Higher Committee for
Greater Cairo Transportation Planning
Government of the Arab Republic of Egypt

Japan International
Cooperation Agency
(JICA)

No.

Transportation Master Plan and Feasibility Study of Urban Transport Projects in Greater Cairo Region in the Arab Republic of Egypt

Phase II

CREATS

Cairo REgional Area Transportation Study

FINAL REPORT Vol. IV

Technical Appendix

December 2003

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Pacific Consultants International (PCI)

Higher Committee for
Greater Cairo Transportation Planning
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(JICA)

Transportation Master Plan and Feasibility Study of Urban Transport Projects in Greater Cairo Region in the Arab Republic of Egypt Phase 2

FINAL REPORT Vol. IV

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The following foreign exchange rates are applied in this study.
USD $1.00 = 6.0 Egyptian Pound (LE)

（As of September 2003）

PREFACE

In response to the request from the Government of the Arab Republic of Egypt, the Government of Japan decided to conduct the Phase 2 Study for "Transportation Master Plan and Feasibility Study of Urban Transport Projects in Greater Cairo Region in the Arab Republic of Egypt" and entrusted the Study to the Japan International Cooperation Agency (JICA).

JICA selected and dispatched the study team headed by Dr. Katsuhide Nagayama of Pacific Consultants International to the Arab Republic of Egypt between February 2003 and October 2003. In addition, JICA set up an Advisory Committee headed by Professor Noboru Harata of Tokyo University between February 2003 and January 2004, which examined the Study from the specialist and technical point of view.

The Study Team held discussions with the officials concerned of the Government of the Arab Republic of Egypt and conducted field surveys at the study area. Upon returning to Japan, the Study Team conducted further studies and prepared this final report.

I hope that this report will contribute to development in the Arab Republic of Egypt, and to the enhancement of friendly relationship between our two countries.

Finally, I wish to express my sincere appreciation to all the officials concerned of the Government of the Arab Republic of Egypt for cooperation to the Study.

December 2003

Kazuhisa Matsuoka
Vice President
Japan International Cooperation Agency

December 2003

Mr. Kazuhisa Matsuoka
Vice President
Japan International Cooperation Agency
Tokyo, Japan

Letter of Transmittal

Dear Sir,

We are pleased to submit herewith the Final Report of the Phase 2 study for "Transportation Master Plan and Feasibility Study of Urban Transport Project in Greater Cairo Region in the Arab Republic of Egypt".

The Study was undertaken in the Arab Republic of Egypt from February 2003 through October 2003 by the Study Team organized by Pacific Consultants International under the contract with JICA.

This report compiles Feasibility Studies of five priority projects identified within the framework of the Transport Master Plan, which was built in Phase 1 study in order to contribute to the sustainable development in Greater Cairo Region.

We would like to express our sincere gratitude and appreciation to all the officials of your agency and the JICA advisory Committee. We also would like to send our great appreciation to all those who were extended their kind assistance and cooperation to the Study Team, in particular, Ministry of Transport and Egyptian National Institute of Egypt as the counterpart agency. We beg to acknowledge our sincere gratitude to H.E. Eng. Hamdy Al Shayeb, the Minister of Transport, for his strong support to our activities.

We hope that the report will be able to contribute significantly to development in the Arab Republic of Egypt.

Very truly yours,

Dr. Katsuhide Nagayama
Team Leader,
The Study Team for the Transportation Master Plan and Feasibility Study of Urban Transport Project in Greater Cairo Region in the Arab Republic of Egypt
Phase 2

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LIST OF ABBREVIATIONS

ATMs	Automatic Teller Machines
BMTA	Bangkok Mass Transit Authority
BOT	Build-Operate-Transfer
BTSC	Bangkok Mass Transit System Co. Ltd.
CTM	Madrid Transport Consortium
ECMT	European Conference of Ministers of Transport
EMT	Madrid Municipal Bus Service
ENR	Egyptian National Railways
ETA	Expressway and Rapid Transit Authority of Thailand
GCBC	Greater Cairo Bus Company
GCR	Greater Cairo Region
HM	Heavy Metals
HVV	Hamburg Verkehrsverband
IBRD	World Bank (International Bank for Reconstruction and Development)
IRPUC	Institute of Research and Planning of Curitiba
JBIC	Japan Bank for International Cooperation
JICA	Japan International Cooperation Agency
KCW	Competenz-Center Wettbewerb
MRT	Mass Rapid Transit
MRTA	Metropolitan Rapid Transit Administration
MTA	New York Metropolitan Transit Authority
PCI	Pacific Consultants International
PCU	Passenger Car Unit
PPP	Public-Private Partnership
PSC	Public Sector Comparator
RENFE	Spanish National Railway System
STT	Secretaria de Transport y Transito
TFM	Transportes Ferroviarios de Madrid
UTP	Public Transport Unit
WHO	World Health Organization

CREATS PHASE II PARTICIPANTS

Higher Committee	
H.E. Eng. Hamdy EL SHAYEB	Chairman of Higher Committee Minister of Transport
General / Ahab Mostafa ELWI	Central Agency for Public Mobilization and Statistics (CAPMAS)
Eng. Mohammed Talaat KHATTAB	Transport Planning Authority, Ministry of Transport
Eng. Mohammed Arafa AL NEWEAM	National Authority for Railways, Ministry of Transport
Eng. Ahmed Fouad ABDUL RAHMAN	General Authority for Roads, Bridges and Land Transport, Ministry of Transport
Eng. Saad Hassan SHEHATA	National Authority for Tunnels, Ministry of Transport
Counselor/ Essam Abdel Aziz Gad EL HAQ	State Council, Ministry of Justice
Eng. Hussein Mahmoud EL GEBALY	General Organization of Physical Planning, Ministry of Housing
Eng. Nabil EL MAZNY	Chairman of the Board, Cairo Transport Authority (CTA)
Eng. Magdy EL AZAB	Cairo Metro Organization, Ministry of Transport.
Prof. Dr. Ali S. HEIKAL	Executive Director, ENIT
General/ Fawzy Ahmed HASSAN	Cairo Traffic Police Department, Ministry of Interior
General/ Sherief GOMAA	Giza Traffic Police Department, Ministry of Interior
General/ Khaled ZORDOQ	Qalubia Traffic Police Department, Ministry of Interior
Eng. Ahmed El Araby Abdel Hamid SOBAIH	General Secretary, Qalyobeya Governorate.
Eng. Fouad Ahmed AWWAD	Roads and Transport Directorate, Cairo Governorate
General/ Medhat DRAZ	Head of Giza City, Giza Governorte
Eng. Mokhtar Mostafa HASSAN	Chairman of Arab Federation Bus Co.
Prof. Dr. Mohammed Abdul Rahman EL HAWARY	Professor of Transportation Planning, Cairo University
Prof. Dr. Ali S. HUZAYYIN	Professor of Transportation Planning and Traffic Engineering, Cairo University
Prof. Dr. Galal Mostafa SAID	Professor of Transportation & Traffic Engineering, Fayoum Branch- Cairo University
Prof. Dr. Mohamed Rashad EL MITAINY	Professor of Highway and Airport Engineering, Cairo University

Steering Committee	
Prof. Dr. Ali S. HUZAYYIN	Chairman of the Steering Committee Prof. of Transportation & Traffic Engineering, Cairo University
Prof. Dr. Galal Mostafa SAID	Prof. of Transportation & Traffic Engineering, Fayoum Branch - Cairo University
Prof. Dr. Mohamed Rashad EL MITAINY	Prof. of Highway and Airport Engineering, Cairo University
Prof. Dr. Ali S. HEIKAL	Executive Director, Egyptian National Institute of Transport (ENIT)
Prof. Dr. Moustafa Sabry ALY	Prof. Transportation & Traffic, Ain Shams University
Eng. Nabil Fathi El MAZNY	Chairman of the Board, Cairo Transport Authority (CTA)
Eng. Fouad Ahmed AWWAD	Roads and Transport Directorate, Cairo Governorate
Eng. Hassan Ahmed SELIM	Transport Planning Authority, Ministry of Transport
Eng. Refki Khalil AL KADI	Director of Cairo Traffic Engineering and Planning Bureau, Cairo Governorate
Eng. Hoda Edward MICHEAL	Director of Greater Cairo Region Urban Planning Center, General Organization for Physical Planning (GOPP), Ministry of Housing
General/ Fawzy Ahmed HASSAN	Cairo Traffic Police Department, Ministry of Interior
General/ Sherif GOMAAH	Giza Traffic Police Department, Ministry of Interior
Ms. Sanaa HEGAZY	State Ministry for Foreign Affairs, Sector of International Cooperation
Eng. Enayat Benyamin KALTA	Ministry of Planning
Dr. Mawahab ABOU EL-AZM	Egyptian Environmental Affairs Agency

Technical Working Group – Program A	
Prof. Dr. Ali. S. HEIKAL	Chairman of the Technical Working Group Executive Director, ENIT
Dr. Fathi Said EL TONI	Associate Prof., Egyptian National Institute of Transport (ENIT)
Dr. Adel ABDEL MAKSOUD,	Associate Prof., Egyptian National Institute of Transport (ENIT)
Miss. Yosra Hassan EL-GOHARI	Egyptian National Institute of Transport (ENIT)
Eng. Ahmed Ibrahim MOSA	Egyptian National Institute of Transport (ENIT)
Eng. Sabri M. Abul MAATI	Egyptian National Railway (ENR)
Eng. Sami ABU ZAID	General Organization for Physical Planning (GOPP)
Eng. Abdul Azeem MABROUK	Cairo Metro Organization (CMO)
Eng. Ashraf Mahmoud Mohamed ZAKARIA	Transport Planning Authority (TPA)
Eng. Mona Abdel MONEM	Road Directorate
Eng. Abdel Aziz M. Abdel AZIZ	GARBLT
Eng. Fifi Mohamed ABDEL GHANI	Cairo Traffic Engineering Bureau (CTEB), Cairo Governorate
Eng. Doaa MOHAMED	Cairo Traffic Engineering Bureau (CTEB), Cairo Governorate
Eng. Khalid Abdel RAHMAN	NCA (MHUNC)

Technical Working Group – Program B	
Prof. Dr. Ali. S. HEIKAL	Chairman of the Technical Working Group Executive Director, ENIT
Dr. Fathi Said EL TONI	Associate Prof., Egyptian National Institute of Transport (ENIT)
Dr. Adel ABDEL MAKSOUD,	Associate Prof., Egyptian National Institute of Transport (ENIT)
Miss. Yosra Hassan EL-GOHARI	Egyptian National Institute of Transport (ENIT)
Eng. Ahmed Ibrahim MOSA	Egyptian National Institute of Transport (ENIT)
Eng. Mona Moustafa ABDEL HAMEED	Cairo Transport Authority (CTA)
Eng. Mostafa BADRY	Cairo Transport Authority (CTA)
Eng. Ayman AHMED	Cairo Transport Authority (CTA)
Eng. Fifi Mohamed ABDEL GHANI	Cairo Traffic Engineering Bureau (CTEB), Cairo Governorate
Eng. Walaa SAID	Cairo Traffic Engineering Bureau (CTEB), Cairo Governorate
Eng. Abdel Monem Emara	Cairo Metro Organization (CMO)
Eng. Maha Fathy SAID	Road Directorate
Eng. Sami ABU ZAID	General Organization for Physical Planning (GOPP)

