7 IMPLEMENTATION PLAN

7.1 Project Outline

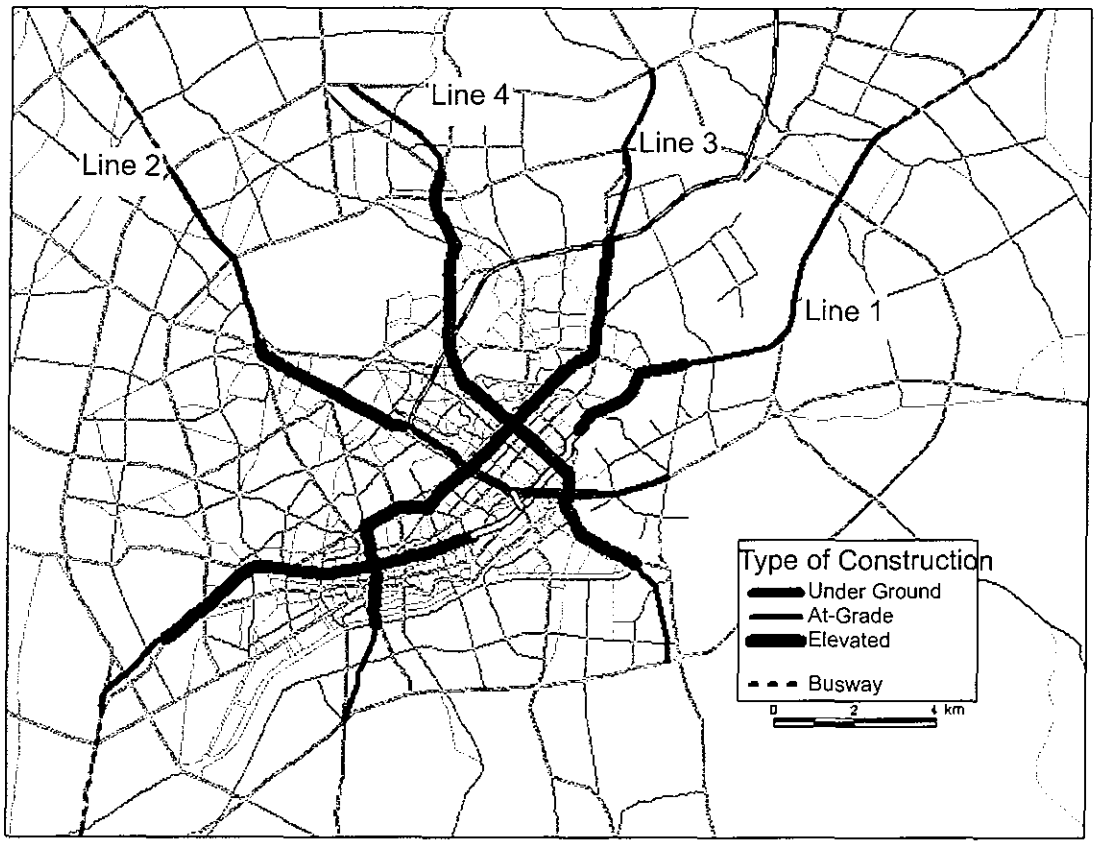
This section of the report reviews several key issues relating to the implementation of the project. These include:

- Master Plan Concept
- Public private participation
- Project schedule
- Construction planning
- Organisational Plan

1) Master Plan

The Ho Chi Minh City Transport Master Plan (Houtrans) envisions a complementary network of road and rail transit lines by 2020 serving the urban and suburban area of HCMC. For mass transit, two rail transit lines – Line 1 and 2 – are proposed to open for passenger operations between 2010 and 2020. These, and the two other future rail transit corridors Lines 3 and 4 , are shown on Figure 7.1.1.

Figure 7.1.1 Future Rail Network for HCMC



Source: Study Team

2) UMRT Line 1 (Red Line)

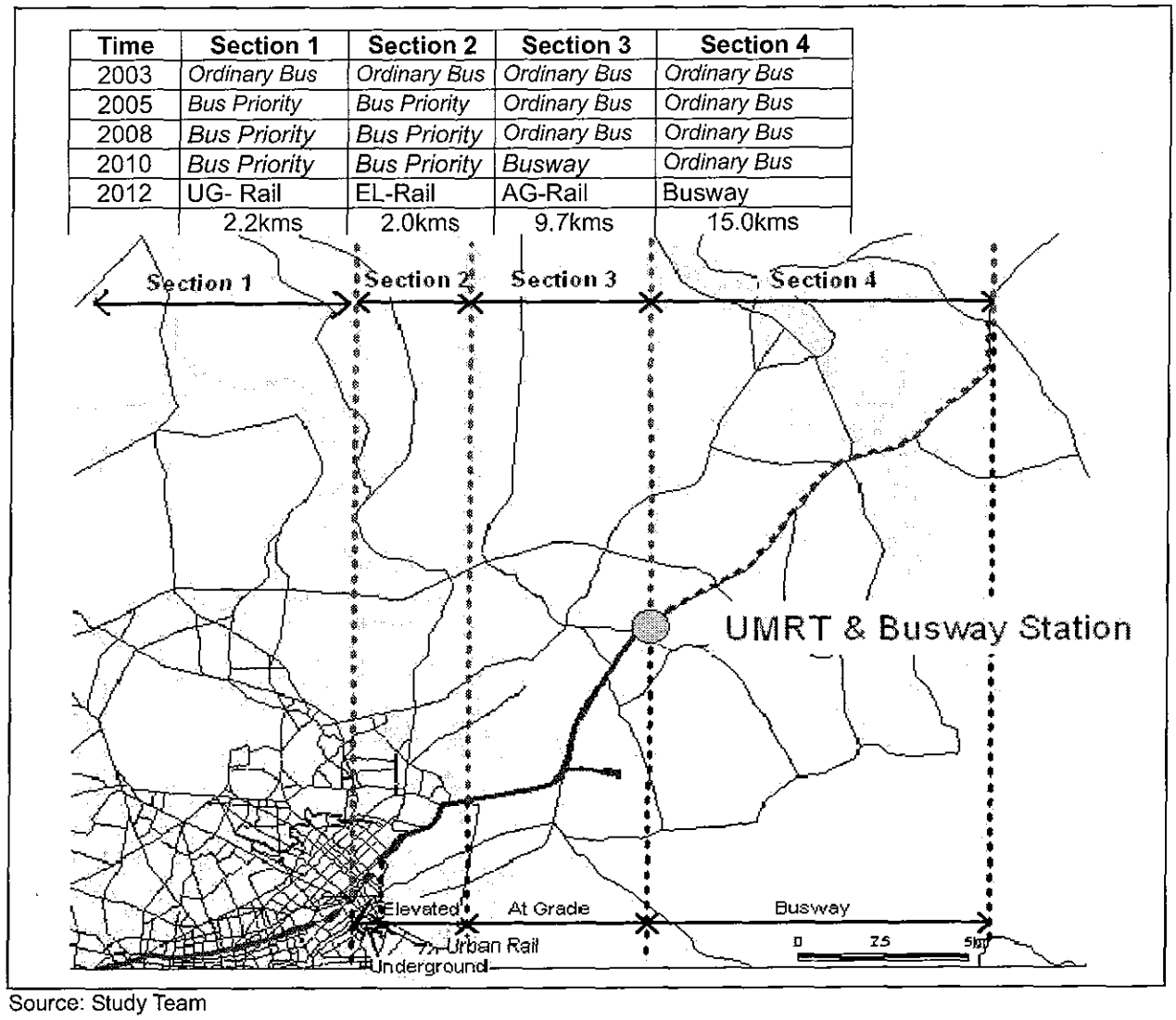
Because of the current relatively low patronage on public transport in HCMC, in the short to medium-term period a road based bus transit system is the most viable mode along the UMRT Line 1 corridor. The earliest start of revenue operations of a high-capacity rail-based transit mode will become necessary is around 2010/11, when the public transport demand reaches levels beyond the maximum capacity that can be achieved from a modern Busway transit system. The study team would suggest that at this preliminary stage of the project development that it would be a high financial risk for HCMC authorities to invest in a rail based transit system until such times as the passenger demand on the transport corridor reaches a desirable patronage threshold. Therefore, the study team suggest that in the first instance it may be a more cost-effective and financially viable option is to use a road based Busway transit system, to be replaced at some later stage with higher-capacity rail based transit mode.

The study conclusions are in the first instance to give highest priority to the phased development of the UMRT Line 1 corridor into a primary Busway transit system initially using regular on-street bus line competing with other road traffic (1st stage), the corridor should be developed into a bus-priority lane (2nd stage), thence into dedicated segregated bus lanes (3rd stage) – section by section from Ben Thanh Market terminal to Cho Nho Station 11. The 4th stage will be the conversion of Stations 1 to 11 into a 13.9-km rail line, with an extended transit corridor route length from Cho Nho Interchange Station 11 to Bien Hoa multimodal Terminal Station 20 as a 15-km long segregated Busway transit system.

This concept of a phased approach to developing the UMRT Line 1 (East) into a high capacity mass transit corridor is illustrated in Figure 7.1.2.

Figure 7.1.2 Staged Development of UMRT Line 1

Time	Section 1	Section 2	Section 3	Section 4
2003	*Ordinary Bus*	*Ordinary Bus*	*Ordinary Bus*	*Ordinary Bus*
2005	*Bus Priority*	*Bus Priority*	*Ordinary Bus*	*Ordinary Bus*
2008	*Bus Priority*	*Bus Priority*	*Ordinary Bus*	*Ordinary Bus*
2010	*Bus Priority*	*Bus Priority*	*Busway*	*Ordinary Bus*
2012	UG- Rail	EL-Rail	AG-Rail	Busway
	2.2kms	2.0kms	9.7kms	15.0kms



Source: Study Team

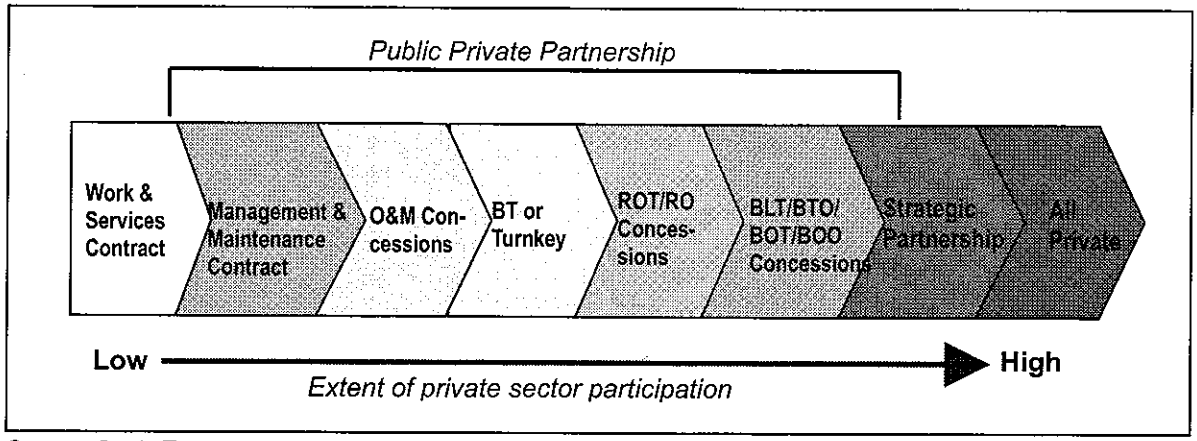
7.2 Public Private Partnership (PPP)

1) Private Sector Participation (PSP) Modality

When considering private sector participation, several variations or models can be considered - ranging from the basic construction/supply contracts and project management contract through to the strategic equity partnership between private and public sector (see Figure 7.2.1). Build, Operate and Transfer (BOT) is a complicated model of PSP, which requires a comprehensive regulatory framework streamlined for private financing, and high-level expertise at various stages.

The factors and conditions the government of Vietnam has to consider in deciding which PSP model or variant to adopt for the implementation the UMRT Line 1 (East) project.

Figure 7.2.1 PSP Modality



Source: Study Team

2) Constraints to PSP in Vietnam

There are three issues to be considered when implementing a PSP project in Vietnam, viz.: country risk or macro-economic factors, regulatory framework, project uncertainty.

(1) Country Risk

The country rating is a starting point in assessing the relative difficulty of private financing in developing countries. The rating of Vietnam, as illustrated in Table 7.2.1, is B1 (as of 2003.2.21) by the Moody's country rating. This is below the speculative grade, at which procurement of private financing in foreign currency would usually entail sovereign guarantee and support from the government as well as bi-lateral (ODA) and multi-lateral financial institutions (such as World Bank and ADB). The current GDP per capita of the country is just over 2,000 USD, which implies the low affordability of transportation users.

