



Economic/Financial Planning of Urban Rail (MRTS) in a Super Metropolitan City- Case Example of Delhi*

There is more need of 'WILL' than 'MONEY'

The subject has been dealt with Under the following five heads:

1. A brief history of Railways in Delhi.
2. Some Salient features of Urban Rail (Metro) at Global level.
3. Problems of Traffic & Transportation and need of Urban Rail In Delhi.
4. Salient featured(financial aspect) Of Urban Rail (MRTS) planned in 1973 & 1990.
 - (i) Urban Rail – 1973.
 - (i) Urban Rail – 1990.
5. Economic/Financial planning of Urban Rail (MRTS) system.
 - (i) Cost And Benefits of urban rail Transportation.
 - (ii) Sources of funding the system.
 - (iii) Inferences from various appendices (data taken from RITES).
 - (iv) Economic/Financial Analysis of The System.

(a) Derivations and Facts.

(b) Proposed Model.

A Brief History of Railways in Delhi :-

Over more than a century, 'Delhi Main Junction' was planned and constructed in Old Delhi. The broad gauge railway Line from Delhi to Ghaziabad was laid. Delhi Main Junction was improved and extended from time to time. The last re-modelling was done after partition of the country. New Delhi Railway Station was also constructed in 1950s.

With the partition of the country, and increase in the population, as well as in local and regional traffic, 'Good Avoiding Lines' (GAL) from Sahibabad to Tughlakabad via the new Yamuna Bridge was opened for goods on 15th November 1966 and for passenger traffic via Tughlakabad Bridge to New Delhi on 13th February, 1967. A year later, 'Delhi

Avoiding Lines'(DAL) connecting Tughlakabad with Rohtak and Panipat were constructed and opened

up for traffic on 16th February,1969. Shifting of marshalling yard to Tughlakabad and Shakur Basti was also implemented in 1960s.

Traffic situation started worsening in early 70s. It was more or less established that problems of mass transportation could not be solved with the help of buses. So, many studies with regard to Mass Rapid Transit System (MRTS) took place in the last two decades. In this paper, outlines have been given of extensive and comprehensive study made during the year 1973 and 1990.

Salient Features of Urban Rail (MRTS) at Global Level

Definitions:

Rail Rapid Transit also known as “Heavy Rail” is a system that moves passengers in large groups on trains over an exclusive right of ways. The system can be in sub-way, elevated or grade separated. Metro (under ground railways) can carry upto 100,000 passengers per hour on two directional tracks with 1.5 minutes train headway, and 0.5 sq.mt. floor area per passenger. The system can be largely useful for any super metropolitan city like Delhi.

Light rail moves passengers in intermediate size groups on short trains or in a single car on a variety of right of ways: grade separated, or shared with street level. The latter is known as street car or tramways, while the others with pre-dominantly reserved but not necessarily grade separated right of ways denote “Light Rail”. Traffic intensities in light rails are much less than in heavy rails. It is between 20 to 30% of the heavy rails. In busy city like Delhi, the system cannot be useful.

From the ‘Table I’ inference can be drawn that in the western countries cities with one million and above population should have metros. In India, decision may be taken that cities with 5 million and more population should have metros.

Table I
Year of Inauguration of Metros in Some Parts of the World

| City | Year of Inauguration Of Metro | Population (in million) 1970 |
|--------------|-------------------------------|------------------------------|
| London | 1863 | 2.80 |
| New York | 1867 | 4.05 |
| Chicago | 1892 | 1.00 |
| Glasgow | 1897 | 0.69 |
| Paris | 1900 | 2.66 |
| Boston | 1901 | 0.55 |
| Berlin | 1902 | 2.71 |
| Liverpool | 1903 | 0.74 |
| Philadelphia | 1907 | 1.55 |
| Buenos Aires | 1911 | 1.21 |
| Hamburg | 1912 | 0.95 |
| Madrid | 1919 | 0.79 |
| Barcelona | 1924 | 0.84 |
| Tokyo | 1927 | 2.22 |
| Moscow | 1935 | 3.50 |
| Stockholm | 1950 | 0.45 |
| Calcutta | 1985 | 10.00(1985) |

Characteristics of Urban Rails in the World:-

i) Length of urban rails in various continents of the world.

In 1980, 345 KM Urban Rails were in USSR, 416 KM in Asia, 144 KM in Latin America, 1056 M in North America, 1496 M Europe and 3456 M plus the rail lines which were under construction at that time, in the entire world. Against this, in India upto 1981, it was nil; though there were four super metropolitan cities and 8 metropolitan cities.

ii) Rail Space Per Passenger.

Rail Space provided in America in various Rapid Transit System varies from .2 Sqm floor space upto 1 Sqm.floor space per passenger. Most of the busy routes have been designed based on .5 Sqm.floor space per passenger. This figure should also be adopted for Delhi.

In United States and in some other countries the gross floor space of .5 Sqm. (5.4 Sq. ft.) is taken as a basic unit of comfort and is called a "Passenger Place." An extreme example is of San Francisco where in cable car, space allocation is .15 Sqm. per passenger.

iii) Headway i.e. time duration between two trains.

In America, headway (time interval between 2 trains) during peak hour i.e. 8-9 A.M. is kept from 1.5 minutes to 7.5 minutes headway between two trains on busy routes during peak hours. Figure of two minutes may be taken for Delhi also.

iv) Physical capacity of a transit line depends upon: a) car width, b) train length and c) minimum headway. Platform varies from 70 mts. To 213 mtrs. In normal cases, Headway is taken of two minutes except with few exceptions as in Moscow where 40 trains are operated per hour and in North America 38 trains are operated per hour.

v) Assuming a headway of 2 minutes and floor space per passenger of .5 sq. mt., a Rapid Transit System's capacity is between 20000-34000 persons per direction per hour in heavy rail. In light rails, with the same conditions, the capacity is between 6800-15900 persons per direction per hour and that too with 3 to 4 cars together. If the space standard is reduced to .35 Sqm. per passenger then capacity would be 39000-48000 persons per direction per hour in case of heavy rails. In New York, one of the heavily used track is with 53000 passengers in peak hours and the same condition prevails in downtown Chicago. Under conditions of extreme congestion, passenger's flow exceeds to 70000 per track in peak hours in Moscow and Tokyo, or or 140,000 in both the directions.

Problems of traffic & transportation: And Need of Urban rail (MRTS) in Delhi.

Problems of Traffic & Transportation.

There are numerous problems of Traffic & Transportation out of which 13 have been mentioned under. Cost of implementation of

various projects to overcome and solve these problems at present day (1992) cost is Rs. 120 billion.

i) Already there are 7 road bridges and 2 rail bridges on the River Yamuna. Two additional road bridges and 2 rail bridges on it are under consideration, besides widening of 3 existing bridges.

ii) Construction of 8 road over/under bridges on the existing railway lines.

iii) Improvements and widening of 13 existing road/rail bridges.

iv) Construction of grade separators of 2 or 4 levels at 20 locations.

v) Widening and improvement of 220 major master plan roads with a R/W of 30 mtr. and above.

vi) Starting of new modes of transport namely; Electric trolley bus, Urban Rail (metro) etc.

vii) Construction of second entry to existing Delhi Main Railway Station and to Nizamuddin Railway Station.

viii) Enlargement of second entry to New Delhi Railway Station.

ix) Planning and development of 4 major railway terminals in 4 directions of Delhi.

x) Development of parking places on the borders of Delhi along highways, and at other important places.

xi) Development and construction of 'Express and Exclusive' cycle tracks with cycle sub-ways at the crossings.

xii) Construction of 5 more ISBTs' four in 4 directions of Delhi and one at Nizamuddin.

xiii) Setting up of a Unified Transport Authority.