JICA Study Team	
Dr. Katsuhide NAGAYAMA	Team Leader, Transport Planning
Mr. Yoshikazu UMEKI	Deputy Team Leader/ Public Transport Planning (Rail)
Mr. John THOMPSON	Deputy Team Leader/ Public Transport Planning (Bus)
Mr. Peter WATSON	Socio-economic Framework
Ms. Mihoko OGASAWARA	Land Use and Urban District Planning/ Study Team Administration
Mr. Len JOHNSTONE	Transport Demand Forecast
Mr. Hurbert METGE	Railway Planning
Dr. Ahmed Hamdy GHAREIB	Bus Operation Planning
Mr. Yasunori NAGASE	Road Planning
Mr. Kimio KANEKO	Traffic Management Planning
Mr. Yoshiyuki ARITA	Traffic Signal Control Planning
Mr. Masao OWADA	Railway Operation Planning
Dr. Eddy DECLERCQ	Intermodal Terminal Planning
Dr. Patrick L. FUSILIER	Finance, Management and Privatization Analysis
Mr. Keishi ADACHI	Economic and Financial Analysis
Mr. Frank de ZANGER	Environmental Impact Assessment

JICA Advisory Committee	
Prof. Dr. Noboru HARATA	Chairman of JICA Advisory Committee
Mr. Tsuyoshi FUJISAKI	Member of JICA Advisory Committee
Mr. Kazuhiro TANAKA	Member of JICA Advisory Committee

JICA Secretariat	
Mr. Yoshiyuki HOSHIYAMA	Deputy Managing Director, First Development Study Division, Social Development Study Department
Mr. Satoshi UMENAGA	Deputy Director, First Development Study Division, Social Development Study Department
Mr. Kenichi KONYA	First Development Study Division, Social Development Study Department
Mr. Norio SHIMOMURA	Resident Representative, Egypt Office
Mr. Toshiyuki IWAMA	Deputy Resident Representative, Egypt Office
Mr. Tomoyuki UDA	Assistant Resident Representative Egypt Office
Mr. Taro AZUMA	Assistant Resident Representative Egypt Office

Consultants	
The Transportation Programme, Development Research and Technological Planning Center, DRTPC, Cairo University	• Traffic Count Survey
MB Consultants	• Environmental Survey
Namaa For Engineering Testing & Consultation S.A.E.	• Soil Investigation Survey

CHAPTER 1: THE TRANSPORT MODEL

1.1 OVERVIEW

This attachment is a supporting document for the transport demand forecast undertaken for Programs A and B and described in their respective main reports. The demand forecasts were developed from the Cairo Transport Model1. This attachment is divided into a further nine sections namely:

- Travel Characteristics review;
- CREATS Transport Model;
- Modified Traffic Zones;
- Revised Socio Economic Forecasts;
- Revised Model Parameters;
- Initial Screening;
- Model Scenarios;
- Indicative Results; and
- Sensitivity Analysis

The following section discusses a review of the travel profile of people within the Study Area. In the next section of the attachment, an overview of the CREATS Transport Model is presented to the reader, whilst Section 4 deals with the development of a revised traffic zoning system. The larger traffic zones along the alignment of the three infrastructure projects, namely Supertram Line 1, West Wing and East Wing, are split into a number of smaller traffic zones.

Section 5 discusses the changes in the socio economic planning data. It also includes a discussion on the socio economic characteristics of the area adjacent to the alignment of the three infrastructure projects. In the next section there is a

[1] Refer to *Phase 1 Final Report - Transportation Master Plan and Feasibility Study of Urban Transport Projects in Greater Cairo Region in the Arab Republic of Egypt*, *Volume III (Transport Master Plan)*, prepared for the Japan International Cooperation Agency and the Higher Committee for Greater Cairo Transportation Planning, by Pacific Consultants International, et. al., November 2002

discussion on the changes incorporated in the model to best reflect the technology of the three proposed infrastructure projects.

In the initial stages of the Phase II Feasibility Studies, there was a screening process to determine the most appropriate alignment and technology for each of the three infrastructure projects. This is discussed briefly in Section 7. The following section presents the model assumptions associated with the scenario adopted for the Feasibility Study. This includes the network assumptions and a discussion on the economic options developed for input into the full economic evaluation.

In Section 9 is a presentation of the basic or indicative transport demand forecasts associated with each of the infrastructure project. Whilst in the last section of this attachment there is an analysis of the sensitivity tests. Both Section 9 and 10 provide the reader with an overview of the basic results from the transport modeling analysis.

1.2 TRAVEL CHARACTERISTICS REVIEW

In the creation of the transport model, the major input was the existing travel characteristics[2]. The backbone of the understanding of the existing travel characteristics was the Household Interview Survey of almost 57,000 households, nearly 1.6% of all the households within the Study Area. The results from this survey suggested that there were 21 million daily linked trips[3] within the CREATS Study Area[4].

Before discussing the travel profile or characteristics of trip makers, it is necessary to appreciate the basic socio economic character of Careens. An important aspect of this character is the distribution of economic activity. In this study there are five classes of household economic activity namely:

- Class 1~Low;
- Class 2~Low-Medium;
- Class 3~Medium;
- Class 4~High-medium; and

[2] Refer to *Progress Report 2 in Phase 1 - Progress Report (2) Vol. I: Current Urban Transport Status for the Transportation Master Plan and Feasibility Study of Urban Transport Projects in Greater Cairo Region in the Arab Republic of Egypt*, prepared for the Japan International Cooperation Agency and the Higher Committee for Greater Cairo Transportation Planning, by Pacific Consultants International, et. al., November 2002

[3] A trip as defined for this study exclude walk trips within the living complex for traditional and frequent purposes such as going to super market or to the mosque. A trip is included in this analysis if it is longer than ten minutes.

[4] The CREATS Study Area is defined in *Phase 1 Final Report - Transportation Master Plan and Feasibility Study of Urban Transport Projects in Greater Cairo Region in the Arab Republic of Egypt*, *Volume III (Transport Master Plan)*, op. cit.

- Class 5~High.

These five classes of economic activity correspond to monthly household income levels of less than 300 LE per month, 300-500 LE per month; 500-1,000 LE per month; 1,000-3,000 LE per month and greater than 3,000 LE per month respectively.

The distribution of the 3.5 million households within the Study Area between these five economic classes is presented in Table 1.2.1. In fact 65% of all households are within the two lower classes of economic activity. These households as is shown in Table 1.2.2 tend to make fewer trips. The people in households in the highest class of economic activity make 58 % more trips per day than those in the lowest class of economic activity.

Table 1.2.1 % of Distribution of Households by Economic Class

Economic Class	Percentage of Households
1	30.9
2	34.6
3	16.7
4	13.8
5	4.0
Total	100.0

Source: JICA Study Team

Whilst the number of trips from the households in the highest economic class is higher, the number of people in these households is lower as shown also in Table 1.2.2. In essence there are fewer people per household in the highest economic class yet these same households make considerably more trips.

Table 1.2.2 Trips per Household by Economic Activity Class

Economic Activity Class	Trips per Household	Household Size
1	5.0	4.00
2	5.7	4.06
3	6.6	4.01
4	7.4	4.04
5	7.9	3.73
Average	6.0	4.00

Source: JICA Study Team and CREATS Home Interview Survey

Households in the higher economic activity classes also have a greater tendency to own one or more vehicles as is presented in Table 1.2.3.

Table 1.2.3 % of Vehicle Distribution by Household Class

Vehicle Ownership	Economic Activity Class				
	1	2	3	4	5
No Vehicle	93.9	83.7	61.6	10.2	6.3
One Motorcycle	2.8	3.8	2.7	10.7	3.8
One Car (including pickup)	2.3	9.9	31.7	64.3	63.8
More than one Vehicle	0.1	0.9	2.5	9.6	23.6
Other Vehicle other than Car	0.9	1.7	1.5	5.2	2.5
Total	100.0	100.0	100.0	100.0	100.0

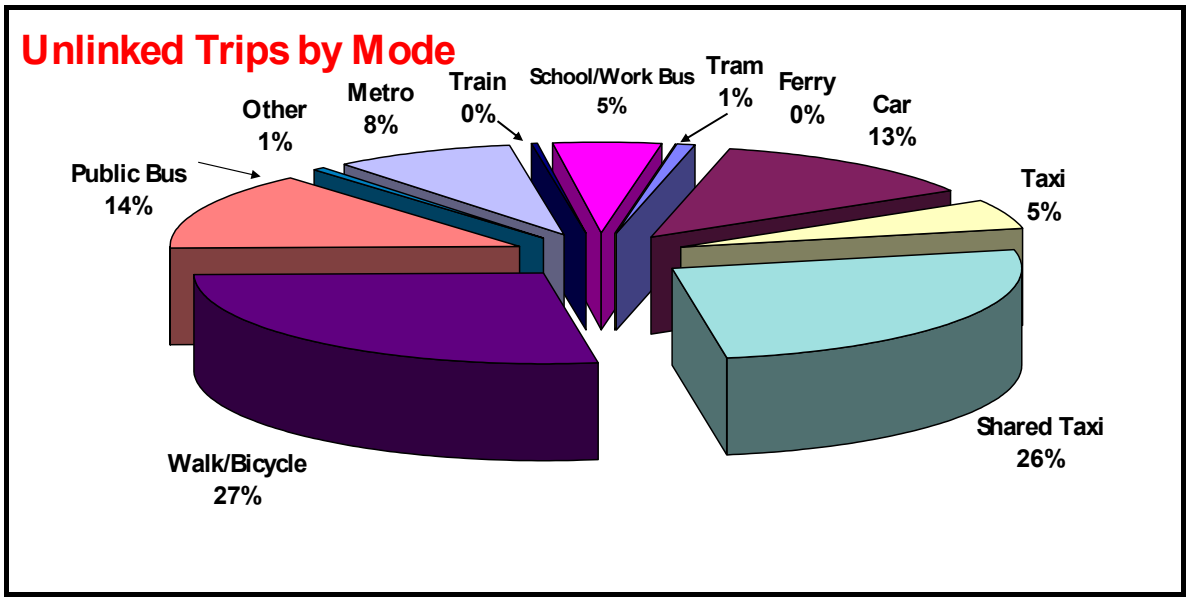
Source: JICA Study Team

There are some 21 million person trips, made each day in Cairo by many different modes as is presented in Table 1.2.4. Often a single trip consists of more then one leg. For example a person traveling into central Cairo by Metro may first access the station using a Shared Taxi. Thus this is a single trip with two legs. In another example to complete a trip, a person may use two Shared Taxis changing from one vehicle to another on route; this is also a single trip with two legs. The individual legs of a multi leg trip are referred to unlinked trips. There are 25 million unlinked daily trips which when linked together equate to the 21 million linked trips in Cairo.

The distribution of unlinked and linked trips by mode is shown in Figures 1.2.1 and 1.2.2 respectively and in detail in Table 1.2.4. It is shown in these figures that the highest proportion of trips is by walk mode.

