngoc Hoi street and is extended to Cau Gie district, This is the main radial axe of Hanoi city. This bus route has over 40 bus stops with more than

30km length. Bus route no.6 plays the most important role in bus system of Hanoi. It meets the traffic demand from suburban to the downtown in the morning and reverse in the evening.

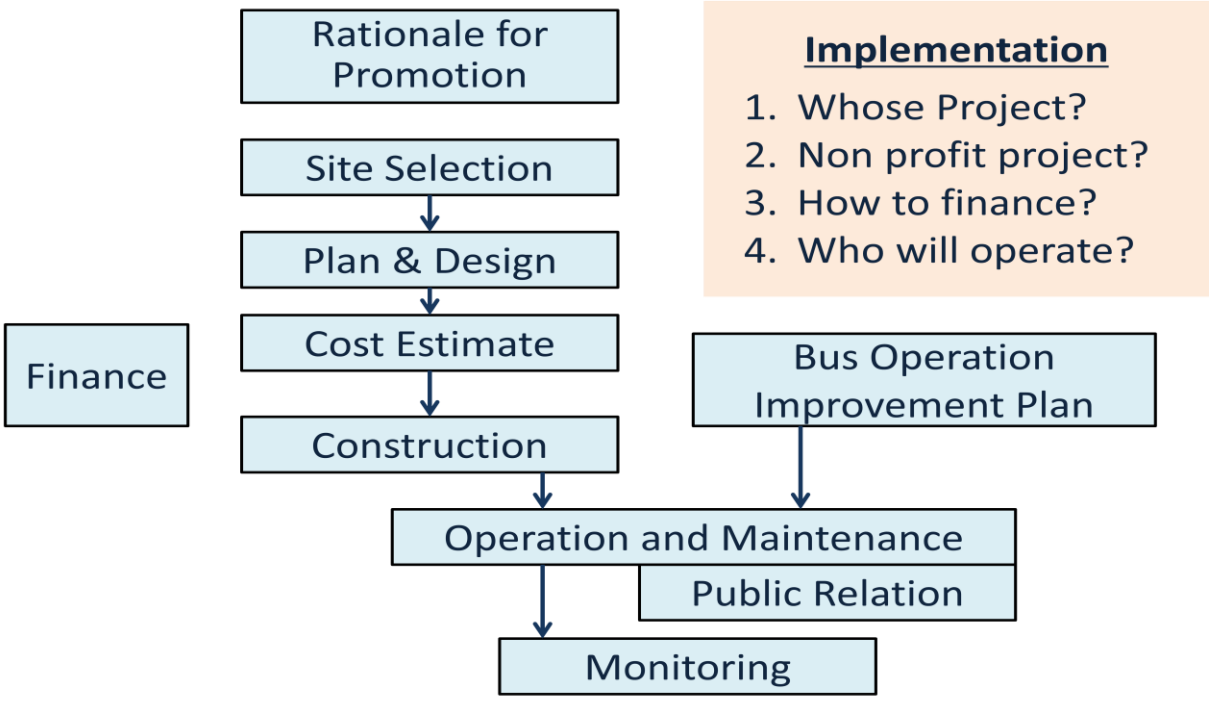


Source: Google maps

Figure 5. Giai Phong & Ngoc Hoi street (in red) and bus route no.6

4.2 Planning Process of P&R Project

The process for P&R project was created as Fig.6 below. Because P&R facilities will support for bus activities, this process is included in the plan to improve bus operation. After construction of P&R facilities, the public relation activity is necessary to inform public use.



Source: TRAHUD II project

Figure 6. Planning process of P&R project

4.3 Criteria for P&R facilities

To ensure the success of P&R pilot project, a list of criteria was developed and analyzed. The criteria for P&R facilities was studied and listed as follow:

4.3.1 Ensure users' high demand

- The location of P&R facilities must ensure the comfort to go to core city, along the main axe and near public transport line;
- Ensure the accessibility from main axe to P&R facilities and from P&R facilities to bus stop. The P&R facilities can be a part of bus interchange or near the bus stop.
- The distance must be over 6-8km and under 40km. The distance of 16-40km is suitable for P&R facilities;
- Service for highest residential areas. The distance is less than 4km from residential areas.