Passengers trips by 2010 A.D.

Taking various factors and past trends into consideration, it is estimated that by 2010 A.D., Delhi's roads will not be able to take more than 19.25 million passengers trips per day even after the widening of roads and construction of new roads too. The break-up of the total number of trips is expected to be: 2.5 million trips by private personalized mode of transport, namely, jeep, van, scooter, motor-cycle; 0.5 million by private hired mode of transport; 0.25 million via slow moving hired transport bus; 3.25 million by cycles; and 4.00 million pedestrian trips.

So far, the Ring(Urban) rail has not been able to play any recognizable role in solving the problems of public mass transport system of Delhi. In order to accommodate 28 million trips, the following model split is proposed to be achieved by 2010 A.D.

| | Million Trips | % |
|--|---------------|---------------|
| - Private personalized mode of transport | 3.25 | 11.6 |
| - Cycles | 3.25 | 11.6 |
| - Bus | 8.75 | 31.25 |
| - Urban Rail trips | *8.75 | 31.25 |
| - Pedestrian trips | 4.00 | 14.3 |
| Total | 28.00 | 100.00 |

*RITES have planned Urban Rail(MRTS) for 14.25 million passenger trips per day.

Number of Vehicles

As compared to only 11000 vehicles in 1948, now Delhi has a total vehicles 1,992,066 today with two-wheelers occupying as high as 12,33,001, the highest in the world. On this basis, number of vehicles by the end of the century may reach to 4 million which would create the worst situation in Delhi in terms of congestion, pollution, accidents etc.

Salient features (financial aspects) of Urban Rail (MRTS) planned in 1973 and 1990.

Salient features (financial aspects) of 1973 MRTS.

| | |
|---------------------|-----------|
| i) Net Work in KM | Upto 2001 |
| Underground Network | 93.88 |
| Surface Newwork | 221.22 |

ii) Capital Cost of 2001 Network Estimated cost of 1971 rates at the time of commissioning of corridor.

i) Total cost for the Newwork Rs. 112 Billion which is 20% of 1990 MRTS, which is only in 184.5 KM

ii) Average rail cost per route km.
 Underground Rs. 164.8 million
 Elevated Rs. 80.9 million
 Surface Rs. 27.4 million

iii) Proposed fare Structure

a) Single journey fare:

| | |
|-------------|-----------|
| Distance | Fare: |
| 0-6 km | 30 Paise |
| 6-10 km | 50 Paise |
| 10-16 km | 80 Paise |
| 16-20 km | 100 Paise |
| 20-25 km | 120 Paise |
| 25-30 km | 130 Paise |
| Above 30 km | 150 Paise |

Proposed fare structure of 1990 MRTS is about 5 times of this.

b) Overall average fare 4.72 paise per passenger per km. Now, it is 25 Paise per Passenger Per km.

(a) DCF rate of return
 With concession on Season tickets as per Proposed fare structure. 2.76%

(b) Without concession on Season ticket. 6.56%

Salient features (financial aspects) Of 1990 Urban Rail (MRTS)

Physical Aspects

i) Existing bus system and its limitations

The Bus System is presently carrying approximately 4.2 million passengers of 14 kms average trip length (1988-89). By the year 2001, the number of mass transit trips is forecast to more than double at 11.4 million. Many roads will need to carry 30,000 or more peak hour trips in peak direction. The existing Ring Railway, till modified completely in Delhi, cannot contribute in solving the transport problems. In view of very heavy future transport demand which is well beyond the capacity of a Bus System or any Light Rail Transit System or the existing Ring Railway, a heavy capacity Mass Rapid Transport System has to be developed.

ii) Alignment of the System (184.5 KM)

The Mass Rapid Transport System will consist of two Metro corridors. **The East-West Corridor** will lie between Patel Nagar in West Delhi and Tilak Bridge in the East (12 kms) via Patel Road, Panchkuin Road and Barakhamba Road. **The North-South Corridor** (15 kms) will extend from Vishwa Vidyalaya in the North to Sewa Nagar in the South via Inter-State Bus Terminal, Delhi Main Railway Station, New Delhi Station, Connaught Place, Central Sectt. and Lodi Estate. The dedicated **Rail Corridors** in 140 km will largely follow the alignment of the existing Ring Railway and its Spurs. The dedicated Busway (17.5 kms) is proposed from Patel Nagar to Najafgarh along Shivaji Marg.

Dedicated bus way will be in the reserved median of Najafgarh Road with stops for passengers to be connected by foot overbridge or sub-ways. They will operate in central 20mt. wide median. Cost of land to achieve the planned 60mt. r /w with 20mt. median or dedicated bus way has been added in the cost of the project.

Major interchange points should be developed at Patel Nagar in the West and at Tilak Bridge in the

East to handle traffic from urban extensions of Delhi and the National Capital Region.

iii) Land Requirement/ Acquisition

Delhi MRT project will require 882 hect. Of land for tracks, stations, maintenance and stabling depots and for providing facilities for transport integration with other modes. The development in accordance with the prevailing byelaws of the air space above a part of this land (547 hect.) which presently belongs to the Government is expected to yield 840,000 sq. mts. (approx.) of commercial space and enough area to construct 74000 dwelling units over a period of twenty years. Assuming that land is transferred to the MRT Authority at the institutional rate applicable to similar public utility projects, the cost of which has been included in the project cost estimate, the above development is estimated to yield a net revenue surplus of Rs. 36.4 billion for the

Full System over twenty years. Property development includes construction of show-rooms, shops, commercial offices, residential houses, recreational places and public and semi-public buildings.

The rates for residential/ commercial areas in Delhi/ New Delhi as circulated by Ministry of Urban Development, Govt. of India (Land Division) vide their letter No. J-22011/4/86-LD (DDI) dated 1st June, 1987 have been adopted for acquisition of private land. Rehabilitation work of roads, sewers, pipeline etc. affected by cut and cover tunneling has also been included.

The cost of government land above ground or below ground required for the Urban Rail (MRTS) is estimated as Rs. 610 million and Rs. 1380 million respectively for the First Phase and the Full System. This has been calculated at the institutional rates of transfer between government departments and included in the estimate. The cost of private land/ property proposed to be acquired or under which the Urban Rail (MRTS) will be laid has been included at prevailing market rates.

Economic/Financial Planning of the Urban Rail (MRTS) System.

would be living in the newly constructed houses and using commercial spaces near railway track.