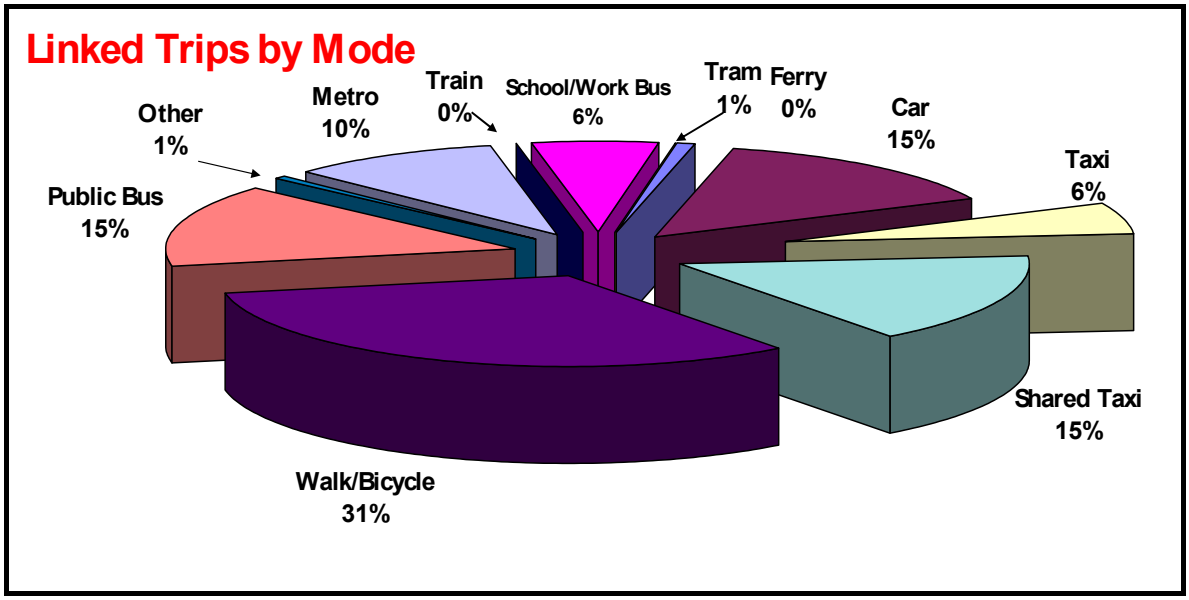
Whist in Figures 1.2.3 and Figure 1.2.4 the proportion of trips by mechanized mode is presented respectively for unlinked and linked trips. The same presentation is depicted in Figures 1.2.5 and Figure 1.2.6 for unlinked and linked trips by major mode. The major mode of mechanized linked trips is Shared Taxi with a 25% share. This is an even higher share, 36% of the unlinked trips. The car share of linked trips at present is 18%.

Currently car and taxi represent only 29% of linked person trips with the remaining trips are using the various public transport mode.



