8.6 Urban Mass Rapid Transit

1) Planning Concepts and Considerations

(1) Main Features of the UMRT

The HAIDEP study revealed that the long-term sustainability of urban development and transportation in Hanoi is largely dependent on how the public transportation system can be effectively developed with an urban mass rapid transit (UMRT) forming the backbone of the whole system. The UMRT is defined as a public transportation system with a large passenger capacity at more than 5,000 passengers per direction per day. It is operated at high speeds and segregated from other traffic. It may include various types of urban rail and bus rapid transit (BRT) (see Figure 8.6.1).

(2) Public Transportation Corridors

From the initial passenger demand forecast based on the existing public transportation network, there appears to be distinct public transportation corridors serving Hanoi City (see Figure 8.6.2). These are as follows: (i) Ngoc Hoi (NH1 south), (ii) Ha Dong (NH6), (iii) Hoa Lac, (iv) Nhon (NH32), (v) Noi Bai (NH2), (vi) Soc Son (NH3), (vii) Yen Vien (NH1 north), and (viii) Sai Dong (NH5).

(3) Existing Urban Rail Network Plan

The MOT master plan identified 8 new rail routes either at grade, elevated, or underground within the master plan study areas, as follows: (i) Yen Vien - Ngoc Hoi, (ii) Hanoi - Ha Dong, (iii) Bac Co - Hanoi Stn - Voi Phuc - Nhon, (iv) Hanoi - Noi Bai, (v) Daewoo - Trung Kinh - Hoa Lac, (vi) Giap Bat - South Thang Long, (vii) Buoi - Dong Anh - Soc Son, and (viii) Co Bi - Gia Lam - Kim No (see Figure 8.5.3). In addition to the urban network, there is a VR mainline network improvement plan in which related sections include the following: (i) south rail to HCM, (ii) Lao Cai Line, (iii) Hai Phong Line, (iv) Ha Long Line, (v) Dong Anh-Quan Trieu Line, and the (vi) Hanoi circular (ring) railway (81.5km).

2) Proposed Urban Mass Rapid Transit Network

On the basis of the future urban structure and demand, the MOT-proposed UMRT lines (see Figure 8.6.3) were restructured into the following four lines (see Figure 8.6.4 and Table 8.6.1):

(1) UMRT Line 1: Ngoc Hoi to Yen Vien, Nhu Quynh

From the passenger demand forecasts for this line, it has been identified that this has one of the highest passenger demands with nearly 500 thousand passenger boardings per day forecast for 2020.

This 34.5-kilometer-long UMRT line will serve the northeastern and southern suburbs of Hanoi via the central business district (CBD) including the proposed multimodal interchange terminal at Hanoi Station.

The alignment will generally follow the existing VR line but will be grade-separated through the CBD on a viaduct structure, thus eliminating the present operating constraints posed by numerous level crossings with the Hanoi street network.

Figure 8.6.1 Examples of Various Types of UMRT

Tokyo Metro (Japan)

Bangkok Sky Train (Thailand)

These systems use dual tracks, running in opposite directions. Each train, which can carry over 1,000 passengers at a time, is equivalent to 800 cars.

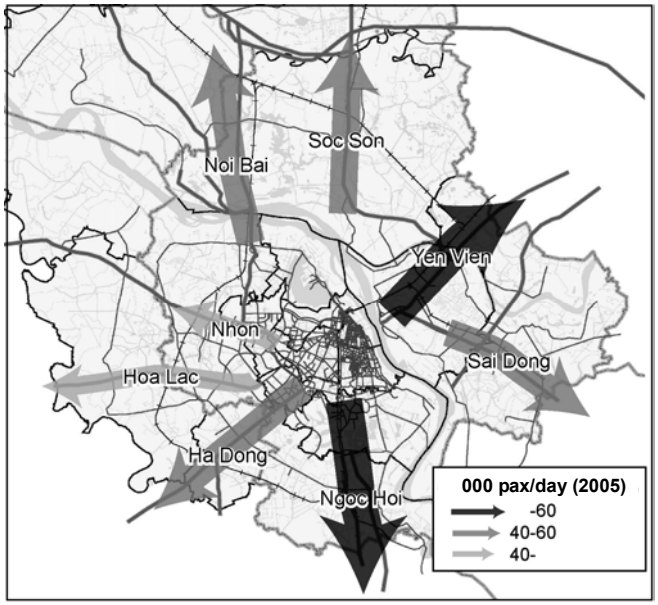
Monorail (Kuala Lumpur)

MRT (Kuala Lumpur)

BRT (Jakarta)

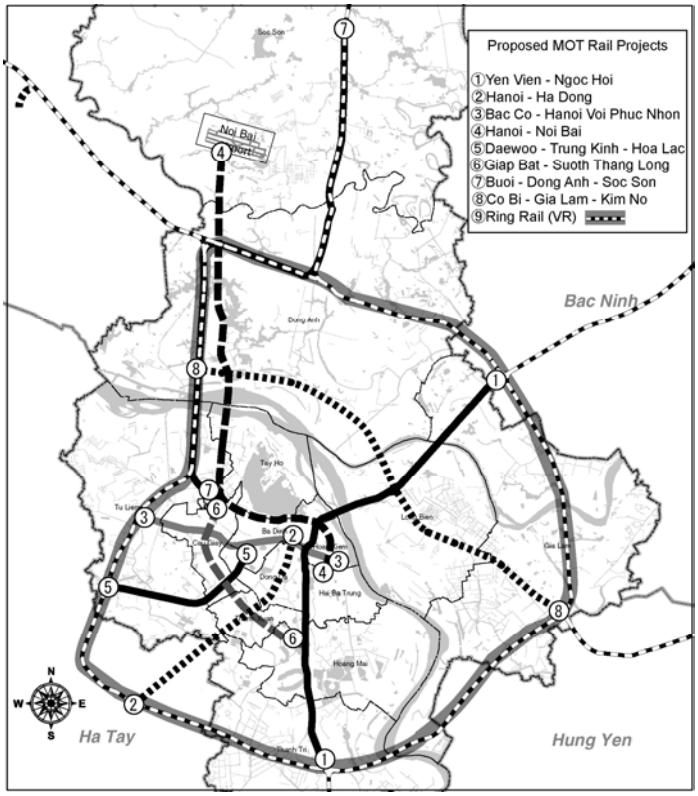
MRT (Metro Manila)

Figure 8.6.2 Public Transportation Corridors



Source: HAIDEP Study Team.

Figure 8.6.3 Urban Rail Routes Proposed by the MOT Master Plan



(2) UMRT Line 2: Ha Dong to Noi Bai, Soc Son

The 63-kilometer-long UMRT Line 2 will combine the proposed Ha Dong and Noi Bai lines which were identified in previous studies. This line will, depending on line patronage demand, be a fully integrated rail and bus transit system which will connect the fast-developing residential suburbs in the southwest of the city, including Ha Dong, via the center of the Hanoi City business district to the proposed new central government facilities in Tu Liem and on to the fast-developing industrial zones on the north bank of the Red River. UMRT Line 2 will also serve the business district of the proposed new town development before the UMRT transit terminates at the Noi Bai International Airport.

(3) UMRT Line 3: Nhon, Hoa Lac to Hai Ba Trung & Ba Dinh

UMRT Line 3 comprises two major components connecting the western suburbs of Nhon and Hoa Lac via the central business district of Hanoi, Hai Ba Trung, and the southeastern suburb of Hoang Mai. The more southerly route from Hoa Lac will have a major interchange with the Nhon line near the Daewoo Hotel on Kim Ma before terminating at the multimodal interchange station with UMRT Line 2 at Ba Dinh on the southern banks of the West Lake. Both lines will generally be either at grade or underground within the Hanoi CBD area.

(4) UMRT Line 4: Tu Liem to Co Bi and Noi Bai

In order to provide a high-capacity, high-speed, and frequent UMRT system to the city for trips which do not commence or end in the CBD of Hanoi City and which will be served by the radial UMRT Lines 1, 2, and 3, the Study Team has identified the need for a circumferential UMRT Line 4 which would provide a “bypass” public transportation service for the city’s suburban areas and provide good connectivity between the suburban zones for the residents of Hanoi.

Generally in the west and south of the city, the route alignment of UMRT Line 4 will follow the planned RR2.5, whereas on the eastern segment it will follow NH5 and its planned extension from Gia Lam to Noi Bai, giving a total route length of 52.5km.

Figure 8.6.4 Proposed UMRT Lines

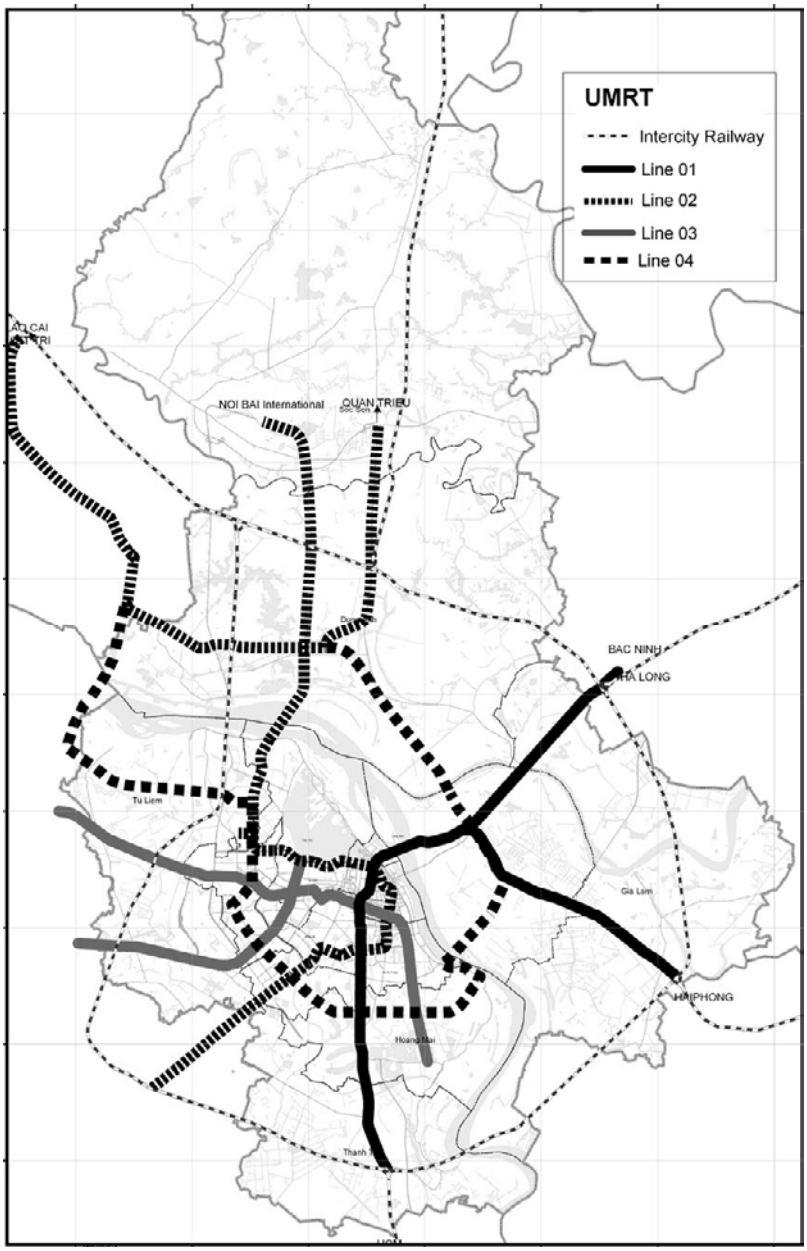


Table 8.6.1 UMRT Lines, 2020

	Urban Rail					BRT	Total
	Underground	Elevated	At-grade	Bridge	Sub-Total		
Line 1	-	12.3	24.4	2.0	38.7	-	38.7
Line 2	18.6	20.4	-	2.5	41.5	33.9	75.4
Line 3	12.0	1.3	7.7	-	21.0	12.0	33.0
Line 4	-	-	-	-	-	53.1	53.1
Total	30.5	34.0	32.1	4.5	101.2	99.0	200.2

3) UMRT Patronage Demand Forecasts

Initial results of the 2020 patronage demand forecasts for the proposed four UMRT lines were prepared (see Table 8.6.2 and Figure 8.6.5). Depending on the particular patronage demand forecast on each UMRT corridor, the Study Team selected the most appropriate technology, be it rail or bus rapid transit (BRT) system.

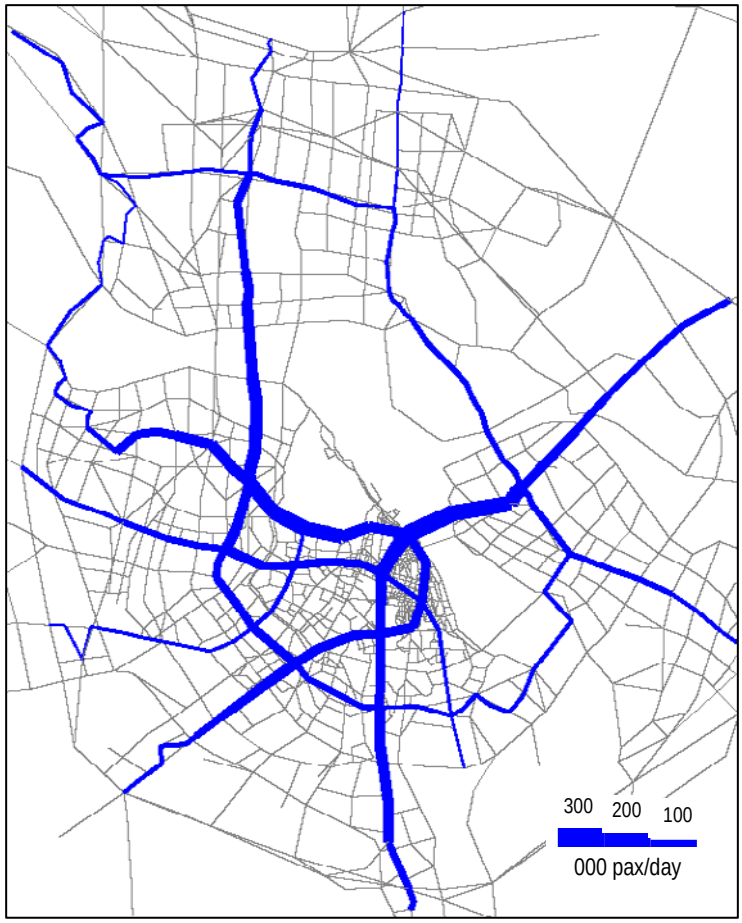
A brief summary of the passenger demand forecasts would indicate that UMRT lines 1, 2, and 3 daily passenger boardings in the range of 500 to 900 thousand passengers would require a rail-based UMRT system as the most appropriate technology in the long term. The results also indicate that the number of boardings and alightings increases significantly (20-30%) when good connectivity between the four systems through multimodal interchange stations is provided in the transportation model, therefore justifying the need to rationalize the original eight rail projects into four and providing multimodal interchange stations in the UMRT network.

In the feasibility stage, a more detailed study of the selected UMRT project will be required to determine the boardings and alightings at each of the UMRT station in the network.

Table 8.6.2 Number of UMRT Passengers by Line, 2020

URMT Line	Pax-km (000/day)	Traffic density (000/day/km)	No. of Pax (000/day)	Ave. Trip Length (km)
1	5,968	173	704	8.5
2	7,278	116	866	8.4
3	2,521	76	488	5.2
4	4,463	85	526	8.5
Total	20,230	111	2,584	7.8

Figure 8.6.5 Estimated UMRT Patronage, 2020



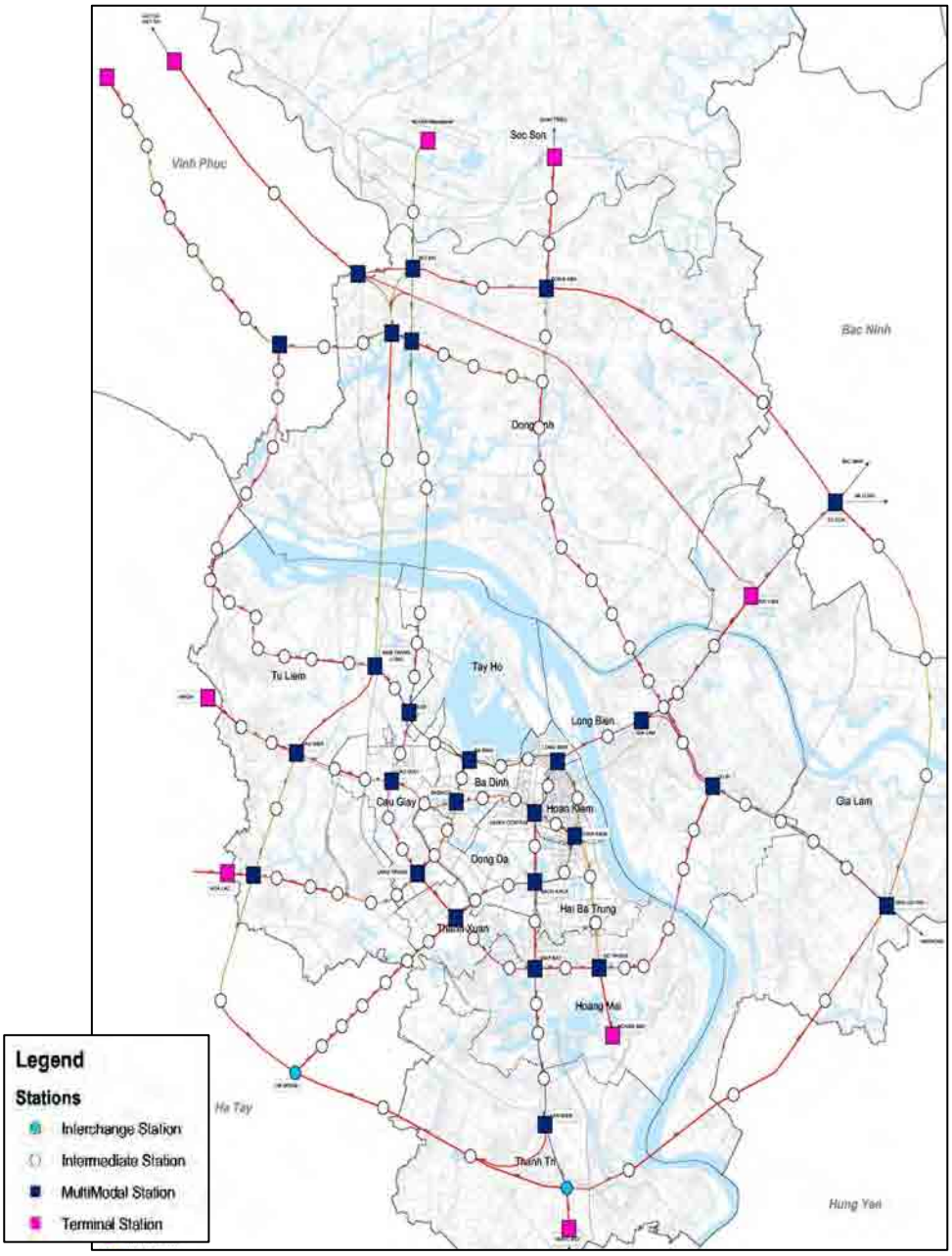
4) Transportation Hubs or Multimodal Stations

Based on the proposed UMRT network, the Study Team has identified 26 transportation hubs or multimodal stations throughout Hanoi and its suburbs as indicated in Figure 8.6.6.

The primary existing multimodal transportation interchanges include: Hanoi Central, Giap Bat, and Gia Lam. In the suburbs these are Ha Dong, Nhon, Yen Vien, and Ngoc Hoi. In addition, there are other locations where interchange facilities between transportation modes can be developed including the following locations: Kim Ma, Daewoo, My Dinh, Van Dien, Hoan Kiem, Long Bien.

Other potential transportation hubs which can be developed at major interchanges between the various urban transit systems have been identified in the master plan. The size of each multimodal will be dependent on the results of the patronage demand forecasts for the final urban transit network and the facilities to be provided at each of the multimodal sites. These facilities will include “drop off and pick up” for taxi, xe om, car and motorcycle, parking, as well as bus interchanges with primary and feeder bus systems.

Figure 8.6.6 Multimodal Stations



At each of these sites, facilities will be provided to allow the smooth transfer of passengers from one transportation mode to another, together with other passenger facilities and possibly residential, commercial, and retail development opportunities.

Table 8.6.3 Typical Multimodal Transportation Facilities at UMRT Line 1

UMRT Line 1 Multimodal	UMRT Line					Bus Interchange			Pick Up/ Drop Off		Parking	
	1	2	3	4	VR	Prov'l	Primary	Feeder	Taxi & Xe Om	Car & MC	Car	MC
Yen Vien	+				+	+		+	+	+	+	+
Gia Lam	+				+	+	+	+	+	+		+
Nhu Quynh	+				+	+		+	+	+		+
Co Bi	+			+				+	+	+	+	+
Long Bien	+	+					+	+	+	+	+	+
Ga Hanoi	+		+				+	+	+	+	+	+
Bach Khoa	+	+					+	+	+	+		+
Giap Bat	+			+			+	+	+	+	+	+
Van Dien	+				+		+	+	+	+		+
Ngoc Hoi	+				+	+		+	+	+	+	+
Total	10											

Note: MC – Motorcycle.

5) Engineering and Technology

An initial review of the existing railway engineering and technology standards has been undertaken to ensure that the proposed upgrading and capacity expansion of the mainline and urban transit systems are fully coordinated, compatible, and integrated with the respective technologies proposed for each UMRT rail system.

This review includes all major elements of a modern urban and inter-city rail system. A detailed review of the existing Vietnamese railway standards is therefore suggested to provide recommendations and guidelines for the future UMRT railway standards for the whole UMRT network to ensure full integration and compatibility.

The following elements of the proposed rail systems for the respective lines will be to review the following critical elements of the system standards:

(i) Rail gauge (standard)
(ii) Structure gauge (platform height/length)
(iii) Alignment standards (horizontal/vertical)
(iv) Rolling stock (type/structure gauge)
(v) Signaling systems (train protection)
(vi) Telecommunications (systems)
(vii) Traction power (DC/AC)
(viii) Fare systems (common ticketing)
(ix) Depot facilities (shared facilities between lines)
(x) Operational Control Center (single point management control)
(xi) Safety and operations (common standards NFPA130)

Further details are included in the subsector report.