Economics of Urban Rail Transportation:

| I Cost | II Benefits | 10. Signalling & Telecomm- Unication | 10. Increase in quality/status of the life of the people in terms of education, health, security, justice and recreation. |
|---|--|---|--|
| 1. Paper planning of the System. | 1. Reduction in Pollution | 11. Purchasing of rolling stock | 11. Creation of thousands of jobs of different categories- tech- nical, non-technical, skilled, semi-skilled and non-skilled. |
| 2. Acquisition of land | 2. Cost Reduction in no. of Vehicles i.e. buses, cars, 3-wheelers & 2-wheelers] | 12. Operating cost of the system. | 12. Saving in travel time. |
| 3. Shifting and laying of services namely; water lines, sewer lines, storm water drains, power lines and telephone lines. | 3. Saving of passenger's time. | 13. Replacement and depreciation | 13. Saving in diesel consumption of residual bus service on decongestion account. |
| 4. Development and cons- truction of rail tracks below the grounds and on the surface. | 4. Saving due to decong- estion effect due to high speed of buses & vehicle time saving. | 14. Maintenance of the system. | 14. Reduction in accidents, making a saving of Rs. 189 million per year. |
| 5. Construction of railway Stations, railway depots, work-shops, bridges and culverts. | 5. Saving in diesel consu- mption due to less no. of buses after MRTS System. | | 15. Increase in land values. |
| 6. Construction of 840000Sqm Commercial space for dispo- sal and to earn revenue. | 6. Saving in petrol consumption due to less no. of petrol vehicle | | 16. Increase in the production of capital and consumer goods. |
| 7. Construction of 74000 housing units. | 7. Saving in petrol consu- mption due to decong- estion effects of petrol consuming vehicles. | | |
| 8. Construction of incidental facilities like; parking place Proper signages, spaces for feeder service. | 8. Availability of 840000 Sqm. commercial Space and 74000 housing units. | | |
| 9. Electrical System | 9. Substantial dec- rease in time by reducing distance between place of living for the families who | | |

Details on some of the benefits have been given under:

a) *Accidents:*

In 1981, 1072 persons were killed; in 1982, 1215; in 1983, 1156; in 1984, 1239; in 1985, 1269; in 1986, 1276; in 1987, 1271; and in 1988, 1474. These figures show about 38% increase in deaths by 1988 over the year 1981, equivalent to an increase of 5.36% per annum (simple) over the years. Assuming a growth of number of deaths @ 2% per annum over the 1988 figures would work out to about 1834 deaths by accidents in the year 2001. It is also assumed that due to Urban Rail (MRTS System), 30% less deaths i.e. 550 would be there. Taking an average cost of Rs. 125,000 per death, the benefits from this system would be 1.25 x 550 = Rs. 69 million (at prevailing

prices) in the year 2001. By a similar method the benefit on account of prevention of accident injuries, cost of which has been taken as Rs. 5000/- per injury would be Rs. 120 million (at prevailing prices) in 2001. Total saving in this component would be = 69 million + 120 million = Rs. 189 million / year for all the times.

b) *Pollution*

It is difficult to measure the effect of pollution and reduction due to Urban Rail (MRTS System) in monetary terms; but it is an established fact that there would be sizable reduction in pollution due to coming up of the system of MRTS.

c) *Savings in other components:*

There would be saving in many other components like expenses on medical treatment, legal expenses, cost of artificial limbs, cost to the Insurance Companies, administration expenses of courts and police department, damage to property, saving in diesel etc.

All these components if measured in monetary terms will give sizable benefits and would be able to sustain financially the entire system of operation, maintenance and replacement.

Sources of funding the system

There are many sources of funding the project. These sources have been divided into 8 categories and explained in brief as under:

1. **Govt. Participation**

i) Sharing of the capital cost by the (a) Centre
b) the concerned State (Delhi State/Delhi Administration) & (c) City authority (Local Authorities of Delhi) namely – MCD, NDMC, DTC, etc. The Nodal Ministry is the Ministry of Urban Development, which has to satisfy the Planning Commission and then finally to the Ministry of Finance to process the request for floating of bonds or approaching the World Bank and other international

financial institutions for financing the foreign exchange element of the project.

- ii) From the consolidated fund of India or from specially created funds like the Metropolitan Transport Consortium Funds. NCU's recommended funds which do not have to bear any interest or dividend / liability.
- iii) Contribution by the State/ City Authority.
 - a) Free allotment of land.
 - b) Profits from property development.
 - c) Funding from consolidated fund of the State.
 - d) Public borrowing at the present rate of interest of 11.5%.
- iv) The Ministry of Urban Development, sometimes in 1987, recommended that 30% of the cost be borne by Delhi Administration and 30% by Local Bodies of Delhi.

2. **Funding through Public Bonds: It can be of the following types:**

- i) After getting permission from the Central Govt./ Ministry of Finance.
 - a) Either at the rate of 9% interest free from any income tax liability.
 - b) Or at the rate of 13% interest subject to the normal taxes as may be permitted by Ministry of Finance.
- ii) Floating loans at 11.5% on the guarantee of the State Govt.
- iii) Floating non- convertible debentures by the project authority at a rate to be approved by Reserve Bank of India (the present rate being 13.5%).
- iv) Market borrowing by means of public bonds not be successful because return from project cannot meet either (a) Interest charges or (b) Repayment of capital. At the most, 10% of the total amount of Rs. 54 billion i.e. 5.4 billion may be collected under

this would be reflected, and taken from the revenues in the shape of ticketing system of the metro. It would be better to avoid it.

3. **Direct loans from major private financial Institutions.**

i) Industrial Credit & Investment Corporation of India (ICICI); This institution can work in an advisory capacity to work out the details of the financial plans of the project, help by raising funds from various sources and by giving a lead by investing Rs 100 crores and making a consortium with other financial institutions like IDBI, IFCI etc.

ii) SBI (State Bank of India) Capital Market Ltd.

This institution charge interest @ 16.5% which is very high and would further strain the financial viability of the project.

iii) Soft loans for certain utilities/ services extended by LIC and Unit Trust of India. These institutions which have many competing demands charge a rate of interest of 10% and their total availability of funds may not be more than Rs.50 crore per yr.

4. **Participation by Private Entrepreneurs.**

This could be on the principle of BOT (Build Operate & Transfer) under which a license agreement with the Govt. is entered upon by a Private Group responsible for design, financé construction and operation of a facility. BOT projects are becoming popular due to i) Reduction in Govt. spending by making use of private sector funds and ii) Efficient management of the private sector.

Under this category, big business houses like TATA, Birla, Ambwani , Ansals etc. could be tried. These big business houses have a lot of innovative skills and better systems of development and construction of the project.

5. **Participation of Foreign Private Entrepreneurs.**

This system is not recommended as it would involve additional foreign exchange burden.

Leasing Finance

It is based on a joint venture basis and under This, leading companies are IDBI, IFCI, ICICI, IRVI and SBI Capital Markets (Leasing Division) Lessor retains the ownership of the assets while lessee has the possession and use for a specific period on payment of specified rentals over a period which will cover i) depreciation ii) interest iii) other overheads iv) insurance arrangements v) management cost and vi) a profit margin for the lessor. This system may be used to acquire the equipments needed during the construction stage and later at operation stage to acquire the components, rolling stock and other equipments necessary for operation.

6. **Funds from Property Development**

This is a very common adopted system in Hong Kong and New York where it yielded upto 40% of the total cost of the project. Funds can be procured by i) Leasing or selection of user's right ii) Outright sale of property to a developer iii) Joint Venture & iv) Direct involvement of the Transport Authority in planning, development and Development and construction of spaces.

7. **Raising foreign loans to finance the project.**

i) Loans from the World Bank which has 3 affiliated agencies namely: International Bank for Reconstruction and Development (IBRD), International Development Agency (IDA) and International Finance Corporation (IFC).

ii) Other Financial Institutions.

a.) Asian Development Bank(ADB).

b.) Overseas Economic Cooperation Funds(OECF) of Japan & Japan International Cooperative Agency (JICA).