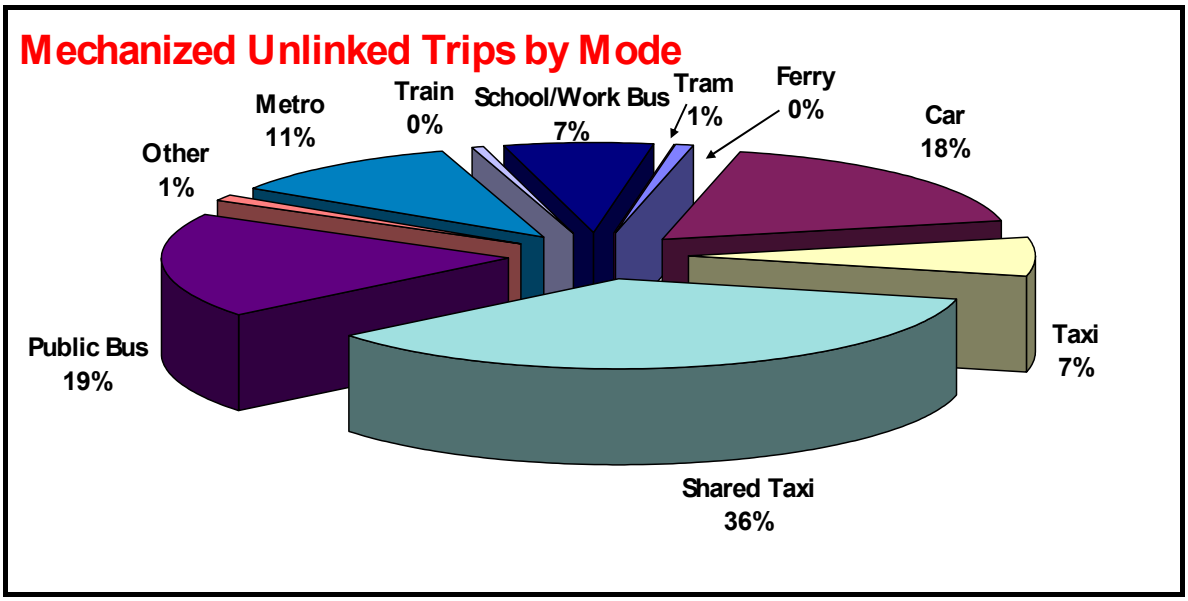
Source: JICA Study Team

Figure 1.2.1 Unlinked Trips by Mode



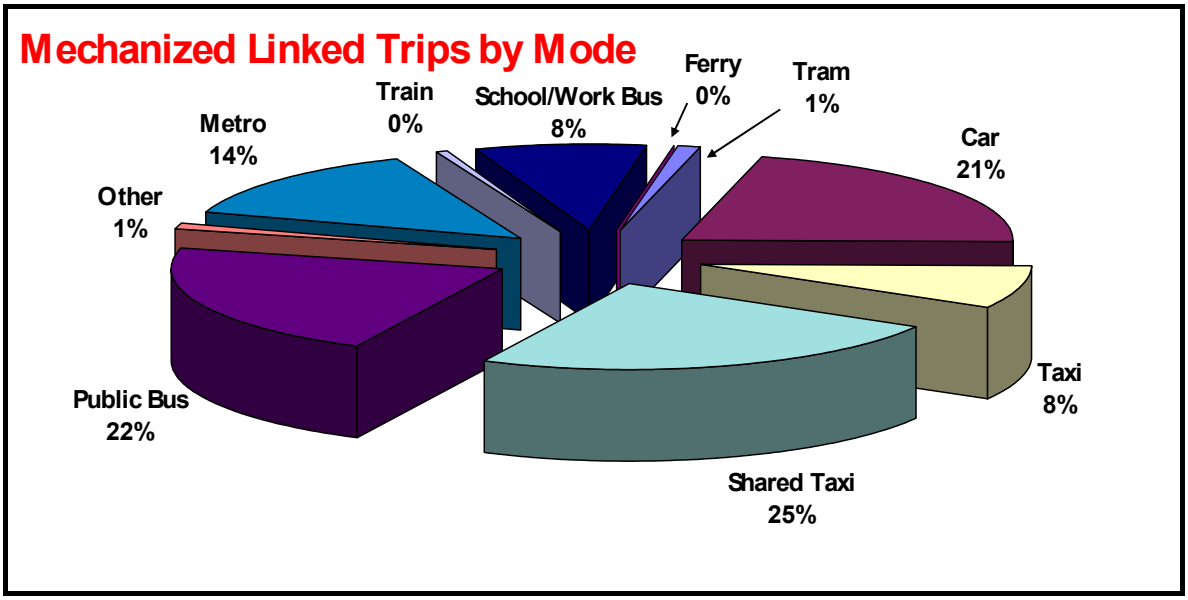
Source: JICA Study Team

Figure 1.2.2 Linked Trips by Mode



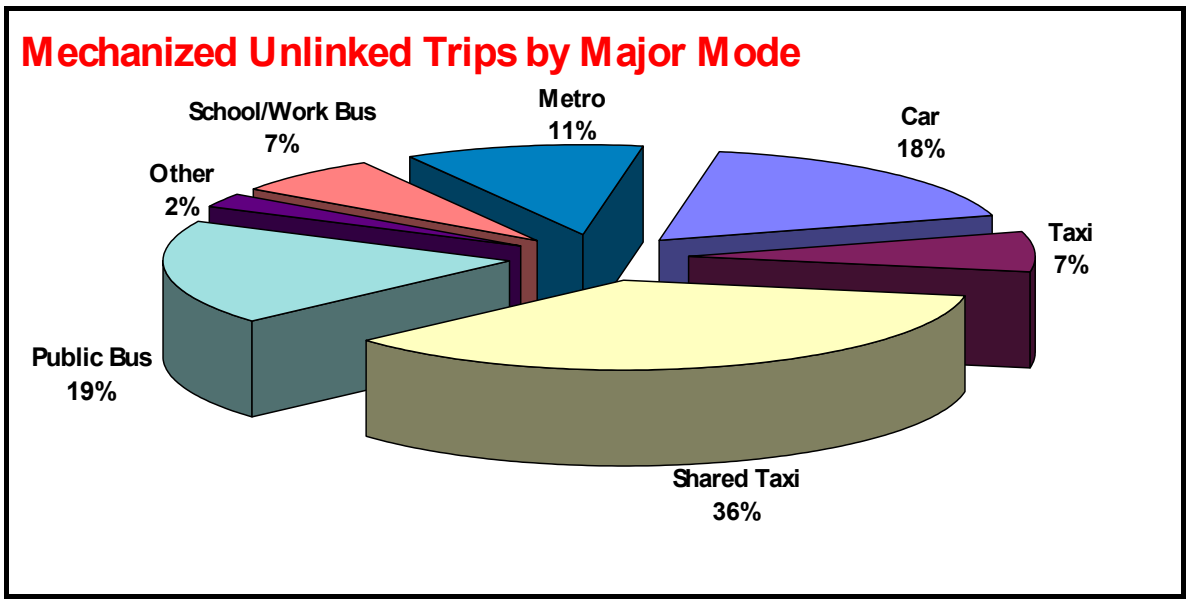
Source: JICA Study Team

Figure 1.2.3 Mechanized Unlinked Trips by Mode



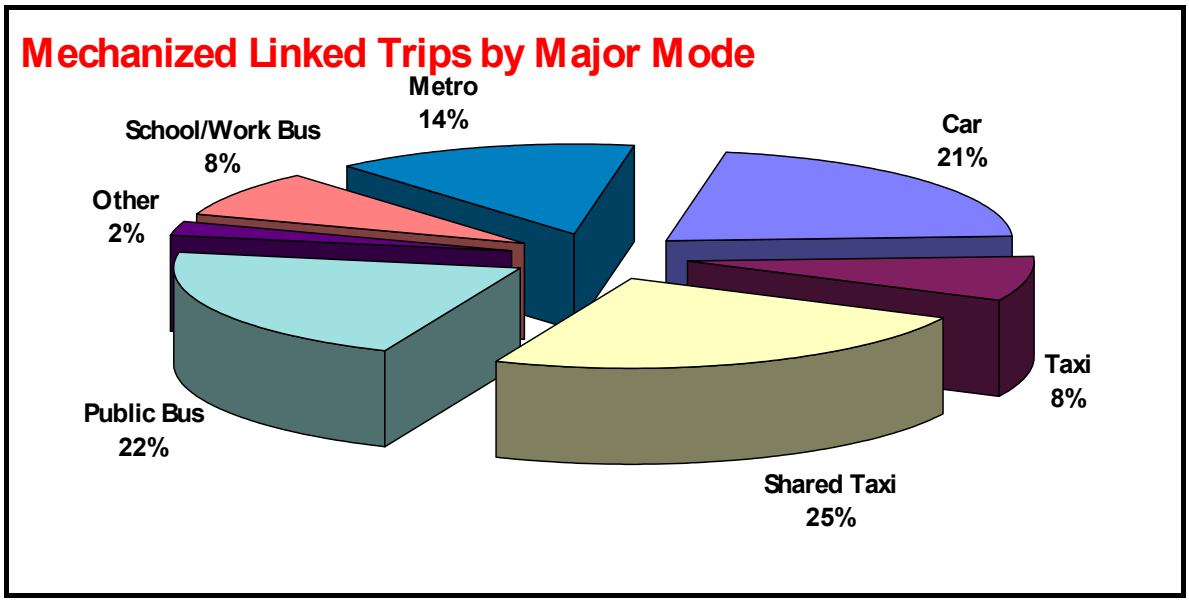
Source: JICA Study Team

Figure 1.2.4 Mechanized Linked Trips by Mode



Source: JICA Study Team

Figure 1.2.5 Mechanized Unlinked Trips by Major Mode



Source: JICA Study Team

Figure 1.2.6 Mechanized Linked Trips by Major Mode

Table 1.2.4 Comparison of Unlinked and Linked Mechanized Trips by Major Mode

Mode of Travel	Linked Trips	Unlinked Trips
Walk	6,676,244	6,676,244
Bicycle	50,480	60,065
Motorcycle	129,400	134,749
Car Driver	2,069,202	2,130,696
Car Passenger	669,725	697,214
Pickup for Passenger	60,889	159,112
Taxi	1,153,993	1,284,847
Shared Taxi	3,422,550	6,507,758
Public Minibus	374,339	425,826
Public Bus	2,514,470	2,858,548
Public Bus A/C	181,483	199,452
Co-Op Minibus	114,469	125,645
Work Car	96,582	110,587
Work Bus	635,526	698,760
School Bus	556,209	564,967
Truck	22,063	45,632
Nile Ferry	6,514	11,469
Tram	45,604	57,032
Heliopolis Metro	103,025	118,339
Metro	2,006,266	2,060,621
ENR Train	48,823	77,948
Animal Drawn	7,399	7,757
Other	25,038	42,603
TOTAL	20,970,291	25,056,305

Source: JICA Study Team

The average length of any trip is presented in Table 1.2.4 by all modes. The average trip length across all modes is 8.2 km. If a person is making a walk trip, this is on average a shorter trip with the overall average of 2.7 km. as many walk trips are intra zonal trips (70%), the effective average trip length is likely even shorter than this. The person who makes a walk trip will not necessarily follow the shortest road distance.

For public transport trips by shared taxi the average trip length is approximately 10 km. which is shorter than the metro trips which are just over 14 km.

Table 1.2.5 Average Linked Trip Length[5] in Kilometers

Mode of Travel	Average Trip Length
Walk	2.7
Bicycle	6.4
Motorcycle	9.0
Car Driver	10.7
Car Passenger	8.2
Pickup for Passenger	10.6
Taxi	6.7
Shared Taxi	10.1
Public Minibus	9.2
Public Bus	10.1
Public Bus A/C	21.3
Co-Op Minibus	11.4
Work Car	14.3
Work Bus	18.4
School Bus	7.3
Truck	9.1
Nile Ferry	14.1
Tram	8.1
Heliopolis Metro	8.3
Metro	14.4
ENR Train	25.1
Animal Drawn	4.3
Other	8.8
Average	8.2

Source: JICA Study Team

1.3 CREATS TRANSPORT MODEL

The foundation of the CREATS Transport Model developed during Phase I is the CREATS database and the Home Interview Survey. The results from this survey are discussed in the previous section. In addition the following surveys were utilized in the model development:

- Roadside Interview and Traffic Counting Surveys;

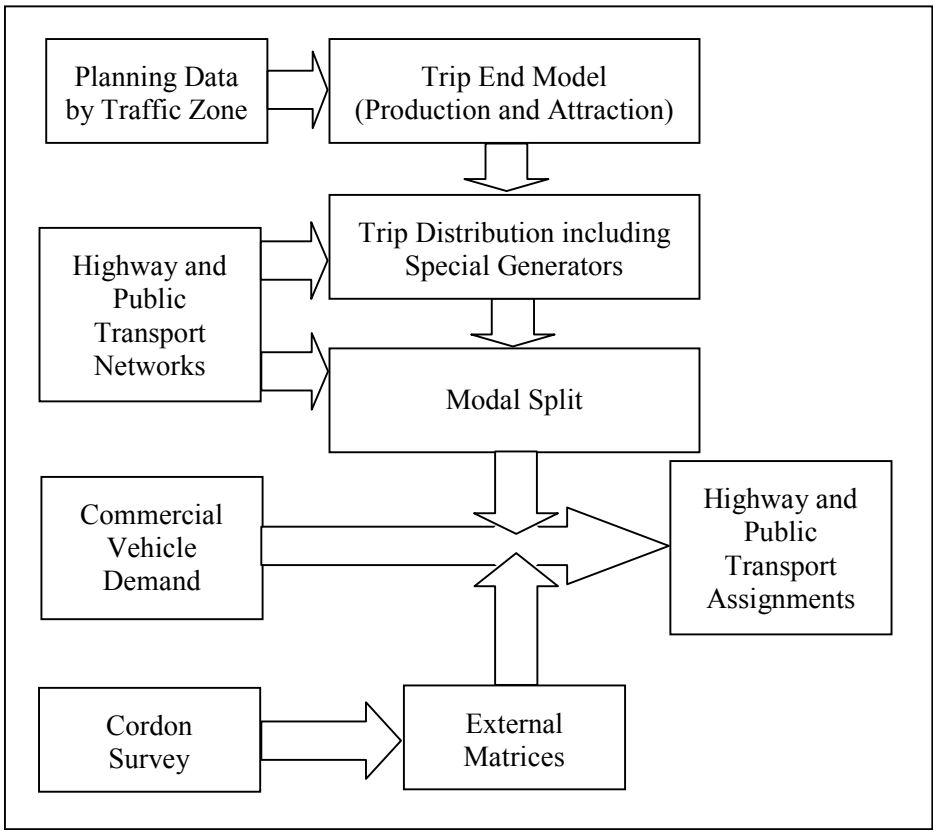
[5] The travel distance is estimated from the transport road network for every possible combination of origin and destination internal to the Study Area.

- Public Transport Passenger Survey;
- Freight Vehicle Survey;
- Road Condition Survey: and
- Transport Network Survey.

The framework of the transport model is shown in Figure 1.3.1. This model was developed for amongst other reasons to provide a good technical tool for the evaluation of strategic network infrastructure projects in the CREATS Study Area.

The model structure follows the conventional 4-stage approach which has been well-tried and found to be effective in many cities of the world. The four stage approach consists basically of a series of nested and cascading sub-models:

- Trip End Models - Estimating the "amount" of travel and where it begins and finishes;



Source: JICA Study Team

Figure 1.3.1 CREATS Transport Model Framework

- Trip Distribution - Linking the trip ends together to form trips between the origins and destinations;
- Modal Split - Accessing the modal shares of the available travel modes for trips between a specified origin and destination; and

- Assignment - Usage of each segment of the highway and public transport networks. In this module the trips using a particular mode are assigned to the highway and public transport network.

The main thrust of the model is targeted at the representation of the travel demand of the residents of the Greater Cairo Region, and their usage of private and public transport. Goods vehicles and the external travel which crosses the boundary of the study area (external travel) are "added-in" prior to the traffic assignment.

Estimates of goods vehicle traffic were derived from the survey data adjusted to reflect the observed travel patterns obtained from the traffic counts undertaken at many locations throughout the city. The forecasts of future goods vehicle traffic has been based on general growth and the employment distribution within the Study Area.

The external travel is derived in the base year from the cordon of roadside interview stations. This survey was executed at 24 locations along the periphery of the Study Area boundary.

A major input into all phases of the transport model is the network. The network is developed in two parts describing the road network and the public transport network. The road network for the base year contains some 4000 links whilst the public transport detail includes the description of 550 bus routes as well as over 500 shared taxi routes.

The traffic assignment is undertaken as part of the final validation process. Due to the problems of identification of individual vehicle types in the vehicle traffic assignment it is not possible to make a clear comparison of traffic counts and vehicles by individual vehicle types. For this reason a comparison is made across all vehicle types in the form of passenger car units or pcu's across the external and river screenline as shown in Figure 1.3.2.

In addition a comparison between the observed and individual traffic counts at over 100 observed sites. This comparison between observed traffic count and estimated traffic flows at individual sites is done via the Mean Absolute Difference (MAD) Ratio.[6] For daily traffic counts with a value in excess of 10,000 the value of the MAD ratio is 0.34 which is considered to reflect a good calibration. By all indications the assignment has accurately replicated the base year.

The analysis of public transport within the Study Area indicated that there were approximately 13 million passenger boardings daily within the Study Area as shown in Table 1.3.1. The estimate from the CREATS Transport Model was 13.3 million, a difference of only 2%. This is a good result from the public transport assignment. A comparison by major modal class showed a difference in estimate

[6] MAD Ratio is defined by the following formula: MAD Ratio = $\sum \left| \frac{Count - Assignment}{Assignment} \right| / n$ where n is the number of observations.

of CTA Bus passengers including GCBC of 4%, of Metro passengers of 2% and of Shared Taxi of 1%. Overall this demonstrates that the model is predicting accurately the total number public transport passengers and the distribution by the different public transport modes.

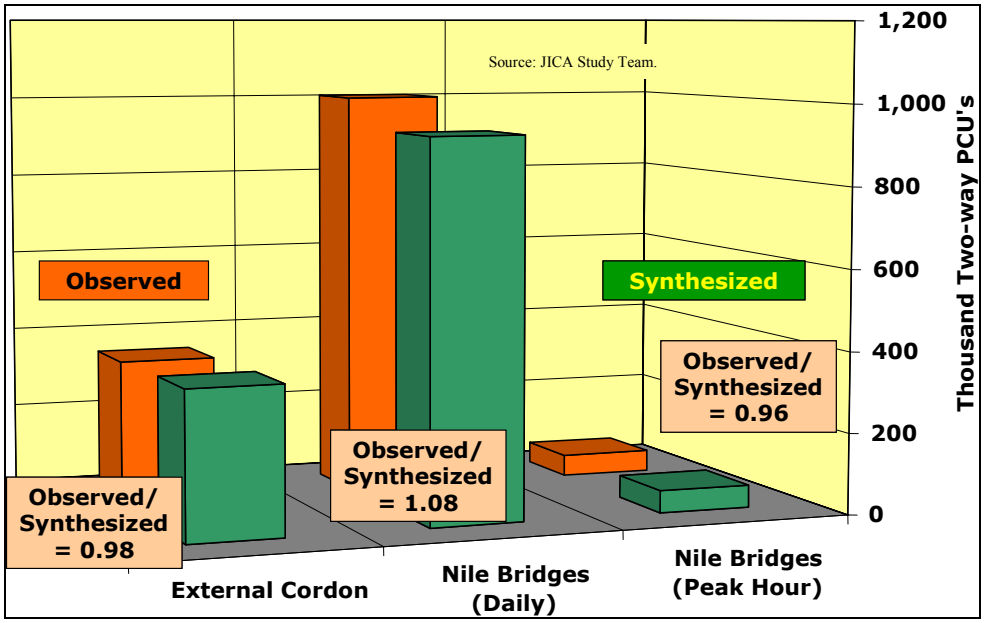


Figure 1.3.2 Cordon Comparison between Observed and Estimated Traffic

Table 1.3.1 Comparison of Synthesized Daily Public Transport Passengers

Public Transport Mode	Model/Synthesized Result (Million Boardings)	Observed Result (Million Boardings)
CTA-Bus	2.963	2.852
CTA-Air Conditioned Bus	0.141	
GCBC Bus	0.681	0.597
CTA Mini Bus	0.512	0.516
Ferry	0.10	0.012
Tram	0.056	0.057
Heliopolis Metro (Tram)	0.115	0.118
Metro	2.034	2.084
Train[7]	0.134	0.200
Shared Taxi	6.608	6.508
Co-op Mini Bus	0.073	0.126