4.3.2 Ensure the accord with management policy

- P&R location must be suitable with land use planning and the policy on land use of local people committee;
- Reduce the influence on environment;
- Reduce the influence of P&R on transport activity and transport safety

4.3.3 Reduce risk and financial problem with P&R management unit

- Consider using temporary parking or existed parking to reduce the demand on finance;
- Consider expanding the good activated parking;
- Select the location which save budget for construction and operation;
- Consider licensing for private company to join and provide P&R service.

4.3.4 Requirement on equipment of P&R facilities

- Try to equip the facilities as roof, lighting, WC and other facilities;
- Provide information on number of free space, waiting time for next bus and transport condition ahead;
- Clean, fire safety equipment;
- Reduce the length of walking inside the P&R facilities;
- Provide and connect the walkway from inside to outside of P&R facilities.

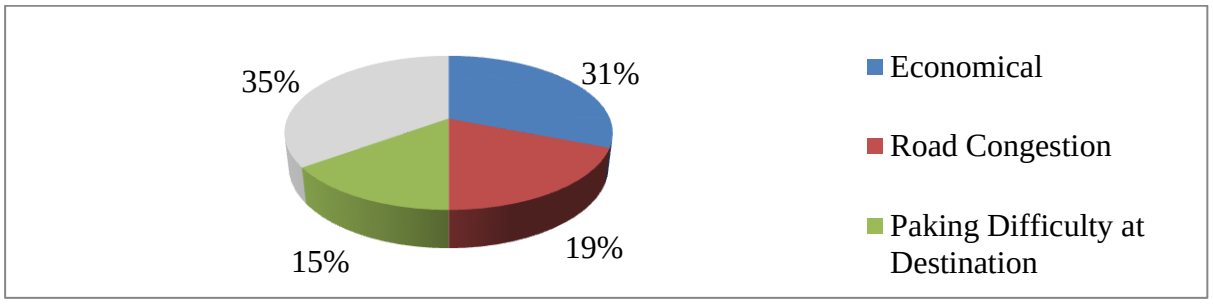
4.3.5 Requirement on parking fare

- Low fare, suitable with expectation of parking user;
- Ensure the affordability for management unit of P&R facilities;
- Follow the policy of the city

4.4 Site survey to collect necessery data

The site survey was conducted to obseve necessery data. The survey includes interview survey in existing parking, ridership survey in bus stops and occupancy survey in important cross section.

500 samples were collected in interview survey. The interview survey gives the data on motivation to use P&R in Hanoi, access mode to parking facilities and transport mode used for access to bus stop. The ridership survey takes the volume of passengers of bus route no.6 and the occupancy survey takes the occupancy rate of vehicle type in the NH1. The most important results of survey show as follow.

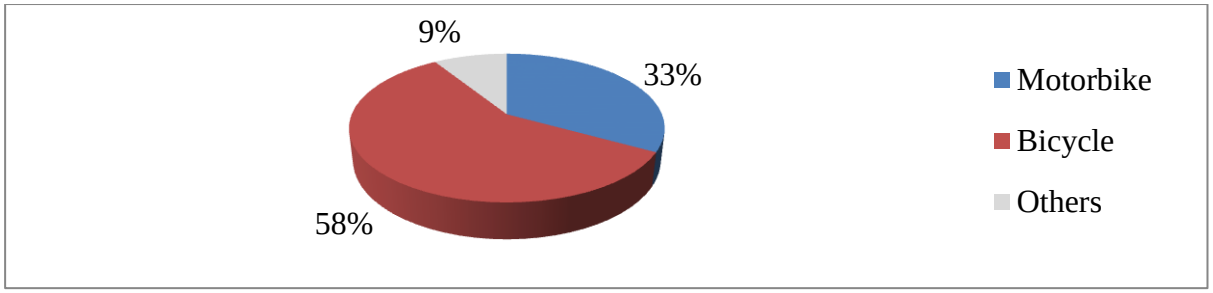


Source: TRAHUD II project

Figure 7. Motivation to use P&R in Hanoi

For motivation to use P&R, the main reason focuses on economical aspect (the increase of petrol price), the influence of road congestion and the limit of parking slot in downtown.