These two institutions provide funds for materials, equipments and services required for specific development projects. It provides the Government with concessional loan for which the grant element is at least 25%.

c.) United Nations Development Programme (UNDP).

d.) Soft loans on deffered payment term by foreign suppliers. This is being done by international industrialists and manufacturers particularly when they are grouped into consortium.

iii) Aid extended to India by various countries under bilateral agreement.

iv) Foreign Exchange financing by means of counter trade.

It is to supply equipments or technology for MRTS and on the system of i) barter ii) compensatory deals iii) counter purchase or reciprocal trade and iv) product buy-back/ offset or advance purchases. This system is good as it does not increase the burden of foreign debt and it creates additional exports in the country.

8. Taxation measures

It can be in terms of enchancing the existing tax rates or both the measures together. Taxes and receipts other than from fare-box revenues are as under:

i) Parking fees

ii) Advertisement charges

iii) Special surcharge on the exisiting tax over the construction period e.g., 50 paise per litre of petroleum and diesel oil would raise raise Rs. 400 million per year.

iv) Enhancement in property tax on the existing buildings, addition of new properties in the perview of taxation and to tax public buildings also.

v) Penal tax on vacant plots or large built-up residential or commercial areas.

vi) Transport cess may be levied on all properties.

vii) A part of the incremental value of the pro-erty to be charged at the time of approval of the plan. It can be passed to the Transport Authority.

viii) Increase the rate of sales tax which is comparatively lower in Delhi than in adjoining States.

ix) Increase in motor vehicle tax which is also lowest in Delhi.

x) Professional tax on the lines of Bombay where a flat rate of Rs. 20 per month has to be paid by all professionals.

xi) Betterment levies as provides under section 37 to section 40 in Delhi Development Act.

Inferences from various appendices (Data taken from RITES)

13 Appendices have been prepared and attached with the paper. These appendices are based on various reports of RITES.

Appendix No. 1A: Norms & Assumptions for benefits estimation.

Appendix No. 1B: Gross benefits in financial terms attributable to investments in MRTS Project in the year 2001. (Phase I) and year 2001 (full system).

Appendix No. 2: Urban Rail (MRTS) traffic forecast.

Appendix No. 3A: Returns from Property Development.

Appendix No. 3B: Estimated Return from Metro Corridors/ Sections.

Appendix No. 3C: Estimated Return Rail Corridors (Full System).

Appendix No. 4A: Cost Stream (First Phase).

Appendix No. 4B: Cost Stream (Full System).

Appendix No. 4C: Mass Rapid Transport System for Delhi: Capital Cost Estimates.

Appendix No. 4D: Capital Cost of Project at 1989-90 price level.

Appendix No. 5A: Break Even Analysis at Different Interest Rates.

Appendix No. 5B: Commercial Internal Rate of Return.

Appendix No. 5C: Economic Internal Rate of Return.

Appendix No. 1A: Norms & Assumptions for benefits estimation.

This appendix has been added only for the purpose of information. It gives information about DTC buses running in Delhi in terms of Vehicle Operating Cost, Average Occupancy per vehicle, number of days vehicle on road, average value of passenger travel time, vehicles utilized per day in KM, average speed.

In second part of the appendix, data has been given on car, taxi, 3-wheeler, average value of passenger time etc. in terms of vehicle operating cost per hour, speed in KM per hour, average daily run in KM and average occupancy per vehicle.

Third part of the appendix gives the details with regard to number of expected vehicles in Delhi in 2000, 10% to be decreased in number in phase 1 and 30% when the full system of Urban Rail (MRTS) would be in operation.

Appendix No. 1B: *Gross Benefits on Financial Terms Attributable to Investments in MRTS Project in the Year 2001 (Phase I) and Year 2011 (Full System).*

Details are given on i) Gross benefits on financial terms due to less vehicles, less operation cost, less congestion/ pollution and lot of time savings. ii) Saving in fuel consumption (2001 and 2011) values in market prices and iii) Effect on investment in buses.

Appendix No. 2: *Urban Rail (MRTS) Traffic Forecast.*

RITES in their detailed studies have estimated that traffic on MRTS would start from 450,000 to 6.86 million passengers in phase 1 and would reach to an ultimate figure of 14.16 million passengers by 2022. This ultimate figure is equivalent to expected traffic to be covered by MRTS in various years as details given upto some extent in para 3.2.

Appendix No. 3A, B & C:

These three appendices give details of return from property development.

Appendix No. 3A: *Returns from Property Development.*

Out of 882 hect. Of land required for MRTS, 547 hect. would be used for property development to generate 840,000 sqm. commercial spaces and 5010,000 sqm. (74,400 units) residential spaces. After subtracting cost of land development and construction, net return from property development would be Rs. 36.4 billion with a break up of Rs. 20 billion from commercial and residential spaces along metro and 16.4 billion along rail corridors. Details of the calculations have been given in this appendix.

Appendix No. 3B & 3C: *Details about estimated returns from property Development along MRTS.*

The system has been further detailed out section/ sitewise with regard to available developed commercial and residential spaces in Sqms., cost of construction of these spaces expected receipts from

sales and net return after subtracting developers profit Phase 1, Phase 2 and Full System as Rs. 27 billion respectively. Ultimate net return is equivalent to 50% of the total capital cost (without customs) of the system. Meaning thereby, if, this is explored then 50% of the capital cost would be available from private sector.

Appendix No. 4A, 4B, 4C & 4D: are with reference to cost stream in terms of i) Capital cost with a break-up into Civil Engineering, Electrical System, Signalling and Tele-communication, Rolling Stock and other miscellaneous items and ii) Operating cost for metro ring rail and busway; yearwise.

Appendix No. 4A: *Cost Stream (First Phase)*

Cost of first 10 years i.e. from 1990 to 2000 is Rs. 26090 million with a break- up of i) capital cost of Rs. 17040 million for metro, Rs. 7340 million for Ring Rail and Rs. 870 million for busway and ii) Operating cost with Rs. 920 million for metro, Rs. 410 million for Ring Rail and Rs. 510 million for busway. Total capital cost for the first 10 years would be Rs. 25250 million and operation cost excluding depreciation Rs. 1840 million.

Details of cost for another 40 years with an interval of 5 years has also been given.

Appendix No. 4B: *Cost Stream (Full System)*

Cost of first 10 years i.e. from 1990 to 2000 is Rs. 32,940 million with a break-up of i) capital cost of Rs. 18,150 million for metro, Rs. 12080 million for Ring Rail and Rs. 870 million for busway, and ii) Operating cost with Rs. 920 million for metro, Rs. 410 million for Ring Rail and Rs. 510 million busway. Total capital for the first 10 years would be Rs. 31100 million and operation cost excluding depreciation Rs. 1840 million.

Details of cost for another 40 years with an interval of 5 years has also been given.

Appendix No. 4C: *Mass Rapid Transport System for Delhi: Capital Cost Estimate.*

It gives the details of capital cost of the full system and first phase under various heads namely; i) Civil Engineering ii) Electrical System iii) Signalling and Telecommunication iv) Rolling Stock and v) Other miscellaneous expenditure. These figures have been calculated for metro, rail and busway. Cost of the full system is 53.78 billion with Rs. 25.55 billion in Phase I.