6) UMRT Operations & Maintenance

(1) Operations Review

A complete review and audit of the present railway operations and maintenance procedures will be required before the introduction of any new technologies into the planned UMRT rail system. International assistance in this respect is recommended and a comparison with best international railway operations and maintenance procedures be carried out by international experts with the relevant experience in operating and maintaining a modern UMRT rail system in an Asian environment.

(2) Depots, Workshops, and Stabling

Depot, workshops, and stabling are situated within the Hanoi region at the following locations: Gia lam, Yen Vien, Hanoi Central, and Giap Bat. It is suggested that these existing rail facilities should be reviewed in some detail and, where possible, rationalized and updated to meet the operating standards of a modern and efficient rail system for both mainline and UMRT systems.

It is therefore recommended that industrial-type rail operations (workshops, etc.) such as those currently operating at Hanoi Central and Giap Bat be relocated out of the city center and located in the suburban section of the network. This would allow the development of an UMRT system and in particular the construction of multimodal interchange stations and facilities at these sites.

(3) Hanoi Urban Mass Transit Authority

The operations division of Vietnam Railway has done a remarkable job in operating and maintaining the existing mainline rail services throughout Vietnam with limited financial resources on a system which is in urgent need of upgrading and modernization. With the advent of new railway management and operating technologies, there is an urgent need to upgrade the existing system within the Hanoi study area.

With the rapid growth in Hanoi and its suburbs, the government has to consider how to meet the new challenges in public transportation both in inter-city and suburban services as well as developing an integrated urban transit system that is fully coordinated with other transportation modes such as bus, taxi, private car, motorcycles, etc.

The operations of a modern urban “metro” or UMRT system are somewhat different to mainline inter-city operations. Therefore, a new and dynamic team of dedicated and experienced team in UMRT project should be formed to meet the challenges of planning, designing, constructing, commissioning, and operating a modern UMRT system for Hanoi.

The government therefore has an important role in shaping this new urban public transportation team, which can be called the Hanoi Urban Mass Rapid Transit Authority. This mass transit management team needs to be openly discussed among and agreed by all divisions of government including Vietnam Railway.

7) Project Costs

Project costs cannot be assimilated until the type of system (transit, BRT, bus, tram, etc.) is selected and the infrastructure construction works are defined (see Table 8.6.4).

For the priority projects, a preliminary outline concept will be prepared to allow an order of magnitude cost to be determined which can be used in determining the project feasibility.

Table 8.6.4 Preliminary Project Cost Estimates

UMRT	Route	Length (km)	Cost (mil. US$)
1	Ngoc Hoi-Yen Vien, Co Bi	38.7	999
2	Ha Dong-Noi Bai,Soc Son	75.4	2,522
3	Hanoi-Nhon,Hoa Lac	33.0	1,145
4	Hanoi-Tu Liem, Co Bi, Noi Bai	53.1	365
Total		200.2	5,031

8) Implementation Schedule

Lines 1, 2, 3, and 4 are all important backbone lines of the proposed UMRT network for Hanoi, although Line 4 is primarily BRT. Technically the network can be completed by 2020. However, other factors, such as land acquisition, reprovisioning of existing VR railway facilities, methods of construction, and constraints on project fund sources, could significantly extend the period of implementation of the UMRT network and the start of passenger revenue services.

8.7 Public Transportation System

1) Structure of the Public Transportation Sector in Hanoi

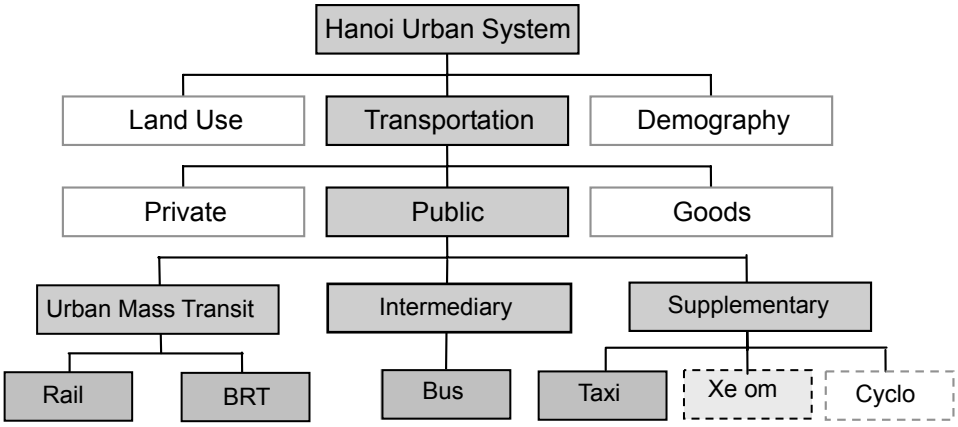
The recommended structure of the urban transportation system in Hanoi is shown in Figure 8.7.1. The public transportation system will have three basic components, as follows:

(i) a high-capacity urban mass transit system composed of rail and BRT;

(ii) an intermediary bus system composed of primary and secondary bus routes; and,

(iii) a supplementary system with small vehicles operated by the private sector.

Figure 8.7.1 Components of the Public Transportation System



2) Systems Design Options

In the master plan work, available options have been considered for the different components of the public transportation system. These have included infrastructural options such as elevated, underground or at-grade construction.

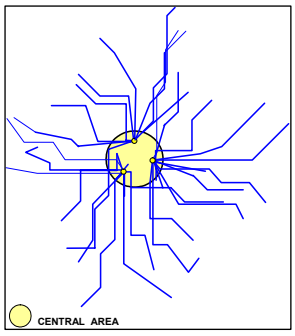
Technical options have been limited to well-proven solutions such as rail and bus, and have excluded various experimental systems as well as trolleybus and street-car. As for buses there are options such as gas propulsion that can be considered for environmental reasons but this does not change the general design of the bus route network.

Generic options for the network and service structure have been reviewed. An evolution is recommended from the present “coordinated” network (bus routes of the same hierarchy in an integrated system) into a trunk line-feeder line network (see Figure 8.7.2).

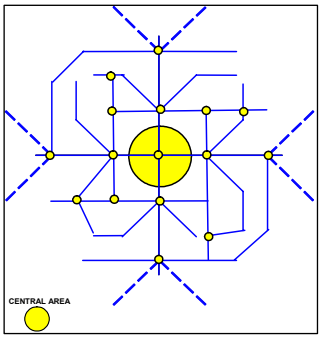
Different organizational options have been taken into consideration. A development towards controlled competition with participation from the private and the public sector is recommended.

The combination of options has been done with careful consideration of their compatibility with each other. For example, public investment in a high capacity metro, light rail or BRT line can be justified in a coordinated trunk line-feeder line system since the service will then be available for all inhabitants, not only those few living close to the line.

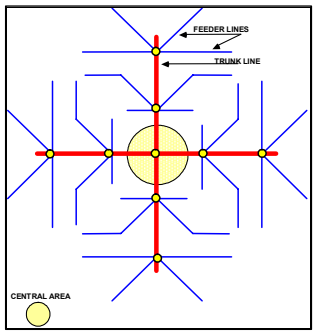
Figure 8.7.2 Different Network and Service Structures



Fragmented network
(Manila, Caracas, Mexico)



Coordinated network
(Hanoi 2005)



Trunk line-feeder line network
(Stockholm, Hanoi 2010)

3) The Bus System

The development potential of the bus system is considerable, and bus technology could very well continue to be the basis of Hanoi's public transport system for many years to come. The success of the bus system in Hanoi during the last few years is the result of a small-scale, low-budget approach (in contrast to grandiose but failed schemes). This process should continue and resources should be allocated to the bus system.

(1) Future Role of the Bus

As described in Chapter 8.6 above, Hanoi will develop an urban mass transit system including a number of radial corridors into the city. Since the completion of a rail-based system requires at least 6 - 8 years (possibly more) the bus will continue to be the main provider of public transportation for some time. Even when a rail transportation system is fully developed, a majority of urban public transport trips will still be by bus. Development of the bus system is essential and cannot be avoided while waiting for a "final solution".

Bus transportation will be supplied in three forms:

(i) a BRT network with special high-capacity buses,

(ii) a primary network with high-capacity/standard buses, and

(iii) a secondary feeder bus network with standard/small buses.

As BRT is considered to be part of the UMRT network, it is discussed in Chapter 8.6 above together with urban railway, including the issue of coordination of BRT and rail construction. In the following, a description is provided of the development of the bus system with emphasis on short term development up to 2010.

(2) Bus Priority Infrastructure Network

An important feature in bus transportation is to secure mobility for the buses. A good commercial speed improves performance and attracts passengers.

A possible strategy to ensure mobility can be to reduce traffic generally but this usually requires restrictions of the ownership and use of private vehicles. A more realistic strategy is to provide priority for public transport in certain streets. This is done in European cities even though they have underground railway systems.

In Hanoi, a bus priority infrastructure network is proposed (see Figure 8.7.3). The purpose is to create a coherent system where mobility is secured. In this infrastructure, different route network configurations can then be applied.

The ways of achieving bus priority will differ. The optimal solution is to provide a two-way busway in the center of the road, physically separated from other traffic. This may be possible in some sections while elsewhere tailor-made solutions will have to be found, for example one-way mid road lanes or side lanes. On RR2, for example, it may be possible that in the short term only one separated bus lane could be provided while the other direction would have to be in mixed traffic. In that case, it could be possible to find a solution where the direction of the reserved lane changes (see Figure 8.7.4).

In addition to physical separation, time separation can be applied with buses given priority in traffic lights.

Another possible approach to secure mobility for buses could be to link the primary bus network to a road pricing scheme on the street level (area licensing schemes are unlikely to work in Hanoi). Motorcycles and cars would pay a monthly fee for the privilege to use the designated part of the street network during peak hours.

A priority bus network can vary from a closed system with designated buses and pre-ticketing facilities (true BRT) to an open or semi-open system possible to use for all buses (which does not mean that all buses must always be allowed). A closed system is most effective if full standard is available in the whole network. An open system, on the other hand, requires monitoring to prevent bus congestion. Generally speaking; the more uncertainties and/or missing links there are, the more there is a case for the less complex approach. (In Hanoi, the interaction between BRT and rail will be an additional factor to consider as clarified in Chapter 8.6 above).

As for the configuration of stations, there are two options (see Figure 8.7.5):

- Central stations: buses with left-hand side doors.
- Righthand side stations: normal buses but requiring more space.

A design based on stops at the righthand side would be the most feasible if an open design is preferred as described above. Within the physical bus priority network, a great number of different bus route network configurations can be designed. If the bus priority network is designed as an open system, the options for route network design becomes even greater since some routes can then be in mixed traffic on some sections and use the separated bus lanes on other sections.

The bus route network will consist of two components: a primary network and a secondary network.

(a) Primary Bus Route Network

The primary bus route network (see Figure 8.7.6) will initially form the backbone of the system and will thus fulfill the role of the future UMRT network. It consists of bus routes providing high capacity and high commercial speed by using the priority network. After the completion of the UMRT system, the primary network will connect to multimodal stations but will not essentially be a feeder network. The primary network will be operated by standard and articulated buses.

(b) Secondary Bus Route Network

The secondary bus network (see Figure 8.7.7) will consist of feeder routes and local routes providing dense coverage. The secondary network will normally operate in mixed traffic and, accordingly, commercial speeds and performance levels will be lower.

This network will be operated by standard and smaller buses.

Figure 8.7.3 Bus Priority Network in 2010

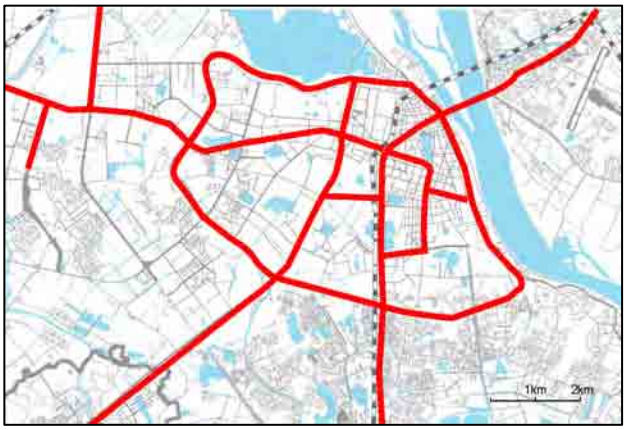


Figure 8.7.4 Variable Bus Priority Direction on RR2

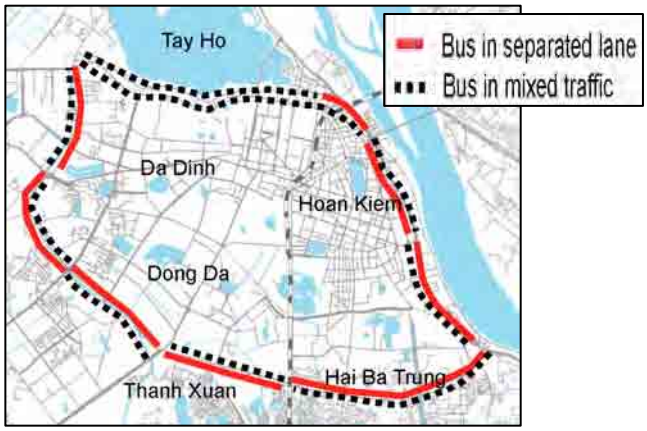
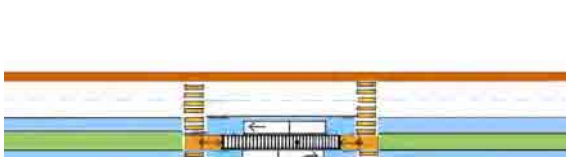
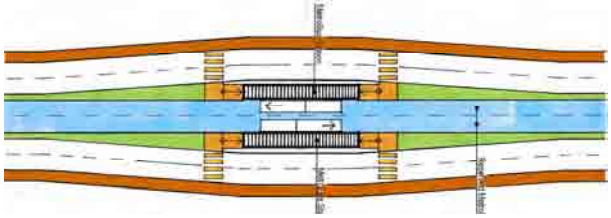


Figure 8.7.5 Optional Stop Locations



Option 1: Central stop position
Special bus design



Option 2: Right hand side stop position
Normal bus design

Figure 8.7.6 Primary Bus Route Network

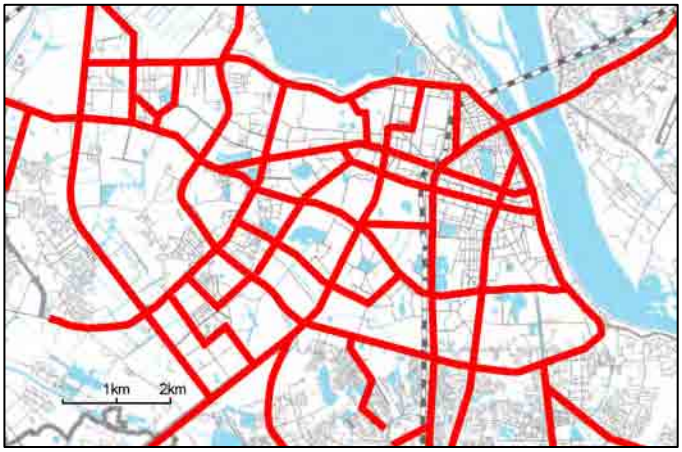
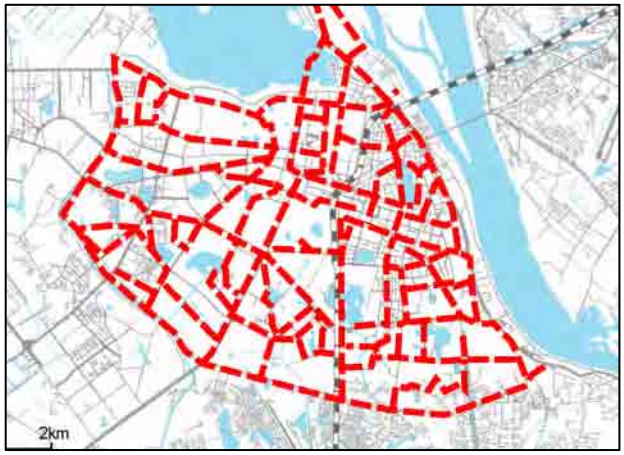


Figure 8.7.7 Secondary Bus Route Network[1)]



1) For inner areas.

(c) Depot Development

There are at present some 700 buses operating in Hanoi. If goals for public transportation ridership are to be met, then the number of buses will increase substantially. The development of service and maintenance facilities and depot capacity will be essential.

Today, only one depot (Thu Do) has been developed to acceptable standard with assistance from the EU. There will be a need for up to 10 bus depots over the next years. In addition to buildings and equipment, there is a need for technical assistance, training, and management development.

A management development program should be linked to a policy of developing the bus depots into semi-independent units which could in the future become separate operating companies and participate in the controlled competition concept. This is feasible since a bus depot is the natural operating unit and profit center. For this reason, management development should not be limited to technical issues but should include all aspects of running a medium-sized bus company.

4) Supplementary Public Transportation Services

There are mainly three types of supplementary public transportation services in Hanoi today: (i) the widespread and well-functioning taxi system, (ii) the unofficial but thriving motorcycle taxis (*xe om*), and (iii) the traditional bicycle rickshaws (*cyclo*) now largely phased out.

(1) Taxi

The newest supplementary public transportation mode is the taxi. Operation was started by TUPWS in 1994 of a service that could be ordered by telephone only and that was monitored by a radio control center. The new system became very successful and soon followers arrived in the market. Today, Hanoi has an extensive and well functioning taxi system with several types of taxi cars from large vans to small micro-taxis. There are now about 45 taxi companies with up to 150 taxi cars in the largest ones. Taximeters are required and taxis must display flag down fare and km fare.

The taxi will certainly remain in Hanoi as in any other modern city. The taxi system will continue to develop along commercial lines. There is not much cause for government intervention other than normal regulations including taximeter inspection.

(2) Xe Om

The xe om (motorcycle taxi) probably started after the introduction of the Doi Moi liberalization policy in 1989 which brought about a decline of the bus services and a simultaneous almost explosive growth of motorcycles. The number of xe om in Hanoi today is unknown. HAIDEP HIS recorded 74,000 xe om trips per day which is about 25% of bus ridership and 30% higher than taxi. Ownership appears to be on an individual basis and there are no signs as yet of the appearance of large fleet owners.

Xe om originally competed with bus services but today their role has changed to form a low-cost alternative to the taxi system and to act as a feeder system at bus stops. This is functional in some parts of Hanoi where accessibility is limited, but for peak hour trips into the center, xe om is likely to become less of an alternative. The xe om may remain in Hanoi for quite some time unless a radical policy change is introduced. Some regulation of the sector seems feasible. A possible option is to require owners/drivers to register and to provide insurance covering passengers. Also, the authorities should be watchful of growing tendencies of the emergence of a touting system (as exists in many countries) in areas with many passengers.

(3) Cyclo

The cyclo is the oldest individual type of public transport in Hanoi that is still in existence since the lambro (a small van) is now all but extinct in the city. The cyclo fulfilled an important role not only for passenger transportation but also for the transportation of various household goods within enclaves with limited access. As late as 1993, cyclo ridership was higher than bus ridership. Today, cyclos have been drastically reduced as

their market has been taken by xe om and bus. At present (HAIDEP HIS, 2005), bus ridership is 100 times higher and cyclos only carry some 3,000 passengers/day. They are now restricted and no longer allowed to ply streets where they would create congestion.

It is evident that the cyclo is already outdated as a substantial provider of urban transportation. Its future for a few registered drivers lies mainly in the tourist industry. Also, at least for some time, they may continue to provide a service in the enclaves without roads.

5) Proposed Projects

Figure 8.7.8 Priority Bus Routes Within Hanoi City, 2010

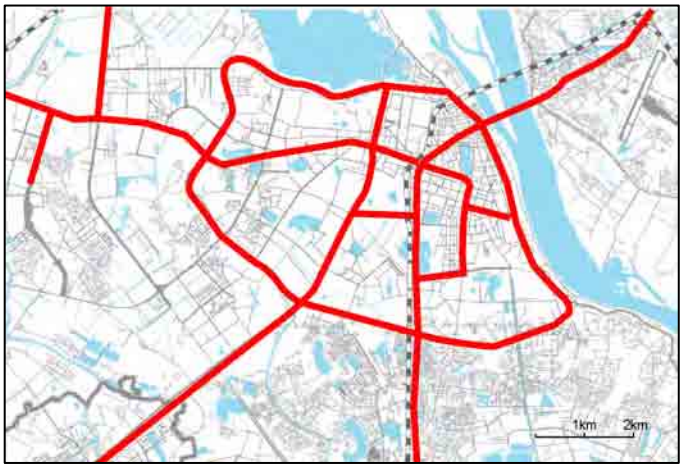


Table 8.7.1 Bus Development Projects

Area	Item	Cost (US$, mil.)
Bus Priority Design	• Design of a contiguous network of reserved lanes and traffic signal priority for buses. Technical assistance to coordinate with traffic management actions. • Consultants, local consultants, staff, office, etc.	1
Infrastructure Development	• Construction of bus lanes. • Signal priority scheme. • Bus stops and interchange bus terminals.	10 10 10
Depot Development	• Buildings and equipment for 10 bus depots. • Technical and management assistance.	10 3
Institutional Development	• Establishment of a Public Transportation Authority, technical assistance, equipment.	2
Total Cost		46

8.8 Traffic Management and Traffic Safety

1) Objectives and Approach

(1) Objectives

Management of traffic and its safety is one of the serious weaknesses which limit the efficient use of available facilities as well as protection of life and property. Poor traffic management also causes environmental degradation and negative impacts on landscape and overall amenity in urban areas.

With the number of vehicles in the study area expected to grow in the coming years, traffic congestion will become severe. Simply constructing new roads or widening existing ones cannot solve this problem. Nor can Hanoi continue converting land into roads. This situation therefore calls for greater reliance to be placed on a more efficient use of the existing road network. To achieve this and to realize efficient and safe traffic, traffic management plays a vital role. The objectives of traffic management are twofold: (i) enhance mobility, accessibility, and safety, and (ii) support public transportation for better and effective services. These objectives can be achieved through the traffic management process.