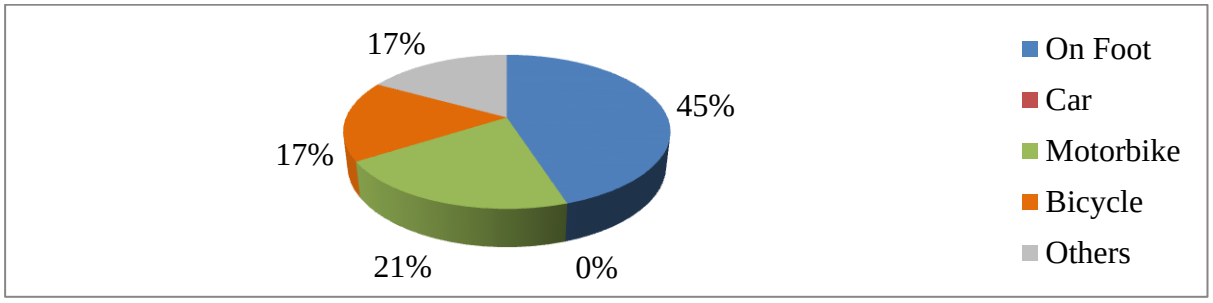
Bicycle and motorbike are the main access mode to go to parking facilities. The proportion of vehicle depends on the distance from home to destination. Students and workers are the most imortant clients of parking facilities.



Source: TRAHUD II project

Figure 8. Access mode to parking facilities

The transport mode user for access to bus stop is presented under the pecentage of mode. The highest percentage mode is walking, bicycle and motobike. It has reason to expect that a volume of walking man will shift to use P&R facilities after their construction.