Source: JICA Study Team

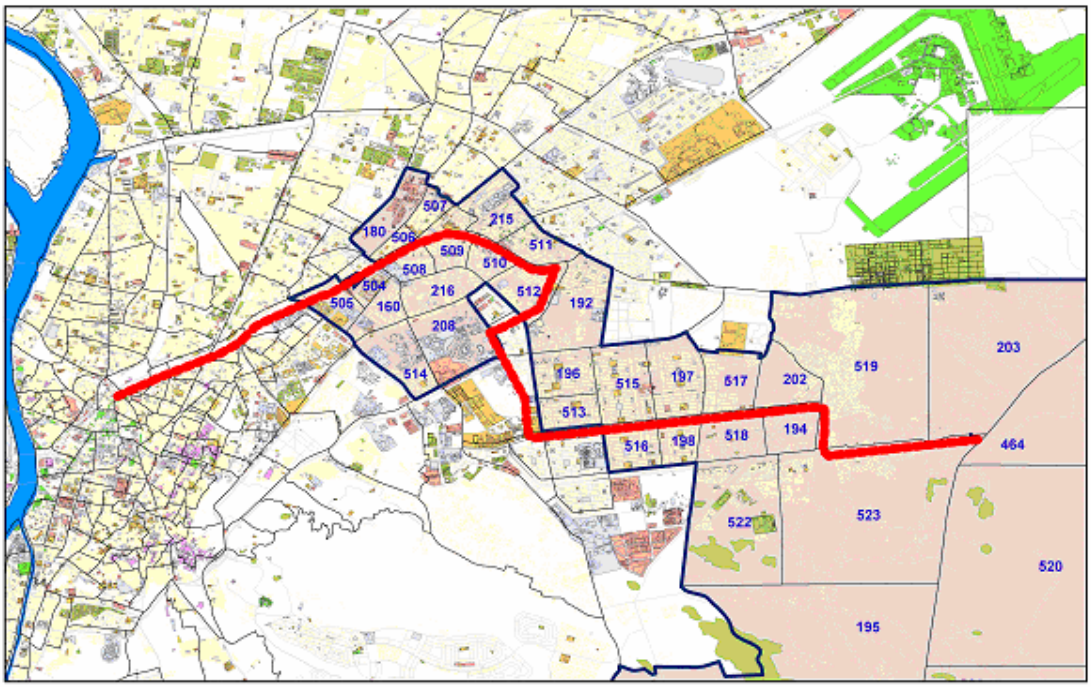
[7] Train passengers are persons traveling on suburban services of the ENR.

1.4 MODIFIED TRAFFIC ZONES

It is a standard requirement of any transport model to have a set of spatial data units, known as traffic zones, which apply to the model study area. They should be designed to classify data at the most appropriate level of detail for the transport model development.

The model Study Area for this transport model comprises in part the Governorates of Cairo, Giza, Qalyobeya and Sharqeya. In the existing model developed for the Master Plan there were a total of 503 traffic zones, 464 internal traffic zones, 10 special generators, 19 external stations and 10 zones reserved for future development.

In the analysis for the Feasibility Study the overall number of traffic zones is increased to 525. Along the route of the Supertram Line 1 an additional 20 zones are added to the network. This enabled the development of smaller traffic zones along the proposed Supertram Line 1 alignment between Ramses and the eastern terminal at the Ring Road. The area of subdivision of the Master Plan traffic zones is shown in Figure 1.4.1. The new zone boundaries are also presented in this figure.



Source: JICA Study Team

Figure 1.4.1 Area of Detailed Zones for Supertram Line 1

Along the western and central portions of the alignment, the traffic zone boundaries were already selected at a sufficient level of detail. There was no need in this case to divide the traffic zones adjacent to the proposed alignment.

The division of traffic zones in proximity to the Supertram alignment ensures that the loading of the Supertram Line 1 is distributed evenly rather than having a spike load to represent several stations. A spike load results from a zone system where the traffic zones are too large for a zone to represent a single station. This subdivision of the larger traffic zones ensures that there is a loading of the Supertram at individual stations.

New Cairo which was originally represented as a single zone is now divided into three traffic zones.

In addition a new traffic zone is added as a Special Generator Zone adjacent to New Cairo. This new zone represents the development of a park-and-ride Station at the eastern terminus of the Supertram Line 1 adjacent to the Ring Road.

In the east and the west of the city are the 'Wings' projects. In these two cases the division of traffic zones along the alignment of the two wings projects has resulted in the addition of 8 new traffic zones with 4 zones in the west and 4 in the east. Some of the additional traffic zones are the result of the splitting of the two new towns, 6th of October and the 10th of Ramadan into a total of 6 zones.

In addition to the subdivision of the new towns, proposed new development centers have been included along the alignment. In the earlier Master Plan study these development centers were incorporated in the transport model as special generator zones because there was insufficient information available to estimate the characteristics of the development. The area of division is shown in Figure 1.4.2 for 6th of October and Figure 1.4.3 for 10th of Ramadan.

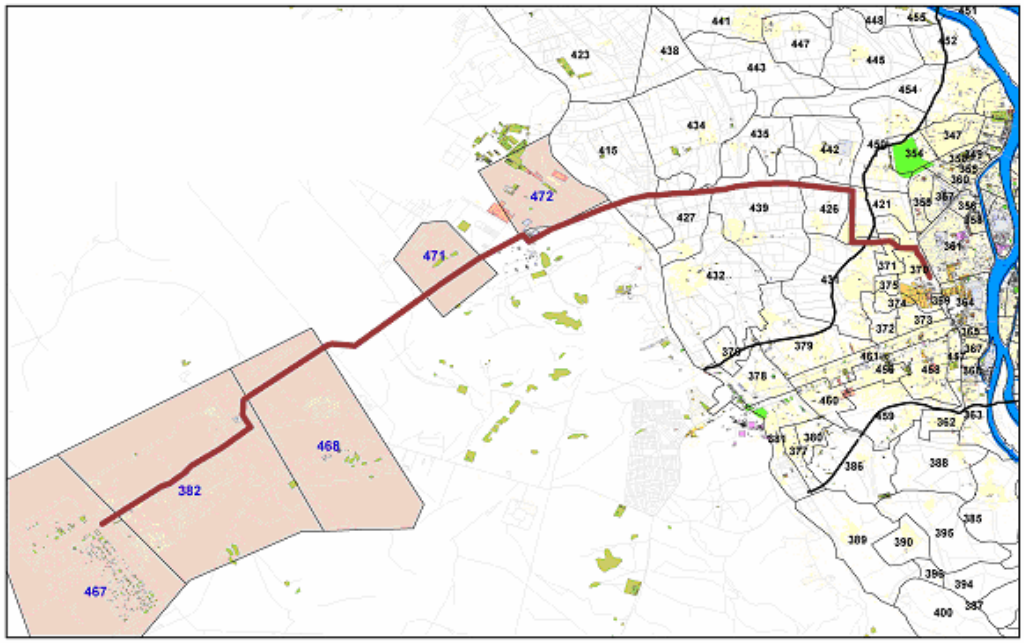
The other new traffic zones in the west are:

- Abu Rawwash West; and
- Abu Rawwash East.

The other new traffic zones in the east are:

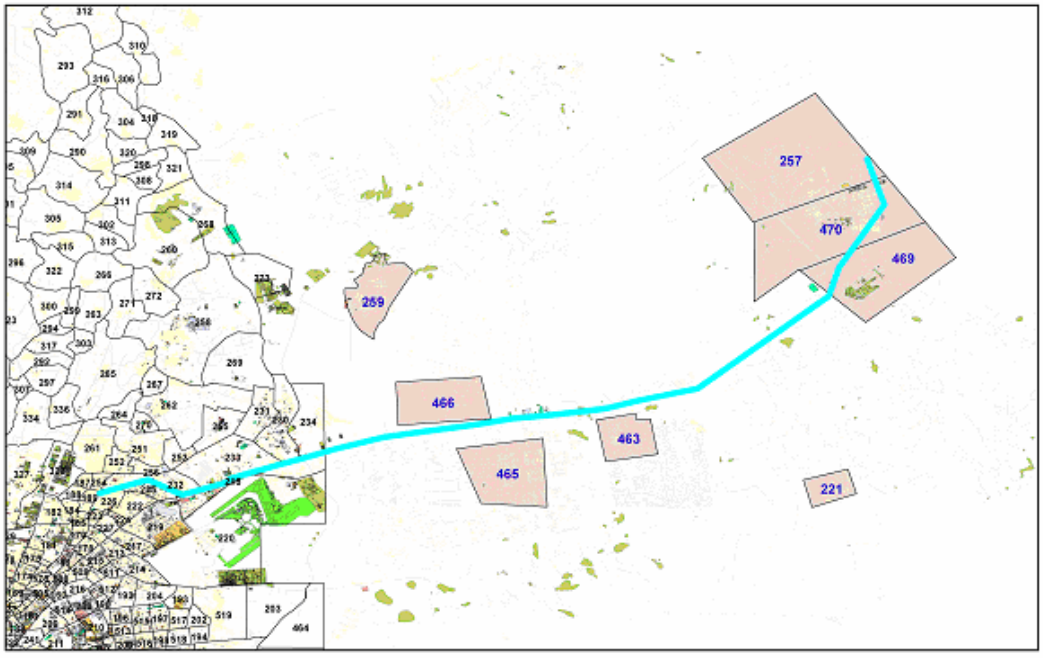
- Oboor Market; and
- Haykstep.

Within the new 525 zone system there are now only three spare traffic zones namely zones 473, 524 and 525.



Source: JICA Study Team

Figure 1.4.2 Area of Detailed Zones for West Wing



Source: JICA Study Team

Figure 1.4.3 Area of Detailed Zones for East Wing

1.5 REVISED SOCIO ECONOMIC FRAMEWORK

1.5.1 Introduction

In the case of Supertram Line 1, the traffic zones along the alignment and in the immediate vicinity of the eastern alignment were split into two or more traffic zones. This required the development of new planning data for the smaller traffic zones.

For the Wings, it was considered necessary to refine some of the new town zones. This refinement was undertaken for the 6th of October, 10th of Ramadan and Oboor. In addition to the above, further zones have been included to take account of known or planned development.

These developments are Haykstep, the military residential area to the south of the road between the city of Cairo and the 10th of Ramadan, and a proposed residential development (low density, higher priced housing) adjacent to the eastern edge of the 6th of October. The latter development is currently known as the 'New developments around the Cairo-Alexandria Desert Road'.

Site visits to the proposed alignment of the West Wing project, have also confirmed the existence of an additional residential settlement, situated to the north of the Cairo – Alexandria desert road and immediately to the west of zone 415, and this is discussed in further detail in the following sections.

1.5.2 Supertram Line 1

The planning data for the revised zones along the eastern alignment of Supertram Line 1 were derived from the larger zones using spatial area as the parameter for allocation of socio economic data from the larger to the smaller zones. . The final number of zones along the catchment of Supertram Line 1 is presented in Table 1.5.1. A new traffic zone was created south of the Ring Road Terminal of Supertram Line 1. This traffic zone was considered to have similar socio economic characteristics of Manteqa El Aashra and a population of 20,000 people in 2022.