(2) Traffic Management Process

The traffic management process is an ordered group of related tasks and activities performed sequentially and repetitively to solve or alleviate traffic problems. Traffic conditions are not a static phenomenon; they gradually change over time with more motorcycles and cars joining the traffic and with the road network improving and expanding. Thus, it is important to establish a mechanism in which the traffic management process can be regularly reexamined to cope with the changes in traffic.

(3) Approach

Traffic management and safety issues were comprehensively assessed by corridor and area since infrastructure/facilities, travel characteristics, land use, enforcement, etc. are interactive. The nature of the problems also differs by area. As a result, a total of 16 transportation corridors were selected and the urban areas were classified into four traffic management areas, namely Ancient Quarter, French Quarter, urban core districts and suburban districts.

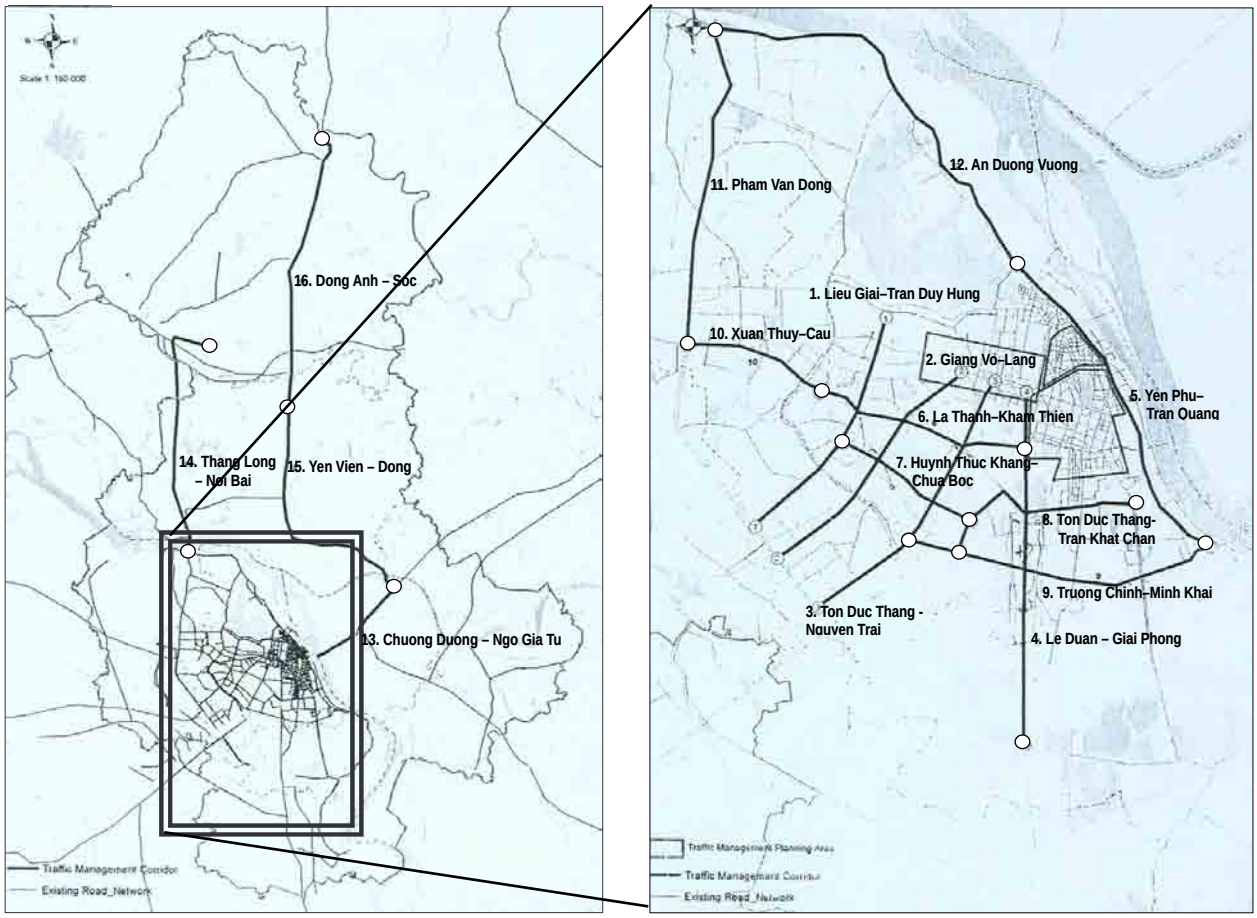
2) Assessment of Transportation Corridors and Urban Areas

(1) Transportation Corridors

Sixteen (16) transportation corridors (see Figure 8.8.1 and Table 8.8.1) were selected to assess their problems with regard to the following aspects:

(i) Roadway (maintenance conditions, lane management, facilities).
(ii) Intersection (design, signal installation).
(iii) Traffic management (traffic control, roadside parking, safety).
(iv) Public transportation (facilities and services).
(v) Amenity (greenery, landscape, air quality).

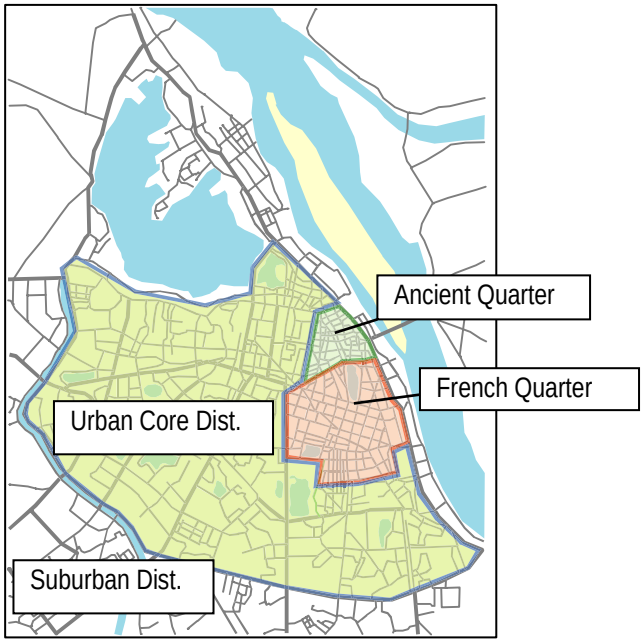
Figure 8.8.1 Selected Transportation Corridors and Traffic Management Areas for Traffic Safety and Management Facility Development



Corridor Name:

1. Lieu GIai-Tran Duy Hung
2. Giang Vo-Lang Ha
3. Ton Duc Thang-Nguyen Trai
4. Le Duan-Giai Phong
5. Ye Phu-Tran Quang Khai
6. La Thanh-Kham Thien
7. Huynh Thuc Khang-Chua Boc
8. Ton Duc Thang-Tran Khat Chan
9. Truong Chinh-Minh Khai
10. Xuan Thuy-Cau Giay
11. Pham Van Dong
12. An Duong Vuong
13. Chuong Duong-Ngo GIa Tu
14. Thang Long-Noi Bai
15. Yen Vien-Dog Anh
16. Dong Anh-Soc Son

Traffic Management Areas



Sources: JBIC SAPROF for Traffic Safety Improvement Project in Vietnam, Draft Final Report, September 2006; HAIDEP Study Team.

Based on the above aspects, each selected corridor was assessment as either A=good, B=fair, C=poor, or D=bad (see Table 8.8.2). As a result, problematic corridors and areas were identified. Although the selected corridors have various types of problem, those with relatively serious traffic problems are:

(i) Ton Duc Thang - Nguyen Trai.
(ii) Long Bien - Chuong Duong.
(iii) La Thanh - Khang Thien.
(iv) Truong Chinh - Bach Khoa.
(v) Nga Tu Vong - CM Dong.
(vi) Chuong Duong - NH5.
(vii) Yen Vien - Dong Anh.
(viii) Dong Anh - Soc Son

Based on the assessment, possible measures to improve the situation were identified (see Table 8.8.3). Main areas of intervention are:

(i) Carriageway: Drainage improvement.
(ii) Intersection: Geometric improvement, signalization and left-turn lane.
(iii) Traffic Management: Roadside parking control, NMV control, traffic signs and markings.
(iv) Traffic Safety: Guardrails for pedestrians, enforcement, education.
(v) Public Transportation: Bus stop facilities, network connectivity, safety and comfort.
(vi) Pedestrian Environment: Motorcycle parking control, sidewalk pavement improvement.

(2) Traffic Management Areas

Hanoi City was divided into four (4) traffic management areas, namely: (i) the Ancient Quarter, (ii) the French Quarter, (iii) urban core districts within RR2 (excluding Hoan Kiem), and (iv) suburban districts. These areas have different traffic patterns, flow characteristics, and traffic management issues, requiring different improvement measures (see Table 8.8.3).

3) Short-term Traffic Management Orientation

Since infrastructure and facilities development requires a lengthy period from planning to construction and finally to operation, it is important to implement various short-term traffic management measures to manage and maximize existing resources. Such measures include control of traffic and vehicles, improvement of safety, formulation of parking policy, and strengthening of enforcement and human resources, etc. (see tables 8.8.4 and 8.8.5).

Table 8.8.1 Characteristics of Selected Transportation Corridors

Corridor/Section		Length (km)	ROW (m)	Roadway		Median (m)	Traffic Volume (000pcu/day)	No. of Intersections		Sidewalk		Land Use	Landscape	
				Width (m)	No. of Lanes			Major	Minor	Right	Left		Street Tree	Street Light
1. Lieu Giai-Tran Duy Hung	Hoang Hoa Tham – Kim Ma	1.4	45	21	4	13.5		3	2	5	4	R	T	T
	Kim Ma – Dai TH Vietnam	0.6	30	21	4	3		1	3	3	3	CB	T	T
	Dai TH Viet - Cau To Lich	1.3	43	21	4	10		2	3	6	6	RM	T	T
	C T Lich – RR3	1.8	49	21	4	10	49.3	2	3	6	6	RM	T	T
2. Giang Vo-Lang Ha	Bx Kim Ma – Giang Vo	1.5	44	30	4	5.5		2	3	4	4	CB	T	W
	Giang Vo – Dien Anh	0.9	31	21	4	2.7		1	1	3	4	CB	T	M
	Dien Anh – Duong Lang	0.7	31	21	4	2.7	31.9	1	2	3	4	CB	T	M
	Duong Lang – RR3	2.0	43	21	4	10		2	2	6	6	R	T	T
3. Ton Duc Thang-Nguyen Trai	Van Mieu – O Cho Dua	1.4	25	19	4	-		2	3	3	3	CB	W	L
	O Cho Dua – Nga Tu So	2.0	25	19	4	-		2	4	3	3	CB	L	R
4. Le Duan –Giai Phong	Dien Bien Phu – Nikko	1.3	15	10	3	-		3	2	2.5	2.5	CB	W	R
	Nikko – Back Khoa	1.0	18	14	4	-		2	1	4	0	CB	L	R
	Back Khoa – Nga Tu Vong	1.1	39	30	4	1		1	2	4.5	3	RM	W	M
	Nga Tu Vong – Bx Giap Bat	2.3	33	30	4	1	104.4	1	4	3	0	RM	W	M
5. Yen Phu-Tran Quang Khai	O Yen Phu – Long Bien	1.5	26	11	4	8.5		2	2	3	3	RM	T	T
	Long Bien – Chuong Duong	0.7	37	17	4	1.5		1	1	1.5	3	CB	R	L
	Chuong Dng – T Khanh Du	2.0	22	17	4	-	36.1	2	3	1.5	3	CB	R	L
6. La Thanh-Kham Thien	Cau Giay – Nguyen Chi Thanh	0.7	9	9	2	-		3	1	-	-	RM	W	L
	DT Vietnam – Giang Vo	0.9	9	9	2	-		1	2	-	-	RM	W	L
	Giang Vo – O Cho Dua	1.2	9	9	2	-		1	2	-	-	RM	W	L
	O Cho Dua – Le Duan	1.1	18	11	2	-		1	1	3	4	CB	L	R
7. Huynh Thuc Khang-Chua Boc	Nguyen Chi Than – Lang ha	0.8	24	14	4	1		2	1	4	5	CB	W	L
	Lang ha – Chua Boc	1.3	22	14	4	1		1	2	4	3	CB	W	L
	Chua Boc – Ngoc Thach	0.8	22	14	4	1		1	2	4	3	CB	W	L
8. Ton That Tung-Tran Khat Chan	Truong Chinh – Chua Boc	0.6	16	8	2	-		2	1	5	3	RM	W	R
	Chua Boc – Bach Khoa	1.4	20	14	4	-		1	2	2.5	3	CB	W	L
	Bach Khoa – O Dong Mac	2.0	46	29	4	3.4		2	3	5	8	RM	T	M
9. Truong Chinh-Minh Khai	Nga Tu So- Nga Tu Vong	2.2	19	11	4	-		2	2	4	4	RM	L	R
	Nga Tu Vong – Mai Dong Bridge	2.2	14	8	2	-		2	2	3	3	RM	W	R
10. Xuan Thuy- Cau Giay	DH Quoc Gia – Ng P Sac	1.0	36	24	4	1.9		2	1	5	5	CB	T	M
	Ng P Sac – Cau Giay	1.5	33	24	4	1.9	83.9	1	1	4	3	CB	T	M
11. Pham Van Dong	DH Quoc Gia – Co Nhue	2.7	22	14	4	1		2	1	4	3	RM	T	M
	Co Nhue – Thang Long Br.	3.2	15	14	4	1		1	1	-	-	RM	T	M
12. An Duong Vuong	Thang Long – Thon Tay	4.0	23	21	4	1			2	0	1	AR	T	W
	Thon Tay – O Yen Phu	4.0	23	21	4	1	42.7	1	1	0	1	AR	M	W
13. Chuong Duong -Ngo Gia Tu	Chuong Duong – NH5	4.0	34	24	4	1		3	-	4.5	4.5	CB	M	W
	NH5 – Cau Duong	3.7	34	24	4	1	42.3	1	-	4.5	4.5	RM	W	W
14. Thang Long-Noi Bai	Thang Long – Phu Cuong	11.0	15	14	4	1		2	-	-	-	IN	W	-
	Phu Cuong – Noi Bai	12.5	15	14	4	-		1	-	-	-	AG	-	-
15. Yen Vien-Dong Anh	Cau Duong - Dong Anh	11.0	7	7	2	-		2	5	-	-	AG	-	-
	Dong Anh – Phu Lo	6.3	7	7	2	-		2	3	-	-	AG	-	-
16. Dong Anh-Soc Son	Phu Lo – Soc Son	6.3	7	7	2	-	14	2	4	-	-	AG	-	-
	Soc Son – Trung Gia	5.0	7	7	2	-		1	2	-	-	AG	-	-

Source: HAIDEP Study Team.

Notes: 1) Street Light: T=both sides and median, W=both sides, L=left side, R=right side, M=median, N=none, (*)=uneven.
2) Planting: T=both sides and median, W=both sides, L=left side, R=right side, M=median, N=none, (*)=uneven.
3) Land Use: R=residential, RM=mixed use, CB=commercial and business, AG=agricultural, IN=industrial.

Table 8.8.2 Assessment of Selected Transportation Corridors[1)]

Corridor		Road way			Intersection		Traffic Management			Public Transport		Amenity			SCORE[2)]
		Maintenance Condition	Lane Management	Facilities	Design	Signal	Traffic Control	Roadside Parking	Safety	Facilities	Services	Greenery	Landscape	Air Quality	
1. Lieu Giai-Tran Duy Hung	Hoang Hoa Tham – Kim Ma	A	A	A	A	B	B	B	B	B	B	A	A	A	27
	Kim Ma – Dai TH Vietnam	B	B	B	B	C	C	B	C	B	B	B	B	B	7
	Dai TH Viet - Cau To Lich	A	A	A	A	B	B	B	B	B	C	A	A	A	25
	C T Lich – RR3	A	A	A	A	B	B	B	B	B	C	A	A	A	25
2. Giang Vo-Lang Ha	Bx Kim Ma – Giang Vo	B	B	B	C	C	C	C	C	B	B	B	B	B	3
	Giang Vo – Dien Anh	B	B	B	B	C	B	C	B	B	C	C	C	B	3
	Dien Anh – Duong Lang	A	A	B	B	B	B	B	B	C	C	B	B	A	15
	Duong Lang – RR3	A	A	A	A	B	B	B	B	C	C	A	A	A	23
3. Ton Duc Thang-Nguyen Trai	Van Mieu – O Cho Dua	C	C	C	C	C	C	B	C	C	B	C	C	C	-9
	O Cho Dua – Nga Tu So	C	C	C	C	C	C	B	C	C	B	C	C	C	-9
4. Le Duan –Giai Phong	Dien Bien Phu – Nikko	C	C	C	C	C	C	B	C	C	B	C	C	C	-9
	Nikko – Back Khoa	B	C	B	B	C	C	B	C	B	B	C	C	B	1
	Back Khoa – Nga Tu Vong	A	B	B	A	C	B	B	B	B	B	B	B	B	15
	Nga Tu Vong – Bx Giap Bat	A	B	B	A	C	B	B	B	B	B	B	B	B	15
5. Yen Phu-Tran Quang Khai	O Yen Phu – Long Bien	A	B	B	C	C	B	B	B	B	B	B	B	B	11
	Long Bien – Chuong Duong	B	C	B	C	C	C	C	C	C	A	C	C	C	-5
	Chuong Dng – T Khanh Du	B	C	B	B	B	C	C	C	B	A	B	B	B	7
6. La Thanh-Kham Thien	Cau Giay – Nguyen Chi Thanh	D	D	D	C	C	D	C	D	D	D	B	D	C	-27
	DT Vietnam – Giang Vo	D	D	D	C	C	D	C	D	D	D	B	D	C	-27
	Giang Vo – O Cho Dua	D	D	D	C	C	D	C	D	D	D	B	D	C	-27
	O Cho Dua – Le Duan	C	C	C	C	C	C	C	D	C	C	D	C	C	-17
7. Huynh Thuc Khang-Chua Boc	Nguyen Chi Than – Lang ha	B	B	B	B	B	B	B	B	C	C	B	B	B	9
	Lang ha – Chua Boc	B	B	B	C	C	B	B	B	B	B	B	C	C	5
	Chua Boc – Ngoc Thach	B	B	B	C	C	B	B	B	B	B	B	C	C	5
8. Ton That Tung-Tran Khat Chan	Truong Chinh – Chua Boc	D	D	D	C	C	C	C	C	C	C	B	C	B	-15
	Chua Boc – Bach Khoa	C	C	C	C	C	C	B	C	B	B	C	C	C	-7
	Bach Khoa – O Dong Mac	B	B	B	B	C	B	B	B	B	C	B	B	B	9
9. Truong Chinh-Minh Khai	Nga Tu So- Nga Tu Vong	B	B	C	C	C	C	B	C	B	B	C	C	B	-1
	Nga Tu Vong – Mai Dong Bridge	D	D	C	C	C	C	C	C	B	B	D	D	C	-17
10. Xuan Thuy-Cau Giay	DH Quoc Gia – Ng P Sac	B	B	B	B	C	B	B	B	B	B	B	B	B	11
	Ng P Sac – Cau Giay	B	B	B	B	C	B	B	B	B	B	C	C	C	5
11. Pham Van Dong	DH Quoc Gia – Co Nhue	B	B	C	C	C	B	B	B	B	B	B	C	C	3
	Co Nhue – Thang Long Br.	B	B	C	C	C	B	B	C	B	B	B	C	C	1
12. An Duong Vuong	Thang Long – Thon Tay	A	A	A	B	B	B	B	B	C	C	C	C	A	13
	Thon Tay – O Yen Phu	A	A	A	B	B	B	B	B	C	C	C	C	A	13
13. Chuong Duong -Ngo Gia Tu	Chuong Duong – NH5	C	C	C	C	C	C	B	C	B	A	C	C	D	-7
	NH5 – Cau Duong	A	A	B	B	B	B	B	B	B	B	B	B	A	19
14. Thang Long-Noi Bai	Thg Long – Phu Cuong	B	C	B	C	C	C	B	C	B	B	C	C	B	-1
	Phu Cuong – Noi Bai	B	C	B	B	C	C	A	C	B	B	C	C	B	3
15. Yen Vien-Dong Anh	Cau Duong - Dong Anh	C	C	B	B	C	C	C	C	C	C	B	B	B	-3
	Dong Anh – Phu Lo	C	C	B	B	C	C	C	C	C	C	B	B	B	-3
16. Dong Anh- Soc Son	Phu Lo – Soc Son	C	C	B	B	C	C	B	C	C	C	B	B	B	-1
	Soc Son – Trung Gia	C	C	B	B	C	C	B	C	C	C	B	B	B	-1

Source: HAIDEP Study Team.
1) A = Good, B= Fair, C= Poor, D = Bad
2) Total score based on A (good) = +3, B (fair) = +1, C (poor) = -1, and D (bad) = -3.