Break up of the total capital cost of various components of the full system is Rs. 30 billion (56.9%) for civil works, Rs. 6.3 billion (11.8%) for electrical system, Rs. 2.8 billion (5.2%) signaling and tele- communication, Rs 9 billion (16.9%) for rolling stock and the balance as miscellaneous expenditure.

Appendix No. 4D: *Capital Cost of Project at 1989-90. Price Level for First Phase and Full System without and with Customs Duty.*

As per this appendix Rs. 59.07-53.78 = Rs 5.29 billion would be customs duty, if to be paid.

Appendix No. 5A: *Break Even Analysis at Different Interest Rates.*

Four alternate rate of discount corresponding to 6.75%, 9%, 15% and 18% for Phase 1 and Full system with and without customs duty has been calculated after including earnings from property development and average lead of 8 KM per passenger. These four rate of interest are i) Indian Railways Dividend Rate ii) the rate at which Indian Railway Finance Corporation raise their debentures, iii) the going rate of interest for commercial public borrowing, and iv) the market rate of interest. This data would be very useful in taking policy decision about rate of interest with or without custom duty to be adopted.

Appendix No. 5B: *Commercial Interest Rate of Return.*

This is also a very important analysis. Fare per passenger per journey has been assumed Rs. 1.0, 1.5, 2.0, 2.5 and 3.0 and then calculations have been

made for excluding custom duty with fare and property development for Phase 1 and Full System.

Commercial return in Phase 1 would meet the prescribed criterion rate of 12% if the fare per journey is fixed between Rs. 2/- and Rs. 2.50/- and the advantages of both waiver of customs duty as well as earnings from property development are credited to the project. The approximate rate, obtained by linear inter-polation is about Rs. 2.25. In the Full System, the corresponding fare to achieve a 12% return should be between Rs. 1.50 to Rs. 2.00 (approximately Rs. 1.90).

Appendix No. 5C: Economic Rate of Return.

In the First Phase and Full System, Economic Rate of Return on base case would be 25.51% and 30.81% respectively. Results of two sensitivity tests have been given in this appendix, one with 20% fall in traffic and the second 10% increase in capital cost.

Economic/Financial Analysis of the System

For economic/financial analysis, it is utmost necessary to have the knowledge of following derivations/facts:-

i) Cost of the System

| | billion |
|----------------|-----------|
| a. Full System | Rs. 53.78 |
| b. First Phase | Rs. 25.55 |

The above figures include all the costs i.e. land acquisition, earth work formation, tunneling, elevated, construction of depots, bridges, stations, offices and quarters, utilities and rehabilitation, electrical system, signaling and telecommunication and rolling stock. Meaning thereby in this cost entire MRTS System can be planned, developed and constructed and would be ready for operation purposes. It is made clear that this amount would be required over a period of 20-25 years i.e. at the average rate of about Rs. 2.4 billion per year. (please see details in appendix 4A, 4B, 4C & 4D).

ii) Property Development

Total requirement of land for MRTS System is 882 hect. out of which 547 hect, would be explored for development of commercial and residential urban spaces and connected incidental facilities. Under this, 840,000 Sqm. of commercial spaces and 5010,000 Sqm. of residential spaces can be created. Assuming cost of construction as Rs. 4672 per Sqm. as adopted by RITES and sale price of residential spaces between Rs. 9000 to Rs. 12000 per Sqm. and of commercial spaces between Rs. 15000 to Rs. 45000 per Sqm . depending upon location; total expected receipts of Rs. 36.4 billion would be there. After deducting share of developers profit as Rs. 7.64 billion, net return from the entire property development system would be Rs. 28.76 billion; (Details given in appendix in 3A, 3B & 3C).

iii) Sources of Funds

An amount of Rs. 53.78-28.76= Rs. 25.02 billion is required for implementation of the project as the balance amount has to be raised from property development. This amount can be raised from the following sources:

- a) Govt. Participation
 - Free allotment of land
 - Funding from Consolidated Fund of the Govt. of India or of the State.
 - Public Borrowing at the present rate of Interest of 11.5%.
- b) Funding through Public Bonds.
- c) Direct loans from major private financial institution; ICICI, IDBI & IFCI, SBI Capital Markets Ltd., LIC, UTI.
- d) Leasing Finance
 - Joint Venture with leading Companies- IDBI, IFCI & ICICI, IRVI & SBI Capital Markets.
- e) Participation by private entrepreneurs on the principles of BOT(Build Operate and Transfer); Under this Category, big business houses like TATA, Birla, Ambwani and Ansals can be there.
- f) Raising loans from foreign agencies of World Bank namely; IBRD, IDA & IFC.
 - Asian Development Bank;
 - Overseas Economic Corporation Funds;
 - United Nation Development Programme;
 - Foreign Exchange by means of Counter Trade.

g) Different types of taxation measures in terms of enhancing the existing tax rates or imposing new taxes or both.

iv) *Cost of Land*

Cost of private land at market rate= Rs. 1.38 billion.
Total= Rs. 2.76 billion

v) *Benefit Streams*

- Capital and operating cost (on present pre-congestion norms) of carrying the total volume of passenger traffic by existing bus system and private vehicle in case MRTS project is not taken up.
- Savings due to decongestion in vehicle operating cost of all buses and other vehicles including those that would continue to use the existing transport network even after the MRT system is introduced.
- Saving in time of commuters using the MRT Over the existing transport because of faster Speeds on MRTS.
- Saving in time of those continuing on existing Modes, because of reduced congestion.

a) Cost of Intangible Benefits

| Benefits (Dull system) | Cost in Rs.million |
|--|--------------------|
| - Cost savings due to decongestion effect | |
| - due to higher speed of buses | 3616.37 |
| - Vehicle time saving(other than buses) | 5840.07 |
| - Time saving of passengers moving by MRTS and by existing bus system | 2101.01 |
| - Passengers time saving(other than buses) | 3642.79 |
| - Saving in diesel consumption due to less Number of buses | 498.53 |
| - Savings in petrol consumption due to less Number of petrol using vehicles on road | 1981.74 |
| - Saving in petrol consumption due to decongestion effect on petrol consuming vehicles | 4261.36 |
| - Savings in diesel consumption of residual Bus service on decongestion account. | 366.94 |

b) RITES have estimated benefits. The total savings would be Rs. 14.735 billion for the year 2001 and Rs. 29.998 billion for the year 2011.

vi) *Operating Cost Vs Revenue*

| System | Operating & maintenance Cost | Depreciation Cost | Total | Revenue |
|--------|------------------------------|-------------------|-------|---------|
|--------|------------------------------|-------------------|-------|---------|

| | | | | |
|------------------------------|------|------|------|------|
| 1 st Phase(2001) | 1480 | 520 | 2000 | 1880 |
| Full System (2011) | 3000 | 1140 | 4140 | 5790 |

It is noted that the estimated fare-box revenue is expected to cover the operating and maintenance cost of the First Phase of the MRTS System in the year 2001, but depreciation also by the year 2011, when the demand and hence the revenue is expected to grow by 50%. The fare box revenue for the Full System in the year 2011 is expected to fully cover the operating maintenance and depreciation cost of the Full System.

vii) *Opinion Survey of Bus Passengers About Ticket*

CRRI in 1987 conducted an opinion survey with the following results:-

1. Between Re. 1 to 1.50 37%
2. Between Rs. 1.50 to 2.00 51%
3. Between Rs. 2.00 to 2.50 10%
4. Above Rs. 2.50 2%

The above indicated that most passengers to pay between Re. 1 to Rs. 2 per trip.