These traffic zones along the eastern alignment (as defined in Table 1.5.1) represented a population of 460,000 people in 2001 increasing to 700,000 people in 2012 and then to 1,1700,00 people in 2022. This is an increase of 4.5 % per annum between 2001 and 2022. The significant growth in population is the addition of 470,000 people into this region between 2012 and 2022. It is estimated that 90% of this growth in population will occur in New Cairo.

In this same area the total employment will increase from 255,000 to 435,000 between 2001 and 2022. This is only an increase of 2.6% per annum. The total number of employment in New Cairo in 2022 is estimated at only 15,000. In general the employment in this section of East Cairo is not increasing at the same rate as the population.

The average household income[8] of this part of East Cairo will increase by 40% between 2001 and 2022 from 1,327 LE per month in 2001 to 1,840 LE per month in 2022. For the whole of the Study area the average household income is expected to increase by 75%. This reflects the fact that the increase in household income in the subdivided zones is less than the overall average. However the average household income for this section of East Cairo is still significantly higher than the overall Study Area average of 1,200 LE in 2022.

Table 1.5.1 Traffic Zones along Catchment of Supertram Line 1

Zone Name	Original Zone Number	Number of Zones within Original Zone
Zaafarany	160	3
Zaytoon El Qebleya	180	3
Golf	192	2
Manteqa El Aashra	194	2
Hay El Aasher	195	3
Manteqa El Ola	196	2
Manteqa El Sadsa	197	2
Manteqa El Thamna	198	2
Sharq El Manteqa El Sadsa	202	2
Ezbet El Haggana	203	2
Estad	208	2
Montazah	215	2
Mansheyet El Bakry	216	4
New Cairo	464	3

Source: JICA Study Team

1.5.3 West Wing

The 6th of October is split into two residential zones, 6th of October West and 6th of October East (zones 382 and 468 respectively) and an industrial zone (zone 467). Zone 468, the eastern zone includes the Sheikh Zayed development. In geographical terms, zone 382 covers approximately 40% of the area of the two residential zones, with zone 468 taking the remainder. However, little development has taken place in Sheikh Zayed to date. Accordingly, residential

[8] The basic planning data quoted in this report including household income was estimated during *Phase 1 Final Report - Transportation Master Plan and Feasibility Study of Urban Transport Projects in Greater Cairo Region in the Arab Republic of Egypt*, *Volume III (Transport Master Plan)*, prepared for the Japan International Cooperation Agency and the Higher Committee for Greater Cairo Transportation Planning, by Pacific Consultants International, et. al., November 2002. Iit is discussed in detail in Chapter 2.

development is assumed to be currently 90:10 for the West and East zones respectively.

However, it is anticipated that the proportions will be more equitable over time, leading to a 40:60 split by the study forecast year of 2022. Primary agricultural production is being developed on the perimeter of the 6th of October city and is thus equally split over the three zones. Secondary industrial activity is entirely located within zone 467. At present, the majority of tertiary industrial activity is carried out within 6th October West. For future projections, it is assumed that tertiary industrial activity is split 70:30 between zones 382 and 468 respectively

In 2001, the 6th of October including Sheikh Zayed, had a population estimated at 200,000 people. This was estimated to increase to 320,000 people in 2007. By 2012 the population is estimated at 512,000 and then is expected to increase to 1,170,000 people by 2022. This is an increase of 8.8 % per annum between 2001 and 2022.

In this same location the total employment is projected to increase from 132,000 to 385,000 between 2001 and 2022. This is only an increase of 5.2% per annum. The total employment is not expected to increase at the same rate as the population. This fact is likely to encourage interaction between this new city and Cairo thus increasing the number of trips between this new city and Cairo.

The average household income of the 6th of October increases by 110% between 2001 and 2022 from 870 LE per month in 2001 to 1,520 per month in 2022. For the whole of the Study area the average household income is expected to increase by 75%.

Regarding the development known as the 'New developments around the Cairo-Alexandria desert road' (new zone number 471), a Masterplan has already been finalized for this development and between 55,000 and 82,000 inhabitants are targeted to be living in this area, with a population density of 20-30 persons per Feddan. As stated above, the development is to be low density and higher priced. Given the preliminary nature of this data, the characteristics that are found in other similar zones, with higher income households, are adopted in the projection of the socio economic data.

In this case, a comparison could be made with the Heliopolis area, Qism 128 where household incomes are in the region of 1,150 to 1,650 LE per month. For the new development, it was thus decided to adopt an average household income of 1,200 LE as a base year (for the year 2001). Very small levels of industrial activity are assumed, mainly tertiary activities. Given that no development has taken place to date, it is unlikely that the target population will be reached by the year 2022 and, therefore, a population of 30,000 has been assumed.

Regarding the identified residential area to the west of Abu Rawwash (zone 415), zone number 472 has been allocated to this existing development. This zone is assumed to have the same characteristics as the adjacent zone 415.

1.5.4 East Wing

The 10th of Ramadan is split into three zones, two residential, North and South and one industrial, zone numbers 257, 470 and 469 respectively. The residential zones are located to the north of the road linking Cairo and Ismailia. The zones are split by area with 65% of residents allocated to zone 257 and 35% to zone 470. The main industrial zone is located to the south of Cairo - Ismailia road. It is assumed that the residential area contains all inhabitants of the city and tertiary industrial activities. In addition to this, some secondary industrial activity is located in the residential zones. An assumed figure of 20% of secondary industrial activity is estimated to be included in the residential zones, with similar proportions allocated for primary industrial activity. The industrial zone includes the remainder of the primary and secondary industrial activity.

In 2001, the 10th of Ramadan population is estimated at 196,000 people increasing to 278,000 people in 2007. By 2012 the population is estimated at 378,000 and then increasing to 576,000 people by 2022. This is an increase of 5.2 % per annum between 2001 and 2022.

In this same city the total employment will increase from 155,000 to 322,000 between 2001 and 2022. This is only an increase of 3.5% per annum. The total number of employment is not planned to increase at the same rate as the population. This fact is likely to encourage interaction between this new city and Cairo thus increasing the number of trips between the new city and Cairo.

The average household income of this part of the 10th of Ramadan will increase by 60% between 2001 and 2022 from 620 LE per month in 2001 to 970 LE per month in 2022. For the whole of the Study area the average household income is expected to increase by 75%.

Oboor has been split into two zones (zone numbers 259 and 466 respectively). As with 10th of Ramadan, zone 259 will contain mainly residents and some primary industrial activity (assumed to be 80% of existing levels). Secondary industrial activity has also been allocated to zone 466. Zone 466 contains the Oboor market. In the absence of a detailed survey, tertiary industrial activity is split 50:50 between the two zones.

Information on the development of Haykstep (new zone number 465) is limited, due to the sensitivities surrounding the development of military complexes. It is believed that private non-military owners can purchase properties within this development and that there are approximately 20,000 inhabitants living there at this present time. The limit of residential development for Haykstep is believed to be 100,000 inhabitants.

Under the medium economic growth scenario assumed in the Master Plan, the population of the new communities is estimated to be exactly 70% of the target population. Using the same assumptions, the estimated population for Haykstep would be 70,000 inhabitants by the year 2022. It is assumed that very little secondary industry would take place within the community. In order to make a

reasonable estimate of household incomes, some assessment must be made regarding the salaries of military personnel.

In general, it is recognized that these are quite low with implicit subsidies made in the form of cheaper accommodation and other allowances. Household incomes, in other residential new communities varied from 352 LE in Badr up to 874 in the 6th of October, in the year 2001. The lower household income data for Badr is adopted for Haysktep. In a similar manner, the proportion of the population involved for both primary and tertiary industrial activities is assumed to be the same as in the case of Badr. Very low incidences of secondary industrial activity are assumed.

By 2022 it is expected the total population of these communities including Shorooq, Oboor and Badr City along the proposed infrastructure route east of the Ring road will increase to 1,446,000 from today's population of 271,000 a growth of 8.3% per annum. This population distribution by locality is shown in Table 1.5.2 In this table the population of Haysktep in 2001 is included with the estimate of Oboor

Table 1.5.2 Population Distribution for East Wing

Locality	Population in 2001	Population in 2022
10th of Ramadan	196,000	576,000
Badr City	32,000	200,000
Shorooq	42,000	300,000
Oboor	1,200	300,000
Haysktep	-	70,000
Total	**271,200**	**1,446,000**

Source: JICA Study Team

The total population of 1.4 million people in the year 2022 within the development corridor of the East Wing is similar to the estimated population of 1.2 million for the 6th of October and adjacent development for the West Wing in the same year.

1.5.5 Summary of New Town Development

In summarizing the development of the major new towns associated with the three infrastructure projects, the population growth rate is high with respect to the overall study growth rate in population of less than 2% per annum.

For Supertram Line 1 the associated new city is New Cairo, the population growth rate here is 8.6 % per annum. For the West Wing, the associated new city is the 6th of October, the population growth rate is 8.8% per annum. In the case of the East Wing and the associated city of the 10th of Ramadan, the population growth rate is

6.4% per annum. However in the West Wing, there are other new cities such as Oboor as shown in Table 1.5.2. The estimated population in the three mentioned new towns between 2001 and 2022 is presented in Table 1.5.3.

Table 1.5.3 Population of the New Towns

Year	New Cairo (Includes Qattameya)	6th October	10th Ramadan (Includes Shorooq)
2001	132,200	200,000	238,000
2007	210,400	332,000	328,900
2012	320,800	512,300	485,400
2022	753,000	1,165,400	876,000

Source: JICA Study Team

These population projections are important inputs into the transport demand forecasts presented later in this Attachment. Another important input to the demand forecasts is the changing level of household income. In the case of the traffic zone adjacent to the eastern alignment of Supertram Line 1 including New Cairo, the average household income is estimated at 1,840 LE per month in 2022. In the West Wing, the average household income of the 6th October is estimated at 1,520 LE per month whilst in the East Wing the average household income of the 10th Ramadan including Shorooq is estimated at 1,050 LE per month. The overall Study Area average estimate of household income in 2022 is 1,200 LE per month

1.6 REVISED MODEL PARAMETERS

In this Phase II study, the public transport assignment is an integral part of the feasibility analysis. It is important to review the critical variables in the public transport assignment procedure.

The public transport network assignment is complex due to the number of factors which have to be considered when examining the optimal modal path. These include:

- The in-vehicle time;
- Waiting time (a function of headway);
- Decision on waiting for faster infrequent service or travelling via a slower frequent service;
- The inconvenience of transferring between public transport services;
- The different travel cost of a service, difference between modes;
- Mode comfort factor or Run Time Factor;
- Walk time to alternative services; and
- Which fast service stops closest to the final destination.

A range of parameters are available to control the path building process, including:

- Mode specific in-vehicle time weighting factors or Run Time Factor;
- Mode specific waiting time weighting factors;
- Mode specific boarding penalties; and
- Mode Specific Value of Time.

These parameters are presented in Table 1.6.1 for the major modes. All parameters were derived during the calibration of the public transport assignment with the exception of the Value of Time which was derived from the Home Interview Survey. The value of time in the year 2022 as specified in this table has been increased from the base year in accordance with economic growth. This value, however is still estimated in units of 2001 LE. The values estimated for the future for Supertram Line 1 and the Wings system fall between the existing technologies of Tram, Metro and Bus. The Run Time Factor which is a measure of the level of comfort is the same for the Wings and Supertram Line 1. (A higher Run Time Factor reflects a lower level of comfort).