Table 8.8.3 Improvement Measures for Selected Transportation Corridors

Countermeasure	Corridor															
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
	Lieu Giai - Tran Duy Hung	Giang Vo – Lang Ha	Ton Duc Thang – Nguyen Trai	Le Duan – Giai Phong	Yen Phu – Tran Quang Khai	La Thanh – Kham Thien	Huynh Thuc Khang – Chua Boc	Ton Thai Tung – Tran Khat Chan	Truong Chinh – Minh Khai	Xuan Thuy – Cau Giay	Pham Van Dong	An Duong Vuong -	Chuong Duong – Ngo Gia Tu	Thang Long – Noi Bai	Yen Vien – Dong Anh (NH3)	Dong Anh - Soc Son (NH3)
1. Carriageway Improvement																
• Pavement Rehabilitation	X	C	C	C	X	A	C	C	B	X	X	X	C	X	C	C
• Drainage Improvement	X	C	C	C	X	A	C	C	A	X	X	X	C	X	B	B
• Median Installation	X	X	X	B	X	B	X	C	A	X	X	X	X	X	A	A
• Street Light	X	X	X	C	X	C	X	X	C	X	X	X	X	B	C	C
• Streetscape Improvement	X	X	C	B	X	C	X	X	C	X	C	X	C	C	C	C
2. Intersection Improvement																
• Geometric Improvement	B	B	B	B	B	A	A	A	B	C	A	C	B	B	A	A
• Signalization	B	B	B	B	B	A	C	C	B	C	A	C	B	A	A	A
• Signal Coordination	X	X	C	X	X	X	X	X	X	X	X	X	X	X	X	X
• Left Turn lane	B	C	B	B	X	C	A	C	C	C	A	X	B	B	B	B
• Grade Separation	C	X	C	C	X	X	C	C	C	X	X	X	X	C	X	X
3. Traffic Management																
• Roadside Parking Control	B	B	B	B	B	B	A	A	A	B	B	X	B	X	C	C
• One way system	X	X	X	C	X	C	X	X	X	X	X	X	X	X	X	X
• Truck Ban	X	C	B	C	C	B	C	C	C	X	X	X	X	X	X	X
• NMV Traffic Management	X	C	C	C	B	C	C	C	C	C	A	B	B	A	B	B
• Signs and Marking Improve.	X	C	C	B	B	B	C	C	B	C	B	C	C	B	B	B
4. Traffic Safety																
• Lane Separation	C	C	C	C	C	X	C	C	C	C	C	X	C	B	C	C
• Guardrail for Pedestrian	C	C	B	B	B	C	C	B	C	B	A	C	C	X	C	C
• Pedestrian Crossing with signal	B	B	C	C	B	C	B	B	B	B	A	C	C	A	B	B
• Pedestrian Bridge/Underpass	C	C	C	C	C	X	C	A	X	C	C	X	C	B	X	X
• Enforcement/Education	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A
5. Public Transportation																
• Bus Stop Facility Improve	B	C	C	C	C	B	C	C	B	C	B	C	C	C	B	B
• Network Connectivity Imprvmt.	B	A	A	A	B	B	A	B	B	C	C	C	C	C	C	C
• Bus Priority Lane	X	C	C	C	C	X	C	C	C	C	X	X	X	C	X	X
• Bus Location System	C	C	C	C	C	C	C	C	C	C	C	C	C	C	C	C
• Bus Safety and Comfort Imp.	B	B	B	B	B	B	B	B	B	B	B	B	B	B	B	B
6. Pedestrian Environment																
• M/C parking control	B	B	A	A	A	A	A	A	B	B	C	X	C	X	C	C
• Sidewalk Pavement Improve.	C	C	B	B	B	C	C	C	B	X	C	X	C	X	C	C
• Pedestrian Mall	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
• Street Furniture	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
• Sidewalk Development	X	X	X	X	X	X	X	X	X	X	X	X	X	X	A	A

Source: HAIDEP Study Team.
1) A = Highly necessary, B= Necessary, C= For further study, D = Unnecessary.

Table 8.8.4 Short-term Traffic Management Policies

Short-term Policy	Action (Measure)	Remark
1. Control of Motorization Growth	(1) Garage registration for car owners. (2) Designated district for TDM. (3) Traffic control ex. one way, no entry, etc. (4) Increase of tax on vehicle ownership and operation (gasoline). (5) Enhancement of public transportation system	• Development of the detail roles and regulations • TDM for the Ancient Quarter • Including enhancement of the changes from motorcycle to public transport use
2. Effective Usage of the Limited Road Space by Traffic Control and Management Measures	(1) Strengthening of ban on illegal parking and vendors. (2) Intersection improvement and effective signal operation. (3) Improvement of pedestrian environment including provision of crossing facilities. (4) Control of safety in traffic flows (no mixed traffic flows). (5) Promotion of comprehensive traffic control and management measures.	• Parking control on the sidewalk • Provision of the hard median and one-way system for narrow streets • Corridor or area comprehensive traffic management system
3. Enhancement of the Traffic Safety Measures	(1) Elimination of accident black spots. (2) Strengthening of traffic enforcement (3) Improvement of traffic education systems. (4) Improvement of emergency medical services. (5) Development of comprehensive traffic safety program.	• Not only engineering improvement, also should coordinate with enforcement and education program • 3Es or 4Es comprehensive approach (Engineering, Education, Enforcement and Emergency)
4. Development of Efficient Parking Systems	(1) Development of roadside parking plan. (2) Imposition of parking fees and parking development fund. (3) Encouragement of off-road parking facilities. (4) Parking facility provision regulation for commercial buildings, institutions, etc. (5) Development of parking information systems.	• Development of the parking management system taking into consideration the road functional classification, particularly in the ancient and old urban areas. Parking ban for primary roads and secondary or tertiary roads with less traffic demand will be useful for the road side parking)
5. Capacity Development	(1) Traffic Police (2) Traffic inspectors (3) Traffic engineers (4) Traffic Safety Committee (5) Improvement of the design standard, roles and regulations.	• Capacity for the planning and implementation for the comprehensive traffic management and safety, including institutional capability

Source: HAIDEP Study Team.

Table 8.8.5 Traffic Management Improvement Directions by Area

Area	Direction	Key Intervention
1. Ancient Quarter	• Enhance mobility by walking, and using NMVs. • Accessible by public transportation.	• Eliminate through traffic. • Prioritize public transportation. • Enhance pedestrian environment.
2. French Quarter	• Good mobility within the area. • Accessible by public transportation.	• Ensure efficient traffic operation at intersections. • Maintain and upgrade existing traffic control facility. • Manage parking.
3. Urban Core Districts (excluding Hoan Kiem)	• Secure maximum capacity while enhancing traffic safety. • Prioritize public transportation.	• Improve bottlenecks. • Upgrade traffic control facilities. • Segregate 2- and 4- wheel vehicles.
4. Suburbs (other districts)	• Provide basic traffic management facilities. • Prioritize public transportation.	• Provide basic facility. • Segregate 2- and 4-wheel vehicles. • Protect pedestrians and bicycle users. • Analyze and improve accident-prone spots and sections.

4) Improvement of Critical Intersections and Corridors

(1) Short-term Traffic Management Process

Through site observations and traffic surveys conducted during the HAIDEP Study, traffic management problems were identified at bottleneck intersections and along corridors. These problems, which make traffic inefficient and hazardous, can be rectified in a relatively short time by applying improvement measures. A short-term traffic management project has been formulated to address these problems. The measures to be implemented include intersection geometry improvement, installation of medians and corner islands, signal installation, signal timing review and updating, as well as installation of pavement markings, traffic signs, delineators, and other traffic control devices. The candidate bottleneck points for this project are listed in Table 8.8.6. The implementation of this project must be decided after coordination with other projects.

(2) Signal and Associated Systems Project

Since signals are an important traffic management tool, this proposed project intends to establish an efficient signal system covering the whole city (see Figure 8.8.2). A total of 600 signals are expected to operate by 2020. Most of them or about 500 signals will be ATC (area traffic control) system signals connected to the ATC center to be established. The remaining signals will either be isolated or coordinated signals.

Currently, there are two ATC systems operating in Hanoi. A French system was introduced several years ago, while an American system is being installed which is scheduled to be fully operational by December 2005. The existing French local controllers will be replaced in 2008 with new ones, together with the establishment of a new traffic management center. In 2013, the American system will be integrated with the new system.

Table 8.8.6 Identified Intersections for Short-term Traffic Management Improvement

Intersection	Location
1	Duong Buoi - Duong Hoang
2	Lang Ha - Thai Ha/Huynh Thuc Khang
3	Duong Nghi Tam/Duong Yen Phu - Duong Thang Nien/An Duong
4	Duong Yen Phu/Tran NH. Duat - Hang Dau
5	Hang Dau - Hang Than/Hang Giay
6	Duong La Thanh/Kham Thien - Nguyen Luong Bang/Ton Duc Thang
7	Tay Son - Thai Ha/Duong Chua Boc
8	Pham Ngoc Thach/Ton That Tung - Duong Chua Boc/Dong Tac
9	Duong Dai Co Viet Tran - Bach Mai/Pho Hue
10	Le Duan – Tran Nhan Tong
11	Le Duan – Dai ACo Viet
12	West end of Chuong Duong Bridge

Figure 8.8.2 Identified Locations for Short-term Traffic Management Improvement

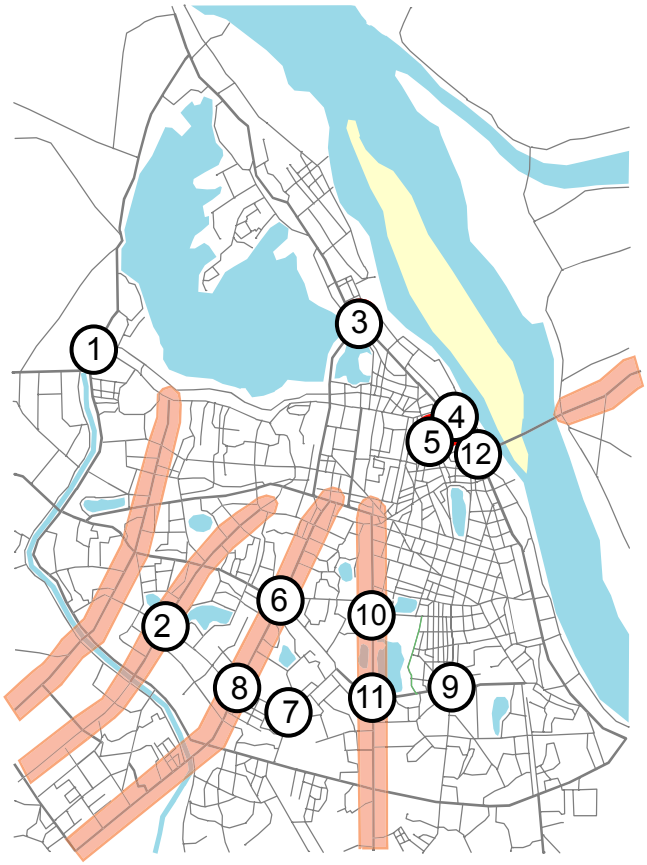


Table 8.8.7 Schedule of Signal Systems Project

Period	ATC System	Local Controller		
		New	Replacement	Total
- 2010	Establishment of traffic management center.	140	100	300
2011 - 2015	Integration of American system with new system.	150	60	450
2016 - 2020		150	0	600
Total		440	160	

Note: As of October 2005, there were 160 signals operating in Hanoi.

In conjunction with the signal system expansion, other systems, such as closed circuit television (CCTV) monitoring systems, driver information systems (DISs), and other intelligent transportation systems (ITSs), will either be expanded or introduced.

The existing CCTV traffic monitoring system will be reorganized and integrated with the traffic management center to be established. A driver information system will be introduced in 2008 to provide road users with traffic information. An ITS system, most probably real-time route guidance system, is expected to start operation in 2016.

5) Parking

(1) Parking Demand

Parking demand is expected to grow rapidly. Parking demand in 2020 was forecasted using traffic model and increases or decreases from the estimated current (2005) parking demand is calculated. The parking demand of 2-wheel vehicles will decrease by 367,000 units by 2020, while that of 4-wheel vehicles will increase by 184,000 units. Because of the difference in the unit parking area, the required parking area in 2020 will be much larger than the currently available parking area. Moreover, parking facility development must focus on 4-wheel vehicles.

Table 8.8.8 Future Daily Parking Demand

Unit: '000 vehicles

		Parking Demand, 2005		Parking Demand, 2020		Increase/ Decrease		
		2W	4W	2W	4W	2W	4W	(2020/2005)
1	Ba Dinh	338	9	251	29	-86	20	3.3
2	Hoan Kiem	370	155	271	33	-99	18	2.2
3	Hai Ba Trung	466	18	367	51	-98	35	3.4
4	Dong Da	481	11	390	38	-90	28	3.6
5	Tay Ho	169	3	154	16	-15	14	6.0
6	Thanh Xuan	248	7	224	19	-25	12	2.8
7	Cau Giay	234	6	222	24	-12	18	4.1
8	Hoang Mai	221	7	329	30	108	23,	4.3
9	Long Bien	291	12	242	28	-49	16	2.3
	Total	2,817	84	2,450	268	-367	184	3.2

Note: 2W: 2-wheel vehicles, 4W: 4-wheel vehicles.

(2) Supply of Parking Facilities

These parking demands may not necessarily be provided by the public sector alone. On the contrary, most of them must be satisfied by the private sector. In this context, a parking development policy must be formulated, clearly defining the roles of the public and private sectors. The basic rule is that parking facilities must be provided by buildings or institutions from which the parking demand is generated. More specifically, the recommended basic parking policy can be stated as:

(i) Exclusive parking must be provided by concerned buildings or institutions.

(ii) Buildings of certain type and size must have adequate parking facility.

(iii) Public parking is limited to short-term parking for the public.

Based on this policy, vehicles used for commuting and going to school must be accommodated by the parking to be provided by work places and schools. Likewise, office buildings and commercial establishments that generate large parking demand must have parking facility of adequate capacity. Vehicle owners must have their own parking places at home or in their respective bases.

If this principle is strictly followed, the demand for short-term parking would be less than 20% of the total parking demand, because “to work,” “to school,” and “to home” trips occupy more than 80% of total trips. In reality, however, parking facilities cannot be developed in a short time and a shortage of parking supply will result in illegal, on-road parking. In addition to short-term parking, therefore, public parking is necessary to address the supply shortage.

The role of the public sector is to develop the following types of parking facilities:

(i) Parking areas in high parking demand areas where there is an urgent need for such facilities.
(ii) Parking areas using part of the land for road.
(iii) Parking areas to be constructed within public facilities and parking using public land.

The share of public parking will depend on the area. The suggested target share is 10 - 30% of the total short-term parking demand, with a higher share for areas where sufficient supply by the private sector cannot be expected.

On the other hand, the private sector is requested to provide parking facilities for the demand which its activities will generate. The existing building code sets the parking requirements for certain types of buildings. The definition of the terms used in the regulation is not clear, however. A clearer requirement and implementation guidelines must be formulated.

(3) Parking Management

It is necessary to create an environment in which parking can be financially viable as private business. For this purpose some priority measures, such as property tax reduction or low interest loan to encourage the private sector to enter into the parking business, can be considered. Under present circumstances, however, constructing office buildings is much more viable than venturing into the parking business.

Other measures necessary for efficient parking management include the following:

(i) Enforcement of parking bans at prohibited places.
(ii) Parking in public spaces, such as on the road and on sidewalks, must be managed by authorized organizations.
(iii) All public parking must be charged.
(iv) Time-based parking fee system must be introduced in high parking demand areas.
(v) Introduction of a parking guidance system for the efficient operation of parking facilities.
(vi) Designation of loading/unloading zones for goods and cargo in commercial areas separate from parking spaces.

(4) Public Parking Development Project

Parking facilities will be developed to provide the public with parking space. The required public parking facilities for each period is summarized in Table 8.8.9.

Table 8.8.9 Public Parking Facilities

Unit: 000 vehicles

District		Facility by Period			Total
		-2010	-2015	-2020	
1	Ba Dinh	80	120	190	390
2	Hoan Kiem	150	150	200	500
3	Hai Ba Trung	140	260	260	660
4	Dong Da	110	160	260	530
5	Tay Ho		60	80	140
6	Thanh Xuan		50	70	120
7	Cau Giay		70	110	180
8	Hoang Mai		90	130	220
9	Long Bien		70	90	160
	Total	480	1,030	1,390	2,900

6) Traffic Demand Management

(1) Area Licensing

Area licensing is a traffic management scheme that restricts the use of private vehicles in designated areas to alleviate traffic congestion and at the same time promote the use of public transportation. The basic idea is that when an area is specified as restricted, charges are levied on vehicles entering that area during certain times of the day. The charge works as a disincentive for using private vehicles. People may choose to use other modes of transportation to avoid the charge, or change the time of travel to off-peak hours when the charge is smaller or none.

Road pricing adopts an economic rule, and the higher the charge, the bigger the impact, resulting in more reductions in the traffic entering restricted areas. Collected charges would be used for improvement of transportation. But it could have adverse effect on the people's mobility, accessibility, and social and economic activities. Thus careful study, planning, and design are required. Table 8.8.10 lists the items to be considered.

It is not too early for Hanoi to study the feasibility of area licensing system. Because the success of the system depends not only on technical adequacy but also on social consensus as to the necessity of the system, all this takes time to develop. An initial idea for area licensing in Hanoi is the designation of Hoan Kiem and Hai Ba Trung districts as restricted areas. Vehicles, including motorcycles, entering these restricted areas will be charged. As a future step, the restriction can be expanded to include the two districts of Ba Dinh and Dong Da. To complement the area licensing system, parking on public areas will be charged with higher parking fees.

(2) Traffic Demand Management Project

An area licensing system is planned for the central area of Hanoi. It will employ an automatic fare charging system with the gates to be erected at the boundaries of the restricted areas. Vehicles will be required to carry an on-board unit which will communicate with the gate. Fare will automatically be deducted in the case of pre-paid cards or charged in the case of post-paid ones. The estimated cost of the system is US$ 54.8 million.

Table 8.8.10 Study Items for Area Licensing System

Category	Subject
Restriction	• Area • Day and time • Targeted vehicles • Inner traffic • Impact on adjacent areas
Charge	• Amount of charge • Fixed or flexible fee • Collection method
Driver Information	• Guide signs • Media
Enforcement	• Monitoring method • Monitoring location • Enforcement • Countermeasure against fraud
Operating Agency	• Authority and responsibility for policy making, system administration, operation monitoring, enforcement, logistics, and fee collection

7) Institutional Arrangement and Capacity Building

In Hanoi, two permanent organizations are directly involved in traffic management. These are TUPWS and the Traffic Police. Besides them, project management units (PMUs) are set up to undertake specific projects. Currently, a PMU under TUPWS is implementing the World-Bank funded "Vietnam Urban Transport Improvement Project" (VUTIP).

As presented earlier, the traffic management process is a cycle to be pursued repetitively. Continued effort must be exerted to consistently improve the traffic situation, as traffic demand and pattern gradually changes with time. It seems, however, that there is no clearly defined mechanism in the existing institutional setup to trigger or initiate the process. TUPWS undertakes planning and design but it is not clear how such tasks are initiated. The Traffic Police deploys policemen to intersections and enforces traffic regulation. But they do not take the initiative in formulating traffic management projects. Thus, it is necessary to define the tasks of each organization, including PMUs, in the traffic management process.

Another weakness in the traffic management of Hanoi is human resources. Traffic engineering and management are relatively new areas of expertise in Vietnam, and there are few experts in these fields. The staff of TUPWS, the Traffic Police, and PMUs do not receive enough training. And from the viewpoint of traffic engineering, existing road facilities are not optimized. Traffic can be more efficient and safer if there is knowledge of traffic engineering and management and if this is effectively applied.

In the HAIDEP Traffic Management Plan, training is recommended for two target groups, traffic engineers and traffic police. Different subjects will be taught to these two groups.

Traffic Management Capability Building Project: This project will be carried out to enhance the capabilities of the staff of organizations responsible for traffic management.

A team of professionals in traffic management will be invited to conduct classroom training on various aspects of traffic management including intersection geometry, traffic survey

and analysis, signal design, pavement marking design, traffic sign, etc. The training period will be 24 months. The first year will be spent mostly on classroom training, while the application of improvement measures will be carried out during the second year.

Design standards will be established as an output of the training. These standards will be compiled into manuals, which will be printed and distributed to national and local government organizations responsible for traffic management. The estimated cost is shown below.

Table 8.8.11 Subjects in Traffic Management Training

Group	Traffic Engineer	Traffic Police
Subject	• Road design standards • Traffic flow theory • Traffic survey • Intersection design • Signal design • Traffic engineering software • Pavement marking and traffic sign • Other traffic control devices • Traffic law and regulation	• Traffic laws and legislation • Enforcement and prosecution procedure • Traffic control and surveillance • Traffic signal operation • Road traffic safety • Use of testing equipment

8) Traffic Safety

(1) Coverage

Currently, the Traffic Police Department in Hanoi has enhanced the enforcement of traffic regulations and has apprehended drivers violating them such as running a red light, reckless driving, and others. Traffic safety facilities, including traffic signals have been improved, so that the number of traffic accidents and fatalities in Hanoi has stopped increasing.

Even though the number of traffic accidents has decreased, the rate of accidents per population size and number of vehicles is still very high. It is thus very important to enforce traffic regulations and penalize violators. But more importantly, such efforts to be effective must be in accordance with the changes in motorization, i.e. from bicycles to motorcycles, from motorcycles to cars, and so forth.

In response to social needs, traffic safety is made as one of the components of HAIDEP's urban transportation subsector. Therefore, the traffic safety master plan which HAIDEP has prepared was based not only on the current accident situation, but also on institutional conditions because traffic safety covers wide-ranging issues, such as engineering, education, enforcement, and emergency medical care. Thus the *Hanoi Traffic Safety Master Plan* will promote a comprehensive approach to traffic safety and will hew closely to the objectives of the "Comprehensive Urban Development Program for Hanoi up to 2020." Detailed programs and actions plans, including a five-year safety program, will be elaborated further.

(2) Es (Engineering, Education, Enforcement, and Emergency)

(i) Traffic Safety Facility Development

- Improve intersections.
- Install guardrails, median, street lights, and other safety facilities.
- Provide sidewalks and bicycle lanes.

- Install road traffic markings and signs.

(ii) Traffic Control and Enforcement

- Strengthen enforcement on the accident black spots.
- Provide sufficient equipment to strengthen traffic enforcement.

(iii) Traffic Safety Education

- Include practical, daily guidelines on traffic safety in school curriculum.
- Promote driver education.

(iv) Emergency Medical Care

- Develop first-aid centers.
- Promote a traffic accident insurance system.

(3) Focus Areas for the Comprehensive Traffic Safety Program

Another significant aspect that will guarantee the success of a traffic safety program is public compliance with traffic safety regulations. Thus, it will be indispensable to have a comprehensive strategy on urban traffic safety for Hanoi City which should be resolutely carried out in the long term. This strategy should include the following:

(i) Strengthen safety planning and implementation capacity.

- Improve accident databases and analytical capacity.
- Develop adequate design standards.
- Establish adequate costing/funding mechanisms for safety projects/programs.

(ii) Build basic social infrastructure for safety enhancement, including;

- Launch awareness campaigns on safety for the entire society including the public and private sectors, various industries and communities, on which social consensus will be built and a strong policy commitment can be established.
- Establish a mechanism on traffic safety publicity, campaign, and education.
- Strengthen enforcement and practice of basic traffic management.