Proposed Models

A. Before full system of MRTS comes into Operation.

- i) Cost of the full system = Rs. 53.78 billion
- ii) Net savings from property development = Rs. 28.76 billion
- iii) Cost of land (assuming this would be given free by the State Government to the Project/Party)=Rs. 2.76 billion

- Sub Total of (ii) & (iii) = Rs. 31.52 billion.

iv) Balance amount required for the project =Rs.53.78-31.52 billion = Rs. 22.26 billion or say Rs. 22.5 billion.

First Model

One model can be that the entire system is constructed by a Public Authority including Property Development. The Public Authority can raise the funds of Rs 22.5 billion besides saving from property developments and free land to be allotted by the Govt. to the Party. This amount can be raised by various sources this needs raising of funds @ Rs. One billion or Rs. 100 million per year which seems to be a tough proposition in the present day economic situation of the country.

Second Model

A seed capital of Rs. 5 billion is given to the selected Party/ Parties. This amount would be on loan for 25 years with conditions of i) Tax free for the first 10 years ii) 6% rate of interest for the next 5 years and iv) 30% rate of interest if kept after 25 years.

Balance amount of Rs. 17.5 billion would be permitted to the Party to be raised from various sources.

The Party would be permitted a gross return of 20% or net return of 15% whichever is less on the entire project except on the amount given at serial no. ii & iii.

After MRTS System comes into operation

It seems to be difficult to manage the operations, management and re-placement (depreciation) of MRTS System in Private sector.

For this, experiments of United States and other countries need to be studied. For the time being, it is stated that this may be tried by Transport Sector Authority which is to be created for this specific purposes. Operation, maintenance and replacement (depreciation) is possible as calculations made by RITES and reproduced below:

| Amount in Rs Million | | | | |
|-----------------------------|------------------------------|-------------------|-------|---------|
| System | Operating & maintenance Cost | Depreciation Cost | Total | Revenue |
| 1 st Phase(2001) | 1480 | 520 | 2000 | 1880 |
| Full Phase(2011) | 3000 | 1140 | 4140 | 5790 |

These calculations have been made based on a ticket of Rs. 2.00 per journey of about 8 KM in length.

Appendix 1A:

Norms & Assumptions for benefits estimation

| | | |
|--|--|-------------------------|
| 1. Bus System | | |
| i. Vehicle operating cost | | Rs.9.21 per vehicle Km. |
| ii. Average occupancy per vehicle | | 53 passengers |
| iii. No. of days vehicle on road | | 365 days |
| iv. Average value of passenger travel time | | Rs. 4/hr. |
| v. Vehicle utilization per day in kms. | | 224 kms. |
| Average speed | | |
| - Existing | | 20km/hr. |
| - Under congested situation | | 13km/hr. |

2. Others (Car, Taxi, 3-Wheeler) System

| Vehicle | VOC/hr (Rs.)present situation | Speed (km/hr) congested | Speed (km/hr) | Av.daily run(km) | Av. occupation per vehicle |
|---------|-------------------------------|-------------------------|---------------|------------------|----------------------------|
| a) Car | 32.77* | 20 | 13 | 30 | 2.5 |
| b) Taxi | 58.10 | 20 | 13 | 80 | 2.5 |
| c) 3-wh | 36.00 | 20 | 13 | 100 | 2.0 |
| d)2-wh | 7.80* | 20 | 13 | 25 | 1.5 |

* Only cost of fuel has been taken.

Average value of passenger time Rs. 5/hr

3.) No. of vehicles (reduced)

| Vehicles by 2001('000) | No. of vehicles | Vehicles benefitted by the Project ('000)* | |
|------------------------|-----------------|--|-------------|
| | | Phase 1 | Full System |
| a) Car | 784 | 78.40 | 156.80 |
| b) Taxi | 24 | 2.36 | 6.72 |
| c) 3-Wheeler | 148 | 23.68 | 42.36 |
| d) 2-Wheeler | 2772 | 221.76 | 443.52 |

* 30% of the vehicles (car and 2-wheelers only) are assumed to divert to MRTS.

Appendix 1B:

Gross Benefits in financial terms attributable to investments in MRTS Project in the year 2001 (Phase 1) and Year 2011 (Full System)

| | (Rs. In Million) | |
|---|------------------|---------------------|
| | Phase 1 2001 | Full System 2011 |
| i) Vehicle capital & operating Cost of continuing with existing Bus system and private vehicles | 7799.85 | 14797.91 |
| ii) Cost savings due to decongestion effect | | |
| - due to higher speed of buses | 2690.92 | 3616.37 |
| - Vehicle time saving (other than bus) | 2172.78 | 5840.07 |
| iii) Time saving of passengers moving by MRTS and by existing bus system | 1109.60 | 2101.01 |
| iv) Passenger's time saving (other than bus) | 961.94 | 3642.79 |

II) Saving in Fuel Consumption (2001 & 2011) (Values in market prices)

| | (Rs. In Million) | |
|--|------------------|---------------------|
| | Phase 1 2001 | Full System 2011 |
| Savings in diesel consumption due to Less number of buses | 202.83 | 498.53 |
| Savings in petrol consumption due to Less number of petrol using vehicles On road | 403.14 | 1981.74 |
| Saving in petrol consumption due to Decongestion effect on petrol consuming Vehicles | 866.88 | 4261.36 |
| Saving in diesel consumption of Residual bus service on decongestion Account | 149.29 | 366.94 |
| | <u>1622.14</u> | <u>7108.57</u> |

III) Effect on Investment in Buses

The effect on investment in buses has been calculated by estimating the number of buses required to meet the transport demand with and without MRTS. The estimate is based on the assumption that transport demand will be double between 2001 and 2021 and will remain constant beyond 2021. The bus replacement costs have been estimated for a bus life of 8 years. The operating cost of the estimated bus fleet is based on the prevailing DTC costs. The calculations give the following results:

| Year | (Rs in Million) | | | | |
|------|------------------------------------|-------------|------------|------|-------|
| | Annual Savings in the yr indicated | | | | |
| | Capital | Replacement | Operations | fuel | Total |
| 2001 | 600 | - | 1190 | 260 | 2050 |
| 2011 | 600 | 300 | 3580 | 780 | 5260 |
| 2021 | 200 | 700 | 4380 | 330 | 6210 |

The table above shows that savings in bus operation costs will more than cover the operation, maintenance and depreciation costs of proposed Delhi MRT System.