Table 7.2.1 Country Risk Assessment of Vietnam

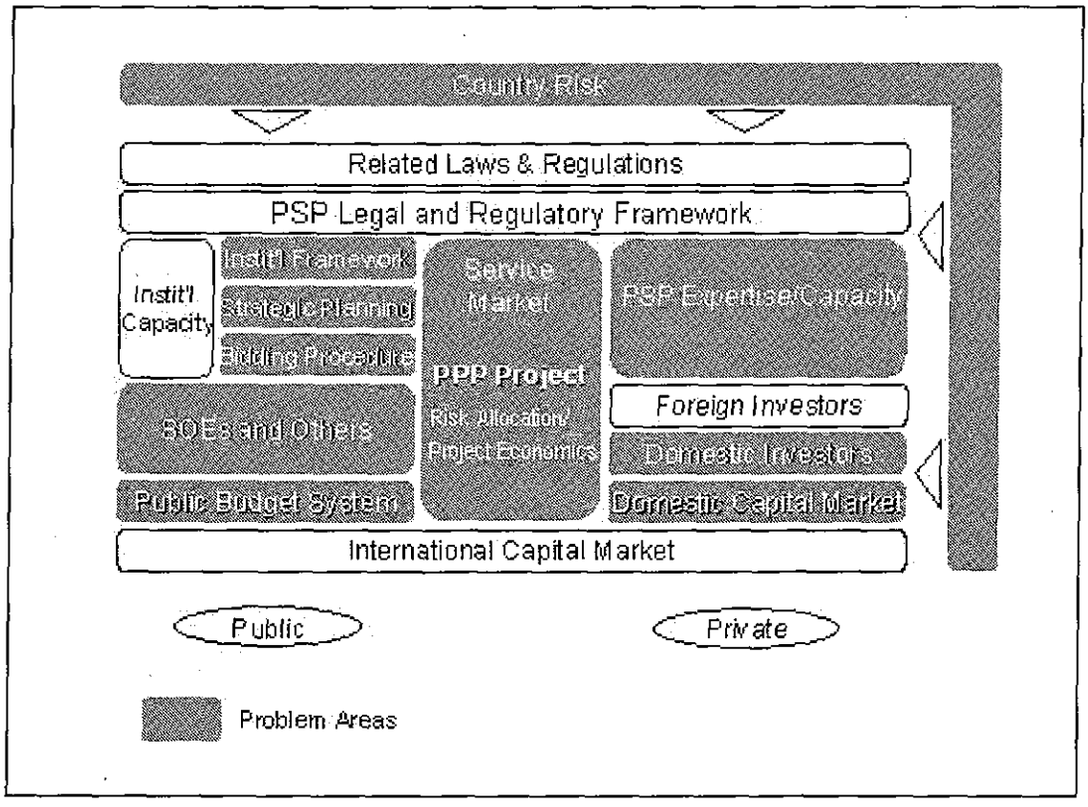
Country	Country Rating (Moody's 2003.2.21)	GDP/Capita (in US$, 2002 est.)
Taiwan	Aa1	17,119
Korea	A3	19,265
China	A3	4,671
Malaysia	Baa1	8,825
Thailand	Baa3	6,575
Philippines	Ba1	3,963
Vietnam	B1	2,072
Indonesia	B3	2,969

Source: Study Team
Note: Aaa>Aa>A>Baa>Speculative>Ba>B>Caa>Ca>C; 1>2>3

(2) Framework for PSP

It is essential for a country wishing to utilize private sector finance will have to prepare a comprehensive PSP framework when a PPP project is implemented. A preliminary assessment was conducted to evaluate the suitability of PSP for Vietnam. The areas assessed as problematic are illustrated in Figure 7.2.2.

Figure 7.2.2 Problem Areas in PSP

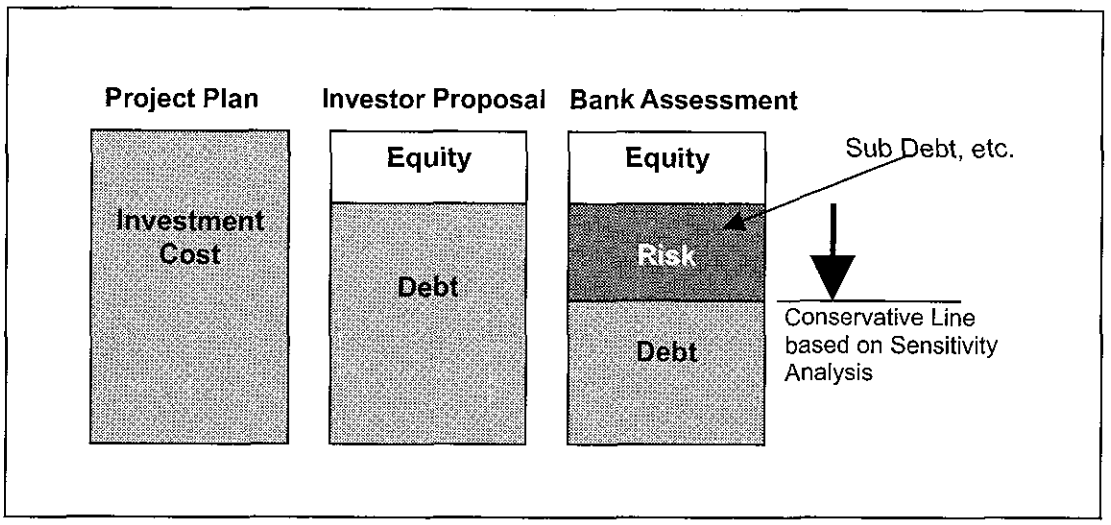


Source: Study Team

(3) Passenger Demand Forecasts

When the viability of a PSP project in the transport sector is examined, the uncertainty in the passenger demand forecast is at the prime concern of potential investors and lenders. As illustrated in Figure 7.2.3, the lenders always evaluate the project risks of the investor's proposal in a conservative manner. When the extent of the project is great, particularly when the project has no historical information on the existing passenger demand, a risk assessment may not be easily determined, thus the viability of financing would tend to be negative. Passenger demand forecasts for "greenfield" projects, especially rail projects, are usually very difficult to predict due to the number of project variables to be assessed.

Figure 7.2.3 Uncertainty in Demand Forecast



Source: Study Team

(4) Limited Options for Private Financing

Due to the risk criteria issues discussed above, it can be conjectured that at the present time other than multilateral banks such as ADB and World bank that there is very little opportunity for private sector project financing in Vietnam for foreign lenders.

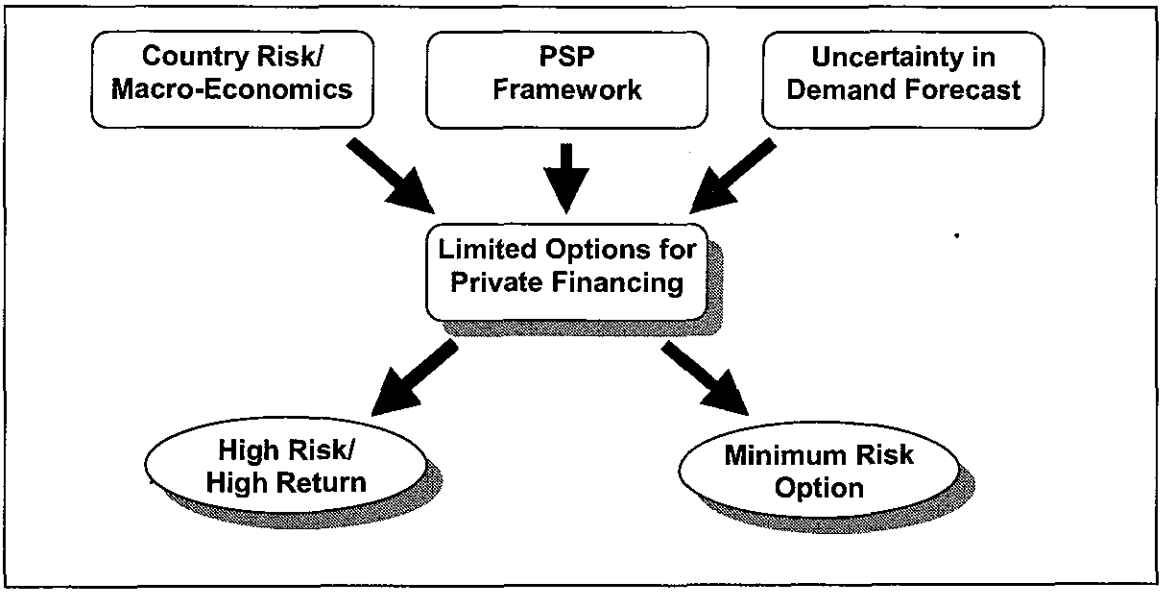
Historically a lender or investor can either be risk averse, or a risk taker (as illustrated in Figure 7.2.4):

- Option 1: High risk/high return
- Option 2: Minimum risk

Option 1 is chosen by a lender or investor when the profitability of the project is sufficiently high enough to compensate for the high risk surrounding the project. Such is the case for the Phu My Hung's Saigon South project.

Option 2 is a risk minimization approach where uncertainty in demand forecast is assumed by the public sector to make private financing more feasible. A Build-Transfer or Build-Lease-Transfer (BLT) contractual structure is adopted in this case.

Figure 7.2.4 Limited Options for Private Financing



Source: Study Team

3) Formulation and Evaluation of Options for UMRT line 1 (East)

(1) Setting up the Basic Options

There are common project elements in both UMRT Line1(East) and Ring Road No.2 Projects as illustrated in the Figure 7.2.5. The elements are treated differently, in terms of risks allocation between the public sector and the private sector.

Among those common elements, the core project elements are "Superstructure" (or systems) and "Infrastructure". In case of UMRT Line1 (East) the Superstructure refers to the rolling stock and electronic/mechanical equipment such as, signaling, traction power, communications, depot equipment, AFC, escalators/lifts etc., and Infrastructure will include trackwork and the civil/structural elements such as tunnels, viaducts, stations and at grade track including the depot and stabling elements of the project. In a similar manner to the Ring Road No.2 project, the Superstructure refers to the pavement and, lighting and safety facilities, and the infrastructure is the road structure and the civil works.

"Residential/Commercial/retail Development" corresponds to the retail, commercial and residential opportunities along the corridor of UMRT Line1 (East) and the Ring Road No.2. "District Infrastructure" means the development of major district roads. power supply, sewer and water supply.

Based on the consideration of the constraints and the extent of private sector participation, basic options can be classified into four different options as illustrated in the Figure 6.2.6.

(2) Formulation of the Options

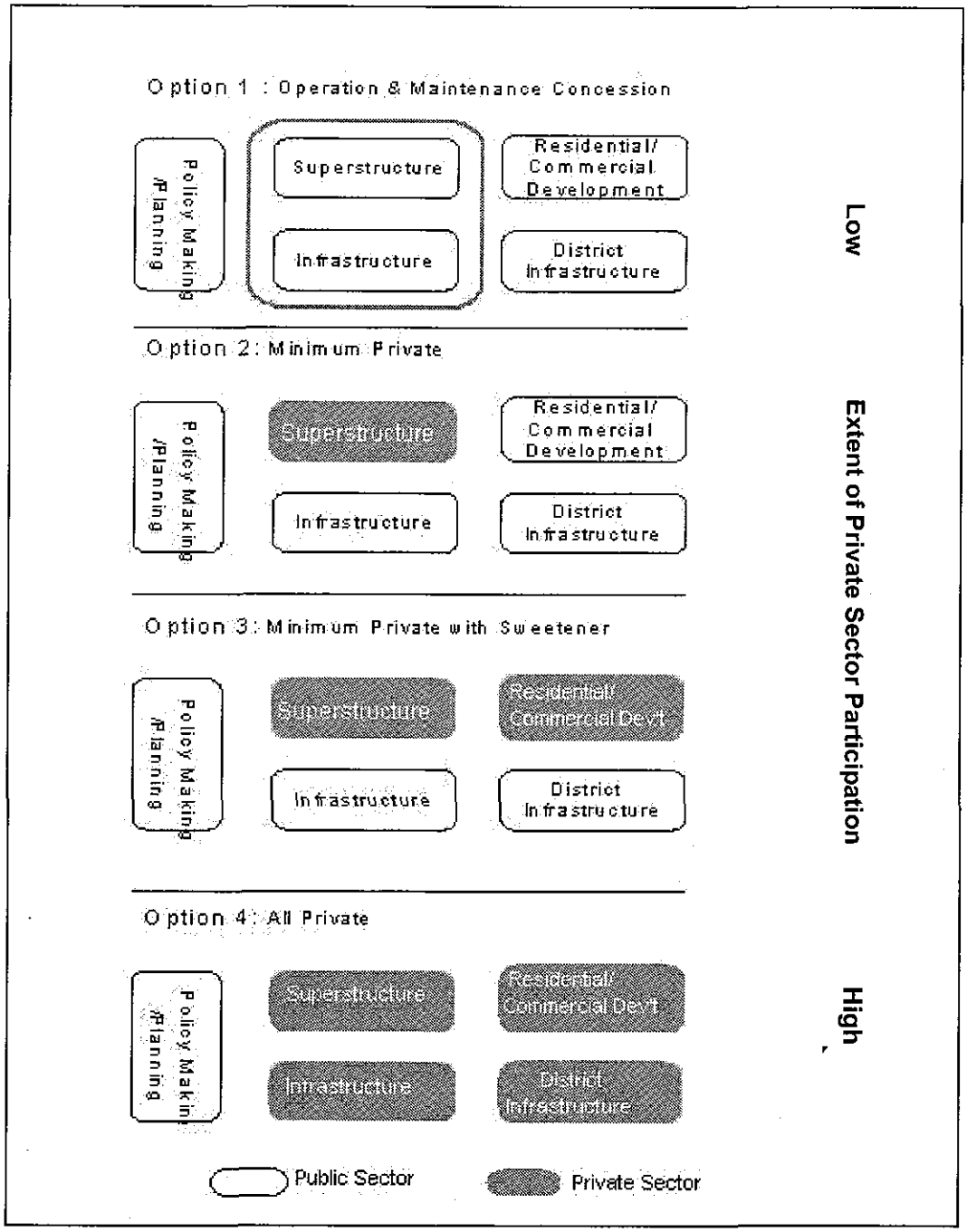
From the four basic options, it is possible to combine those features that will make the UMRT Line 1 (East) project acceptable from the private and public lender viewpoint. The project structure will depend on how the lenders would rate against the nine factors, as shown in Table 7.2.2.

A summary of the features of each implementation options is shown in Table 7.2.3.

In conclusion, the resulting options were then evaluated against the seven issues (see Table 7.2.4): Necessity for institutional reform, Creation of a competitive market, Bankability of the project, Magnitude of Government Debt Burden, Risk Transfer from government to the private sector, construction and operational risk, and Regional Development Impact.

The results of the initial assessment would indicate that an "All Private" option to the least desirable, and that "minimum private sector" was ranked highest and is considered the most appropriate project financing option in terms of i) creation of private sector competition, ii) bankability, and iii) risk transfer.