(iii) Develop/Improve safety measures and mechanism.

- Improve vehicle safety by strengthening safety inspection and standards.
- Improve driving and observation skills through training and testing.
- Establish an effective safety audit system.

(iv) Develop Institutions including:

- Enact necessary laws and regulations on traffic safety.
- Strengthen safety organizations and their management capacities (e.g. form a Comprehensive Traffic Safety Unit [tentative name]).
- Improve agency coordination on traffic safety.

(v) Formulate a coordinated program and establish a workable mechanism at the local level.

- Provide stakeholders with a clear, long-term vision and targets (next 10 years) and specific medium-term (3 - 5 years) and short-term (1 - 3 years) action plans.
- Provide sufficient budget for the Comprehensive Traffic Safety Program.

8.9 Evaluation of the Urban Transportation Master Plan

1) Approach

This section explains the evaluation of the proposed urban transportation network and projects comprehensively from the economic, financial, social, and environmental aspects. This process is important to clarify the nature of the projects and the priorities for implementation. The evaluation was made both for the Master Plan as a network and for major individual projects. After the collective network performance was deemed justifiable, individual projects or project packages were evaluated.

2) Performance of the Proposed Network

(1) Overall Performance

In order to grasp the network performance of the master plan, the comparison of demand and supply by area was conducted. Compared to the “do-something” network, the capacity resulted in an overall increase of 1.9 times, and 2.3 times in the east and 1.9 times in the north, where the amount of proposed investments in the HAIDEP master plan is comparatively higher. Due to these investments, the volume capacity ratio was forecasted to be around 0.5 in all areas in 2020 (see Table 8.9.2).

The results of traffic assignment are shown in Table 8.9.3 and Figure 8.9.1. Based on the results, there will be very few congested roads (traffic volume will be below the capacity) in 2020 if the HAIDEP master plan is realized.

The effects of the proposed network can also be seen from the coverage of the areas that can be reached within 30 minutes from a 60-minute travel to/from Hoan Kiem Lake. Without the plan, the coverage is reduced quickly, while with the plan, it can expand farther toward all directions in the city (see Figure 8.9.2).

(2) Demand-Supply Analysis of Bridges Crossing Hong River

Table 8.9.4 compares the capacities and traffic volumes on bridges crossing the Hong River. Based on this analysis, the following can be pointed out:

- In the north of Hanoi, there is only one existing bridge – Thang Long. By 2020, there would be two new bridges constructed which would ease traffic congestion.
- In the east of Hanoi, there are two existing bridges, i.e. Long Bien and Chuong Duong. These bridges have already reached their capacities. By 2020, however, congestion will be alleviated after the construction of the three new bridges of Vinh Tuy, Thanh Tri, and RR4.

As mentioned above, if all the proposed bridges are constructed by 2020, and if the share of public transportation is raised through the proposed policy measures, adequate supply of road space will be guaranteed for cross-river traffic demand. The only problem that will remain is the Chuong Duong Bridge.

(3) Road Development Index

The HAIDEP road network master plan will provide Hanoi with a relatively good level of road network and road area compared with other selected cities in the world (see Figure 8.9.4). Road development in the urban core and urban fringe, as well as in the suburban and rural areas will improve to a great extent. Table 8.9.5 shows the road development index of the HAIDEP road network master plan.

Table 8.9.1 Results of Mini-screen Line Analysis[1)]

SL	2005 Do Nothing Network				2020							
					Do Something Network				HAIDEP M/P Network			
	No. of Links	Capacity (PCU000)	Volume (PCU000)	V/C Ratio	No. of Links	Capacity (PCU000)	Volume (PCU000)	V/C Ratio	No. of Links	Capacity (PCU000)	Volume (PCU000)	V/C Ratio
1	5	124	43	0.35	5	124	94	0.76	5	180	68	0.38
2	4	164	76	0.47	4	164	194	1.19	4	164	112	0.68
3	6	336	132	0.39	6	336	284	0.85	6	336	226	0.67
4	6	204	91	0.44	6	204	263	1.29	9	396	172	0.43
5	5	215	47	0.22	5	215	206	0.96	5	215	185	0.86
6	2	154	43	0.28	2	154	87	0.57	2	154	87	0.57
7	2	57	21	0.36	2	57	49	0.86	2	57	51	0.90
8	3	76	13	0.17	3	76	48	0.63	3	76	43	0.57
9	2	111	58	0.53	2	111	140	1.26	2	111	124	1.11
10	3	56	15	0.26	3	56	53	0.95	4	127	43	0.34
11	5	145	47	0.32	5	177	205	1.16	11	703	293	0.42
12	3	64	13	0.20	3	96	37	0.39	5	255	38	0.15
13	1	64	60	0.93	1	64	232	3.62	3	245	223	0.91
14	2	86	146	1.69	3	197	368	1.87	5	378	346	0.92

Source: HAIDEP Study Team.
1) See Figure 8.2.6 for the location of the mini-screen lines.

Table 8.9.2 Comparison of Area-based Demand and Supply Analysis

Area	2005 Do Nothing Network				2020							
					Do Something (Committed) Network				HAIDEP M/P Network			
	Highway Length (km)	Capacity (PCU*km), 000/Day	Volume (PCU*km), 000/Day	V/C Ratio	Highway Length (km)	Capacity (PCU*km) ,000/Day	Volume (PCU*km), 000/Day	V/C Ratio	Highway Length (km)	Capacity (PCU*km) ,000/Day	Volume (PCU*km) ,000/Day	V/C Ratio
Urban Core	238.9	6,305	3,568	0.57	238.9	6,666	6,656	1.00	241.5	7,688	4,506	0.59
South	172.3	4,892	1,886	0.39	176.5	5,351	5,819	1.09	369.4	7,227	4,439	0.61
West	291.9	8,369	2,512	0.30	296.1	8,939	8,864	0.99	478.2	12,052	5,993	0.50
East	199.4	4,506	2,275	0.50	203.6	4,965	7,247	1.46	346.2	11,644	6,886	0.59
North	440.8	9,198	2,678	0.29	445.0	10,751	11,234	1.04	509.4	19,913	8,357	0.42
Total	1,166.8	28,606	11,426	0.40	1168.5	30,360	34,251	1.13	1207.0	58,524	37,760	0.52

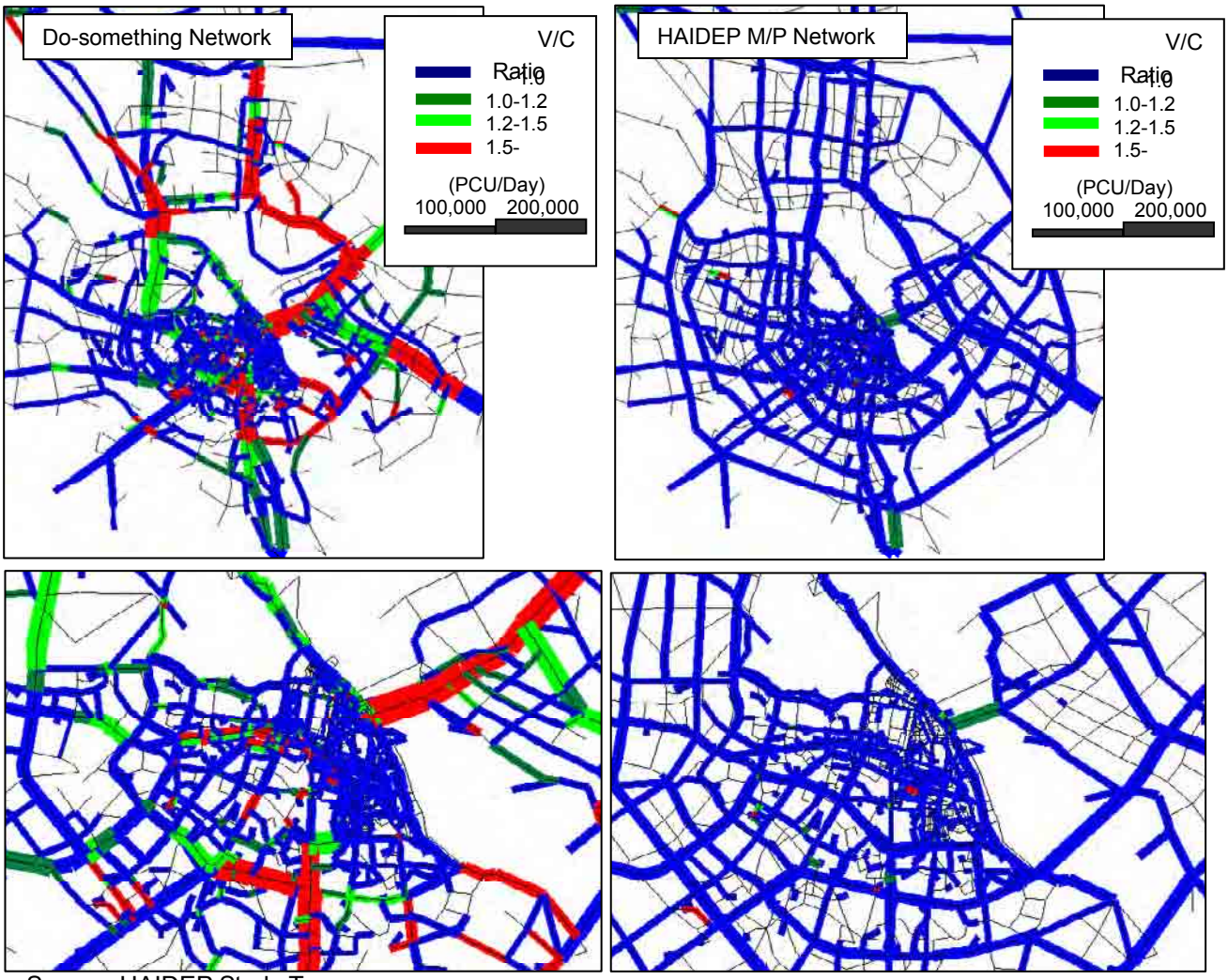
Source: HAIDEP Study Team.

Table 8.9.3 HAIDEP Master Plan Network Performance

Volume/Capacity Ratio (VCR)	Network: Total Link Length		Total Traffic on Links (PCU-km)	
	Km	% of Total	000	% of Total
- 0.5	1,293	44.7	4,160	11.9
0.5 - 1.0	1,534	53.1	29,580	84.4
1.0 - 1.5	37	1.3	780	2.2
1.5 - 2.0	17	0.6	390	1.1
2.0 - 2.5	4	0.1	060	0.2
over 2.5	3	0.1	080	0.2
Total	2,888	100.0	35,060	100.0

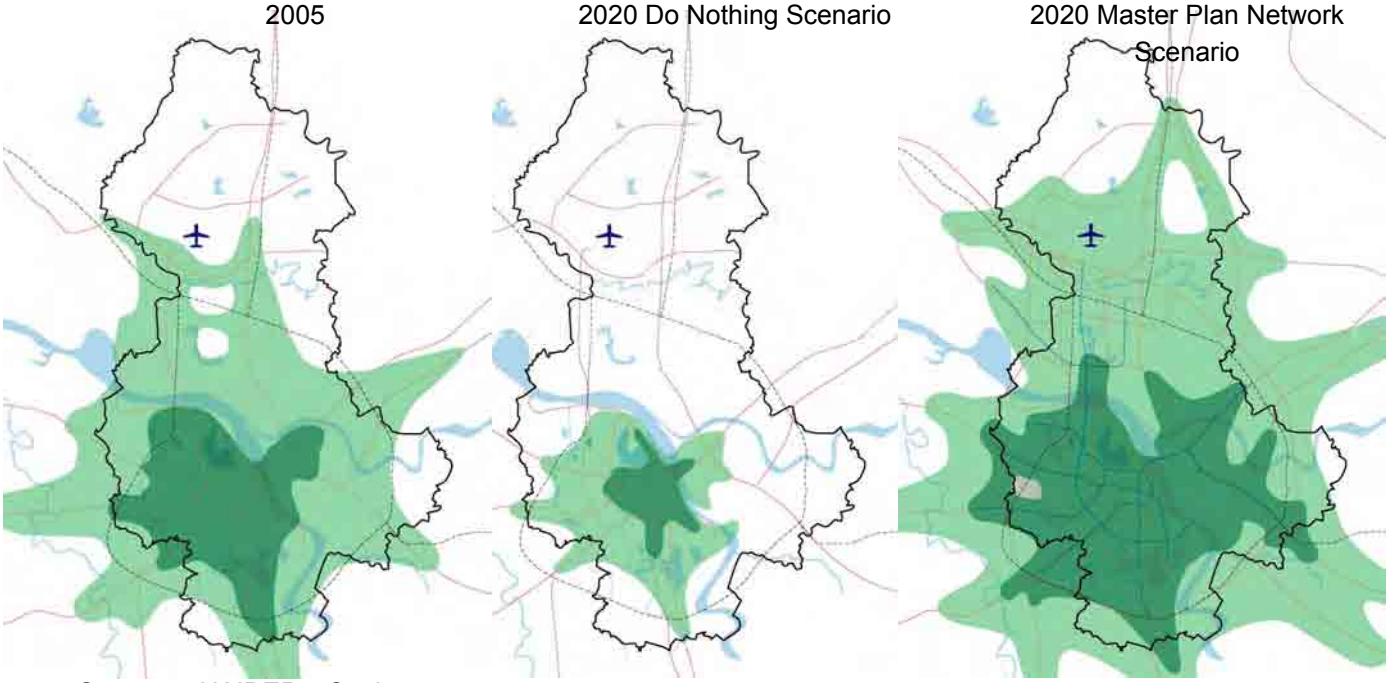
Source: HAIDEP Study Team.

Figure 8.9.1 HAIDEP Master Plan Network Performance



Source: HAIDEP Study Team.

Figure 8.9.2 Areas Reachable within 30- and 60-Minute Travel to/from Hoan Kiem Lake



Source: HAIDEP Study

Figure 8.9.3 Location of Bridges Across the Red River

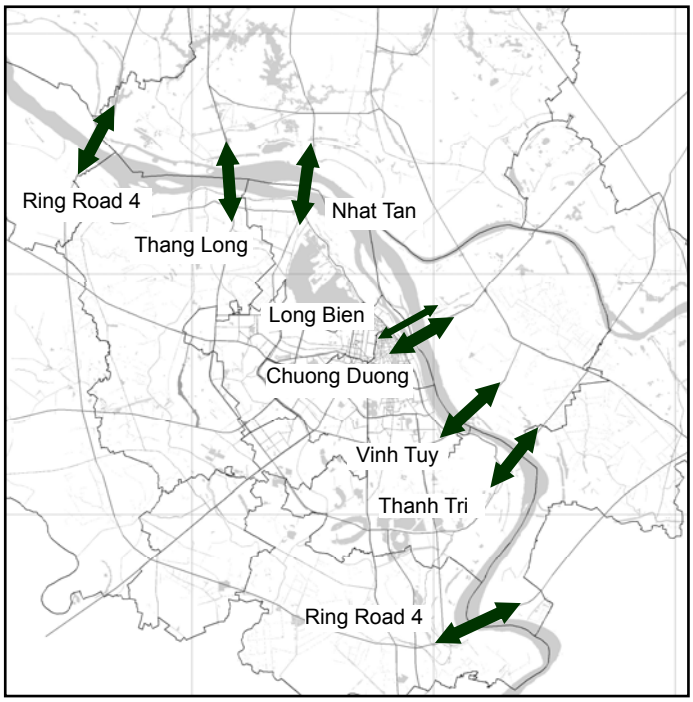


Table 8.9.4 Bridge Capacities vs. Traffic Volumes

Name of Bridges		Capacity (000 PCU)	Traffic Volume (000 PCU)		
			2005	2020	
				Do Something	HAIDEP M/P
North of Hanoi	RR4	88	-	-	64
	Thang Long	64	60	232	58
	Nhat Tan	110	-	-	100
	Subtotal	263	60	232	222
East of Hanoi	Long Bien	9	9	9	9
	Chuong Duong	77	136	250	90
	Vinh Tuy	110	-	-	95
	Thanh Tri	110	-	109	99
	RR4	88	-	-	54
	Subtotal	395	145	368	345

Figure 8.9.4 Comparison of Road Network Densities

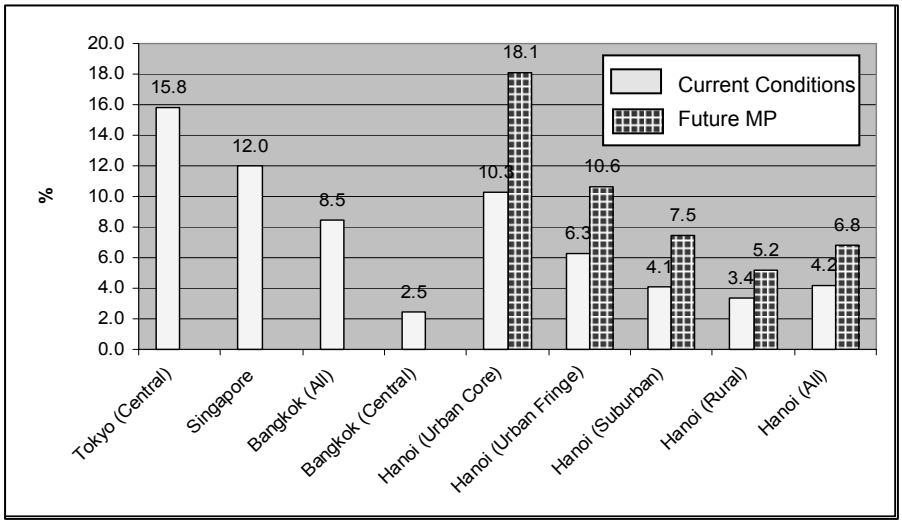


Table 8.9.5 HAIDEP Road Development Index

Area	Net Land (km^2)	2005[5]					2020[5]				
		Population (000)	Total Road Length[1] (km)	Road Ratio[2] (%)	Length/ Area (km/km^2)	Length/ Population (km/000)	Population (000)	Total Road Length[3] (km)	Road Ratio[4] (%)	Length/ Area (km/ km^2)	Length/ Population (km/000)
Urban Core	31	1,053	138	10.3	4.42	0.13	865	183	18.1	5.88	0.21
Urban Fringe	119	827	128	6.3	1.07	0.15	1,549	250	10.6	2.10	0.16
Suburban Area	127	392	108	4.1	0.85	0.28	828	212	7.5	1.67	0.26
Rural Area	558	735	250	3.4	0.45	0.34	1,258	498	5.2	0.89	0.40
Hanoi Total	835	3,008	624	4.2	0.75	0.21	4,500	1,143	6.8	1.37	0.25

1. Total road length: Lengths of district, provincial, and national roads in Hanoi calculated based on the road inventory survey done by the Study Team.
2. Road ratio (road area [km2] / net land area [km^2]): Total right-of-way area of district, provincial, and national roads in Hanoi calculated based on the road inventory survey done by the Study Team.
3. Total road length: Total length of roads which the HAIDEP master plan network categorized as primary, secondary, and tertiary.
4. Road ratio (road area [km2] / net land area [km^2]): Road area was calculated based on the total width of roadway and sidewalk, defined as typical cross-section proposed by the Study Team, and the road length.
5. Road areas were calculated below.

Area		Existing Road Area(km^2)	Project Roads (km^2)			Total Area (km^2)
			Primary/Secondary	Tertiary	Total	
Classi-fication	Urban Core	3.2	0.94	1.46	2.40	5.59
	Urban Fringe	7.5	3.50	1.63	5.13	12.62
	Suburban	5.3	2.94	1.45	4.39	9.67
	Rural	19.1	6.52	3.31	9.83	28.91
	Hanoi Total	35.0	13.90	7.85	21.75	56.79
District	Ba Dinh	0.9	0.27	0.37	0.64	1.52
	Hoan Kiem	0.8	0.02	0.53	0.55	1.33
	Hai Ba Trung	0.9	0.27	0.36	0.63	1.52
	Dong Da	0.6	0.38	0.20	0.58	1.22
	Tay Ho	0.8	0.25	0.13	0.39	1.18
	Thanh Xuan	1.1	0.31	0.18	0.49	1.62
	Cau Giay	1.4	0.37	0.13	0.49	1.94
	Hoang Mai	1.7	1.08	0.48	1.56	3.22
	Long Bien	2.5	1.49	0.71	2.20	4.66
	Tu Liem	3.8	1.81	1.07	2.87	6.64
	Thanh Tri	1.5	1.13	0.38	1.51	3.03
	Soc Son	7.9	2.15	1.18	3.33	11.24
	Dong Anh	6.8	2.62	1.39	4.01	10.82
	Gia Lam	4.4	1.74	0.74	2.49	6.83
	Hanoi Total	35.0	13.90	7.85	21.75	56.79

3) Economic Evaluation

(1) Evaluation Method

Economic evaluation was conducted on the road and railway projects by carrying out the cost-benefit analysis through a “with and without comparison”. Economic benefit was defined as the savings in vehicle operating cost (VOC) and travel time cost (TTC) brought about by the implementation of a project. For the application of this approach, unit VOC and TTC were estimated.

(2) Evaluation of Road Projects

Table 8.9.6 shows economic transport cost of three representative cases for the two “snapshot” years 2010 and 2020. The estimation was made by assuming construction period of 2006 - 2009 and service commencement in 2010 for all the projects.

By comparing the benefit of the Master Plan and individual projects with their economic

cost (assuming to be 85% of financial construction cost and 100% of land and compensation cost), the evaluation indicators were calculated as shown in Table 8.9.7. The entire road projects (except TR01) of HAIDEP master plan showed an EIRR of 21.0% which suggests the Plan as a whole was highly feasible, economically.

The EIRRs of Individual projects are mostly over 12%. The highest one is 37.1% of TR 09 and there are 3 projects with EIRR over 30%. On the other hand, only three projects showed EIRR lower than the threshold of 12%: 10.7% of TR02, 9.8% of TR40 and 11.8% of TR28. If, in the future, land cost lowers down to a reasonable level, the EIRR of these three projects will be higher.