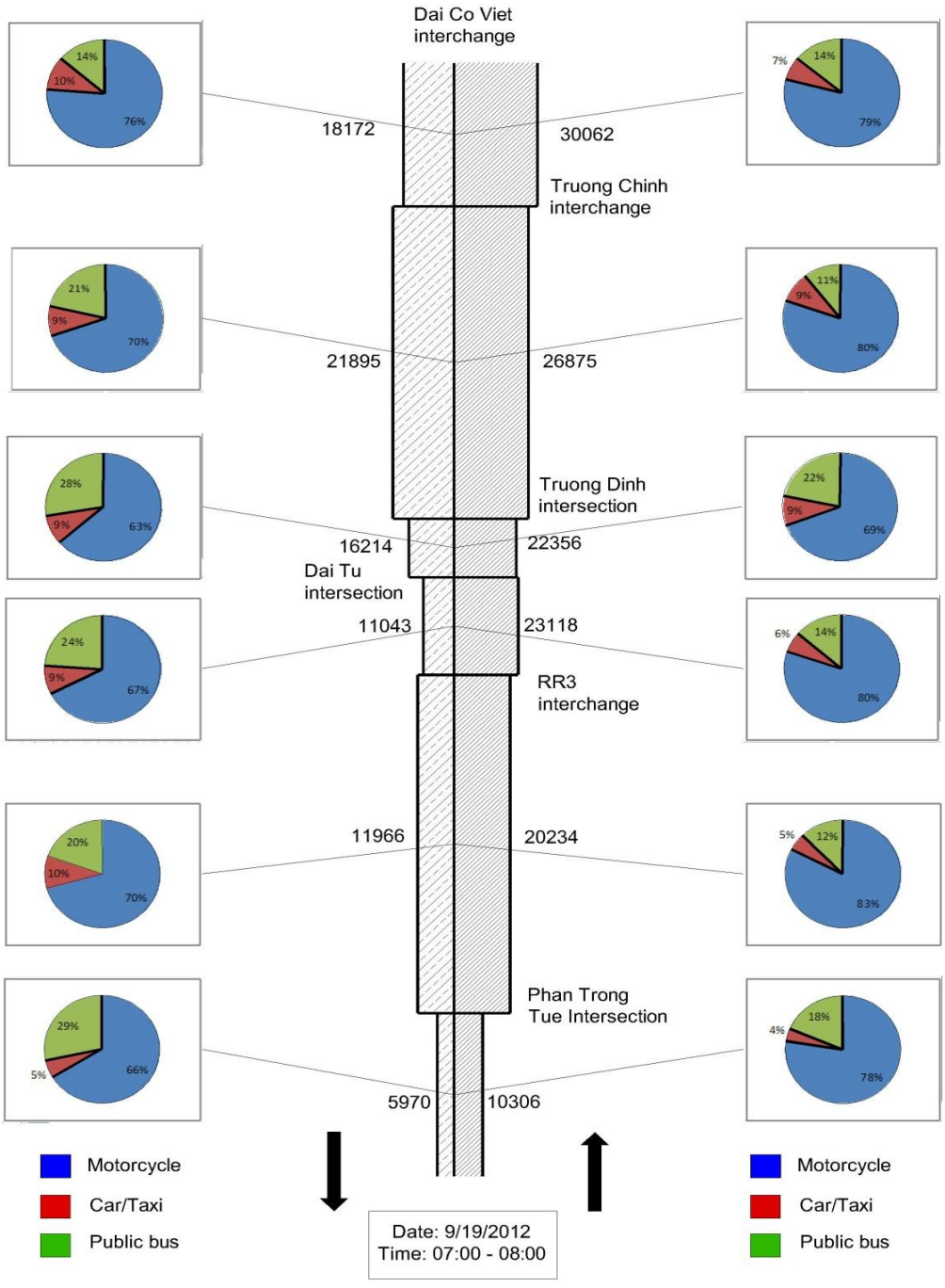


Source: TRAHUD II project

Figure 9. Transport Mode used for access to Bus Stop

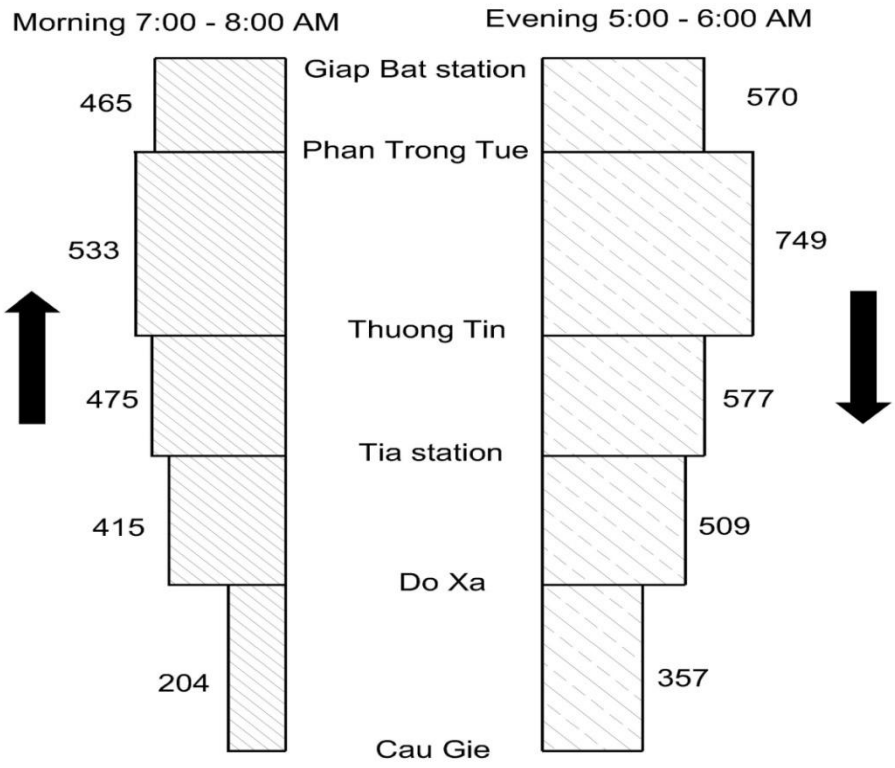
The Fig.10 presents the passenger volume on the pilot corridor in peak hour by every mode of transport including motorcycle, car/taxi and public bus, from 7AM to 9AM. The volume increases by the distance to downtown. In the morning peak hour, the demand to go to downtown is more important than reverse.