Appendix 2 Urban rail (MRTS) Traffic Forecast

| Year | (Figs. In Million) (pass. Per day) | |
|----------|--|-------------|
| | Phase 1 | Full System |
| 1 (1997) | 0.45 | 0.45 |
| 5(2002) | 3.43 | 3.43 |
| 10(2007) | 4.19 | 7.07 |
| 15(2012) | 5.14 | 10.58 |
| 20(2017) | 5.13 | 12.21 |
| 25(2022) | 6.86 | 14.16 |

Appendix 3A

Returns from Property Development

| Estimate | Metro | Rail | Total |
|---|-------------|-------------|-------------------------------------|
| 1.Land requirement | 355 Hect. | 527 Hect. | 882 Hect |
| 2.Land for development | 184 Hect. | 364 Hect. | 547 Hect |
| 3.Floor area in 000sq.mt. | | | |
| - Commercial | 640 | 200 | 840 |
| - Residential | 1600 | 3410 | 5010 |
| | 24400 units | 50000 units | 74400 units |
| 4.Sale price(Rs. In million) | | | |
| 1989-90 Price Level | | | |
| - Commercial | 18790 | 4110 | 22900 |
| - Residential | 22420 | 38070 | 60490 |
| 5.Construction Cost(in Rs. Million) | 10450 | 16880 | 27330 |
| 6.Return(after deducting Cost of construction and Developers profit) In Rs. Million | 20000 | 16400 | 36400 or say Rs. 36.4 billion |

Appendix 3B

Estimated Return from Metro corridors/sections

First Phase

| Site | Area(Sq.m.) | | Sales | | Construction | |
|-------------------|-------------|--------|-------|----------------------|--------------|--|
| | Comm. | Res. | Comm. | Res.(Rs. In Million) | | |
| 1. Ring Road | 275000 | - | 5050 | | 1540 | |
| 2. Tilak Bridge | 220000 | - | 5840 | | 1180 | |
| 3. Barakhamba | 55000 | - | 1710 | | 300 | |
| 4. Pusa Institute | | 840000 | | 10580 | 4700 | |
| . Pandav Ngr A. | | 80500 | | 1080 | 350 | |
| . Pandav Ngr B. | | 85750 | | 1150 | 380 | |
| . Kashmere G. | 174000 | | 4060 | | 940 | |
| . State Entry | 31250 | | 1150 | | 170 | |
| Total | | | 17810 | 12810 | 9560 | |

Second Phase

| | | | |
|--|--------|------|------|
| 9. Khyber Pass | 405000 | 3670 | 1260 |
| 10.Vishwavidyalaya to ISBT (3 sites) | 37500 | 400 | 180 |
| 11. Motilal Nehru Road Tp Sewa Nagar (5 sites) | 483000 | 650 | 190 |
| Total | 925500 | 4720 | 1630 |

Return From First Phase

Amount in Rs. Million

| | | |
|------------------------------------|-------------|-------------------------------------|
| ffCommercial | 17810-4130= | 13680 |
| gResidential | 12810-5430= | 7380 |
| TTotal | | 21060 |
| DDeduct Developer's profit@ 14% | | 2970 |
| NN Net Return | | 18090 |
| R RReturn From Second Phase | 4720-1630= | 3090 |
| DDeduct Developer's profit | | 440 |
| N Net Return | | 2650 |
| T Total of first and second phase= | 18090+2650= | 20740 million or Rs. 20.74 billion. |

Appendix 3 C

Estimated Return Rail Metros/ Full System

| Description | Area (Sq.m.) | | Sales | | Cons. cost |
|--|--------------|---------|-------|--------------|------------|
| | Comm. | Res. | Com | Res. (In Mi) | |
| 1. 9 Station | 290000 | | 7300 | | 1350 |
| 2. 58 Stations | | 1740000 | | 19740 | 8120 |
| 3. 7 Depots(230H) | | 3450000 | | 30960 | 16110 |
| 4. Patel Nagar to Rohini including Rohini Depot. | | 810000 | | 5300 | 3080 |
| Total | | | 7300 | 56000 | 28660 |

| | | |
|---------------------------|-------------------------|------------------|
| Return | (Amount in Rs. million) | |
| Commercial | 7300-1350= | 5950 |
| Residential | 56000-27310= | 28690 |
| Total | | 34640 |
| Deduct Developer's profit | | 7640 |
| Net Return | | 27000 |
| | | Or Rs.27 billion |

Appendix 4A

Cost Stream (First Phase)

(Rs. in billion)

| Year | Capital Cost | | | Total Cap. cost | Operating C (Excl. Dep. cost) | | | Total Oper. cost | T.C. |
|------|--------------|------|--------|-----------------|-------------------------------|------|-----|------------------|------|
| | Metro | Ring | Busway | | Metro | Ring | Bus | | |
| | Rail | Rail | | | Rail | way | | | |
| 1990 | 400 | 60 | 0 | 460 | 0 | 0 | 0 | 0 | 460 |
| 1991 | 400 | 70 | 0 | 470 | 0 | 0 | 0 | 0 | 470 |
| 1992 | 400 | 360 | 0 | 1660 | 0 | 0 | 0 | 0 | 1660 |
| 1993 | 1520 | 360 | 0 | 1880 | 0 | 0 | 0 | 0 | 1880 |
| 1994 | 2490 | 360 | 0 | 2850 | 0 | 0 | 0 | 0 | 2850 |
| 1995 | 2490 | 360 | 0 | 2850 | 0 | 0 | 0 | 0 | 2850 |
| 1996 | 2490 | 1200 | 190 | 3880 | 0 | 0 | 0 | 0 | 4000 |
| 1997 | 2560 | 1140 | 200 | 3900 | 0 | 100 | 0 | 100 | 4000 |
| 1998 | 1440 | 1140 | 480 | 3060 | 0 | 100 | 0 | 100 | 3160 |
| 1999 | 970 | 1140 | 0 | 2110 | 450 | 100 | 250 | 800 | 2910 |
| 2000 | 980 | 1150 | 0 | 2130 | 470 | 110 | 260 | 840 | 2970 |
| 2005 | 130 | 50 | 10 | 190 | 860 | 430 | 320 | 1610 | 1800 |
| 2010 | 130 | 50 | 30 | 210 | 910 | 480 | 400 | 1790 | 2000 |
| 1015 | 130 | 50 | 310 | 490 | 1030 | 550 | 470 | 2050 | 2540 |
| 2020 | 130 | 50 | 40 | 220 | 1190 | 630 | 530 | 2350 | 2570 |
| 2025 | 0 | 0 | 50 | 50 | 1220 | 650 | 540 | 2410 | 2460 |
| 2030 | 130 | 50 | 20 | 200 | 1220 | 650 | 540 | 2410 | 2610 |
| 2035 | 130 | 50 | 40 | 220 | 1220 | 650 | 540 | 2410 | 2630 |
| 2940 | 130 | 50 | 30 | 210 | 1220 | 650 | 540 | 2410 | 2620 |

Appendix 4 B

Cost Stream (Full System)