Table 8.9.6 Economic Evaluation of Highway Project Packages

Item	Unit	Vehicle Type	Do Nothing		Do Something		Do Maximum	
			2010	2020	2010	2020	2010	2020
Passenger-Hour	Million/ Year	Motorcycle	329	782	275	665	169	277
		Car	121	855	104	764	59	286
		Bus	193	709	159	565	128	276
PCU-Km		Motorcycle	1718	1986	1712	1974	1686	1905
		Car	1515	4709	1517	4754	1499	4746
		Bus	396	588	394	584	450	655
		Truck	2310	5801	2293	5769	2096	5708
Travel Time Cost (TTC)	Million US$/Year	Motorcycle	496	1304	458	1109	282	462
		Car	275	2116	257	1890	147	708
		Bus	231	942	212	751	170	366
		Total TTC	1002	4362	927	3750	599	1536
Vehicle Operating Cost (VOC)		Motorcycle	156	270	140	235	110	148
		Car	157	736	147	670	119	436
		Bus	42	107	39	89	40	66
		Truck	208	924	190	818	131	460
		Total VOC	564	2039	516	1813	399	1111
Total Cost		TTC+VOC	1566	6401	1443	5563	998	2648

Source: HAIDEP Study Team.

Table 8.9.7 Results of Economic Evaluation of Road Projects

Project Package		Economic Project Cost	Plus Case			Ecomno			Average E-IRR (%)
Code	Project Name	(US$ mill.)	Benefit (US$mill.)		E-IRR (%)	Benefit (US$mill.)		E-IRR (%)	
			2010	2020		2010	2020		
TR01	Ongoing and Committed Project	916.8	-	-	-	-	-	-	-
TR02	CBD Center Area Upgrade	174.9	14.5	49.7	14.5	4.9	16.7	7.0	10.7
TR03	Ring Road 2 (Nhat Tan Bridge Section)	423.8	14.2	101.4	19.5	3.7	99.2	22.1	20.8
TR04	Ring Road 2 (CBD West Section)	83.0	1.1	60.5	26.9	1.3	15.3	13.3	20.1
TR05	Ring Road 2 (CBD South Section)	128.4	7.4	24.5	11.5	6.5	33.8	14.1	12.8
TR06	Ring Road 2 (Vinh Tuy Bridge Section)	302.3	34.7	115.2	20.4	6.7	60.5	14.6	17.5
TR07	Ring Road 3 (South West Section)	302.9	22.9	203.7	22.2	1.4	34.1	12.5	17.4
TR08	Ring Road 3 (South East Section)	86.9	32.6	114.0	33.7	2.8	37.8	19.8	26.8
TR09	Ring Road 3 (North East Section)	122.9	49.4	357.8	44.9	10.3	138.3	29.2	37.1
TR10	Ring Road 3 (North Section)	128.1	4.2	142.2	34.9	1.5	23.8	18.7	26.8
TR11	Ring Road 4 (West Section)	255.5	18.8	228.9	27.2	3.5	67.7	18.1	22.6
TR12	Ring Road 4 (South West Section)	157.9	16.8	242.9	32.4	2.6	62.3	21.5	26.9
TR13	Ring Road 4 (South East Section)	450.5	21.0	217.4	21.6	3.8	136.4	21.3	21.5
TR14	Ring Road 4 (North Section)	131.7	20.8	210.3	32.4	1.4	35.2	18.4	25.4
TR15	NH 2 West	30.0	1.7	6.0	12.3	0.6	27.0	28.7	20.5
TR16	East West Highway North in the North	24.0	0.7	10.2	20.2	1.7	13.2	21.5	20.9
TR17	East West Highway in the North	51.3	1.2	96.1	35.9	1.1	1.2	1.3	18.6
TR18	East West Highway South West	17.6	0.2	2.2	11.9	0.3	5.0	18.0	15.0
TR19	East West Highway in the South East	89.7	6.0	126.3	44.2	0.2	5.0	16.3	30.3
TR20	North South Highways in the North	248.1	7.1	222.2	30.7	6.4	92.3	21.8	26.2
TR21	North South Express Way (NH3)	111.2	0.1	31.1	28.9	0.5	2.3	1.4	15.2
TR22	North South Highways in the South	18.0	1.7	20.7	27.5	1.0	1.2	5.1	16.3
TR23	North South Express Way (NH1A)	35.1	5.0	27.4	23.8	0.7	6.0	12.2	18.0
TR24	West Corridor (R3)	43.2	6.0	6.9	11.2	0.2	5.0	13.0	12.1
TR25	NH32 North Corridor (Inner RR3)	148.8	2.8	92.2	24.0	2.5	16.4	9.0	16.5
TR26	NH32 North Corridor (Outer RR3)	365.1	5.8	93.4	16.1	5.4	37.7	8.7	12.4
TR27	Lang Hoa Lac North Corridor (Inner RR3)	128.8	1.4	37.3	18.3	1.2	11.6	8.7	13.5
TR28	Lang Hoa Lac North Corridor (Outer RR3)	203.9	1.8	30.6	13.0	2.3	25.0	10.6	11.8
TR29	CBD South West Area Upgrade	220.8	23.7	88.3	17.4	8.9	47.5	12.6	15.0
TR30	NH6 North Corridor Package	218.2	8.7	99.0	19.2	5.1	39.5	12.2	15.7
TR31	NH6 South Corridor Package (Inner RR3)	229.1	21.8	126.9	20.1	5.7	35.9	10.8	15.5
TR32	NH6 South Corridor Package (Outer RR3)	118.2	7.4	119.8	26.2	5.1	30.1	14.1	20.1
TR33	NH1A East Corridor Package in the South	262.0	44.8	155.1	21.6	4.8	45.3	12.3	16.9
TR34	NH5 North West Corridor Package	48.2	10.0	207.7	42.0	5.2	44.7	26.0	34.0
TR35	NH5 North East Corridor Package	34.6	2.5	10.9	16.1	0.8	4.9	10.6	13.3
TR36	NH5 South Corridor Package (Inner RR3)	46.1	13.9	100.8	35.8	4.7	30.1	22.1	29.0
TR37	NH5 South Corridor Package (Outer RR3)	49.6	3.5	57.2	28.3	4.5	28.9	21.6	24.9
TR38	NH1Corridor Package in the East of Hanoi	19.1	0.7	52.2	39.3	0.2	2.7	12.3	25.8
TR39	South East Highway	87.2	0.4	89.5	34.9	0.1	3.7	8.9	21.9
TR40	CBD South East Area Upgrade	75.4	2.3	5.3	5.1	2.2	18.8	14.4	9.8
TR41	RR2-North Ring Road	102.1	0.5	75.3	33.7	0.7	17.6	17.1	25.4
TR42	RR4-RR4	45.0	3.1	123.1	37.9	0.2	8.8	18.2	28.1
TR43	NH2-Noi Bai TL	118.8	4.3	70.1	22.7	2.0	5.0	3.3	13.0
All Project except TR01		6,794	257.4	2915.0	21.0	257.4	2915.0	21.0	21.0

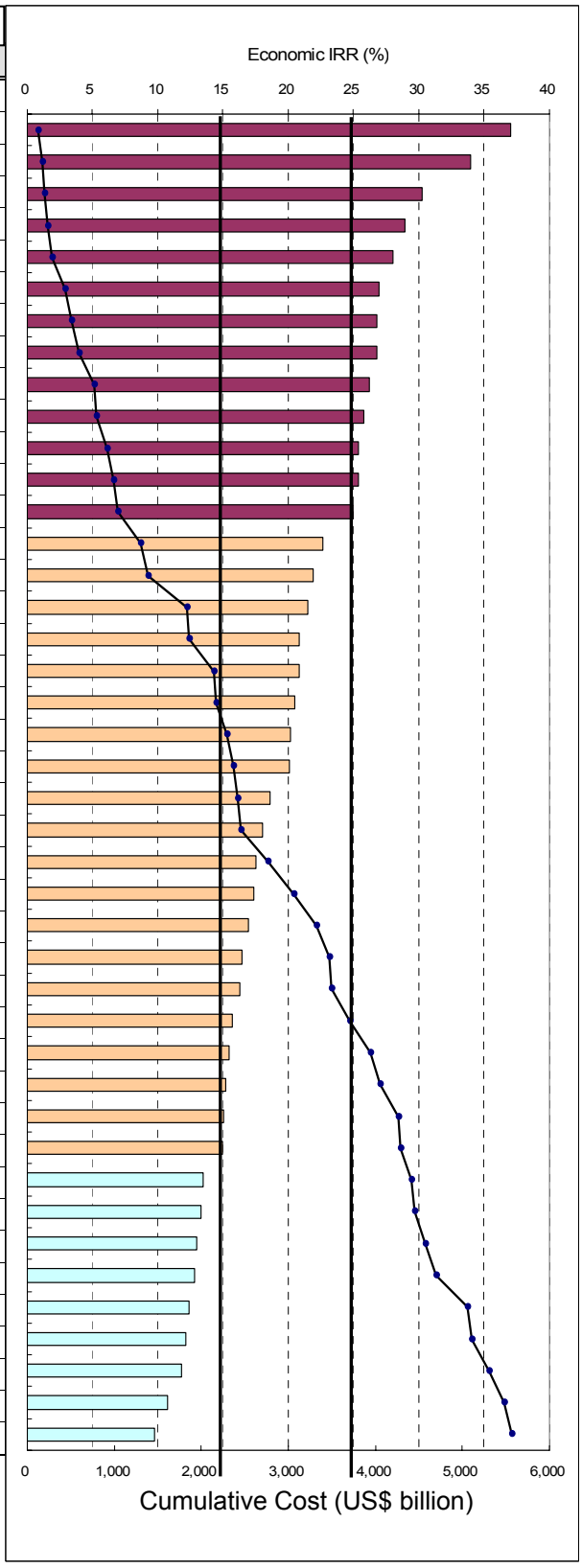
Note: Package _1 (Do minimum) is inclusive of on-going and committed projects which are not subject to evaluate.

Figure 8.9.5 intends to put road projects in descending order of EIRR and also shows the cumulative project costs. If ignoring all the criteria other than economic efficiency, it may be recommended to implement the projects in this order as long as the budget allows. If the budget constraint is US$ 1,000 million, the top 13 projects can be selected and if it is US$ 2,000 million, then top 17 projects can be implemented. Although, the EIRR becomes lower when the rank goes down, the 33rd project still shows an EIRR as high as 15%, while total cost of top 33 projects is US$ 4.3 billion.

Figure 8.9.5 Project Prioritization Based on Economic IRRs

Project	
Code	Project Name
TR01	Ongoing Project (not evaluated)
TR09	Ring Road 3 (North East Section)
TR34	NH5 North West Corridor Package
TR19	East West Highway in the South East
TR36	NH5 South Corridor Package (Inner RR3)
TR42	RR4-RR4
TR12	Ring Road 4 (South West Section)
TR10	Ring Road 3 (North Section)
TR08	Ring Road 3 (South East Section)
TR20	North South Highways in the North
TR38	NH1Corridor Package in the East of Hanoi
TR14	Ring Road 4 (North Section)
TR41	RR2-North Ring Road
TR37	NH5 South Corridor Package (Outer RR3)
TR11	Ring Road 4 (West Section)
TR39	South East Highway
TR13	Ring Road 4 (South East Section)
TR16	East West Highway North in the North
TR03	Ring Road 2 (Nhat Tan Bridge Section)
TR15	NH 2 West
TR32	NH6 South Corridor Package (Outer RR3)
TR04	Ring Road 2 (CBD West Section)
TR17	East West Highway in the North
TR23	North South Express Way (NH1A)
TR06	Ring Road 2 (Vinh Tuy Bridge Section)
TR07	Ring Road 3 (South West Section)
TR33	NH1A East Corridor Package in the South
TR25	NH32 North Corridor (Inner RR3)
TR22	North South Highways in the South
TR30	NH6 North Corridor Package
TR31	NH6 South Corridor Package (Inner RR3)
TR21	North South Express Way (NH3)
TR29	CBD South West Area Upgrade
TR18	East West Highway South West
TR27	Lang Hoa Lac North Corridor (Inner RR3)
TR35	NH5 North East Corridor Package
TR43	NH2-Noi Bai TL
TR05	Ring Road 2 (CBD South Section)
TR26	NH32 North Corridor (Outer RR3)
TR24	West Corridor (R3)
TR28	Lang Hoa Lac North Corridor (Outer RR3)
TR02	CBD Center Area Upgrade
TR40	CBD South East Area Upgrade

Source: HAIDEP Study Team.



(3) Evaluation of UMRT Projects

(a) UMRT Patronage Demand Forecasts

Initial results of the 2020 patronage demand forecasts for the proposed four UMRT lines have been prepared and are as noted in Table 8.9.8. Depending on the particular patronage demand forecast on each UMRT corridor, the Study Team has selected the most appropriate technology be it rail or a BRT/PBT system.

A brief summary of the passenger demand forecasts would indicate that UMRT Lines 1, 2, and 3 daily passenger boardings in the range of 300 to 600 thousand passengers would require a rail-based UMRT system as the most appropriate technology, while UMRT Line 4 with under 200 thousand passengers per day in 2020 would be more suited to be developed into a BRT/PBT project.

The patronage demand forecast results also indicate that the number of boarding and alighting increases significantly (20 - 30%) when good connectivity between the four systems through multimodal interchange stations is provided in the transportation model, therefore justifying the need to rationalize the original eight rail projects into four and providing multimodal interchange stations in the UMRT network.

During the feasibility stage, a more detailed study of the selected UMRT project will be required to determine the boarding and alighting at each of the UMRT station in the network.

Table 8.9.8 Number of UMRT Passengers by Line, 2020

URMT	Pax-km (000/day)	Traffic Density (000/day/km)	No. of Pax (000/day)	Ave. Trip Length (km)
1	5,968	153	704	8.5
2	7,.728	108	866	8.4
3	2,521	77	488	5.1
4	4,463	83	526	8.5
Total	20,230	105	2,585	9.8

(b) UMRT Evaluation

UMRT projects were economically evaluated in the same manner as road projects. Table 8.9.9 shows the performance of UMRT (4 lines) and transport cost. In 2020, US$ 456 million of economic benefit will accrue by UMRT projects.

The UMRT projects show high economic indicators (Table 8.9.10). The group of 4 lines implies 13.6% of EIRR, which suggests the development of UMRT network is moderately feasible. Among others, Line 1 and Line 4 show high rates. It is noted however, that Line 4 is a BRT system (bus exclusive way) and its high return is mainly due to the low cost. Table 8.9.11 shows the sensitivity of EIRR of UMRT projects to changes in project cost and benefit. The group of four lines will lose its feasibility only when the cost overruns by 20% and over and at the same time, the benefit becomes smaller by more than 20% of the original estimates. Thus, the economic feasibility of UMRT projects is stable.

Table 8.9.9 Performance and Transportation Costs of UMRT Projects

Item	Unit	Vehicle Type	Do Master Plan W/o UMRT		Do Master Plan + All UMRT	
			2010	2020	2010	2020
Passenger-Hour	Million/ Year	Motorcycle	231	298	226	277
		Car	89	306	87	286
		Bus	450	976	318	524
		UMRT	0	0	79	260
PCU-Km		Motorcycle	1,744	1,945	1,733	1,905
		Car	1,567	4,834	1,556	4,746
		Bus	563	1,220	397	655
		Truck	2,316	5,785	2,308	5,708
Travel Time Cost (TTC)	Million US$/Year	Motorcycle	165	498	162	462
		Car	94	758	92	708
		Bus	257	1,297	181	696
		UMRT	0	0	45	345
		Total TTC	516	2,552	480	2,212
Vehicle Operating Cost (VOC)		Motorcycle	129	156	127	148
		Car	141	455	139	436
		Bus	55	136	38	66
		Truck	175	480	173	460
		Total VOC	500	1,227	477	1,111
Total Cost		VOC + TTC	1,016	3,779	957	3,323

Note: Do-Something (committed) road network was assumed for 2010, and HAIDEP master plan road network for 2020.

Table 8.9.10 Economic Evaluation Results of UMRT Projects

Line	Cost	"Plus" Case			"Minus" Case			Average		
	US$ mil.	EIRR	NPV	B/C	EIRR	NPV	B/C	EIRR	NPV	B/C
		%	US$ mil.	-	%	US$ mil.	-	%	US$ mil.	-
UMRT 1	850	18.5	374.6	1.63	19.7	526.1	1.88	19.1	450.3	1.75
UMRT 2	2,144	14.6	779.2	1.54	14.6	765.9	1.53	14.6	772.5	1.54
UMRT 3	923	14.1	361.3	1.44	14.6	467.9	1.57	14.3	414.6	1.50
UMRT 4	310	20.8	696.5	2.82	22.0	1,065.2	3.79	21.4	880.8	3.31
All Lines	4,276	15.2	2,057.9	1.64	15.2	2,057.9	1.64	15.2	2,057.9	1.64

Note: NPV and B/C are estimated under a 12% discount rate.

Table 8.9.11 Sensitivity Analysis for UMRT Economic Evaluation

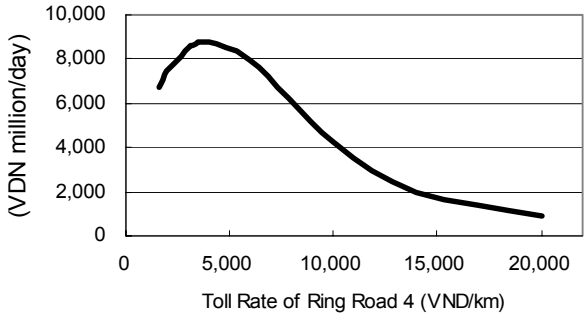
	Line	Sensitivity Analysis				
UMRT 1	Condition Changes		Cost up			
	Benefit down		Base	40%	50%	60%
		Base	19.1	16.7	16.2	15.7
		40%	15.4	13.1	12.7	12.2
		50%	14.2	11.9	11.4	11.0
		60%	12.7	10.4	9.9	9.5
UMRT 2	Condition Changes		Cost up			
	Benefit down		Base	10%	20%	30%
		Base	14.7	14.2	13.6	13.1
		10%	14.1	13.5	13.0	12.5
		20%	13.4	12.8	12.3	11.8
		30%	12.6	12.0	11.4	10.8
UMRT 3	Condition Changes		Cost up			
	Benefit down		Base	10%	20%	30%
		Base	14.3	13.8	13.3	12.8
		10%	13.7	13.2	12.7	12.2
		20%	13.0	12.5	12.0	11.5
		30%	12.3	11.7	11.2	10.8
UMRT 4	Condition Changes		Cost up			
	Benefit down		Base	40%	50%	60%
		Base	21.4	18.7	18.2	17.7
		40%	17.4	14.1	14.1	13.6
		50%	15.9	13.2	12.6	12.1
		60%	14.1	11.3	10.7	10.1
All Lines	Condition Changes		Cost up			
	Benefit down		Base	10%	20%	30%
		Base	15.2	14.6	14.0	13.4
		10%	14.5	13.9	13.3	12.8
		20%	13.8	13.1	12.6	12.0
		30%	12.9	12.3	11.7	11.2

4) Financial Analysis

(1) Ring Road 4

Prior to the financial evaluation of Ring Road 4 (TR11 to TR14), the relationship of toll rate and total revenue was examined. As Figure 8.9.6 shows, the revenue will have a peak at around VND 4,300 per km in 2020. Based on this, the toll rate was assumed at VND 5,000/km. It is expected that such toll rates would be affordable considering the fast increasing income levels and the relatively higher incomes of car-owning households.

Figure 8.9.6 Daily Toll Rate and Daily Total Revenue, 2020



Under a toll rate of VND 5,000/km, the net cash flow is estimated as shown in Table 8.9.12. As the cash flow is to estimate the financial IRR, interest payment is not included. In the first ten years, revenue is very low and after 2020, it grows rapidly. Accordingly, it is apparent that the opening in 2010 is too early and the project is premature. This cash flow cannot actually bear the burden of interest payment in the decade of 2010.

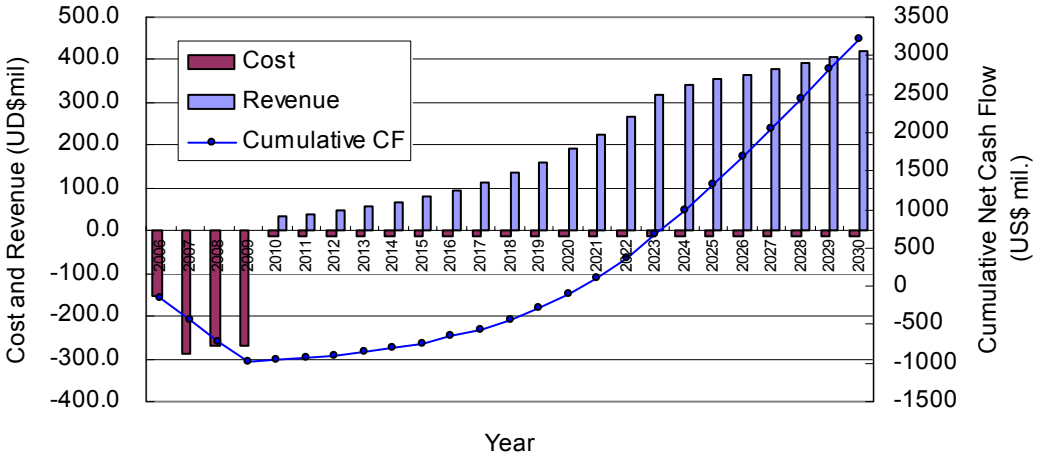
Table 8.9.12 Financial Evaluation of Ring Road 4

Indicator	Unit	Cost 20% down	Revenue 20% up	Base Case (5000VDN/km)	Cost 20% up	Revenue 20% down
FIRR	%	14.1	13.7	12.1	10.5	10.2
NPV	US$ million	182.6	184.1	7.7	-167.2	-168.7
B/C	-	1.26	1.21	1.01	0.84	0.81

Source: HAIDEP Study Team.

The financial IRR is estimated to be 12.1% under the cash flow (Figure 8.9.7). This rate is not very low as a highway project, but not high enough to attract the capital in the private sector.

Figure 8.9.7 Cash Flow of Ring Road 4



Demand for the RR4 varies by section and a project in the PFI (or PPP) scheme will take a long time and therefore, it may be recommended to start a preparation work (a feasibility study and formulation of the project scheme) in an early stage, aiming at opening the first stage in the late 2010s.