Figure 7.2.5 Basic Options for PSP



Source: Study Team

Table 7.2.2 Formulation of Implementation Options for UMRT Line 1 (East)

Criteria	Option 1: O&M Concession	Option 2: Minimum Private	Option 3: Min. Private w/Sweetener	Option 4: All Private
1. Private Sector Risk	**Private:** Bus operation, Long-term railway maintenance contract, **Public:** Rolling stock, power and signaling, depot Building & facilities Trackwork, stations, depot platform, ROW	**Private:** Bus operation, rolling stock, power and signaling, depot building & facilities, maintenance contract **Public:** trackwork, stations, depot platform, ROW	Same as Option2 plus: Opportunity for commercial/ residential development for Private Sector	All Project Elements are implemented by Private Sector: UMRT Line 1 (East) Commercial/Residential Development District Infrastructure Development
2. Freedom in Operation	Work to a Performance specification	Fare setting with Public	Freedom of commercial/ residential development	Large freedom in operation
3. Clear Risk Allocation	Clear risk allocation against a performance specification by the contract	Relatively clear risk allocation by BOT availability type concession contract	Uncertainty in commercial/ residential development	Uncertainty in project completion
4. Investment Recovery	No significant investment by Private	By availability payment from Public funds	Availability payment and proceeds from commercial/ residential development	Proceeds of various development in the long term
5. Finance	**Private:** No significant financing **Public:** ODA	**Private:** Project finance **Public:** ODA	**Private:** combination of project finance and private equity **Public:** ODA	**All Private**
6. Implementation Setup	Conventional setup or Mass Transit Authority	Mass Transit Authority	Mass Transit Authority	Mass Transit Authority and /or Regional Development Authority
7. ODA	All the investment may be financed by ODA	Significant infrastructure investment covered by ODA. Combination of ODA with PPP concession.	Significant infrastructure investment covered by ODA. Combination of ODA with PPP concession	None
8. Consistency with present government System	Possible under current system	Small modification	Small modification	Possible under current system
9. Regional Development Impact	Minimal impact	Small	Relatively significant	Large

Source: Study Team

Table 7.2.3 Summary of Features of Alternative Options for UMRT Line 1 (East)

PPP Options	Public Sector	Private Sector
1. O& M Concession	- Busway (widening, etc. from ODA; ROW from budget) - Railway (construction from ODA) - Operation: by Transit Authority	- Busway O&M Concession (short-term) - Maintenance (railway, rolling stock, EMS) contract
2. Minimum Private	- Busway (widening, etc. from ODA; ROW from budget) - Railway Infrastructure: ODA (including mainline tunnels, viaducts, station & other facilities) - Operation: by Transit Authority - Subsidy back-up	- Busway O&M concession (short-term) - Railway: rolling stock, EMS and others: BOT concession (availability payment), Busway Operator to have right of first refusal
3. Minimum private with Sweetener	- Same as Option 2	- Same as Option 2, plus: Concession of station and related commercial development
4. All Private	- Role of corridor development authority	- Same as Option n3, plus: - All residential and commercial development along the corridor

Source: Study Team

Table 7.2.4 Evaluation of Risk for Implementation Options

Issue / Options	1 Reform Needs	2 Creation of Competition	3 Bankability	4 Govern-ment Burden	5 Risk Transfer	6 Difficulty in Implementation	7 Regional Dev't Impact	Overall Rating
1: O&M Concession	4	3	4	1	4	4	1	21
2: Minimum Private	3	4	4	3	4	3	2	23
3: Min. private with sweetener	3	3	2	3	3	2	3	19
4. All private	4	2	1	4	2	1	4	18

Source: Study Team

Note: 4 – Most preferable; 3 – Preferable; 2 – Some Problems; 1 – high risk

4) Preferred PPP Option for UMRT Line 1 (East)

Following the "Minimum Private" option, the allocation of responsibilities and risks between the public and private sectors are as shown in Figure 7.2.6.

Under this scheme, the government assumes the risks of constructing the basic infrastructure portion of the UMRT Line 1 (East) - covering road widening, busway, railway, mainline tunnels, viaducts, at grade section, stations, depot and stabling and ROW acquisition. The private sector would therefore assume the risks associated with rolling stock, the EMS including traction power, signaling, communications AFC, depot building & workshop facilities and the operations & maintenance contract.

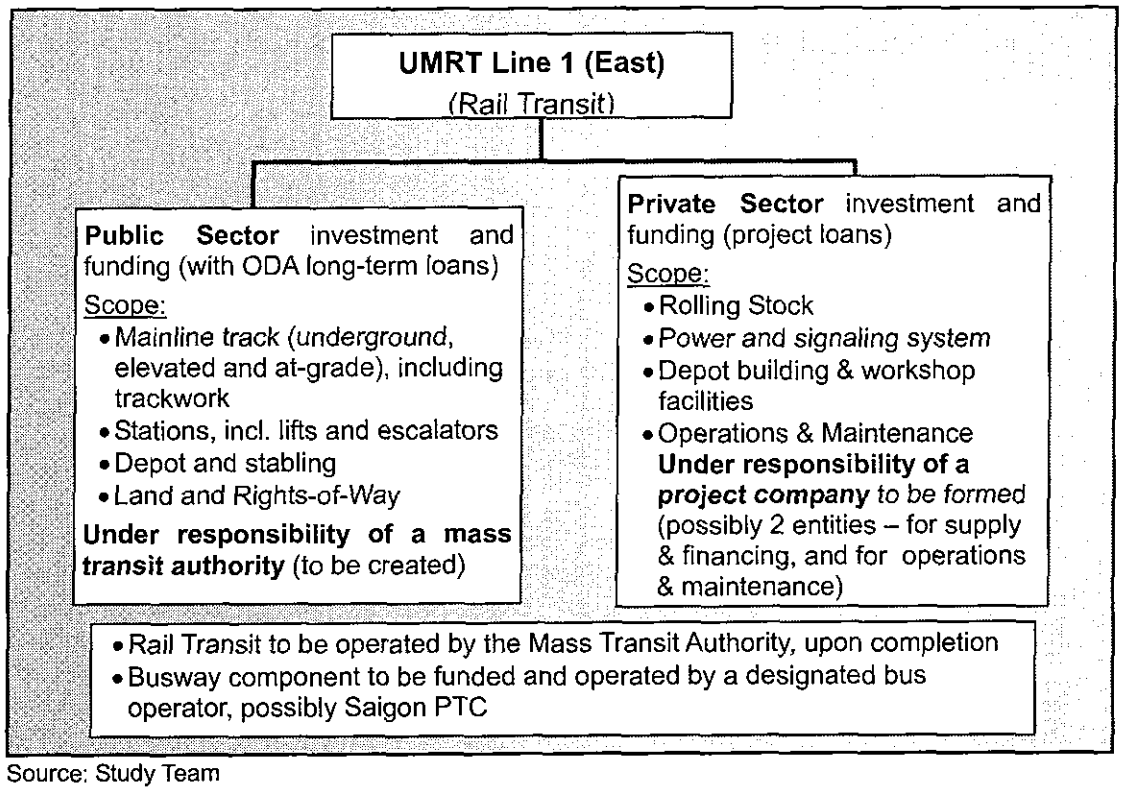
Under this particular funding arrangement, the Vietnamese central government will leverage ODA funds with budgetary allocations to fund the civil and structural works. The balance of the project cost for the systems including rolling stock will be put up by the private sector, who will then recoup his investments from lease and maintenance fees,

based on train availability, over a long term period ranging from 10 -20 years. A shorter period is more attractive to private parties, while a longer period is desirable from the government viewpoint. Since market risk (i.e., uncertainty in patronage) is firmly with the government of Vietnam, private investors would find this model attractive or stable. Its only downside is the difficulty in the negotiations to "harmonize" the expectations, obligations and the financial and social expectations of the two parties – especially prior to and during the construction/ implementation phases of the project.

The recommended PPP model has some of the funding features of the Bangkok Metro (or Blue Line) project. The use of ODA loans, as well as state-ownership of the track infrastructure, is similar to the Blue line project. But unlike the Bangkok Metro, transit system operation will be the responsibility of the government rather than the private sector. Because of the low level of passenger affordability and the higher traffic forecast uncertainty in HCMC (versus Bangkok), the project funding structure for the UMRT Line 1 (East) was similar to the Blue Line in Bangkok it would most probably be considered as non-bankable under international banking practices and standards. Therefore, awarding a concession similar to the Bangkok Metro, or the Kuala Lumpur LRTs, is deemed unsuitable for HCMC UMRT Line 1 (East) project.

The Busway transit component of the UMRT Line 1 (East), however, could possibly be assigned to one of the more established bus operators in HCMC, with the government only having to provide public funds the major infrastructure improvements on the existing Highways including the dedicated bus lanes, multimodal interchanges, intermediate stations and terminals and perhaps low interest loans for the high capacity bus rolling stock to make this section of the transit system financially viable.

Figure 7.2.6 Recommended PPP Implementation Structure



Source: Study Team

7.3 Project Implementation Schedule

1) Project Sequence

Figure 6.3.1 shows the development timeline of the rail transit section of UMRT Line 1 (East) from its inception in 2004 to operational revenue within 7 to 9 years or about year 2011 to 2013 depending on the phasing of the project. The schedule is based on the premise of the Government of Vietnam making use of ODA bilateral fund sources for part of, or the whole project in accordance with the PPP model discussed earlier in this report. This financing mode will entail a minimum 2 years lead-time, before actual tendering or construction of the civil and structural works contract can commence. The normal and mandatory stages on which the project will go through to use ODA funds are as follows:

- Preparation of the feasibility study;
- Evaluation of the study and inclusion of the project in the lending agency's portfolio;
- Appoint a consultant to carry out the basic engineering design including the
- Preparation of detailed design, bill of quantities, and firm cost estimates;
- Preparation of bid documents, followed by bidding, evaluation and award;
- Actual construction of the civil works, with the manufacture and installation of the electromechanical systems components following suit;
- Testing and commissioning;
- Commercial revenue service or operation

If the Vietnamese Government chooses to finance the project with its own internal resources, it could perhaps shorten the project development period of the project implementation schedule by about 2 years. However, the government would still have to undertake detailed engineering works for the civil works as well as the various electromechanical systems which would take about 12 to 15 months therefore the potential time savings would only be about twelve (12) months if the Vietnamese government was to fund the transit system from its own fund sources.

The Design and project management of a modern mass transit rail system implementation programme would most likely require the assistance from experienced foreign consultants as the required urban mass rail transit expertise is not available domestically. Rail transit systems are not off-the-shelf commodity products; they are purpose built to order and adapted to meet the particular needs of every city. But before they can be built and operate successfully, the manufacturer or systems supplier must know what the buyer/operator wants – which means detailed technical performance specifications will have to be prepared by the project consultants.

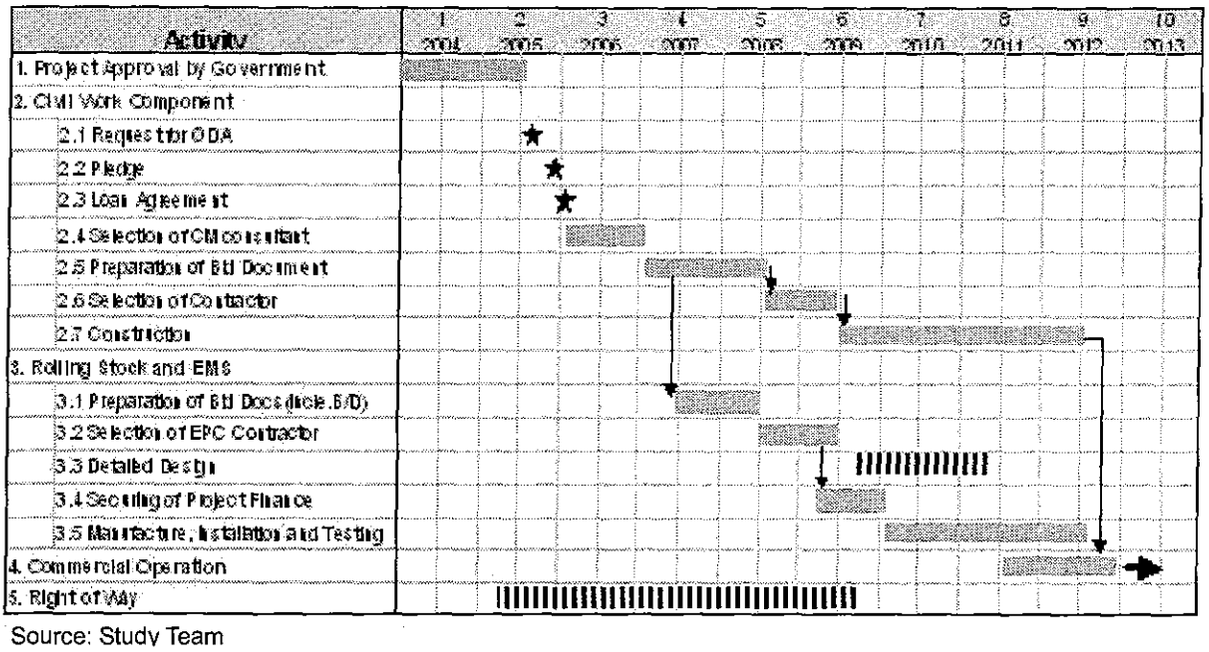
The implementation schedule in Figure 7.3.1 also assumes a hybrid approach to the design problem – detailed design and specifications for the civil works, but only performance (i.e., broad) specifications for the electromechanical systems components. This will reduce design time, on the part of the government or owner. Contractor for the latter components would then conduct their own EPC (engineering, procurement, construct- manufacture-installation) and deliver a product, which meets the performance

specification. This transfers the risk and the detailed design responsibility of the more complex systems technologies to the manufacturer/supplier, rather than the government as the project owner. This system has the added advantage of allowing bidders to optimize their own products – rather than combining a mix-bag of components from sub-suppliers – with a resulting lower cost beneficial to the owner.

However, to ensure long-term system performance, the EPC contract should require a concomitant maintenance support or guarantee over 5-10 years after turnover or maintenance responsibility over the entire life of the system. This type of arrangement is consistent with the PPP model discussed in other sections of this report.