(Rs. in billion)

| Year | Capital Cost | | | Total Cap. cost | Operating C (Excl. Dep. cost) | | | Total Oper. cost | T.C. |
|------|--------------|------|--------|-----------------|-------------------------------|------|-----|------------------|------|
| | Metro | Ring | Busway | | Metro | Ring | Bus | | |
| | Rail | Rail | | | Rail | way | | | |
| 1990 | 400 | 60 | 0 | 460 | 0 | 0 | 0 | 0 | 460 |
| 1991 | 400 | 70 | 0 | 470 | 0 | 0 | 0 | 0 | 470 |
| 1992 | 1300 | 360 | 0 | 1660 | 0 | 0 | 0 | 0 | 1660 |
| 1993 | 1520 | 360 | 0 | 1880 | 0 | 0 | 0 | 0 | 1880 |
| 1994 | 2490 | 360 | 0 | 2850 | 0 | 0 | 0 | 0 | 2850 |
| 1995 | 2490 | 360 | 0 | 2850 | 0 | 0 | 0 | 0 | 2850 |
| 1996 | 2490 | 1200 | 190 | 3880 | 0 | 0 | 0 | 0 | 3880 |
| 1997 | 2560 | 1140 | 200 | 3900 | 0 | 100 | 0 | 100 | 4000 |
| 1998 | 1440 | 2390 | 480 | 4310 | 0 | 100 | 0 | 100 | 4410 |
| 1999 | 970 | 2390 | 0 | 3360 | 450 | 100 | 250 | 800 | 4160 |
| 2000 | 2090 | 3390 | 0 | 5480 | 470 | 110 | 260 | 840 | 6320 |
| 2005 | 1290 | 1310 | 10 | 2610 | 880 | 950 | 320 | 2150 | 4760 |
| 2010 | 180 | 1130 | 30 | 1340 | 1070 | 1330 | 400 | 2800 | 4140 |
| 1015 | 170 | 280 | 310 | 760 | 1230 | 1670 | 470 | 3370 | 4130 |
| 2020 | 170 | 280 | 40 | 490 | 1420 | 1930 | 530 | 3880 | 4370 |
| 2025 | 0 | 350 | 50 | 400 | 1470 | 1980 | 540 | 3990 | 4390 |
| 2030 | 170 | 280 | 20 | 470 | 1470 | 1980 | 540 | 3990 | 4460 |
| 2035 | 180 | 290 | 40 | 510 | 1470 | 1980 | 540 | 3990 | 4500 |
| 2940 | 170 | 280 | 30 | 480 | 1470 | 1980 | 540 | 3990 | 4470 |

Appendix 4C

Mass Rapid Transport System for Delhi Capital Cost Estimate.

| Guage 16 mm | | (1989-90 Price Level) | | (Rs in M) | |
|-------------|-------------------------------|-----------------------|----------|-----------|--------|
| S. No. | Item | Full System | | 1 Phase | |
| 1. | Civil Engg. | 1269.0 | 17410.0 | 895.0 | 4842.6 |
| a) | Land | 730.00 | 5520.00 | 530.00 | 1310.0 |
| b) | Formation | 8.10 | 292.00 | 5.30 | 8.60 |
| c) | Tunneliing | 5789.20 | 612.50 | 4206.0 | 612.50 |
| d) | Elevated | - | 3521.50 | - | 850.80 |
| e) | P. Way | 549.60 | 1046.20 | 395.70 | 268.10 |
| f) | Depots(P. Way) | 710.00 | 1525.30 | 445.00 | 311.50 |
| g) | Bridges | 20.00 | 1335.00 | - | 479.40 |
| h) | Stations | 4151.10 | 2785.00 | 2860.40 | 726.20 |
| i) | Offices & quartr | 202.00 | 510.00 | 127.40 | 118.00 |
| j) | Utilities & Rehab | 540.00 | 262.50 | 380.00 | 157.50 |
| 2. | Electrical System | 3742.00 | 2536.00 | 2546.0 | 717.50 |
| 3. | Signalling & Telecomm. | 1530.00 | 1290.00 | 970.0 | 327.00 |
| 4. | Rolling Stock | 3400.00 | 5600.00 | 2600.0 | 1350.0 |
| 5. | Preliminary Exp. 0.44% | 80.00 | 93.40 | 54.50 | 26.20 |
| 6. | Estb. Charges 7.95% | 1215.60 | 1108.00 | 841.00 | 328.10 |
| 7. | Other than Estb. Charges 2.0% | 344.80 | 314.30 | 238.0 | 93.10 |
| 8. | Contingency 3.0% | 690.00 | 850.00 | 484.0 | 232.90 |
| TOTAL | | 23700.00 | 29200.0 | 16680 | 7990 |
| 9. | Bus Way | 875.00 | 875.00 | | |
| Grand TOTAL | | 53770.00 | 25550.00 | | |

Appendix 4D

Capital Cost of Project at 1989-90 Price Level

| (Rs. in millions) | | | | | |
|-------------------|-----------------|------------------|------------------|--------|------------------|
| System | Year of Opening | Metro | Rail | Busway | Total |
| First Phase | 2001 | 16680 (19800) | 7990 (9490) | 880 | 25550 (30170) |
| Full System | 2011 | 23700 (27140) | 29200 (31050) | 880 | 53780 (59070) |

Appendix 5A

Break Even Analysis at Different Interest Rates

4 alternative rates of discount corresponding to i) Indian Railway's dividend rate, ii) the rate at which Indian Railway Finance Corporation raise their debentures, iii) the going rate of interest for commercial public borrowing, and iv) the market rate of interest have been used.

Table
(Cost per passenger)

| Rate of Interest (%) | Phase I with Customs Duty | (Fig. in Rs. per journey) | | |
|----------------------|---------------------------|---------------------------|-------------------|-----------------------------|
| | | Full Without Customs Duty | With Customs Duty | System Without Customs Duty |
| 6.75 | 1.84 | 1.68 | 1.52 | 1.44 |
| 9.00 | 2.16 | 1.84 | 1.76 | 1.60 |
| 15.00 | 3.44 | 2.72 | 2.80 | 2.32 |
| 18.00 | 4.24 | 3.36 | 3.44 | 2.80 |

Appendix 5 B

Commercial Interest Rate of Return

| Fare per Passenger Per journey | Excluding Customs Duty | | Including Customs | |
|--------------------------------|------------------------|---|-----------------------|------------------------------|
| | Return with fare only | Return with fare from prop. development | Return with Fare only | Re with fare from pro. deve. |
| (Rs.) | (%) | (%) | (%) | (%) |
| Phase 1 | | | | |
| 1.00 | Neg. | Neg. | Neg. | Neg. |
| 1.50 | 0.94 | 4.86 | 0.38 | 3.18 |
| 2.00 | 4.60 | 10.12 | 3.82 | 7.71 |
| 2.50 | 7.12 | 13.66 | 6.19 | 10.81 |
| 3.00 | 9.14 | 16.44 | 8.07 | 13.26 |
| Full System | | | | |
| 1.00 | Neg. | Neg. | Neg. | Neg. |
| 1.50 | 2.67 | 7.96 | 2.24 | 6.38 |
| 2.00 | 5.91 | 12.73 | 5.32 | 10.53 |
| 2.50 | 8.34 | 16.25 | 7.63 | 13.60 |
| 3.00 | 10.35 | 19.10 | 9.52 | 16.09 |

Commercial return in Phase 1 would meet the prescribed criterion rate of 12% if the fare per journey is fixed between Rs.2 and Rs. 2.50 and the advantages of both waiver of customs duty as well as earnings from property development are credited to the project. The approximate rate, obtained by linear interpolation is about Rs. 2.25. In the Full System, the corresponding fare to achieve a 12% return should be between Rs. 1.50 to Rs. 2.00 (approximately Rs. 1.90).

Appendix 5C

Economic Internal Rate of Return.

For this, it is necessary to eliminate the effects of elements like subsidies, taxes, duties etc. Problems can be taken care by evolving accounting ratios which can result in implicit shadow prices higher or lower than those used in commercial financial analysis.

Economic Internal Rate of Return(%)

| | Phase 1 | Full System |
|--|---------|-------------|
| i) Base Case | 25.51 | 30.81 |
| ii) Sensitivity Test 20% fall in traffic | 18.94 | 24.58 |
| iii) Sensitivity Test 10% increase in capital cost | 23.68 | 28.62 |