(2) UMRT Projects

Financial feasibility of four UMRT Lines was preliminarily studied. Here, the fare of UMRT assumes to be distance-proportional at US$ 0.05 per kilometer with US$ 0.2 for the first 4.0 km. The operating cost of UMRT is estimated at US$ 0.016 per passenger-km, of which US$ 0.011 is the capital cost of rolling stock including its depreciation.

Every line has a large volume of demand as shown in Table 8.9.13. However, the financial IRR is relatively low at 4% to 24%. This is mainly due to the low fare comparing to the huge amount of the project cost. Only Line 4 has a possibility of implementation by BOT scheme.

Table 8.9.13 Passenger Demand on UMRT Projects

UMRT Line	Extension		Project Cost (US$ mil)	Daily Passenger (1000 Passenger-km)			
	UMRT	BRT		Plus Case (with no other lines)		Minus Case (with all other lines)	
	km	km		2015	2020	2015	2020
UMRT 1	38.7	0.0	999.5	3,877	5,729	3,938	5,968
UMRT 2	41.5	33.9	2.521.7	4,513	7,334	4,627	7,278
UMRT 3	21.0	12.0	1,144.6	1,583	2,615	1,703	2,521
UMRT 4	0.0	53.1	365.2	3,810	5,833	2,921	4,463
Total	101.2	99.0	5,031.0	13,784	21,511	13,189	20,230

Source: HAIDEP Study Team.

Table 8.9.14 Financial Evaluation of UMRT Projects

UMRT Line	Revenue (US$ million)		Financial Evaluation		
	2015	2020	FIRR (%)	NPV (US$ mil)	B/C
UMRT 1	73.8	112.1	9.8	-123.0	0.77
UMRT 2	90.0	140.5	5.8	-727.0	0.43
UMRT 3	36.1	54.0	2.9	-602.4	0.25
UMRT 4	55.7	84.4	22.6	202.7	2.77
All Lines	255.6	391.1	7.2	-1,238.4	0.54

Source: HAIDEP Study Team.

Without considering interest payment, the net cash flow of entire projects is as shown in Figure 8.9.8. Even without paying the interest, the capital recovery period of Line 2 and Line 3 is very long.

The minimum level of FIRR to introduce a private capital to an infrastructure project is generally believed to be around 15%. Table 8.9.15 shows the necessary capital cost reduction in order to secure a 15% of return on investment to the private investors. In the case of UMRT-2 for example, if the initial cost is reduced by 72.1% from the originally estimated project cost, the FIRR reaches to 15% under the fare of VND 5,000.

As the economic analysis shows, the UMRT will bring about a huge economic return. In other words, the diseconomy due to the traffic congestion will become sizeable without a UMRT system. Therefore, an early start of research and study is recommended in order to develop a feasible structure of PPP scheme for the UMRT lines.

Figure 8.9.8 Financial Cash Flow of UMRT Projects

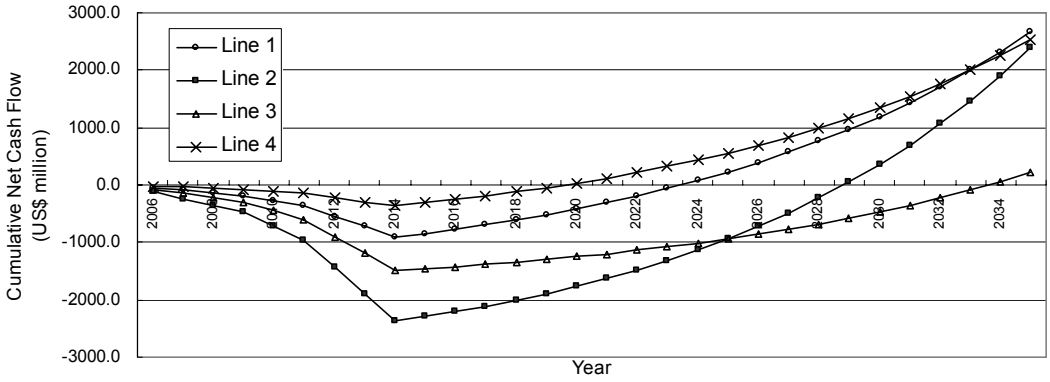


Table 8.9.15 **Reduction in Investment Costs to Obtain 15% FIRR**

UMRT Line	Necessary Cost Reduction (%)
UMRT 1	47.2
UMRT 2	72.1
UMRT 3	83.3
UMRT 4	-112.0
All Lines	55.5

5) Environmental and Social Considerations

(1) Plan Components Generating Environmental and Social Impacts

By implementing the proposed plan, it will not only enhance transportation efficiency, capacity, and quality, but the plan will also bring a number of positive and negative environmental and social effects, including the following (see Table 8.9.16):

(a) **Improvement of Road Network and Capacity:** Inefficient fuel combustion under low travel speeds due to traffic congestion causes higher emission of pollutants. According to an estimate in Japan, a reduction in average vehicle travel speeds from 40-50kph to 20kph causes approximately 40-50% reduction in fuel efficiency (mileage). By improving road network and capacity, traffic congestion will be alleviated and average travel speeds will increase, resulting in lower air pollution levels along the roads, more efficient energy use, and reduced CO_2 emissions which in turn will help prevent global warming.

(b) **Enhancement of Traffic Management Measures:** Besides improved road network and capacity, appropriate traffic management measures can help realize the above effects.

(c) **Promotion of Public Transportation Use:** Increased use of mass transit, such as UMRT, for passenger transport uses less energy per passenger per distance. It contributes less air pollution along the roads/railway. In addition, the provision of low-fare public transportation will benefit socially vulnerable groups such as low-income people who cannot afford private vehicles.

(d) **Improvement of Public Transportation Network:** Improved public transportation network connectivity through physical and nonphysical measures, such as adequate distribution of intermodal stations, will further promote public transportation use.

(e) **Control of Through Traffic in the Urban Center:** Reduction in vehicle traffic passing through the urban center by constructing ring roads and bypasses will ease traffic flow. It will also alleviate air pollution along the roads and reduce CO_2 emission for prevention of the global warming as well as enhancing the efficient energy use.

(f) **Reduction in On-road Parking:** On-road parking disturbs vehicle traffic flow and reduces road capacity. A more serious situation in the future should be avoided by enforcing rules/regulations on vehicle and pedestrian traffic flow as well as on urban amenity.

(g) **Restriction of Private Vehicle Use and Ownership:** Restriction of private vehicle use and ownership through control measures, such as area licensing, road pricing, and higher parking fees, will reduce private vehicle traffic, facilitate the shift to public transportation use, and contribute to the reduction in traffic congestion, better energy use, and lower air pollution, among others.

(h) **Sidewalk Improvement:** To secure walking space is indispensable for the safety, comfort, and amenity of pedestrians as well as for the enhancement of the landscape.

(i) **Improvement/Increase in Road Safety Facilities:** Improving and expanding safety facilities will enhance road safety for both vehicle users and pedestrians.

(j) **Undergrounding of Railway:** Reduction of road traffic disturbance by eliminating at-grade intersections between road and railway will contribute to smooth traffic flow in the city center. Contribution to landscape improvement is also expected.

(k) **Promotion of Inland Water Transportation:** Increase in mass transit for freight transport through inland water transportation will significantly contribute to efficient energy use and lower air pollutant emissions.

Table 8.9.16 Environmental and Social Impacts of Urban Transportation Subsector Plan

Plan Component (Effect(s) of the component)	Environmental and Social Impact					
	Alleviation of air pollution and noise	Prevention of global warming (Reduction of CO_2 emission)	Efficient energy use	Safety	Considerations for Social vulnerable groups	Landscape
1. Improvement of road network and capacity	O	O	O	-		-
2. Enhancement of traffic management measures	O	O	O	-	-	-
3. Promotion of use of public transportation	O	O	O	-	O	-
4. Improvement of public transportation network	O	O	O	-	O	-
5. Vehicle traffic control only passing through the central urban area	O	-	O	-	-	-
6. Reduction of parking on the road by increase of parking space	-	-	-	O	-	-
7. Restriction of the private vehicle use and ownership	O	O	O	-	-	-
8. Improvement of the sidewalk	-	-	-	O	O	O
9. Improvement/increase of facilities for road safety	-	-	-	O	O	-
10. Elevation of the railway	O	O	O	O	-	-
11. Promotion of inland water transportation	O	O	O	-	-	-

(2) Quantitative Estimate of Air Pollution Alleviation Effects

A preliminary quantitative estimate was conducted for air pollution reduction and global warming prevention effects by implementing the proposed urban transport subsector plan, with comparing a without-plan case and a with-plan case for NOx and CO_2 emissions from motorcycle, car, and bus. As results of the estimate, NOx and CO_2 emissions will be reduced at 1,157 ton/year (16%) and 107,910 ton/year (31%), respectively, in the year of 2020, as shown in the table below.

Table 8.9.17 NOx and CO_2 Reduction by Urban Transportation Subsector Plan

Unit: ton/year

	2005	2020 (Do-Something (Committed) Network)	2020 (HAIDEP master plan)
NOx Emission			
1. Motorcycle	290.2	288.6	240.5
2. Car	1,101.8	6,561.2	5,468.6
3. Bus	143.8	181.0	165.1
Total	1,535.7	7,030.7	5,874.2
Effect of M/P			-1,156.5
			(-16.4%)
CO_2 Emission			
1. Motorcycle	112,428.8	126,838.8	85,344.2
2. Car	34,524.7	196,213.0	132,874.5
3. Bus	17,496.2	23,385.6	20,308.3
Total	164,449.6	346,437.4	238,527.0
Effect of M/P			-107,910.4
			(-31.1%)

(3) Initial Environmental Examination of Proposed Projects

An initial environmental examination (IEE) was conducted for the proposed projects of the different components of the urban transportation subsector plan. Potential environmental impacts were examined based on various factors of the proposed projects such as scale, characteristics, and location. Based on the identified environmental impacts, measures to avoid or minimize them are proposed in this section.

(a) IEE of Proposed Urban Road Project Packages

The proposed 43 urban road project packages, consisting of 117 projects, were preliminarily examined from both the environmental and social aspects, namely: (i) involuntary resettlement, (ii) air quality and noise/vibration, (iii) impacts on fauna in rural areas, (iv) global warming, (v) split of rural communities, (vi) impacts on socially vulnerable groups and cultural heritage assets, and (vii) environmental and social impacts during construction (see Table 8.9.18).

Measures that alleviate negative environmental and social impacts, such as air quality, noise/vibration, and split of communities, resulting from urban road development are limited to the aspects of a project's operational phase, such as traffic management. This means that most of these measures have to be implemented in the construction phase as they are physical measures such as noise barriers and underpass facilities (see Table 8.9.19).

Table 8.9.18 Environmental and Social Impacts of Proposed Urban Road Projects

Environmental Item / No. of Project Package		Pollution					Natural Environment				Social and Cultural Aspects								Overall evaluation[7]	Requirement of EIA approval[8]
		Air quality[2]	Water quality[3]	Waste	Noise and vibration	Soil[4]	Plant	Animal	Ecosystem	Global warming	Involuntary resettlement	Regional/local economy	Regional severance	Social vulnerable groups	Remains and cultural assets	Landscape	Health, safety, and hygiene[5]	Other social issues[6]		
TR-2	C[1]	A	-	A	A	-	-	-	-	-	A	B	-	C	C	C	C	C	A	un
	O	B	-	-	B	-	-	-	-	B	-	+	-	-	-	C	C	C		
TR-3	C	B	-	C	B	-	-	C	C	-	B	-	C	C	-	-	C	C	B	un
	O	B	-	-	-	-	-	C	C	B	-	+	C	-	-	-	C	C		
TR-4	C	B	-	A	A	-	-	-	-	-	A	B	-	C	C	-	C	C	A	un
	O	B	-	-	B	-	-	-	-	B	-	+	-	-	-	-	C	C		
TR-5	C	A	-	A	A	-	-	-	-	-	A	B	-	C	C	C	C	C	A	un
	O	B	-	-	B	-	-	-	-	B	-	+	-	-	-	C	C	C		
TR-6	C	B	-	A	B	-	-	-	-	-	A	B	A	C	C	C	C	C	A	un
	O	B	-	-	B	-	-	-	-	B	-	+	A	-	-	C	C	C		
TR-7	C	A	-	A	A	-	-	-	-	-	A	B	B	C	C	C	C	C	A	un
	O	B	-	-	B	-	-	-	-	B	-	+	B	-	-	C	C	C		
TR-8	C	A	-	A	A	-	-	-	-	-	A	B	B	C	C	-	C	C	A	un
	O	B	-	-	B	-	-	-	-	B	-	+	B	-	-	-	C	C		
TR-9	C	B	-	A	B	-	-	C	C	-	A	C	C	C	C	-	C	C	A	un
	O	B	-	-	B	-	-	C	C	B	-	+	C	-	-	-	C	C		
TR-10	C	-	-	B	-	-	-	C	C	-	B	-	C	C	C	-	C	C	B	un
	O	-	-	-	-	-	-	C	C	B	-	+	C	-	-	-	C	C		
TR-11	C	-	C	B	-	-	-	C	C	-	B	-	C	C	C	-	C	C	B	un
	O	-	-	-	-	-	-	C	C	B	-	+	C	-	-	-	C	C		
TR-12	C	B	-	A	B	-	-	-	-	-	A	-	C	C	C	-	C	C	A	un
	O	B	-	-	B	-	-	-	-	B	-	+	C	-	-	-	C	C		
TR-13	C	-	C	-	-	-	-	C	C	-	-	-	C	C	C	-	C	C	B	un
	O	-	-	-	-	-	-	C	C	B	-	+	C	-	-	-	C	C		
TR-14	C	B	-	B	B	-	-	C	C	-	B	+	B	C	C	-	C	C	B	un
	O	-	-	-	-	-	-	C	C	B	-	+	B	-	-	-	C	C		
TR-15	C	-	-	B	B	-	-	C	C	-	B	B	B	C	C	-	C	C	B	un
	O	-	-	-	-	-	-	C	C	B	-	+	B	-	-	-	C	C		
TR-16	C	-	-	C	-	-	-	C	C	-	C	C	B	C	C	-	C	C	B	un
	O	-	-	-	-	-	-	C	C	B	-	+	B	-	-	-	C	C		
TR-17	C	B	-	A	B	-	-	C	C	-	A	C	B	C	C	-	C	C	A	un
	O	-	-	-	-	-	-	C	C	B	-	+	B	-	-	-	C	C		
TR-18	C	B	C	C	C	-	-	C	C	-	C	-	B	C	C	-	C	C	B	un
	O	-	-	-	-	-	-	C	C	B	-	+	B	-	-	-	C	C		
TR-19	C	-	-	-	-	-	-	C	C	-	C	-	C	C	C	-	C	C	C	un
	O	-	-	-	-	-	-	C	C	B	-	+	-	-	-	-	C	C		
TR-20	C	B	-	B	B	-	-	C	C	-	B	-	B	C	C	-	C	C	B	un
	O	-	-	-	-	-	-	C	C	B	-	+	-	-	-	-	C	C		
TR-21	C	-	-	C	-	-	-	C	C	-	C	-	B	C	C	-	C	C	B	R
	O	-	-	-	-	-	-	C	C	B	-	+	B	-	-	-	C	C		
TR-22	C	-	-	B	-	-	-	-	-	-	B	-	C	C	C	-	C	C	B	un
	O	-	-	-	-	-	-	-	-	B	-	+	C	-	-	-	C	C		
TR-23	C	-	-	C	-	-	-	-	-	-	C	-	C	C	C	-	C	C	C	un
	O	-	-	-	-	-	-	-	-	B	-	+	C	-	-	-	C	C		
TR-24	C	A	-	A	A	-	-	-	-	-	A	-	-	C	C	-	C	C	A	un
	O	B	-	-	B	-	-	-	-	B	-	+	-	-	-	-	C	C		
TR-25	C	B	-	A	B	-	-	-	-	-	A	-	C	C	C	-	C	C	A	un
	O	-	-	-	-	-	-	-	-	B	-	+	C	-	-	-	C	C		
TR-26	C	-	-	B	-	-	-	-	-	-	C	-	C	C	C	-	C	C	C	un
	O	-	-	-	-	-	-	-	-	B	-	+	C	-	-	-	C	C		
TR-27	C	A	-	A	A	-	-	-	-	-	A	-	C	C	C	-	C	C	A	un
	O	-	-	-	B	-	-	-	-	B	-	+	C	-	-	-	C	C		
TR-28	C	B	-	A	B	-	-	-	-	-	A	-	C	C	C	-	C	C	A	un
	O	-	-	-	B	-	-	-	-	B	-	+	C	-	-	-	C	C		
TR-29	C	A	-	A	A	-	-	-	-	-	A	B	-	C	C	-	C	C	A	un
	O	B	-	-	B	-	-	-	-	B	-	+	-	-	-	-	C	C		
TR-30	C	B	-	A	B	-	-	-	-	-	A	B	-	C	C	-	C	C	A	un
	O	B	-	-	B	-	-	-	-	B	-	+	-	-	-	-	C	C		
TR-31	C	A	-	A	A	-	-	-	-	-	A	B	-	C	C	-	C	C	A	un
	O	B	-	-	B	-	-	-	-	B	-	+	-	-	-	-	C	C		
TR-32	C	A	-	A	A	-	-	-	-	-	A	B	C	C	C	-	C	C	A	un
	O	B	-	-	B	-	-	-	-	B	-	+	-	-	-	-	C	C		
TR-33	C	A	-	A	A	-	-	-	-	-	A	B	C	C	C	-	C	C	A	un
	O	B	-	-	B	-	-	-	-	B	-	+	-	-	-	-	C	C		
TR-34	C	B	-	B	B	-	-	-	-	-	B	-	C	C	C	-	C	C	A	un
	O	B	-	-	B	-	-	-	-	B	-	+	-	-	-	-	C	C		
TR-35	C	B	-	-	B	-	-	-	-	-	C	-	-	C	C	-	C	C	B	un
	O	B	-	-	B	-	-	-	-	B	-	+	C	-	-	-	C	C		
TR-36	C	B	-	A	B	-	-	-	-	-	A	B	-	C	C	-	C	C	A	un
	O	B	-	-	B	-	-	-	-	B	-	+	-	-	-	-	C	C		
TR-37	C	-	-	-	-	-	-	-	-	-	-	-	C	C	C	-	C	C	C	un
	O	-	-	-	-	-	-	-	-	B	-	+	C	-	-	-	C	C		
TR-38	C	B	-	B	B	-	-	-	-	-	B	-	C	C	C	-	C	C	B	un
	O	-	-	-	-	-	-	-	-	B	-	+	C	-	-	-	C	C		
TR-39	C	B	-	A	B	-	-	-	-	-	A	B	C	C	C	-	C	C	A	un
	O	B	-	-	B	-	-	-	-	B	-	+	C	-	-	-	C	C		
TR-40	C	A	-	A	A	-	-	-	-	-	A	B	-	C	C	-	C	C	A	un
	O	B	-	-	B	-	-	-	-	B	-	+	-	-	-	-	C	C		
TR-41	C	B	-	B	B	-	-	-	-	-	-	C	C	C	C	-	C	C	B	un
	O	B	-	-	B	-	-	-	-	B	-	+	C	-	-	-	C	C		
TR-42	C	B	-	B	B	-	-	-	-	-	-	C	C	C	C	-	C	C	B	un
	O	B	-	-	B	-	-	-	-	B	-	+	C	-	-	-	C	C		
TR-43	C	B	-	B	B	-	-	-	-	-	-	C	C	C	C	-	C	C	B	un
	O	B	-	-	B	-	-	-	-	B	-	+	C	-	-	-	C	C		

Note: Categories for evaluating each environmental item:
A: Significant negative environmental impact is expected. B: Negative environmental impact is expected to some extent.
C: Negative environmental impact is not known in this study stage (Further study will be required.).
+: Positive environmental impact is expected to some extent. -: No impact is expected.
[1] Project phase - C: Constriction phase, O: Operational phase [2] Air quality includes offensive odor.
[3] Water quality includes groundwater and bottom sediment. [4] Soil includes topography & geology, soil contamination, soil erosion, and land subsidence
[5] Health, safety, and hygiene include accident and infectious diseases such as HIV/AIDS
[6] Other social issues may include inequity between beneficiaries and project-affected peoples, conflict of interests, water use right and common land use right, land use and utilization of local resources, social institutions such as social infrastructure and local decision-making, gender, and children's rights.
[7] Categories for overall evaluation
A: Significant adverse impact(s) is/are expected for one/some of the environmental items.
B: Negative environmental impact(s) is/are expected to some extent. C: Minimal or no adverse impact is expected.
[8] Requirement of EIA approval as Category I project based on Circular No.490/TT-BKHCNMT R: required, -: not required, un: unknown at present stage.

Table 8.9.19 Mitigation Measures During Construction of Urban Roads

Impact	Mitigation Measure
Involuntary Resettlement	1. Examine on-site resettlement (ie within the same community or on adjacent lands) and necessary support to minimize negative social impacts, in cases where resettlement can not be avoided. Secure appropriate resettlement sites and help in livelihood recovery with support from the project, if on-site resettlement is not possible.
Dust and Suspended Particulates	1. Sprinkle water on tires of construction vehicles, such as dump trucks, and in construction sites and roads near the construction sites. 2. Cover the trucks with sheets when transporting construction materials, soil, or wastes.
Noise and Vibration	1. Prevent noise from construction work by: • Using low-noise construction machineries. • Restricting heavy equipment use during nighttime construction work. 2. Prevent noise from vehicle traffic during operational stage by: • Considering a combination of the following measures in the detailed design stage based on an examination of roadside situations and the necessity and effects of the measures: – Buffer strips of trees and vegetation along roads. – Buffer buildings along roads. • Using the following, if necessary and applicable: – Noise barriers along roads. – Low-noise pavements such as drainage pavements.
Disturbance of Road Traffic	1. Restrict construction work during peak traffic period. 2. Assign traffic control staff in and around construction sites.
Split of Community	1. Install crossing facilities, such as pedestrian overpasses and underpasses, in affected sections.
Global Warming	1. Implement comprehensive road traffic improvement measures to further reduce CO_2-equivalent emissions. According to estimates on road development in Japan, additional measures on road traffic improvement, such as improvement of vehicle fuel efficiency, improvement of freight transportation efficiency, promotion of public transportation usage, and the promotion of public awareness, have led to overall decreases in such emissions.