Some transit owners have also adopted this philosophy by using the design-build approach for the civil infrastructure works. The detailed of final engineering design (FED) is also left to the civil works bidders. While this may shorten the time to completion of the civil and structural works, it also increases risk to the contractor who tends to price the risk into the cost of the works. This concept and makes it difficult to evaluate bid and award the contract on the basis of price unless a very detailed preliminary engineering and an experienced program management team is employed by the project proponent.

Figure 7.3.1 Implementation Schedule for UMRT Line 1 (Rail Transit Segment)



Source: Study Team

2) Project Schedule

As indicated earlier, there is no extreme urgency for HCMC to commit to a rail transit line in the short term and then rush its development and implementation. Therefore the government of Vietnam It has the benefit of time to fully develop the basic engineering concepts included in this study and project implementation schedule to match the demand forecast for public transit project on this corridor. The study team would caution against the government committing too early to a particular individual supplier or manufacturer which may or may not be the most favourable option for the government of Vietnam, in terms of cost, technology risk and potential unforeseen delays in the project

implementation due to affordable project financing (such as ODA) not being readily available. A competitive bidding process with international suppliers/contractors will most probably result in an overall lower project cost the government.

The time for government to make the final decision to go ahead with the project would be in the next 18 to 24 months from now or when the project is in the ODA pipeline and the design of the transit system has been developed to the next level of detail. Such a "go/no go" decision should also have the advantage of being able to monitor bus patronage data on the UMRT line 1 (East) corridor. The government and its consultants would then be in a position to better assess the willingness to pay by passenger for the provision of modern rail transit, and whether there is likely to be a major shift from private transportation (motorcycles) to public transport commuting.

3) Implementation Schedule for the Busway Transit System

Before the completion of the rail transit component (stage 1), it is proposed that the Busway will operate on the proposed UMRT Line 1 (East) route. A variety of actions are taken to increase service and improve ridership. Stage 2 occurs when the traffic forecast volumes for the Busway rapid transit system are reached. This is expected to be by 2010 (or earlier) – with a dedicated Busway on median lanes from Van Thanh to Thu Duc, with bus priority lanes from Ben Thanh market to Van Thanh. Stage 3 would be implemented when the rail transit section is completed. At that point (sometime in 2010/11), the bus service would then be discontinued from Thu Duc to Ben Thanh market to give way to the rail service. The role of the bus system in the corridor is changed to provide feeder buses to the rail transit stations along the line. On the Bien Hoa to Thu Duc section, a Busway will function as an extension of the rail line with a major transfer station at Cho Nho. The bus fleet previously operating in Stage 2 will now be transferred to that outer section from Cho Nho to Bien Hoa multimodal terminal in the eastern suburbs of HCMC.

7.4 Construction Planning

Under a traditional mode of project implementation, the full burden for contract administration, construction coordination management, and interface with various contractors and suppliers fall on the Project Management Unit (PMU). At the opposite end of the spectrum, where a Build-Own-Operate model is adopted, this responsibility falls squarely on the concessionaire – with the PMU providing a monitoring and reporting role only to the concessionaire.

The preferred PPP model divides the construction responsibility also. For the civil works aspects, it is possible to divide the contracts into five discrete bid-construct packages:

(1) The underground tunnel works and stations including the tunnel portal;

(2) The elevated viaducts and stations and the major river bridge crossings;

(3) The at-grade construction and stations;

(4) Depot including workshops, stabling, ancillary buildings and facilities and substations;

(5) Trackwork and trackside equipment.

The fewer the contract packages, the easier it will be for the PMU to manage. In fact there

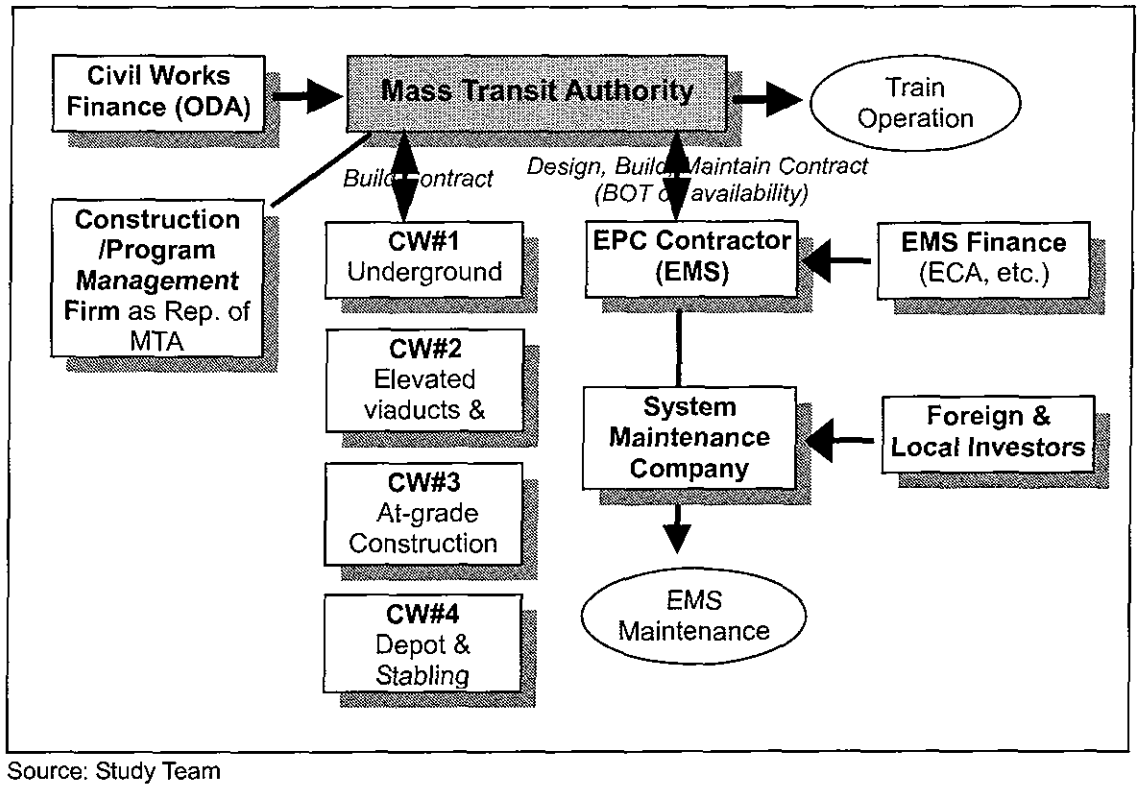
may be some strong merit in appointing a managing contractor for the civil works programme who would take responsibility for a fee for the successful completion of the project on time, within project budget and to the desired quality and workmanship. However, the risk of construction delays (or failures) also decreases.

On the other hand, dividing the works into many smaller packages may allow more domestic contractors to participate but complicate the required integration and coordination tasks and also increase the risk of late delivery of the completed project if one contractor does not complete his section of the works on schedule.

The Timetable for construction could be shortened by dividing the project into discrete works packages. For the electro/mechanical system components – which encompass rolling stock, traction power and signaling/communications, AFC, SCADA, escalators/elevators, tunnel ventilation and fire protection systems – a single EPC contractor is envisaged.

This concept is depicted in Figure 7.4.1.

Figure 7.4.1 Contracting Structure for UMRT Line 1 (East)



Source: Study Team

7.5 Organizational Plan

1) Interim Organization

At the inception of the project, a Project Management Unit (PMU) can be formed to undertake all the necessary project preparation such as design, site investigation, survey and construction planning and other pre-investment activities possibly with the assistance of foreign consultants experienced in railway transit projects. This is the normal procedures for a project of this magnitude. What requires further discussion and agreement is whether this PMU shall be

a) a unit within the Vietnam National Railways (VR) organisation,

b) directly under the Ministry of transport (MOT), or

c) a new unit set up within TUPWS under the HCMC-PC.

Initially thoughts are that VNR would seem to be the preferred institution. However, the UMRT Line 1 (East) transit project is unlike any rail system currently being managed by VR and technology and systems that the new transit will adopt will not be compatible with the existing experience of the VNR organisation. To compare the two systems the UMRT project will be electrified, rather than diesel-powered as in VR. The trackwork will be based on standard gauge, rather than the VR meter gauge. Initial operations before 2010, the transit line is essentially operated as a Busway system. Also, the transit line will not be an extension of the VNR inter-provincial rail network but rather a separate intra-urban rail and bus network.

Therefore in the opinion of the study team, the VNR-option may not be the most appropriate option as the operations for an urban mass transit system are quite different from an intercity mainline rail operation.

From a project financing viewpoint, the MOT-option has distinct advantages, but the geographical focus, as well as the urban redevelopment aspects of the project favors the option where a PMU under the city government structure may be the most appropriate project management option.

To ensure vertical and horizontal coordination, a Steering Committee should be formed to oversee the activities of the PMU. This Committee should include the Deputy Ministers of MOT, the Deputy Minister of MPI, the General Manager of VNR, and the Chairman of the HCMC-PC.

From 2004 to 2010, the PMU will be the organization to guide the development of the UMRT Line 1 (East) from the initial concept planning, thru detailed engineering or design and construction phases of the project to commissioning and the start of revenue operations. At that stage the PMU would be reorganized or disbanded after the transit system is completed and put into commercial revenue service.

In the first two years of the project, the PMU should focus on the following:

- Understand all rail developmental options and seek consensus within HCMC and with the national authorities on the preferred implementation mode for Line 1 (i.e. whether entirely by public sector or through PPP, and if so, what variant or PPP model);
- Review and develop the proposed alignment and gather and collate all necessary

technical information along the alignment, including topographic survey, geotechnical data, building condition surveys existing and new utilities, prepare parcilliary plans defining lot boundaries and ownerships;

- Secure the land for the proposed Depot and tunnel portal and other works sites, or secure commitments for a better site;
- Secure the necessary rights-of-way including the station sites;
- Explore development opportunities with property owners along the alignment particularly at station ;
- Develop the performance specifications, materials & workmanship for key technical issues in more detail including the tunnel works, viaduct construction, station planning and for the systems rolling stock, traction power (DC vs AC, 750v or 1500v), heavy rail or light rail, automated driverless system versus driver-controlled trains, preferred train control and signaling system, fare system, communications and control systems (SCADA) and the like.
- Perform other detailed planning and project preparation tasks, including re-assessment of project programming and economic viability

The study team believes that HCMC UMRT Line 1 (East) should avoid locking itself to a particular Supplier at an early stage in the project development until after the technical and financial team has fully examined all the developmental and technical options. And review the lessons learnt by other cities in their rail transit development programme.

To aid the PMU during this crucial time of project development the study team firmly believe that it will be extremely beneficial for HCMC UMRT line 1 (East) to appoint an impartial experienced international rail consultant to assist the PMU team during this critical phase and developing a bankable, cost effective and efficient Mass Rapid Transit System for the city of Ho Chi Minh.

2) *Permanent and Long-term Organization*

The study team would suggest that no later than the completion of UMRT line 1 (East) construction, and no earlier than approval of the investment or the financing arrangements are in place that a new state-owned enterprise (SOE) should be formed. Which would suggest formation of the SOE around 2006-2007. A tentative name for the SOE is the Saigon Mass Transit Authority (SMTA), which should be organized with a Board of Directors that includes the key members of the proposed steering committee for the PMU. Once the SOE is formed, the PMU should be transferred as a technical unit under the SMTA.

The SMTA shall be empowered to undertake all kinds of activities necessary to plan, operate, and maintain urban rail transit systems in HCMC and surrounding areas. In addition, it can undertake property developments or enter into joint ventures to exploit commercial opportunities in and around the rail stations and depot. All the foreign and domestic loans secured for the project, as well as any budget allocations from the City and National governments, should be pooled together and recorded in the books of the SMTA. It is advisable that the tendering for construction of the civil works contracts, and for the supply of the rolling stock and electro-mechanical systems, be conducted already

under the umbrella of the SMTA.

It is envisaged that the operations of the system shall be directly under SMTA, but that the maintenance of the physical assets would be contracted out in accordance with the PPP model recommended earlier in this study.

A key issue is whether SMTA shall be charged with running the rail system along "prudent commercial lines" similar to the Hong Kong Mass Transit Corporation (MTRC) and be given the power to decide its own fare levels. If the only consideration is the rail mode, then the answer should be. However, there are other inter-modal aspects with the Busway, and perhaps later with the waterbus. In the event that MOCPT becomes an independent public transport regulatory body, then fare setting should be excluded from SMTA. Alternatively a common ticketing system similar to the "octopus" system in Hong Kong should be considered.

Another strategic issue that needs to be resolved (when the SMTA is formed) is long-term funding. It is evident that the operation of UMRT Line 1(East) will incur financial losses, and therefore require annual operating subsidy from the government. The long-term sustainability of the system depends on how the subsidy will be channeled to SMTA, and from what sources it would come from. Perhaps, this issue should also be studied by the PMU or their international consultants.

3) Internal Structure of the Transit Authority (SMTA)

For purposes of the feasibility study, an integrated transit authority was conceptualized to cover all aspects within one unified organization. In short, no outsourcing was assumed – even for such non-core tasks as janitorial and security services. This is illustrated in Figure 7.5.1, where all business processes - other than Operations and Maintenance – are grouped under a third division called Support Group. However, no staff build-up were assumed for handling non-recurrent tasks like project planning and preparation for the next line or extension of the rail line, or construction management of a new line. These types of one-off activities are more efficient being outsourced to international consultants specializing in rail transit projects.

In terms of manpower, the estimated number of employees required to operate and maintain Line 1 is 1,283 distributed as shown in Table 7.5.1 below. Using a 10-level compensation structure (see Table 7.5.2) that is set slightly higher than prevailing rates in HCMC, the annual manpower expenses would come to VN₫ 30.6 billion or about US$ 2.0 million.