Table 1.6.1 Mode Specific Parameters

Mode	Wait Time Factor	Run Time Factor	Boarding Penalty (Equivalent Minutes)	Value of Time in 2022 (Piaster per Hour)
Bus	0.8-2.0	0.7-1.2	5-20	225-535
Tram	1.0	0.6	5	150
Metro	0.3	0.7	5	220
Shared Taxi	1.0	1.0	10	190
Supertram	0.8	0.7	5	220
Wings System	0.3	0.7	5	375

Source: JICA Study Team

In the case of where there are two or more public transport routes available for a trip, the probability of choosing a route, P_i is given by the following formula:

$$P_i = \frac{e^{-SF(TD_i - ETD)}}{1 + e^{-SF(TD_i - ETD)}} \quad \text{....Equation A.1}$$

where TD_i is the time using Service i. , ETD_i is the average time of using all available services and SF is a scale factor whose value is set to 0.005. This is the procedure that was developed during the model calibration.

1.7 INITIAL SCREENING AND PROJECT DESCRIPTION

1.7.1 Overview

In the initial screening analysis several options of alignment and technology were reviewed to produce the recommended alignment and technology. These different options and the project description are described in this section of the attachment.

1.7.2 Supertram Line 1

The alignment of Supertram Line 1 together with its proposed stations is shown in Figure 1.7.1. For the initial screening analysis of Supertram Line 1 two options were investigated namely:

- Option 1 ~ Full Segregation; and
- Option 2 ~ Partial Segregation.

Option 1 is a fully segregated LRT system. This implies that there are few at grade intersection with the adjacent road network. Whereas for Option 2, there will be a limited number of at grade intersections. These differences are reflected in a different set of operating conditions for each option. These are presented in Table 1.7.1.

Table 1.7.1 Operational Characteristics of Supertram Line 1

Operational Characteristic	Option 1	Option 2
Average Speed (kph)	32	28
Headway (Min)	3	4

Source: JICA Study Team

In the implementation, all other remaining tram routes will terminate at the alignment of Supertram Line 1. The proposed fare structure for Supertram Line 1 is a flat fare. The fare used in the patronage estimation for Supertram Line 1 in 2007 is 63 Pt increasing to 100Pt in 2022. The fare was chosen to maximize revenue. The choice of fare is discussed in further detail elsewhere in the main report of Program B.

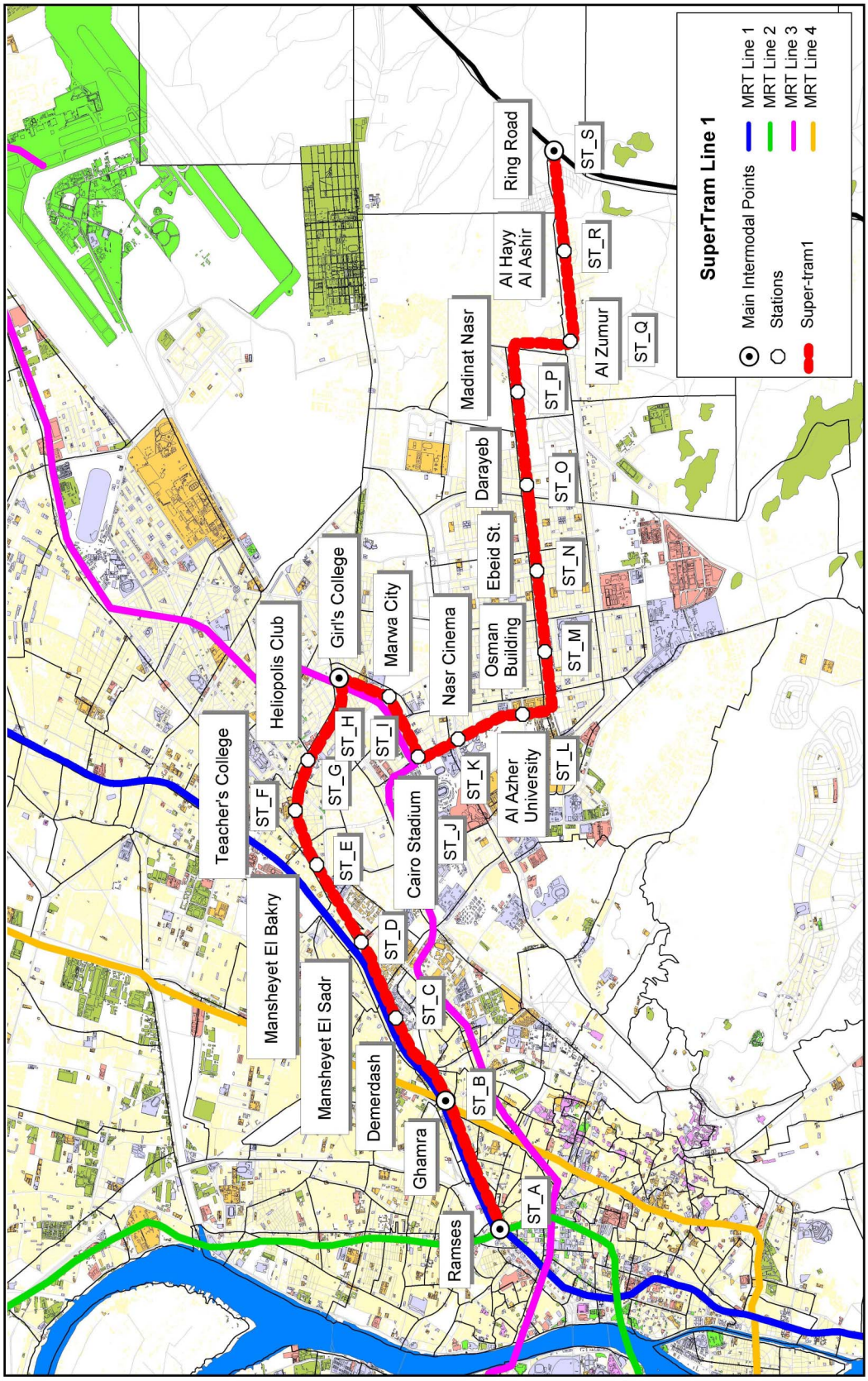


Figure 1.7.1 Supertram Line 1 Alignment and Station Locations

Source: JICA Study Team

The increase in fare between 2007 and 2022 is proportional to the average increase in Household Income within the Study Area during the same time frame.

For many reasons discussed elsewhere of which the transport demand forecast was but only one reason, the first option was chosen for full evaluation in this Feasibility Study.

1.7.3 West Wing

The final alignment of the West Wing together with its proposed stations is shown in Figure 1.7.2. The operational characteristics of the West Wing project are presented in Table 1.7.2. Initially in 2007 the proposed service will operate with 9 minute headways, decreasing to 2.5 minute in 2012 and finally to 2 minutes in 2022.

The West Wing is in fact a busway that links the development centers of the 6th of October with Giza and hence central Cairo. Three alignment options were reviewed during the initial screening. These alignments were as follows:

- Option 1 ~ 6th October City to Imbaba Station on Metro Line 3;
- Option 2 ~ 6th October City to the Ring Road with an extension from Metro Line 3 to the Ring Road; and
- Option 3 ~ 6th October City to Cairo University Station on Metro Line 2.

Option 3 was chosen as the route for the detailed Feasibility Study. The reasons to support this choice are documented in the main report of Program A.

The fare structure for the West Wing is a distance based fare. The fare used in the patronage estimation in 2007 is a Boarding Fare of 63 Pt plus a distance fare of 2.8 Pt per km. This increases to a Boarding Fare of 100 Pt plus a distance fare of 5 Pt per km in 2022. This increase is proportional to the average increase in Household Income within the Study Area between 2007 and 2022.

Table 1.7.2 Operational Characteristics of West Wing

Operational Characteristic	West Wing
Average Speed (kph)	40
Headway (Min)	2-9

Source: JICA Study Team

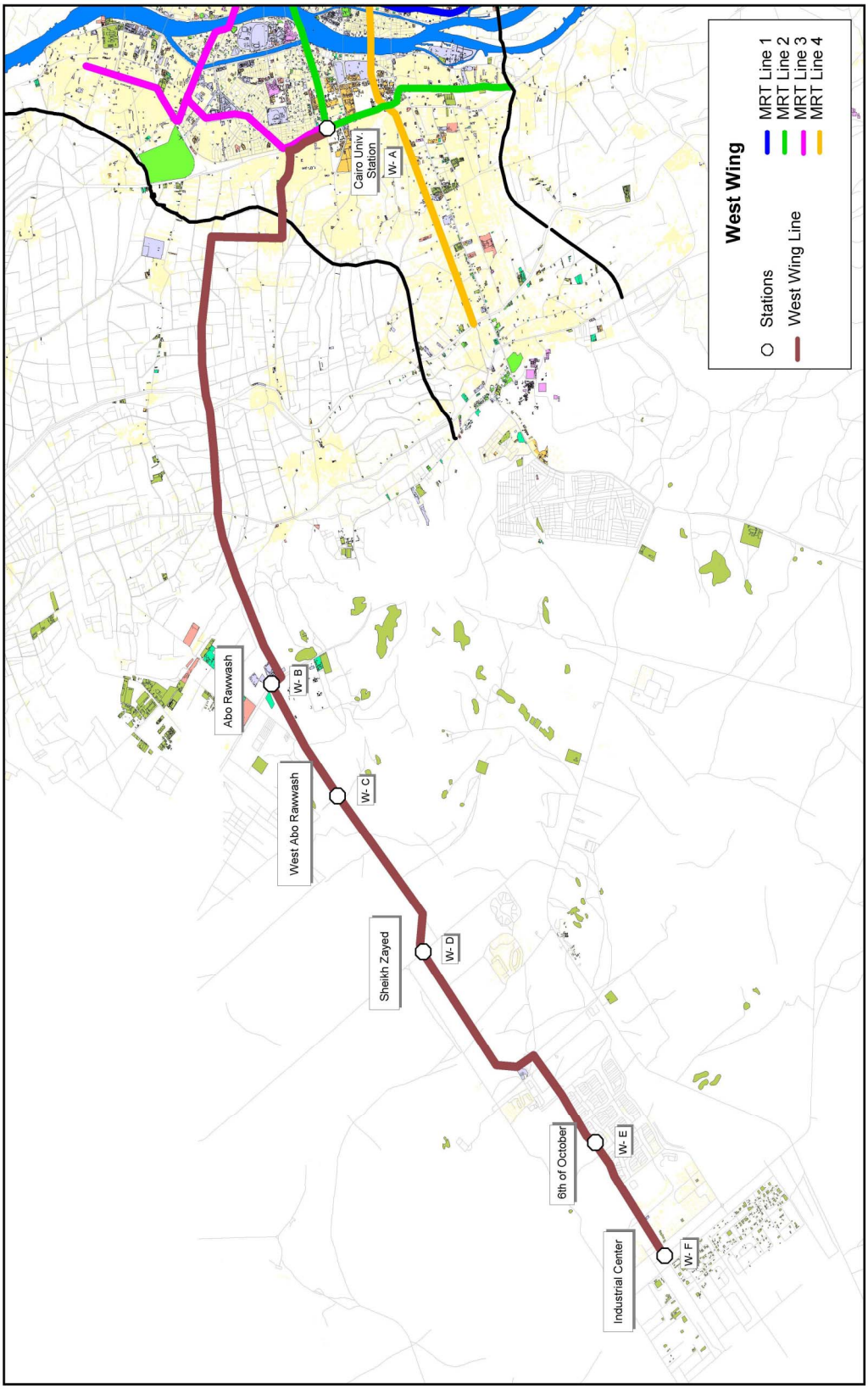


Figure 1.7.2 West Wing Alignment and Station Locations

Source: JICA Study Team

1.7.4 East Wing

The final alignment of the East Wing together with its proposed stations is shown in Figure 1.7.3. The intention of the East Wing is to link Ain Shams Station on Metro Line 1 with the new city of the 10th of Ramadan. The operational characteristics of the East Wing project are presented in Table 1.7.3.