The number of bus passengers is shown in Fig.11. The survey was conducted for important direction in peak hour. Because our corridor is radial lines, the demand is important by direction from suburban to core city in the morning peak hour and reverse in the evening peak hour.



Source: TRAHUD II project

Figure 10. Passenger volume on NH1 in peak hour by every mode of transport

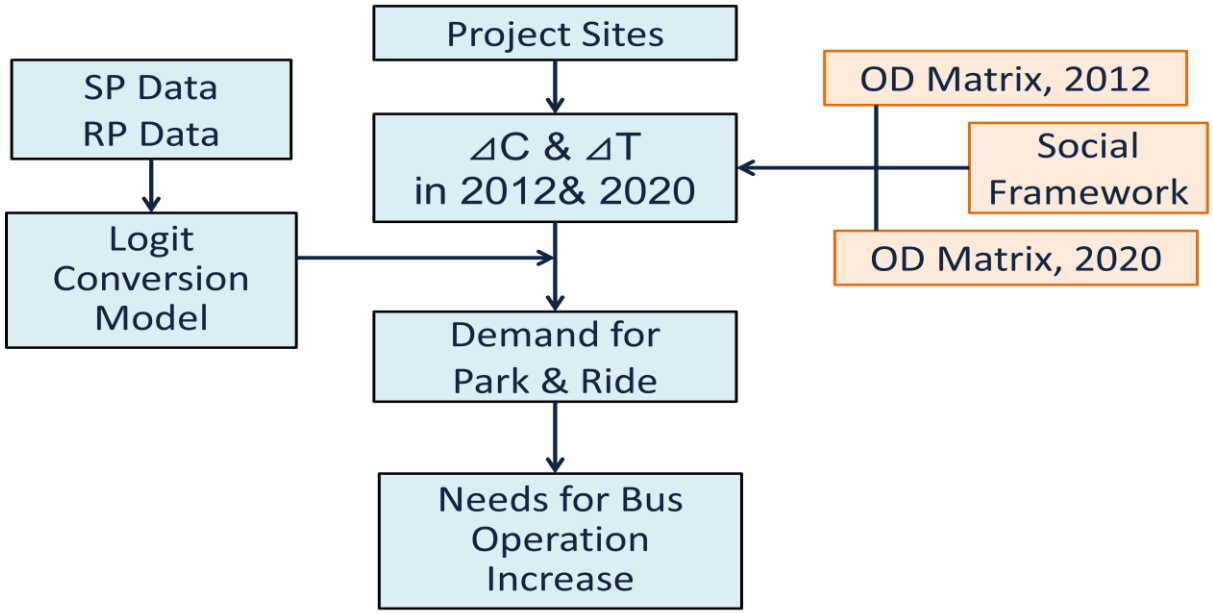


Source: TRAHUD II project

Figure 11. Passenger volume on bus route no.6 in peak hour

4.5 Estimation of the parking demand

The survey data will be used for estimation of the parking demand for new P&R facilities. Fig.12 shows the P&R demand forcast method. Logit conversion model was selected to conduct the demand forecast.



Source: TRAHUD II project

Figure 12. Diagram for estimation of parking demand

4.6 Study on institutions and policies

4.6.1 Mechanism of P&R facilities management

Two concepts below show the solution for mechanism of P&R facilities management. In Hanoi, bus management agencies belong to Hanoi city. So it would be good if the P&R management board belong to Hanoi city, it will take advance in improving the coordination between parking management unit and bus management agencies. In other hand, if the P&R management board belong to local people committee, it's easy to solve the local problem and other problem on administrative management.