Table 7.5.1 SMTA Manpower Requirements by Position Category

Position Category by Division	Head Count	Annual Cost	
		In VND million	in US$ 000
A. General Management	24	680	43.9
Managerial	6*	117	7.6
Supervisory	4	148	9.6
Rank and File	14	415	26.8
B. Operations Division	409	10,212	658.8
Managerial	5	208	13.4
Supervisory	78	2,890	186.4
Rank and File	326	7,114	459.0
C. Maintenance Division	371	8,912	575.0
Managerial	4	167	10.8
Supervisory	34	1,260	81.3
Rank and File	333	7,485	482.9
D. Support Group	484	10,765	694.5
Managerial	8	330	21.3
Supervisory	22	815	52.6
Rank and File	454	9,620	620.6
Grand Total	**1,288**	30,569	1,972.2

Source: Study Team
* including 5 members of Board

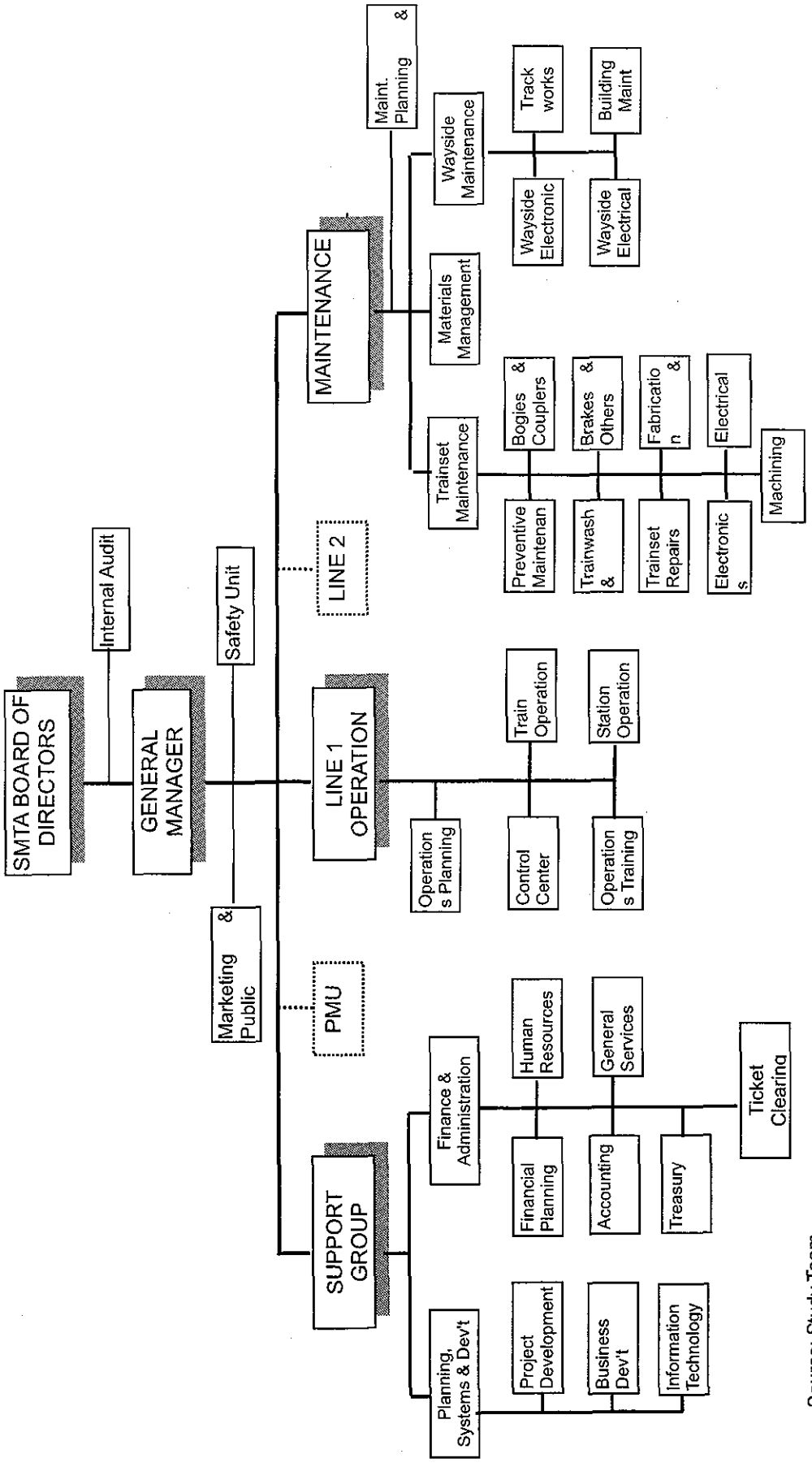
Table 7.5.2 Compensation Structure for SMTA

Salary Grade	Position Titles	Monthly (in 000VND)	Benefits (% x Monthly)	Annual Cost (13xmthly)
1	Janitor, Cleaner, Utility Man, Laborer	1,200	0.12	17,472
2	Security Guard, Clerk, Administrative Support Staff, Driver	1,400	0.12	20,384
3	Secretary, Technical Aide, Train Driver	1,600	0.12	23,296
4	Technician II, Lathe Technician	1,800	0.12	26,208
5	Technician I, Machinist	2,000	0.12	29,120
6	Professional Staff, Analyst, Accountant	2,250	0.13	33,053
7	Supervisor, Officer	2,500	0.14	37,050
8	Manager	2,750	0.14	40,755
9	Division Manager, AGM	3,000	0.15	44,850
10	General Manager	3,500	0.15	52,325
	Directors Fees/Honoraria	1,000		13,000

Source: Study Team

The manpower level (of 1,283) can be reduced through out-sourcing – by 371 if the whole maintenance responsibility is left to a private entity following the proposed PPP model, by another 157 and 253 for janitorial and security services, respectively.

Figure 7.5.1 Organizational Structure of Transit Authority for UMRT Line 1



Source: Study Team

4) Busway Transit

A policy issue is whether the SMTA should also be authorized to engage in other forms of public transport, such as taxi and feeder bus services. The combination of rail and Busway on UMRT Line 1(East) may argue for an integrated organization, i.e., SMTA as the unified agency to own and operate the rail services from Ben Thanh to Cho Nho, as well as the bus services from Cho Nho to Bien Hoa interchange terminals.

Nevertheless, the recommendation is for SMTA to focus on rail transit and to outsource the Busway service provisions to existing bus operators – say, to Saigon PTC or the existing bus operator on the route. In this way, there is a resulting specialization. Separation also avoids potential conflict with private bus operators or with Saigon PTC, as the bus routes extend outside the UMRT Line 1 (East) corridor. There is little, if at all, economies-of-scale to be achieved in placing bus and rail in one organization when there is only one line involved. More importantly, separation will insulate the liabilities and weaknesses of one from the other. However there is a high degree of inter dependence of the two transit modes with a "win win" situation possible where Busway traffic will feed passengers to the rail transit system. Close coordination of services will be necessary to ensure a fully integrated and efficient transport system is developed for the corridor.

The desired coordination of services between the rail and bus segments can be realized in various ways, without necessarily placing both under one body. The ticketing system can be designed such that a ticket for the rail can be used in the Busway and vice-versa. The schedules and frequencies for the rail vehicles (under SMTA) can be synchronized with the Busway operations (under Saigon PTC) through mutual agreement or by order of HCMC-PC. Dispatching of buses on the Cho Nho – Bien Hoa section can set its timetable and frequency of service from the arrival and departure of trains at Cho Nho multimodal interchange Station 11. Similarly, the feeder bus service to the other stations can set their timetable from the UMRT Line train schedules.

Total exclusion of Busway transit from the scope of SMTA is not to be construed as fixed and the study team would suggest a flexible approach to the integration of both rail and road based transit systems. In the event that Saigon PTC is privatized before 2010, it will be logical to consolidate all transport assets of the city under the SMTA. Such a scenario implies state ownership of bus and rail assets, but that management of the bus services itself is under private hands. The integration decision, therefore, can be deferred and should await a prior decision on the future status of Saigon PTC. An example of this can be found in United Kingdom where many of the larger cities have several modes of public and private transport groups under a Passenger Transport Authority (PTA), who coordinate, monitor and in some instances subsidizes non profitable but socially desirable transit routes.

A second policy issue concerning Busway is whether to adopt an open or closed system of operation. The alternatives, as well as their respective positive and negative aspects, are summarized in Table 7.5.3. A closed system is closest to a rail operation – where the buses are used exclusively in the Busway and under one operator. A partially open system is where the bus continues to run outside the Busway, either at the southern end only or at the northern end only, or at both ends, of the line. A totally open system is where several bus routes are allowed to use the Busway fully or partly, such that buses

can exit at both ends or somewhere in between and proceed to other destinations.

Table 7.5.3 Type of Busway Operation

Operational Consideration	Closed System	Open: South End	Open: North End	Open: Both Termini	Open: Ends & Major Stops
Headway reliability	High	Moderate	Moderate	Low	Low
Capacity maximization	High				Low
Possibility of congestion	Low	Low	Low	Low	High
Traffic enforcement	Easy	Moderate	Moderate	Moderate	Difficult
Operator's viability	High	High	High	High	Low

Source: Study Team

The estimated manpower requirement, as well as corresponding cost, to support the Busway section of UMRT Line 1, assuming a closed system and under different headways, is shown in Table 7.5.4.

Table 7.5.4 Manpower Number and Cost for Busway Segment

ITEM	Headway			Unit Pay/Mth (VND 000)
	5.0 min	7.5min	10.0min	
Number of buses required, net of reserves	21	15	11	
Drivers	49	33	26	2,000
Conductors	49	33	26	1,350
Dispatchers/Inspectors	4	4	4	1,350
Service staff	5	3	2	1,350
Administrative staff	4	2	2	1,500
Other overhead	2	1	1	2,000
Total Manpower	113	76	61	
Cost per Month (in 000 VND)	186,300	125,000	100,200	
Cost per bus per day (in US$)	16.7	16.8	16.6	

Source: Study Team

Should the frequency of bus service is increased, then the fleet and crew requirements would need to be adjusted also. It has been calculated that a frequency of 30 seconds (2 buses/minute) is the theoretical maximum that could be achieved when the buses are operated along a "rail-type" regime. At this headway, the number of buses required would be 218, providing a line capacity of 10,800 passengers per hour per direction.

5) *Organizational Responsibilities against Time*

As the Project moves from concept to operation, the challenges to specific organizations would also change, as shown in Table 7.5.5.

Table 7.5.5 Allocating Responsibility through Time

Aspects	Existing Organizations	Project Management Unit	Mass Transit Authority
Starting date	Now	2004	2008
Main focus: short-term	TUPWS to plan and implement bus priority measures on line 1 corridor	Project preparation Securing of ROW Resolution of pre-implementation issues	None
Main focus: medium-term	MOCPT to supervise bus operator on line 1 to adjust service in accordance with Busway standards	Construction of rail line and Busway sections	Organizational development for rail operations Maintenance framework & contractual terms
Main focus: long-term	MOCPT (and affected bus operators) to adjust bus services in light of Line 1 operation	None, unless construction of Line 2 is commenced	Efficient management of commercial service
Required External Expertise	Minimal, perhaps in the area of corridor traffic engineering	• Project development; • Detailed engineering; • Construction Management	Maintenance of rail assets, following the recommended PPP model

Source: Study Team

8 EVALUATION

8.1 Methodology

The feasibility of a railway line is usually assessed, *quantitatively*, in two ways: through the method of economic analysis and through financial analysis. For comprehensiveness, the UMRT 1 project is also evaluated *qualitatively* – as to its environmental, social and land use impacts. This review includes the following evaluation criteria:

- Economic
- Financial
- Environmental
- Land use
- Social impact

The economic evaluation considers the benefits and costs to Society as a whole. In contrast, the financial evaluation takes the viewpoint of the firm – or the profit and loss to the rail-owning and management entity. This difference in viewpoints also differentiates how the project's costs and incomes are calculated.

The items comprising the cost side of the equation are not much different in the economic or financial methods, except for the following treatments:

- Taxes are excluded from the economic analysis, and therefore the cost items have to be deflated to remove any embedded taxes;
- Imported items require foreign currency, and therefore are "shadow-priced" in the economic calculations (but no adjustments in the financial evaluation);
- The shadow price represents the scarcity value of the foreign currency, and is equal to one only when there is free convertibility and the local currency is allowed to follow its value in the international markets;
- Cost of local labor is also subjected to shadow pricing, in a situation of surplus labor (i.e., many unemployed and a minimum wage is set by law), but the adjustment rate is not the same as that for foreign exchange.

On the other hand, the items comprising the benefits and revenue sides are quite different in the economic and financial methods.

- The financial benefits consist of the fares collected from passengers, as well as other non-transit incomes that maybe derived from the operations of the railway system;
- The economic benefits consist of savings in vehicle operating costs as well as savings in passenger time due to the presence of the project. Without the UMRT 1 project, the urban transport system has an imputed or derived vehicle-kilometers run, vehicle-operating hours, and passenger traveling hours. These 3 variables are compared with the situation of "with UMRT 1 project". The differences, converted into money values, provide a good estimate of the benefits.

The yearly costs and benefits are estimated over the life of the project. From these streams of benefits (or revenues) and costs, the following indicators of viability are derived:

- Economic Internal Rate of Return (EIRR), is the discount rate at which the present

value of benefits is equal to the present value of costs.

- Benefit Cost Ratio (BCR) is the number that results when the present value of benefits is divided by the present value of costs. In this case, the discount rate is the opportunity cost of capital. The latter is approximated by the yield on long-term government bonds.
- Net Present Value (NPV) is the difference between the present value of benefits and the present value of costs, using the opportunity costs of capital as the discount rate. It should be noted that when the EIRR = opportunity cost, the NPV =0.
- Financial Internal Rate of Return (FIRR), is the discount rate at which the present value of revenues is equal to the present value of costs, with interest and depreciation charges excluded.

Sensitivity analysis is usually conducted to determine the change in the value of the above indicators when the costs or benefits are adjusted either upwards or downwards.