(b) IEE of Proposed Urban Mass Rapid Transit Project Package

The proposed UMRT project package, which is a combination of railway and bus systems, consists of the following projects: (i) electrification; (ii) double tracking; (iii) grading of existing railway system; (iv) construction of new railway bridge; (v) development of an electrified railway system with at-grade, elevated, and underground levels; (vi) development of various types of stations such as interchanges, intermediate, multimodals, and terminals with developed peripheral areas (see Table 8.9.20). The aspects considered are: (i) involuntary resettlement, (ii) noises and vibrations during operation, (iii) waste generation, (iv) split of community, (v) radiowave interference, (vi) impacts caused by underground structures, (vii) environmental and social impacts during construction, (vii) positive environmental impacts on air quality and energy use, and (ix) impacts on socially vulnerable groups and cultural heritage assets.

Potential measures to mitigate negative environmental and social impacts from the construction and operation of the UMRT system are shown in Table 8.9.21. Environmental monitoring should be periodically conducted when the system becomes operational.

Table 8.9.20 Environmental and Social Impacts of Proposed UMRT Projects

Name of Project / Environmental Item		Pollution					Natural Environment				Social and Cultural Aspects								Overall evaluation[7]	Requirement of EIA approval[8]
		Air quality[2]	Water quality[3]	Waste	Noise and vibration	Soil[4]	Plant	Animal	Ecosystem	Global warming	Involuntary resettlement	Regional/local economy	Regional severance	Social vulnerable groups	Remains and cultural assets	Landscape	Health, safety, and hygiene[5]	Other social issues[6]		
TL-1 UMRT Line 1 (Ngoc Hoi-Yen Vien, Co Bi)	C[1]	B	C	A	B	-	-	-	-	-	A	+	-	-	-	-	B	C	A	A
	O	-	-	-	A	-	-	-	-	+	-	+	B	-	-	A	-	-		
TL-2 UMRT Line 2 (Ha Dong-Noi Bai, Soc Son)	C	B	C	A	B	-	-	-	-	-	A	+	-	-	-	-	B	C	A	A
	O	-	-	-	A	C	-	-	-	+	-	+	A	-	-	A	-	-		
TL-3 UMRT Line 3 (Hanoi-Nhon, Hoa Lac)	C	B	C	A	B	-	-	-	-	-	A	+	-	-	-	-	B	C	A	A
	O	-	-	-	A	C	-	-	-	+	-	+	A	-	-	A	-	-		
TL-4 UMRT Line 4 (Hanoi-Tu Liem, Co Bi, Noi Bai)	C	B	-	B	B	-	-	-	-	-	B	-	-	-	-	-	-	C	B	un
	O	-	-	-	-	-	-	-	-	+	-	+	-	C	-	-	-	-		

Note: Categories for evaluation of each environmental item:
A: Significant negative environmental impact is expected. B: Negative environmental impact is expected to some extent.
C: Negative environmental impact is not known in this study stage (Further study will be required.).
+: Positive environmental impact is expected to some extent. -: No impact is expected.
[1] Project phase - C: Constriction phase, O: Operational phase [2] Air quality includes offensive odor.
[3] Water quality includes groundwater and bottom sediment. [4] Soil includes topography & geology, soil contamination, soil erosion, and land subsidence
[5] Health, safety, and hygiene include accident and infectious diseases such as HIV/AIDS
[6] Other social issues may include inequity between beneficiaries and project-affected peoples, conflict of interests, water use right and common land use right, land use and utilization of local resources, social institutions such as social infrastructure and local decision-making, gender, and children's rights.
[7] Categories for overall evaluation
A: Significant adverse impact(s) is/are expected for one/some of the environmental items.
B: Negative environmental impact(s) is/are expected to some extent. C: Minimal or no adverse impact is expected.
[8] Requirement of EIA approval as Category I project based on Circular No.490/TT-BKHCNMT R: required, -: not required, un: unknown at present stage.

Table 8.9.21 Mitigation Measures during Construction of the UMRT System

Impact	Mitigation Measure
Involuntary Resettlement	1. Examine on-site resettlement (ie within the same community or on adjacent lands) and necessary support to minimize negative social impacts, in cases where resettlement cannot be avoided. Secure appropriate resettlement sites and help in livelihood recovery with support from the project, if on-site resettlement is not possible.
Dust and Suspended Particulates	1. Sprinkle water on tires of construction vehicles, such as dump trucks, and in construction sites and roads near the construction sites. 2. Cover the trucks with sheets when transporting construction materials, soil, or wastes.
Noise	1. Prevent noise from construction work by: • Using low-noise construction machineries. • Restricting heavy equipment use during nighttime construction work. 2. Prevent noise from railway operations by: • Installing fence along the ROW – Wall-type fencing along the railway acts as a kind of noise barrier at certain levels. Especially for electric trains, the main noise source is concentrated near the wheels and rail tracks (or under rolling stocks), so the wall-type fence will effectively contribute in reducing noise more than a net-type fence. Therefore, it is recommended that a wall-type fence be installed near residential areas or sensitive receptors. • Using lightweight rolling stocks. – Lightweight rolling stocks can reduce noise and vibration levels. • Buying low-noise rolling stocks. – Acceptable noise levels will be specified when acquiring rolling stocks. 3. Install noise receptors. • Install noise receptors, such as soundproof glasses, in buildings, in cases where the above measures are not enough.
Vibration	1. Strengthen foundations of structures, strengthen the ground, etc. 2. Implement measures to reduce noise, since noise and vibration are closely related.
Waste Generation	1. Segregate construction wastes and properly dispose of them at designated disposal sites.
Split of Community	1. Install crossing facilities such as overpasses and underpasses in sections where railroad crossing gates are not adequate.
Dust and Suspended Particulates	1. Sprinkle water on tires of construction vehicles, such as dump trucks, in construction sites and roads near them.
Disturbance of Road Traffic	1. Give the public advance notice on traffic disturbances, such as location, schedule, and detours, through various media. 2. Restrict construction work during peak traffic periods. 3. Assign traffic control staff in and around construction sites.

Table 8.9.22 Mitigation Measures during Operation of the UMRT System

Impact	Mitigation Measure
Noise and Vibration	1. Use low speeds in critical areas, such as residential areas, especially in early morning and nighttime operation.
Wastewater	1. Ensure that wastewater from washing rolling stocks is adequately discharged into wastewater pipes and oil wastes are disposed of properly at designated disposal sites. 2. Discharge wastewater from station facilities, such as toilets, into wastewater pipes.

(c) IEE of Proposed Inland Water Transportation Project Package

The proposed inland water transportation (IWT) project package is composed of the development of a new port and the improvement of two ports along the Red River, as well as the development of a new port along the Duong River, a Red River tributary. A preliminary examination of the environmental and social impacts of each proposed project was made, taking account of the following: (i) accidents and oil/chemical spills, (ii) environmental impacts caused by dredging activities, (iii) impacts on socially vulnerable groups and cultural heritage assets, and (iv) environmental and social impacts during construction (see Table 8.9.23).

Potential measures to mitigate negative environmental and social impacts of the construction and operation of the proposed IWT projects are shown in tables 8.9.24 and 8.9.25. Environmental monitoring should be periodically conducted when the ports become operational.

Table 8.9.23 Environmental and Social Impacts of Proposed IWT Projects

Name of Project		Environmental Item	Pollution					Natural Environment				Social and Cultural Aspects								Overall evaluation[7]	Requirement of EIA approval[8]
			Air quality[2]	Water quality[3]	Waste	Noise and vibration	Soil[4]	Plant	Animal	Ecosystem	Global warming	Involuntary resettlement	Regional/local economy	Regional severance	Social vulnerable groups	Remains and cultural assets	Landscape	Health, safety, and hygiene[5]	Other social issues[6]		
TT-1	New North Port	C	B	B	B	B	-	-	-	-	-	-	-	-	-	-	-	-	C	B	un
		O	-	B	B	C	-	-	-	-	-	-	+	-	-	-	B	B	C		
TT-2	Hanoi Port	C	B	B	B	B	-	-	-	-	-	-	-	-	-	-	-	-	C	B	un
		O	-	B	B	C	-	-	-	-	-	-	+	-	-	-	B	B	C		
TT-3	Khuyen Luong Port	C	B	B	B	B	-	-	-	-	-	-	-	-	-	-	-	-	C	B	un
		O	-	B	B	C	-	-	-	-	-	-	+	-	-	-	B	B	C		
TT-4	New East Port	C	B	B	B	B	-	-	-	-	-	-	-	-	-	-	-	-	C	B	un
		O	-	B	B	C	-	-	-	-	-	-	+	-	-	-	B	B	C		

Note: Categories for evaluation of each environmental impact:
A: Significant negative environmental impact is expected. B: Negative environmental impact is expected to some extent.
C: Negative environmental impact is not known in this study stage (Further study will be required.).
+: Positive environmental impact is expected to some extent. -: No impact is expected.
[1] Project phase - C: Constriction phase, O: Operational phase [2] Air quality includes offensive odor.
[3] Water quality includes groundwater and bottom sediment. [4] Soil includes topography & geology, soil contamination, soil erosion, and land subsidence
[5] Health, safety, and hygiene include accident and infectious diseases such as HIV/AIDS
[6] Other social issues may include inequity between beneficiaries and project-affected peoples, conflict of interests, water use right and common land use right, land use and utilization of local resources, social institutions such as social infrastructure and local decision-making, gender, and children's rights.
[7] Categories for overall evaluation
A: Significant adverse impact(s) is/are expected for one/some of the environmental items.
B: Negative environmental impact(s) is/are expected to some extent. C: Minimal or no adverse impact is expected.
[8] Requirement of EIA approval as Category I project based on Circular No.490/TT-BKHCNMT R: required, -: not required, un: unknown at present stag

Table 8.9.24 Mitigation Measures during Port Construction

Impact	Mitigation Measure
Dust and Suspended Particulates	1. Sprinkle water on tires of construction vehicles, such as dump trucks, and in construction sites and roads near construction sites. 2. Cover trucks with sheets when transporting construction materials, soil, or wastes.
Noise and Vibration	1. Use low-noise construction machineries. 2. Restrict heavy equipment use during nighttime construction work. 3. Restrict construction work time and other applicable measures in critical areas, such as schools and hospitals, near construction sites.
Disturbance of Road Traffic	1. Restrict construction work at peak traffic periods. 2. Assign traffic control staff in and around construction sites.
Workers' Waste	1. Install temporary septic tanks to collect and treat workers' wastewater before discharging it into rivers or wastewater pipes.

Source: Partly sourced from the "The Study on the Red River Inland Waterway Transport System in the Socialist Republic of Vietnam," March 2003.

Table 8.9.25 Mitigation Measures during Port Operation

Impact	Mitigation Measure
Oil Spill	1. Equip ships and barges with the means to prevent oil spills such as oil-isolating float systems, oil pumps, and oil separators. 2. Equip ports with the means to prevent oil spills such as booms, skimmers, and oil pumps. 3. Prepare guidelines and train port personnel on handling oil spills.
High Turbidity in Dredging	1. Use efficient, less intrusive dredging equipment, like silt curtains, timed to coincide with low flows. 2. Limit dredging activities during critical spawning periods for shellfish, if any.
Dust and Suspended Particulates	1. Sprinkle water on tires of freight vehicles, such as trailers, and on roads in and around the port facilities. 2. Cover trucks with sheets when transporting bulk cargoes.
Workers' Waste	1. Install septic tanks to collect and treat workers' wastewater before discharging it into rivers or connecting into wastewater pipes.
Solid Waste Disposal	1. Install waste bins and contract waste collection companies to collect and dispose wastes at designated waste disposal sites.

Source: Partly sourced from the "The Study on the Red River Inland Waterway Transport System in the Socialist Republic of Vietnam," March 2003.

(d) IEE of Proposed Traffic Safety, Public Transportation, and Traffic Management Projects

Most of the proposed projects on traffic safety, public transportation, and traffic management consist of soft components such as systems development, capacity building, and enhancement of public awareness that are aimed at improving traffic management and transportation safety. Therefore, there will be no expected negative environmental impacts during both their preparation and operational stages. However, some of the construction works that may affect the environment include the installation of traffic signals at intersections, the application of traffic markings on roads, and the construction of parking lots and multi-story parking buildings, although their impacts are expected to be limited to inside and around the site during their short construction stages.

8.10 Proposed Urban Transportation Development Orientation

1) Regional Transportation

(1) Goals and Objectives

HMA and the northern region must develop a strategic regional transport network comprising competitive multimodal primary transport corridors and an effectively integrated provincial/rural transport network to provide efficient links between international gateways and major cities as well as between urban and rural areas. At the same time, transportation development must be more strategically integrated with overall regional development.

(2) Proposed Strategies, Actions, and Strategic Projects

In order to promote the objectives of regional transportation development, three strategies are set for which more concrete actions and strategic projects are proposed (see Figure 8.10.1). The basic strategies are as follows:

(i) Establishment of a coordinated regional transportation policy
(ii) Promotion of the strategic development of transportation corridors
(iii) Further improvement of transportation conditions at provincial and local levels

Strategic projects for priority action are the following:

(i) Development of internationally competitive growth corridors
(ii) Development of cross-border transportation and integrated with the region
(iii) Development of provincial transportation network integrated with strategic growth corridors

2) Urban Transportation

(1) Goals and Objectives

Hanoi must establish an efficient transportation system to improve mobility and accessibility of people, goods, and services within the city, between Hanoi and the provinces, within HMA, and within the northern region. Hanoi must develop a sustainable urban transportation system through the development of high-quality public transportation services, efficient traffic, environment and safety management and infrastructure development. Hanoi must also exert its best effort to achieve a public-transportation-oriented society wherein the role of cars and motorcycles is clearly defined and urban development/land use is managed in integration with public transportation development.

(2) Proposed Strategies, Actions, and Strategic Projects

In order to promote the objectives of urban transportation development, seven strategies are set for which more concrete actions and strategic projects are proposed (see Figure 8.10.2). The basic strategies are as follows:

(i) Establishment of a coordinated urban transportation policy
(ii) Enhancement of public awareness and understanding of urban transportation issues
(iii) Promotion of the realization of mass transit-oriented urban development
(iv) Strengthening of the effective management of traffic and demand
(v) Strengthening of the effective management of traffic and demand

(vi) Focusing on the need for a comprehensive development of transportation space and environment

(vii) Strengthening of capacity for effective transportation sector administration and management

Strategic projects for priority action are the following:

(i) Establishment of coordinated mechanism for preparation, monitoring, and updating of the urban transportation master plan

(ii) Development and conduct of capacity building program on transportation planning and management

(iii) Strengthening of traffic management and safety improvement capacity

(iv) Completion of key sections of main roads in Hanoi

(v) Development of urban roads in integration with urban development

(vi) Comprehensive improvement/development of sidewalk network and space

(vii) Expansion and improvement of bus services

(viii) Establishment of clear policy and support measures for paratransits including taxis, xe om,, and other services

(ix) Integrated development of UMRT network

(x) Establishment of comprehensive parking policy and facility development

(xi) Comprehensive improvement of traffic environment in CBD

(xii) Comprehensive improvement of transportation and urban environment in key corridors

(xiii) Development of water transportation services in Hanoi

(xiv) Improvement of inter-city public transportation services between Hanoi and satellite cities/urban areas

(xv) Improvement of public transportation services between rural and urban areas

Figure 8.10.1 Proposed Strategies, Actions, and Strategic Projects for Regional Transportation Development

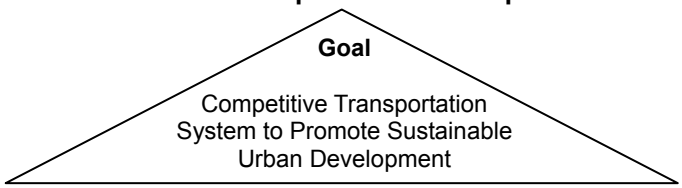
Objectives	• Ensure efficient/effective transportation services between international gateway ports (Hai Phong and Cai Lan) and between Hanoi and Vinh Phuc to support existing and future competitive industrial developments • Ensure smooth travel of the people and transportation of goods among all provinces including Hanoi • Prepare for increased cross-border transportation demand in a way that the region will benefit from it

Strategy	Action	Monitoring Indicator
Dr1 Establish coordinated regional transportation policy	Dr11 Finalize integrated regional transportation master plan in coordination with ministries and relevant provinces which include clear project priority and budget envelope Dr12 Improve project information system for more effective project preparation by ministries and involvement of stakeholders including donors Dr11 Establish concrete institutional arrangement for key pending issues including road fund, improved road maintenance, road safety, and rural transportation	• Prepared integrated/coordinated master plan • Functioning coordination mechanism • Prioritization methods shared among stakeholders • Available comprehensive information on projects • Functioning common information system • Responses from donors • Clearly identified issues • Progress made
Dr2 Promote strategic development of transportation corridors	Dr21 Determine specific strategies for main transportation corridors with due consideration of local characteristics, future role of subject areas, and multimodal arrangement covering road, rail, and inland water Dr22 Incorporate corridor development strategies into development plans for provinces to benefit from central government projects Dr23 Facilitate development of competitive services, such as michi-no-eki (roadside stations), with private sector involvement	• Shared understanding of strategies among stakeholders • Strategies reflected in projects prepared at central and provincial government levels • Incorporated corridor development strategies into provincial plans • Prepared projects / actions • Progress of actions
Dr3 Further improve transportation conditions at provincial and local levels	Dr31 Strengthen capacity for formulating provincial plans wherein local transportation's role is clearly defined Dr32 Improve urban transportation infrastructure and services in provinces Dr33 Improve rural transportation infrastructure and services	• Assessed quality of plan • Level of planning capacity of provinces • Specific projects / actions prepared including implementing plans and mechanisms • Progress of projects / actions

Strategic Projects	PDr1 Development of internationally competitive growth corridors PDr2 Development of cross-border transportation and integrated with the region PDr3 Development of provincial transportation network integrated with strategic growth corridors

Source: HAIDEP Study Team.

Figure 8.10.2 Proposed Strategies, Actions, and Strategic Projects for Urban Transportation Development



Objectives	• Promote development of public-transportation-based urban area and society • Ensure equitable and safe mobility and accessibility for all • Ensure efficient/effective transportation between Hanoi and the rest of region

Strategy	Action	Monitoring Indicator
D1 Establish coordinated urban transportation policy	D11 Establish effective modal policy to ensure sustainable urban transportation including management of private transportation D12 Establish clear strategy for effective interface of urban and regional transportation network and services D13 Establish rational and transparent framework for prioritization transportation policy and projects D14 Establish workable mechanism for effective coordination among relevant sectors and organizations D15 Establish sustainable funding mechanism to promote private sector participation	• A coordinated/integrated policy statement issued by government • Standard project management information system shared by relevant ministries/departments • Roadmap for each action and their progress
D2 Enhance public awareness and understanding of urban transportation issues	D21 Expand transportation education, campaigns and public information to appeal to mind and heart of the people D22 Implement various experimental projects for policy test with the involvement of communities and transportation users D23 Strengthen research and studies on urban transportation issues	• Improved attitude of road users • Response of the people • Progress of projects/actions.
D3 Promote realization of mass transit-oriented urban development	D31 Develop mass transit and public transportation system in full integration with urban growth strategy, land use and urban development D32 Integrate transportation master plan with overall urban /regional master plan as one coordinated statutory plan D33 Establish effective institutional framework and practical development methods for transit-oriented development (TOD)	• Necessary institutional arrangements done • Concrete arrangement for integration of transportation plan with urban/regional plan • Shared understanding of the strategy among stakeholders
D4 Expand attractive public transportation system	D41 Develop UMRT network as the city's public transportation backbone D42 Expand and strengthen bus system and services in a coordinated manner with UMRT to provide public transportation services in the entire city D43 Develop supplementary public transportation services including taxi, xe om, cyclo, water transportation, school buses, company buses, etc.	• No. of public transportation users • Coverage of bus services • People's satisfaction
D5 Strengthen effective management of traffic and demand	D51 Strengthen traffic control and management to regulate traffic flow for enhanced safety, comfort, and efficiency D52 Enhance enforcement capacity in parallel with social awareness (D2) D53 Establish workable parking policy D54 Introduce phased TDM measures D55 Expand introduction of information technology (IT) for effective transportation management	• Changes in road users' attitude • No. of traffic accidents • Road users' satisfaction • Revenue generated • Degree of traffic congestion
D6 Focus on need for comprehensive development of transportation space and environment	D61 Establish shared concept of comprehensive development of transportation space and environment D62 Strengthen comprehensive management and improvement of transportation corridors D63 Establish comprehensive management of traffic and transportation related issues in CBD D64 Provide adequate transportation environment for pedestrians bicycle users D65 Provide adequate transportation services and environment at district and community levels both in urban and rural areas	• Length and area of sidewalks with improved pavements, pedestrian shade, and street lighting • Responses of road users and communities
D7 Strengthen capacity for effective transportation sector administration and management	D71 Strengthen planning and project preparation capacities including database, planning tools and human resources D72 Develop alternative methods for smooth acquisition of lands for infrastructure development D73 Expand participation of private sector and communities	• Availability of database, planning tools • No. of qualified transportation planners, engineers • Land and compensation costs • Extent of private sector involvement

Strategic Projects	PD1 Establishment of coordinated mechanism for preparation, monitoring, and updating of the urban transportation master plan PD2 Development and conduct of capacity building program on transportation planning and management PD3 Strengthening of traffic management and safety improvement capacity PD4 Completion of key sections of main roads in Hanoi PD5 Development of urban roads in integration with urban development PD6 Comprehensive improvement/development of sidewalk network and space PD7 Expansion and improvement of bus services PD8 Establishment of clear policy and support measures for paratransits including taxis, xe om,, and other services PD9 Integrated development of UMRT network PD10 Establishment of comprehensive parking policy and facility development PD11 Comprehensive improvement of traffic environment in CBD PD12 Comprehensive improvement of transportation and urban environment in key corridors PD13 Development of water transportation services in Hanoi PD14 Improvement of inter-city public transportation services between Hanoi and satellite cities/urban areas PD15 Improvement of public transportation services between rural and urban areas

Source: HAIDEP Study Team.