1) Manager by the city

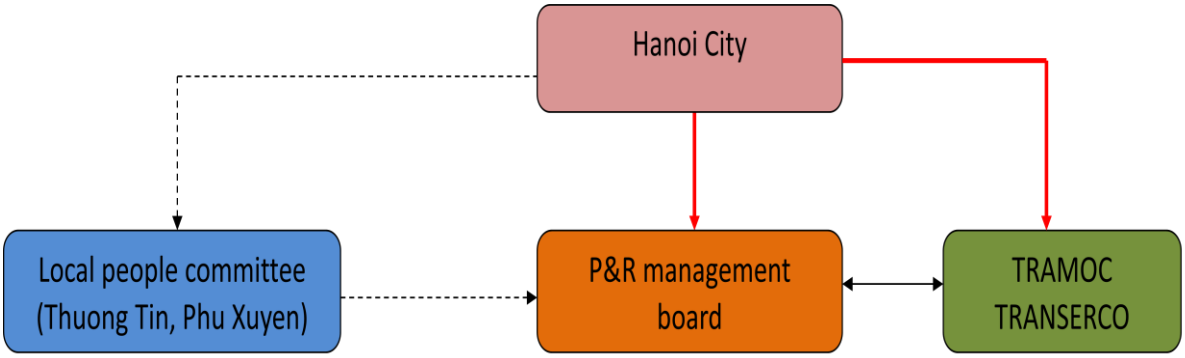


Figure 13: Concept of "management by the city"

Note: *TRAMOC: Hanoi Public Transport Management and Operation Center; TRANSERCO: Hanoi Transportation Company*

Table 3. Advantage and disadvantage of 1st concept

Advantage	Disadvantage
- Improve the coordination between parking management unit and bus management agencies - Effectiveness on solving the problem on parking fare, subsidy,land use taxes…	- Difficulties in solving the local problem - Difficulties in parking facilities administrative management from local people committee.

2) Manager by local people committee

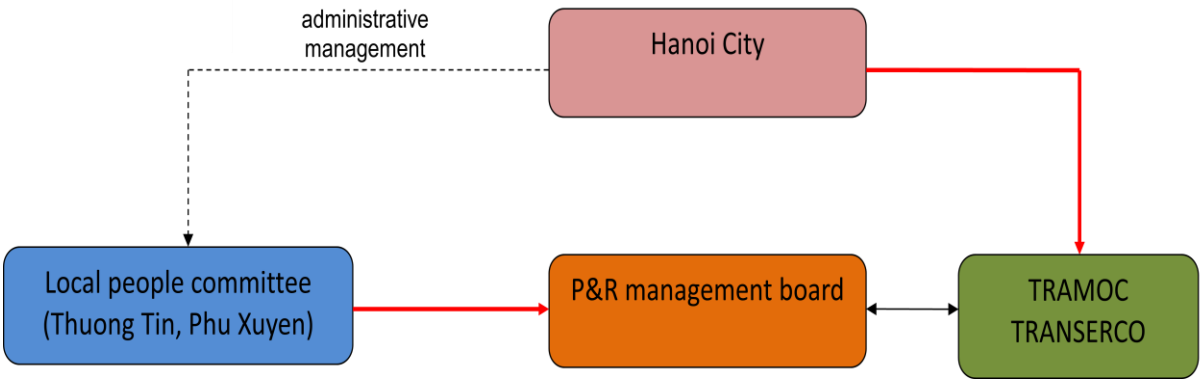


Figure 14: Concept of "management by local people committee"

Table 4. Advantage and disadvantage of 2st concept

Advantage	Disadvantage
- Convenient for the construction of parking facilities - Effective on solving the local problem - Effective for development others parking facilities in the local area - Increase the revenue for local people committee	- Difficulties in the coordination between parking management unit and bus management agencies

4.6.2 Put forward priority policy for management unit of P&R facilities

To encourage organization and individual participation to P&R operation, two policies will be proposed to state management agencies as following:

1) **Reduce the land taxes for P&R management unit:** The P&R management unit will have the priority on land taxes, basing on that, the land taxes for them will be lower than other parking company

2) **Subsidy from the city:** P&R management unit will receive the subsidy from the city to maintain the activities of parking facilities.

5. CONCLUSION

In the current situation of Hanoi, traffic problems are increasing and serious day by day. While capital investment in developing transportation infrastructure is limited and depends on foreign investment, TDM was hoping the solution for current traffic problems. The TDM solutions if are studied and applied correctly will bring the enormous benefits of reducing traffic congestion, reduce pollution and towards sustainable transport.

P & R pilot project will reduce the traffic volume in core city, so contribute to reducing traffic congestion. This project is a pilot project to develop the concept and policies for P&R measure, which can be expanded and developed in near future.

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