8.2 Capital and Operating Costs

Table 8.2.1 recapitulates the capital cost in financial terms, and expresses the same to economic cost. It is estimated that the effective tax rate is 15%, in which case, the equivalent economic cost is 85% of the financial cost. In addition, the foreign cost items are increased by 20% due to shadow pricing.

Table 8.2.1 Capital Cost, Financial and Economic

Cost Items	Financial Cost ($ m)			Economic Cost ($ m)		
	Foreign	Local	Total	Foreign	Local	Total
Railway Component						
- Carriageway	150.0	55.0	205.0	153.0	46.8	199.8
- Electrification & Signaling	90.0	10.0	100.0	91.8	8.5	100.3
- Trackworks	11.0	7.0	18.0	11.2	6.0	17.2
- Depot	20.0	15.0	35.0	20.4	12.8	33.2
- Contingency	6.8	1.7	8.4	6.9	1.4	8.3
Sub-total	277.8	88.7	366.4	283.3	75.4	358.7
- Rolling Stock	135.0	33.0	168.0	137.7	28.1	165.8
- Contingency	6.8	1.7	8.4	6.9	1.4	8.3
Sub-total	141.8	34.7	176.4	144.59	29.45	174.0
- Eng'g & Supervision	21.3	6.3	27.6	21.7	5.4	27.1
Total Cost: Railway	440.8	129.6	570.4	449.6	110.2	559.8
Busway Component						
- Road carriageway	10.0	13.0	23.0	10.2	11.1	21.3
- Mobilization	33.0	18.0	51.0	33.7	15.3	49.0
- Contingency	1.7	0.9	2.6	1.7	0.8	2.4
Sub-total	44.7	31.9	76.6	45.5	27.1	72.7
- Eng'g & Supervision	1.7	0.9	2.7	1.8	0.8	2.6
Total Cost: Busway	46.4	32.8	79.2	47.3	27.9	75.2
ROW & Resettlement	0	73.6	73.6	0	36.8	36.8
Grand Total	487.2	236.1	723.3	496.9	174.9	671.8

Source: Study Team

Aside from the capital cost, the relevant operating and maintenance cost items are summarized in Table 8.2.2 below.

Table 8.2.2 Key Operating and Maintenance Assumptions

Cost Items	2010	2020	Remarks
Manpower cost	1,916	2,453	From Chapter 7, section 7.5
Power cost	2,747	3,691	$0.07/kwhr and 7kwhr/train-km
Materials cost	8,408	11,300	$1.50 per train-km
Overhead	2,346	2,492	For insurance, contracted services and miscellaneous supplies
Train-km/day	16,584	22,288	

Source: Study Team

8.3 Economic Evaluation

The two standard economic benefits arising from a transport project are: savings in vehicle operating costs (VOC) and savings in travel time costs (TTC). The former accrue to motor vehicle road users, who benefit from less traffic congestion and hence lower operating costs. The latter accrue to commuters whether they take the mass transit or not.

Table 8.3.1 shows the benefits for the two 'snapshot' years 2010 and 2020. From this two planning year values, the corresponding benefits for the other years were derived by extrapolation.

Table 8.3.1 Economic Benefits of UMRT 1

Benefit Item	Year 2010		Year 2020		Net Benefits	
	With	*With/Out*	*With*	*With/Out*	**2010**	**2020**
VOC/day (in $ million)	9.7	9.8	6.8	7.2	0.13	0.41
TTC/day (in $ million)	12.0	12.2	23.2	23.3	0.25	0.11
VOC per year (in $ million)	3,533	3,579	2,479	2,627	46	148
TTC per year (in $ million)	4,362	4,455	8,468	8,509	93	41
Total Benefits (in $ million)	7,895	8,034	10,947	11,136	139	189
Other Benefits:						
- Number of fatalities	1,538	1,558	2,107	2,155	20	48
- Value of fatalities ($ m)	49.12	49.75	109.60	112.10	0.64	2.48
- Cost of pollution ($ m)	$4.23/1000 pax-km, rail over car/MC advantage				3.49	8.27

Source: Study Team

Aside from the two (VOC and TTC) standard yardsticks of economic benefits, there had been attempts in recent years to quantify the values derived from lower accidents and lower pollution levels when rail transit is introduced into an urban setting. The derived cost of fatalities in Vietnam, excluding values of property damage and non-fatal injuries, is $31,935/person in 2010 and $52,019/person in 2020. Available data on cost of pollution from international sources is $6.07 per thousand passenger-kilometers for cars and $1.84 for rail transit; for a net benefit of $4.23 per thousand passenger kilometers if the journeys are made on rail instead of cars. The emission advantage of rail over motorcycles is higher than cars, but for conservatism, the same values over cars can be used.

The result of the economic analysis for the combined railway and busway showed an EIRR = 20.0%, not counting the benefits from lower accidents and pollution. If the latter is included, the EIRR goes up to 20.8%. The capital and operating cost of the bus rolling

stocks (=80 units) was excluded since the same would be required regardless of whether the railway component is implemented or not. In any case, if the cost of operating these buses is also included, the EIRR dips from 20.0% to 18.0%. This suggests that UMRT 1 is economically feasible.

If the construction is deferred by 5 years, the EIRR goes up to about 21.1% It supports the recommendation that it would be wise for HCMC not to commit too early – and irreversibly - on the rail option.

Table 8.3.2 shows the sensitivity of EIRR to changes in capital costs as well as change in the benefit values. The project is more sensitive to changes in the values of benefits; a 20% decrease in benefits pushes down EIRR to 15.9% while a 20% increase in capital cost only cuts down the EIRR to 17.0%.

Table 8.3.2 Sensitivity Analysis of EIRR

		Changes in Capital Cost			
		10% Down	0%	10% Up	20% Up
Changes in Benefits	10% Up	23.8%	21.8%	20.1%	18.6%
	0%	21.8%	20.0%	18.3%	17.0%
	10% Down	19.8%	18.0%	16.5%	15.2%
	20% Down	17.6%	15.9%	14.5%	13.3%

Source: Study Team

8.4 Financial Evaluation

1) Scope of financial assessment

A key issue in financial evaluation is the structure of the project. This is particularly relevant to UMRT 1, because the project has two components with different timeframes.

One valid viewpoint is to assume a single structure – where the incomes and costs of operating both the rail and busway components are consolidated into one. This assumes a single entity, and the calculation would have to commence from the first date of commercial operation of the busway component.

Another approach is to consider the rail component only, and ignore the incomes and costs of the busway component. This approach is also valid, because the busway service can stand on its own as a separate project, would likely operate under a separate entity, and be an on-going concern regardless of the final decision on the rail. Accordingly, the starting point of the analysis would be at the start of commercial operation of the railway component.

The foregoing two approaches will, of course, lead to different investment costs and revenue streams; and by extension, markedly different financial results.

2) Results of financial analysis

The total project cost for the railway component only is US$579.9 million, excluding the rights-of-way and resettlement cost of about $73.6 million. The busway infrastructure will require another $56.2 million.

Taking the aggregate project cost of US$709.8 million, the financial analysis yields a FIRR

= 4.1%, assuming average fare = VND5,000 per passenger. The FIRR jumps to 10.8% if the fare is set at VND5,000 plus VND500 per kilometer. The latter fare assumption is unrealistic under current conditions in HCMC, and would likely drive away passengers to other modes. However, such a fare structure would be reasonable under future conditions of greater traffic congestion and higher income.

Under whatever fare and ridership combinations, however, the FIRR is marginal as to attract private sector capital. A threshold rate at which private capital may consider investing is 12%. Under a Public-Private-Partnership framework, some of the capital cost items can be shouldered by government without any expectation of cost recovery. This would reduce the investment cost to the private sector. Table 8.4.1 shows the FIRRs under two fare scenarios and with three cost packages progressively taken out of the cost equation of a private firm.

Table 8.4.1 FIRRs with Selected Cost Items Excluded

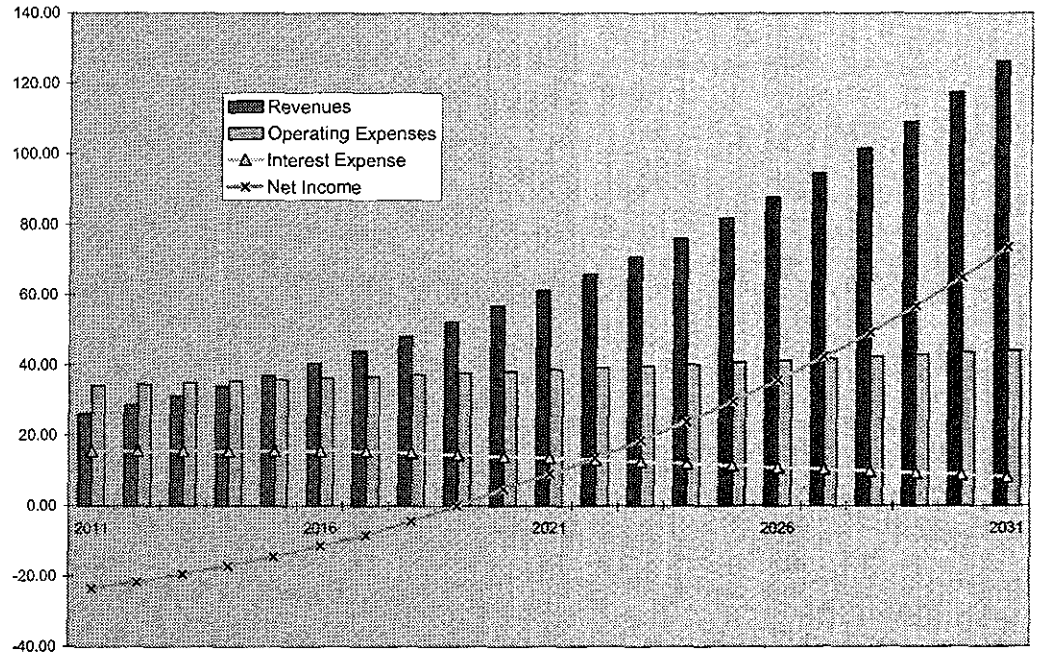
Cost Item Excluded	Exclusion	Project Cost	Fare Assumptions (VND)	
	(in US$m)	(in US$ m)	5,000	5,000+500/km
ROW + resettlement	73.61	636.14	4.9%	12.2%
Busway Infrastructure	128.79	580.96	5.5%	13.1%
Railtrack infrastructure + Depot	503.84	205.92	13.9%	27.7%

Source: Study Team

The FIRR is highest at 27.1% when only the rolling stock is absorbed by the investing firm (and, conversely, cost of right-of-way and infrastructure is picked up by the public sector).

Figure 8.4.1 shows the projected revenues, operating expenses, and net income over a 20-year period. Like any other urban rail transit system in the world, it is expected to register net losses for about 10 years from start of commercial operation before moving into the profitable zone.

Figure 8.4.1 Projected Revenue, Expense and Income of UMRT Line 1 (East)

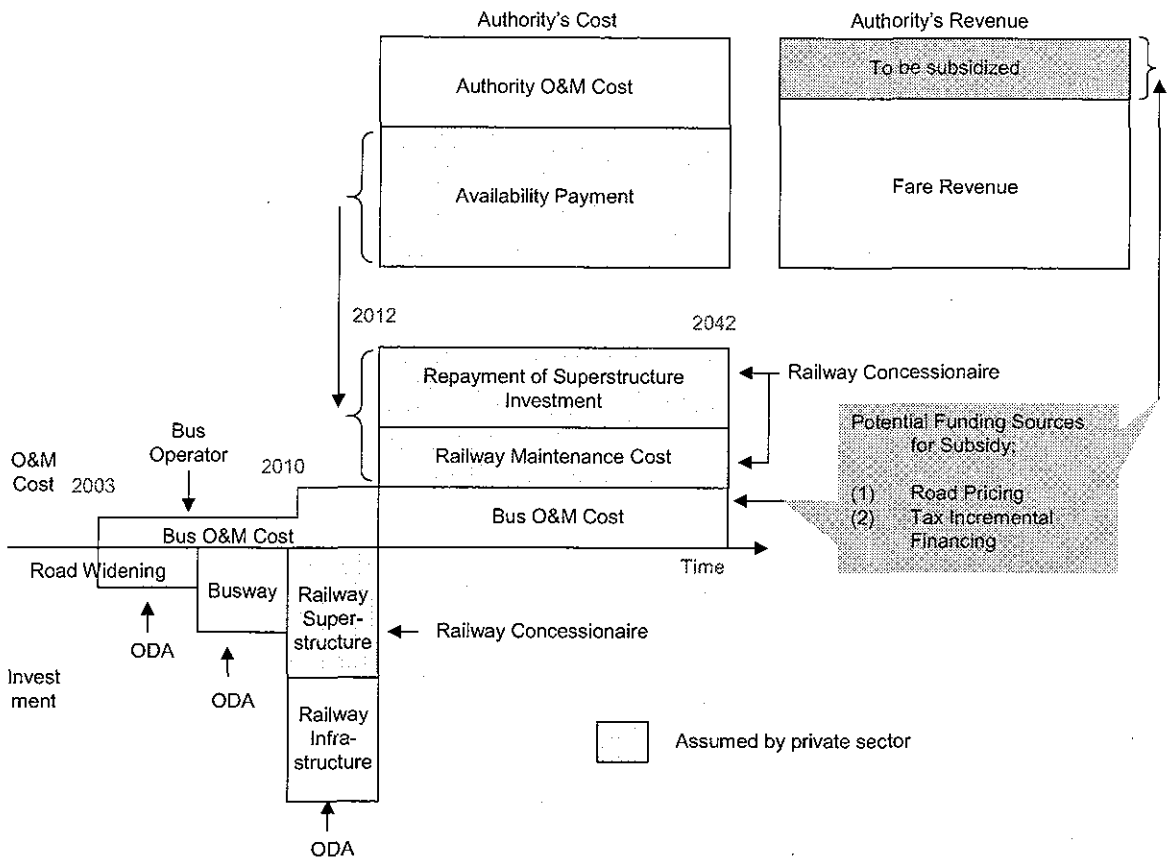


Source: Study Team

3) Financing Plan

The funding structure as illustrated in Figure 8.4.2, which assumes some investment on the part of the private concessionaire.

Figure 8.4.2 Funding Structure for UMRT Line 1 (East) (Railway Segment)



Source: Study Team

8.5 Initial Environmental Examination

1) Environmental Impact

(1) Topography, Geology and Soils

a) Construction Period: Some erosion during road construction is unavoidable and will occur as a result of runoff in areas of excavation and other earthworks. Failure to properly clean up and replant borrow areas, fill areas and spoils disposal areas would lead to erosion. Short- or long-term diversion of rivers for bridge construction could lead to future bank erosion unless properly designed and constructed.

b) Operation Period: Runoff from areas not properly resurfaced or re-vegetated would lead to erosion. Long- term diversion of major drainage courses or any significant alteration of surface water hydrology along the UMRT Project would also lead to erosion.

c) Mitigation: The following soil erosion mitigation measures will be implemented:

- Borrow and fill areas will be excavated and filled utilizing best practice

rehabilitation measures. Slope stability at cut faces will be maintained by "benching" and by installing erosion protection devices during construction such as silt barriers and sedimentation ponds. No arbitrary borrowing will be allowed. Topsoil will be stockpiled for later rehabilitation activities.

- An erosion protection plan will be developed and approved prior to construction. Approved borrow pit locations will be defined in construction tender documents. All borrow materials, solid wastes and temporary sewerage disposal sites will require prior approval of the national environmental management agency (MONRE or DONREs).
- Trees along borrow pit edges will be protected. Random movement of heavy machinery at excavation sites will be prevented. Large borrow areas will be replanted or transformed into ponds after consultation with local authorities.
- All cut slopes, embankments and other erosion-prone working areas will be stabilized while work is going on to the extent feasible. All earth disturbance areas will be stabilized within 30 days after earthwork has ceased at the site.
- Disposal of waste soil and rock, both the placement of the materials (not indiscriminate dumping) and rehabilitation methods will be carefully considered and planned as a part of the erosion protection plan. Placement areas will be selected with aesthetic considerations in mind as well as for economy and distance of transport.
- Spoil placements will be stabilized considering the type of material to be placed. Rehabilitation will include surface compaction as well as planting with vegetation types that have root systems that hold the soil in early stages, then with trees and larger vegetation at later stages.
- Temporary earth settlement basins will be provided at locations where runoff may occur during construction. After construction, such drains will be refilled.
- Temporary construction camps and storage areas will be designed to minimize land area required and minimize impacts on soil erosion. Use of abandoned establishments for such activity will be encouraged.
- Maintenance of ring road slopes, cuts and embankments, such as watering, fertilizing, pest control, and replanting when needed, will be continued during operations. Maintenance of all such areas will be budgeted as part of regular ring road maintenance.

(2) *Groundwater and Surface Water Quality*

a) Construction Period: Alteration of natural drainage by new road construction can result in erosion as well as flooding in and absorption of pollutants by areas not previously subject to flooding. Irrigation flows of paddy fields are a critical element in crop production. Any interruption of these flows during construction or any permanent alteration of these flows would have a direct impact during the construction period. Local flooding could be caused by excessive watering or flushing of construction sites. Contamination can be caused by sewage from construction camps. Sand and gravel removal from river beds is not expected to have any adverse impact but will be monitored, and sites for such

materials approved prior to construction. There is a possibility of groundwater contamination and surface water contamination from bridge and underground railway construction. Surface water or groundwater may be contaminated by improper utilization or storage of construction materials, such as chemicals or petroleum products.

b) Operation Period: The principal impact during operation is expected to be surface water and groundwater contamination from rainfall runoff from the project area.

c) Mitigation: The following water quality mitigation measures will be employed:

- All toxic, hazardous or harmful construction materials including petroleum products will be managed to prevent entry to surface water or groundwater systems. Construction area drainage will be controlled through the preparation of settling basins and planted runoff areas.
- To maintain adequate flow in the irrigation system, drainage installations and piping (culverts, side drains, bridges) will be planned and designed based on hydrological studies and evaluations of irrigation flows. Contaminated road runoff will be separated from irrigation and drinking water by proper design of piping and drainage facilities wherever feasible.
- Toilet facilities for construction workers will, at the minimum, be pit privies that are regularly serviced and maintained.
- Solid waste disposal will be handled in consultation with local authorities to protect surface water and groundwater resources.
- Roadway runoff will be directed to detention and sedimentation basins or allowed to flow over grassed areas as long as such areas have adequate erosion protection.

(3) Flora and Fauna

a) Construction Period: Loss of vegetation and natural habitat will occur in the project area, including loss of various land types, orchards and other productive crops. There is expected to be no impact on rare or endangered plants and animal species.

b) Operation Period: No plant or animal impacts are expected during operation other than the effects from vehicle exhaust emissions.

c) Mitigation: The following are mitigation measures for minimizing impacts on flora and fauna:

- Since soil erosion will occur in areas left without vegetation, stabilization by re-vegetation will be necessary. The use of fast-growing local grasses, shrubs and trees is recommended.
- Trees reduce erosion and noise, and they improve air quality by producing oxygen. There is consequently a large budget for green space landscaping. The re-vegetated roadside areas may also eventually provide a habitat for common species of small animals and birds. Replanting along the road will consist of a mix of local vegetation species similar to the mix and composition found locally. Consultation with biology/forest experts will be undertaken to confirm appropriate species for project landscaping. This will be made a part of the contractor's

responsibility, to be estimated and budgeted as a construction cost. Plantings will be placed in the median strip, on embankments and slopes, on the inner areas of interchanges, and along the sides of the road.

- Most of the naturally occurring animal species have long since been lost to the immediate area, other than some common species of birds, small mammals and amphibians. However, every effort will be made to stop and reverse the steady decline in available habitat by avoiding established natural areas and providing an extensive landscaping budget to enhance buffer landscaping along the project corridor. Trees and other vegetation will not arbitrarily be felled outside of the right of way (ROW).

All lost vegetated and natural habitat will be offset by replanting an equivalent or larger area. The biology/forest experts will be consulted during preliminary design to ensure that this requirement is met.

(4) Air Quality

a) Construction Period: Dust from aggregate production, concrete mixing and construction traffic, and emissions from asphalt plants and heavy diesel equipment will affect air quality during the construction phase. Impacts will be confined to areas downwind from construction and materials processing sites.

b) *Operation Period:* The principal air quality impacts during operation will come from vehicle emission pollutants. Pollutants monitored will include CO, NOx, TSP, and total hydrocarbons (THC). The air quality projection model will be used to predict impacts during operation, including diffusion patterns, mass and concentrations of the pollutant source (i.e. vehicle emissions based on traffic forecasts), wind velocity patterns, and project lifetime. Baseline monitoring will be necessary to indicate that TSP, NOx and CO concentrations in the ambient air along the proposed alignment will meet Vietnam air quality standards.

c) Mitigation: The following air quality mitigation measures will be utilized:

- Asphalt plants and mixers will be sited as far away as possible (preferably a minimum of 200m downwind) from the nearest human settlement areas and other sensitive land use sites.
- Emissions control equipment will be installed on batch plants; trucks carrying material that may generate dust will be covered.
- Exposed construction access roads and exposed construction sites will be watered on a set schedule depending upon weather conditions.
- Proper maintenance of diesel equipment and curtailment of unnecessary idling will be practiced to help control emissions.
- New residential projects, hospitals, health clinics, schools, and other sensitive land use construction will be prohibited within 60m of the edge of the ROW of the new road facilities.
- Vehicle emission pollutants will be reduced through integrated measures such as use of cleaner fuels, improved vehicle emissions controls, traffic demand

management, and improved public transportation options.

(5) Noise Impacts

a) Construction Period: Noise impacts during construction will result mainly from the operation of heavy machinery, including concrete mixing plants and stone crushing and screening plants. In addition, a small amount of blasting in areas of rock excavation is expected. Noise intensities from these activities and equipment will range from 80 to 100 dB(A) at the source. Sustained noise levels during construction are expected to exceed 70 dB(A) at a distance of 200m from the source.

b) Operation Period: A predictive model will be used to forecast noise impacts, which will consider several factors including noise levels generated by various types of vehicles; operating speeds; period of assessment (the peak hour); traffic volume forecasts; distance from point source to noise receptor location; distance from baseline monitoring location; and attenuation factors regarding noise absorption, including other noise obstructions such as buildings and land forms.

c) Mitigation: The following noise mitigation measures will be applied :

- To reduce night-time disturbance from construction noise, construction activities within 500m of residences will be prohibited between the hours of 22:00 and 06:00.
- To help avoid the adverse impacts from noise during operation, new sensitive receptor construction (i.e. schools, hospitals, residential uses, etc.) will be prohibited within 60m of the edge of the highway or ROW.
- Additional surveys will be undertaken prior to or during preliminary design to determine noise impacts and develop appropriate abatement measures in consultation with those affected. Preliminary engineering design and projections of noise impacts based on adjusted traffic forecasts will be reviewed to determine whether any noise-sensitive areas will be affected
- Noise-sensitive locations identified in a subsequent survey will be the subject of design analyses to incorporate appropriate mitigation measures if needed. Solid masonry walls, cuts in the natural terrain, other types of noise barriers, and depression of the road below the surrounding surface are considered effective noise attenuation methods. Planting of vegetation screens should not be considered, by itself, as an effective method for alleviating serious impacts. The cost of these measures will be included as part of the final design cost estimate if needed.

8.6 Impact on Land Use

The Hanoi Highway promoted industrial development along the corridor. On the other hand, the residential development has been limited only to the adjacent area to highways.

(1) Residential Development: By the road widening, the immediate area to the roads will be less suitable for residential use. Thus, it is necessary to set appropriate buffer zone or green belt to utilize the adjacent area for residential use.

In order to attract more people in the areas, development of secondary roads intersecting

the UMRT corridor will be a key. There are a couple of large scale residential complex in progress in District 2. UMRT project will accelerate the residential development in Districts 2, 9 and Thu Duc.

(2) Commercial Development: The immediate area along the UMRT within the HCM city is most suitable for commercial development. Especially, the large scale shopping centers, such as CORA or METRO, will be located. This will stimulate the peoples' consumption life and small shops in the downtown will be curtailed.

Additionally, amusement or sports facilities are also suitable for the area.

(3) Industrial Development: HCMC already regulates large-scale industrial development. The new location of industries with hazardous materials are most discouraged within the HCM city but may be accepted in Dong Nai Province. The UMRT Project will promote the industrial development in Dong Nai Province as the workers from the HCM City increases.

8.7 Social Impact

(1) Split of Communities: The neighborhood of the current Hanoi Highway has already been split to different Districts. The northern side belongs to Thu Duc and southern side does to Districts 2 and 9. This means the administrative systems including school districts are different on both sides. Even now, the communication between the both sides is inactive. Nonetheless, there are some needs to go to the other side on foot.

To mitigate the split of communities, all UMRT stations will be accessible from both sides by bridges. The Project will also install pedestrian bridges every 500m over the road widening section.

(2) Urban Landscape: District 1 has significant historical urban heritage in its landscape and modern architectures. The river front view and vista style street design with eye-stop architecture is unique in Asian countries.

To preserve the urban landscape in the District 1, the UMRT will be constructed underground in most part of the District.

However, the 2.7km section in Binh Than District adopted elevated ROW on the center of existing road to avoid congestion on the ground. This may hamper the current street view

(3) Cultural Property: No significant cultural properties on ground have been identified within the ROW. The underground section may encounter buried cultural property. Because the former palace of Gina Ding was in the north of Le Loi Street, which the UMRT will operate under, it is unlikely to encounter underground cultural property.

(4) .Religious Premises: Within the ROW, no religious premises have been identified. It is necessary to relocate the premises if found in the later phase of the project.

9 CONCLUSION AND RECOMMENDATIONS

9.1 Conclusions

From the results of the Houtrans master plan study, a strategic east/west transport corridor (from Ben Thanh market to An Binh and to Cho Nho) linking the inner city with the residential suburbs and industrial growth areas has been identified for future development.

This transport corridor will be the backbone of mass rapid transit system. A combination rail-busway system (UMRT 1) is most appropriate on this corridor – considering resource constraints, current high reliance on private transport, and the future direction for a public-transport oriented city.

The development of UMRT Line 1 will be a formidable challenge to HCMC. Similarly, getting more commuters to ride public transport in general, and on the UMRT system in particular, will require a 'carrot-and-stick' approach. Government will have to promote public transport and discourage private vehicles (cars and motorcycles).

Today's traffic volumes on this corridor, while already high, can not yet justify a rail-based mass transit. Demand will not follow supply. To minimize risk, a phased development along the corridor is appropriate in matching passenger capacity with evolving demand. With minimum outlay, a road-based busway system can, and should, be introduced as soon as possible.

The UMRT Line 1 (East) Metro rail transit project viability could exceed the minimum (EIRR) hurdle rate of 12%, if operational after 2010. However, it will not be financially-viable as a wholly funded private sector investment due to the high risks associated with passenger demand and the regulated fare structure.

It will still be possible for the private sector to participate in UMRT Line 1 under a public-private-partnership (PPP) framework. The pre-condition is for government to assume a larger portion of the capital costs, as well as insulate the private sector from market or commercial risk arising from uneconomical fare and high degree of uncertainty. This can take the form of a Build-Lease-Transfer (BLT) scheme for the electromechanical components of the system, with government taking direct responsibility for the basic rail infrastructure (such as tunnels, viaducts, stations, depot).

Major planning, environmental, route alignment and engineering issues along the transport corridor have been examined; they do not present a major constraint in the development of a high capacity Metro rail transit system along the proposed corridor. However further detailed study and surveys are needed to sharpen cost estimates.

9.2 Recommendations

1) The government must confirm the proposed UMRT Line 1 alignment. This must be followed by route protection measures - particularly for the important sites such as the depot area, tunnel portal, tunnel vent shafts, stations, electrical substations, and the multimodal interchange terminals.

   - Route protection measures shall ensure that no additional physical constraints along the transport corridor could arise as to impact the project cost or implementation schedule. This is of particular importance for the section of the line from Peoples Station 2 to Saigon Bridge Station 5.

   - The HCMC authorities should monitor and coordinate all new works along the transport corridor including road widening, major utilities, urban redevelopment including retail, commercial, residential developments.

2) The government must lay out a timetable leading to, but not rushing the, implementation. Make haste slowly. It takes 6 to 10 years to get a project of such complexity completed. And because it may also be the first urban rail system in Vietnam, early commitment to a particular technology (or supplier) option should be avoided.

3) HCMC should implement as soon as possible Stage 1 of the project, which involves the busway transit component. Dedicated bus lanes on the route Ben Thanh Market – Thu Duc (Cho Nho) segment of the transport corridor should be made operational.

   - Following a risk minimization strategy, it is recommended that existing buses (preferably the new and larger units from the Model Bus program) be deployed for the purpose. Procurement of articulated buses (of the Bus Rapid Transit type) should be considered depending on the results of the pilot project and the out-turn volume of passengers using the Busway system.

   - With the results of the initial phase Busway the scheme can be extended to cover the whole route from Ben Thanh Market to Bien Hoa.

4) A dedicated Project Management Unit (PMU) should be formed to steer the project in accordance with the timetable mentioned above. A budget should be approved for the PMU, starting in year 2005. Aside from studying the implementation experiences of other Asian cities, the PMU should appoint an international railway consultant to assist in the preparatory works (railway planning, design, management and supervision of the project development).

   - One of the immediate tasks of the PMU is to conduct detailed studies and engineering surveys along the 15-km alignment of the UMRT Line 1 (East). These studies should include a detailed topographic, parcillary, geotechnical, hydrological, utility, building condition, traffic patronage surveys including an environmental impact assessment (EIA) of the project.

   - In parallel, the PMU should arrange with Saigon PTC the introduction of the busway pilot project (the stage 1 as mentioned above).

   - The transportation planning and preliminary engineering design should be taken

to the next level of detail to allow key elements of the transit system to be defined in more detail. This would include the tunnels, viaducts, station and depot layouts and associated works such as trackwork, substations, tunnel ventilation shafts. Ancillary buildings and transport interchanges.

- For the systemwide elements the design should be progressed in sufficient detail to allow performance specifications for all the major systems including rolling stock, traction power, signalling, communications, tunnel ventilation, fire protection, AFC, SCADA, signages, escalators/lifts, Platform screen doors (PSD) on the underground stations, depot equipment, building services and the like.
- The basic contract documents to allow for competitive bidding will be required including conditions of contract, general & particular/performance specifications, materials & workmanship etc. , including preparation of a more detailed project budget and construction schedule.

5) A policy issue that will guide the PMU is a decision on whether to implement the project in the traditional mode (i.e., a purely public sector undertaking) or in the PPP mode. This will also impact on subsequent funding arrangements. The project needs to combine local, central government equity and international bilateral or multilateral financing. This decision will affect the following:

   - The scope and composition of the railway consultants stated earlier, as well as the construction supervision services
   - The subsequent tendering for key elements of the project (the civil works contractors, the supplier for the specialist systems and equipment including rolling stock).
   - The operating, maintenance, and regulatory powers of the proposed Saigon Metro Transit Authority.

Appendix 1 Comparison between Alternating Current (AC) and Direct Current (DC) Traction Power

The construction cost of alternating current (AC) electrification system is superior to direct current (DC) system; AC traction power supply can increase between 10 to 15 times the distance of overhead line served by DC substations. In the case of having the long underground sections of track the cost differential can be quite significant, hence the study team have carried out a comparison of the total installation cost between AC and DC traction power systems which includes the civil/structural construction cost such as substations.

For long distance transportation railway systems AC traction power systems are preferred, However for the proposed new urban subway in New Delhi, India railway an AC traction power system has also been adopted.

A brief comparison n between 25kv AC and 1500v DC traction power system is shown in table 1.1 below.

Table 1.1 Comparison between Commercial Frequency Single-phase AC 25 KV System and DC 1,500 V System

	Commercial Frequency Single-phase AC 25 KV System	DC 1,500 V System
Ground Facilities		
Substation	The construction cost is low. 1) The interval between substations is long (100 km in the case of the AT system), and many substations are not required. 2) The substation facilities are simple because a transformer is the main facilities.	The construction cost is high. 1)The interval between substations is short (approx. 3 to 5 km), and many substations are required. 2)A transformer switchgear from AC to DC is required and the substation facilities are complicated.
Transmission Line	The construction cost is low because many substations are not required.	The construction cost is high because many substations are required.
Overhead Contact line System	A thin OHL feed line is sufficient because the load current is small. In addition, the OH trolley line dose not wear quickly and the cost for replacement is small.	A large feeder line is required because the load current is high. In addition, the trolley line wears quickly, and the cost for replacement is high.
Comparison Copper Amount	Only a small amount of copper is required.	A large amount of copper is required.
Feeding Voltage	A transformer can be used for an electric car and high voltage can be utilized.	Since the insulation design of the traction motor and DC transforming device is restricted, high voltage cannot be used.
Countermeasures against Voltage Drop	The voltage drop can be casually compensated by installing a series capacitor and a voltage compensator.	With the increase of load, it is necessary to increase feeding lines and newly establish substations.
Insulation Separation	The insulation separation is large because of high voltage, and generally the tunnel cross-section is large.	The insulation separation can be small because of low voltage.
Communication Equipment	Since the load current contains harmonics, the problem of communication inductive interference arises. Therefore, it is necessary to replace the bare communication lines by underground cables and install auto-transformers, or boosting transformers, etc.	Installation of a filter in the substation suppress the communication inductive interference.
Power Source	The three-phase power source unbalance is caused due to single-phase load so that some measures must be taken against it	The problem of three-phase power source unbalance doesn't arise.
Voltage Transformer and Current Transformer	It is necessary to provide a transformer, a rectifier and high voltage insulation for a car which requires higher investment cost and maintenance expenses for a car.	They are not required.
Accessories	A low-voltage AC power source can be obtained freely with a voltage transformer, and a simple and rigid induction motor can be utilized. Electric facilities such as fluorescent lamps and air-conditioning units are also simple.	A DC machine is driven with a trolley voltage and the structure is complicated. Electric facilities such as fluorescent lamps and air-conditioning units are also complicated.

Source: Study Team

Appendix 2 Distribution of Traffic Volume

Table 2.1 Distribution of Traffic Volume by Time Band (Both Directions)

(person, %)

Time Band	1	2	3	4	5	6	7	8
Distribution of Traffic Volume	15,685	26,062	46,754	148,771	700,090	2,448,694	1,866,236	1,007,052
	0.1	0.1	0.2	0.8	3.7	12.8	9.7	5.3
Time Band	9	10	11	12	13	14	15	16
Distribution of Traffic Volume	705,485	928,484	1,261,643	801,627	643,263	665,141	572,549	1,395,337
	3.7	4.8	6.6	4.2	3.4	3.5	3.0	7.3
Time Band	17	18	19	20	21	22	23	24
Distribution of Traffic Volume	1,574,602	1,089,474	1,288,419	854,985	751,286	308,653	53,715	14,870
	8.2	5.7	6.7	4.5	3.9	1.6	0.3	0.1

Source: Study Team

Appendix 3 Estimate of Land Costs

As the basic data were not able to be collected, districts other than HCMC were set referring to the land use type.

The Right of Way (ROW) cost in the undeveloped area such as agricultural land etc. was set to 15 % of the developed area.

Table 3.1 Proposed ROW Cost by District

Unit: US$/m2

Province	District	Land use	Developed	Undeveloped
HCMC	District 1	Inner Core	1,529.67	229.45
	District 2	Emerging Peripheral	160.87	24.13
	District 3	Inner Core	1,463.00	219.45
	District 4	Inner Core	789.67	118.45
	District 5	Inner Core	1,496.33	224.45
	District 6	Inner Core	656.33	98.45
	District 7	Emerging Peripheral	180.87	27.13
	District 8	Inner Fringe	431.67	64.75
	District 9	Emerging Peripheral	147.53	22.13
	District 10	Inner Core	789.67	118.45
	District 11	Inner Core	789.67	118.45
	District 12	Emerging Peripheral	180.87	27.13
	BINH THANH	Inner Fringe	431.67	64.75
	PHU NHUAN	Inner Core	589.67	88.45
	TAN BINH	Inner Fringe	431.67	64.75
	GO VAP	Inner Fringe	431.67	64.75
	THU DUC	Emerging Peripheral	180.87	27.13
	BINH CHANH	Emerging Peripheral	147.53	22.13
	NHA BE	Suburban	75.27	11.29
	CU CHI	Rural	55.27	8.29
	HOC MON	Suburban	88.60	13.29
	CAN GIO	Rural	41.93	6.29
BINH DUONG	THU DAU MOT	Satellite Urban	166.42	24.96
	THUAN AN	Suburban	81.93	12.29
	DI AN	Suburban	81.93	12.29
DONG NAI	BIEN HOA	Satellite Urban	166.42	24.96
	LONG THANH	Rural	48.60	7.29
	NHON TRACH	Rural	48.60	7.29
LONG AN	TAN AN	Satellite Urban	166.42	24.96
	CAN GIUOC	Rural	48.60	7.29
	LAN DUOC	Rural	48.60	7.29
	CHAU THANH	Rural	48.60	7.29
	TAN TRU	Rural	48.60	7.29
	BEN LUC	Rural	48.60	7.29
	THU THUA	Rural	48.60	7.29
	DUC HOA	Rural	48.60	7.29

Source: Study Team

Table 3.2 Land Acquisition Costs for UMRT Line 1 (Railway)

Unit : USD/m2

Line	Order	Name	Name Detail	District	Length (km)	R.O.W	Widening Type on Railway	Area (m2)	Unit Cost	Costs (USDMil.)
L1E			Rang Depot	2			ERail	64,000	24.13	1.5
L1E			Entrance & Exit Line	2	0.67	5.7	ERail	3,819	24.13	0.1
L1E	13	3362	Saigon Bridge Left	2	3.78	11	ERail	41,580	24.13	1.0
L1E	14	3038	Saigon Bridge Right	BINH THANH	0.98	11	ERail	10,780	64.75	0.7
L1E	26		Saigon Ship Yard	1	1.29	13	U	16,770	229.45	3.8
L1E	27	2003	Single Shield	1	0.40	7 x 2	U	5,600	1,529.67	8.6
								142,549		15.8

Source: Study Team
Note) Erail: Exclusive Railway
U: Underground

Appendix 4 Basic Value of Operation and Maintenance Costs

4.1 Methodology of Calculation

The trial calculation of the operation and maintenance costs of UMRT Line 1 is done in reference to the traffic volume, number of rolling stocks, number of staff, and operation and maintenance costs of Japanese twelve large private railway companies. The operation and maintenance costs consist of labor costs and material costs.

4.2 Labour Costs

The number of staff for railway management is calculated based on work volume. The labor costs are calculated based on the number of staff by the average wage of UMRT staff. The operational staff consists of the station clerk, operator and conductor, staff of car maintenance, staff of track maintenance, and staff of electric maintenance. The management staff of head office to operational staff are assumed 10 %. The number of operational staffs of UMRT is set 130 % of the Japanese railway staff level, taking into consideration of the working efficiency developed in a mature railway system. (Refer to Table 4.2.1)

Table 4.2.1 Average Number of Staffs per Unit on Japanese Private Railway and UMRT

	Average Number of Staff in Japan	Calculation Method on UMRT
Management Staff of Head office	14 % for operational staff	10 % for operational staff
Station Clerk	15 persons, number of staff per station (on a two-shift-a-day basis)	20 persons, number of staff per station (on a two-shift-a-day basis)
Operator and Conductor	0.00001 person per car km (6cars per train)	0.000013 person per car km (6 cars per train)
Staff of Car Maintenance	0.45 person per car	0.60 person per car
Staff of Track Maintenance	1.58 person per km for double track	2.0 person per km for double track
Staff of Electric Maintenance	1.65 person per km for double track	2.4 person per km for double track

Source: Study Team

The average wages of UMRT staff per month is assumed 172 USD per month, the average wages of workers and engineers in HCMC. The average wages of UMRT staff is takes into consideration that the average wage of VR staff is national base and the wages of HCMC is higher than Hanoi. (Refer to Table 4.2.2)

Table 4.2.2 Average Wages by Occupation

USD/Month, as of 2003

	Staff of VR (on TDSI-South)	Occupation in HCMC		
		Worker	Engineer	Middle-Grade Manager
Average Wages	160 USD	120	224	550

Source: Study Team

4.3 Material Costs.

Material Costs consists of general administration, maintenance administration, transportation, power, car maintenance, track maintenance, and electric maintenance. (Refer to Table 4.3.1)

Table 4.3.1 Average Material Costs per unit on Japanese Private Railway and UMRT

	Average Japanese Material Costs	Calculation Method of UMRT
General Administration	4,645 USD per Staff	Multiply Japanese cost by 20 %
Maintenance Administration	0.0645 USD per Car km	Multiply Japanese cost by 10 %
Transportation	0.00727 USD per person km of passenger	Multiply Japanese cost by 10 %
Power	0.339 USD per car km	Multiply Japanese Cost by 50 % considering ratio, 0.56 between Vietnamese power rates, 0.07 USD and Japanese power rates, 0.125 USD.
Car Maintenance	0.235 USD per car km	Multiply Japanese cost by 50 %
Track Maintenance	0.327 USD per car km	Multiply Japanese cost by 20 %
Electric Maintenance	0.145 USD per car km	Multiply Japanese cost by 20 %

Source: Study Team

The ratio of Vietnamese material costs to Japanese material cost is assumed as following.

The material costs related to administration and transportation costs are assumed10 to 20 % with many consumption articles. The material costs related to track maintenance and electric maintenance costs are assumed 20 % with many cheap materials for repair. The material costs related to car maintenance costs are assumed 50 % with many expensive materials.