In the East Wing six alignment options were considered in the screening procedure namely:

- Option 1 ~ Rail Link from Ain Shams to 10th of Ramadan Bus Terminal;
- Option 2 ~ Rail Link from Ain Shams to 10th of Ramadan Industrial Center;
- Option 3 ~ Rail Link from Ain Shams to Robeiky;
- Option 4 ~ Option 1 plus 3;
- Option 5 ~ Rail Link from Ain Shams to 10th of Ramadan Bus Terminal via Robeiky; and
- Option 6 ~ Busway from 10th of Ramadan Bus Terminal to Ain Shams.

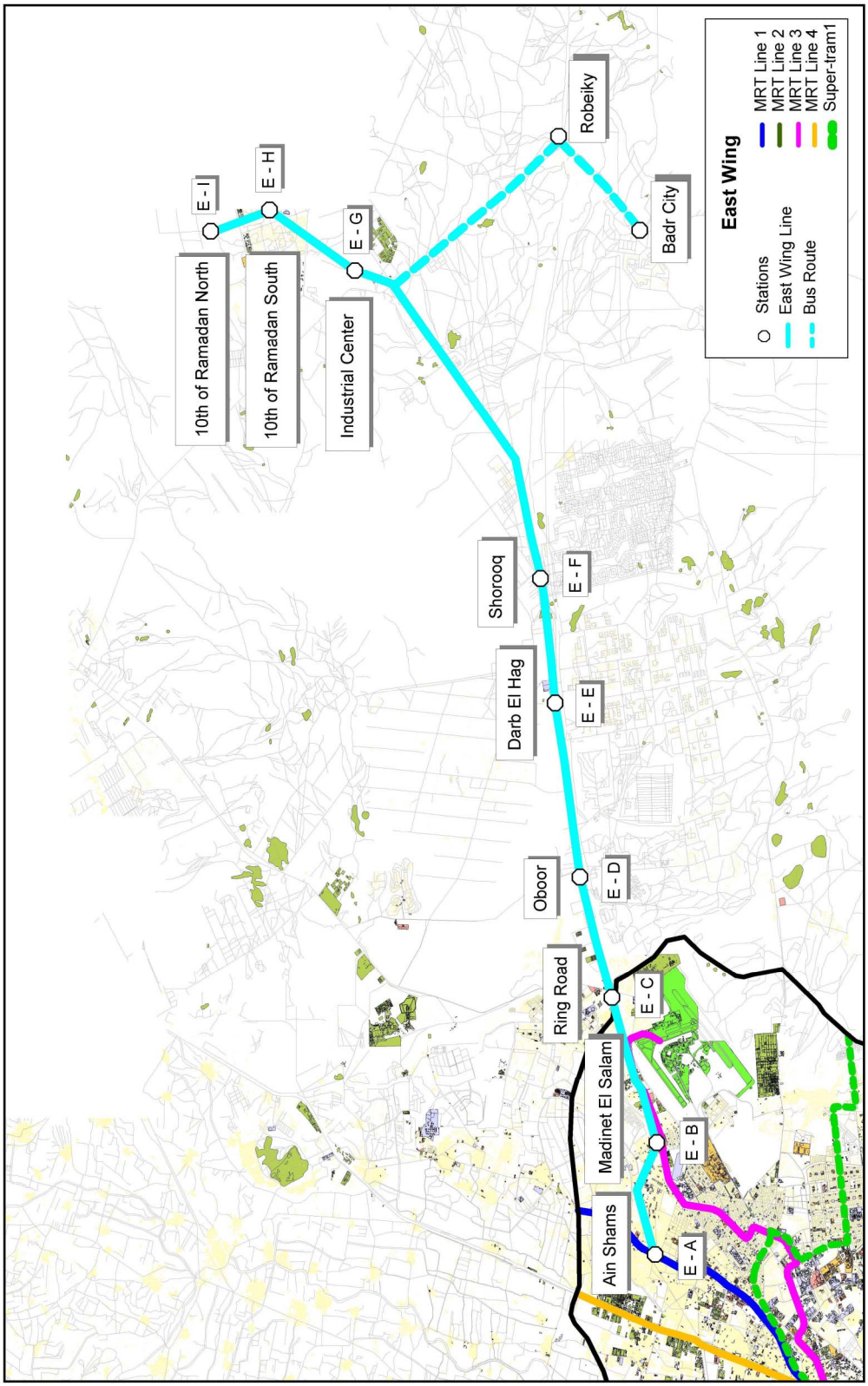
For Option 4, the service has two destinations namely at 10th of Ramadan and Robeiky. In for example 2007, there is a 20 minute headway to both destinations thus achieving an average headway of 10 minutes between Ain Shams and Shorooq.

In the case of Option 6 the average speed in Table 1.7.3 refers to the exclusive busway section between 10th of Ramadan Industrial Center and Ain Shams. Between the Industrial Center and the Ring road it was necessary to reduce the road capacity in order to accommodate the busway.

Table 1.7.3 Operational Characteristics of East Wing

Operational Characteristic	Option 1	Option 2	Option 3	Option 4	Option 5	Option 6
Average Speed (kph)	70	70	70	70	70	40
Headway (Min) in 2007	10	10	10	10	10	10
Headway (Min) in 2012	8.5	8.5	8.5	8.5	8.5	8.5
Headway (Min) in 2022	3.5	3.5	3.5	3.5	3.5	3.5

Source: JICA Study Team



Source: JICA Study Team

Figure 1.7.3 East Wing Alignment and Station Locations

The fare structure for the East Wing is a distance based fare. The fare used in the patronage estimation for in 2007 is a boarding fare of 63 Pt plus a distance fare of 2.8 Pt per km. This increases to a boarding fare of 100 Pt plus a distance fare of 5 Pt per km in 2022. This is the fare structure originally proposed in the Master Plan. The fare increase is similar to the average increase in household income within the Study Area between 2007 and 2022.

Option 1 was chosen as the route for the detailed Feasibility Study. The reasons to support this choice including the transport demand forecasts are documented in the main report of Program A.

1.8 MODEL SCENARIOS

1.8.1 Overview

During the initial screening for the feasibility of the three infrastructure projects, different approaches were adopted in refining the options for the Supertram Line 1 and the Wings. However with the final evaluation of the proposed alignments and technologies for the three projects, a common approach was adopted for this analysis. This section of the Attachment documents the major assumptions associated with this scenario.

1.8.2 Network Assumptions

The network assumptions are basically those recommended in the CREATS Phase I Master Plan. The operational characteristics of the three projects are described in an earlier section. The details of the network assumptions are described in Table 1.8.1.

In the case of shared taxi, the CREATS Master Plan fare assumptions and area licensing are adopted within the Study Area. The Study Area is divided into nine license areas namely:

- Area 1 ~ 6th of October;
- Area 2 ~ Imbaba;
- Area 3 ~ Giza;
- Area 4 ~ Badrasheen;
- Area 5 ~ South Cairo;
- Area 6 ~ Central Cairo;
- Area 7 ~ Qalyobeya
- Area 8 ~ East Cairo; and
- Area 9 ~ 10th of Ramadan.

The role of shared taxi under the Master Plan scenario is thus as a feeder service to other public transport services rather than supplying a line haul service. This is discussed in detail in the reports of the Master Plan.

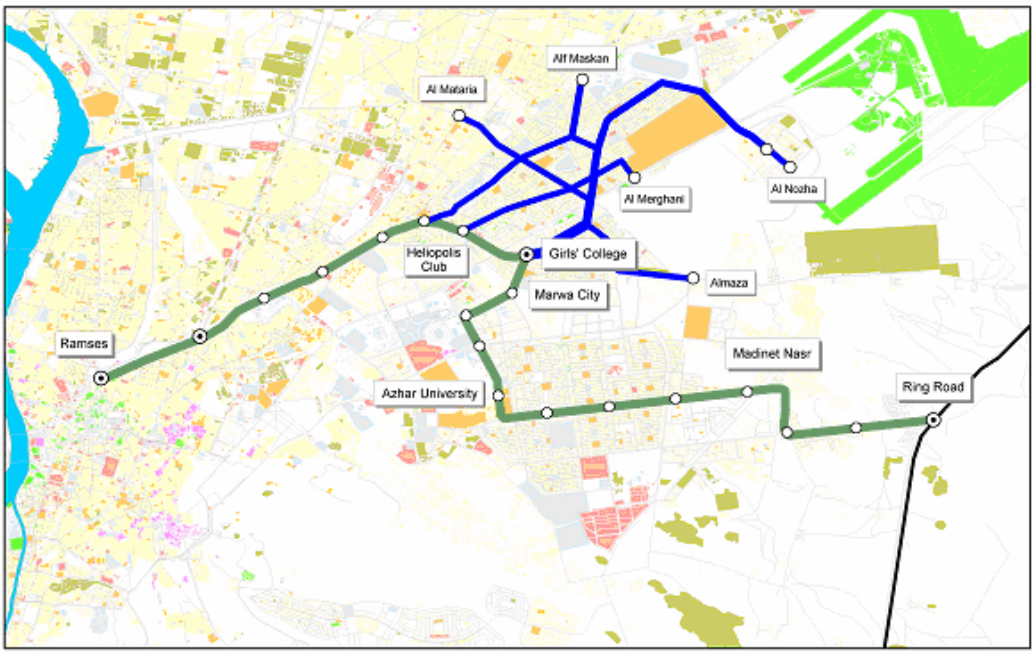
Table 1.8.1 Major Network Assumptions

Mode	Description	Year : 2007	Year : 2012	Year : 2022
Public Transport Network	Bus	Existing plus Modified Routes in East Cairo	Existing plus Modified Routes in East Cairo	Existing plus Modified Routes in East Cairo
	Shared Taxi	Area Licensing	Area Licensing	Area Licensing
	Supertram	Line 1	Line 1	Line 1
	Heliopolis Metro/CTA Tram	Reduced Network	Reduced Network	Reduced Network
	Metro Line 1	Extension to Ring Road	Extension to Ring Road	Extension to Ring Road
	Metro Line 2	Moneeb-Qalyoob	Moneeb-Qalyoob	Moneeb-Qalyoob
	Metro Line 3	Ataba-Abaseya	Extension to Heliopolis	Full Line
	Metro Line 4	-	-	Full Line
	Wings	East and West Wing	East and West Wing	East and West Wing
Road Network	Toll Expressway	-	Partial (Expressway 3 and 4)	Full
	Local Roads	Improvements as Recommended in Master Plan	Improvements as Recommended in Master Plan	Improvements as Recommended in Master Plan

Source: JICA Study Team

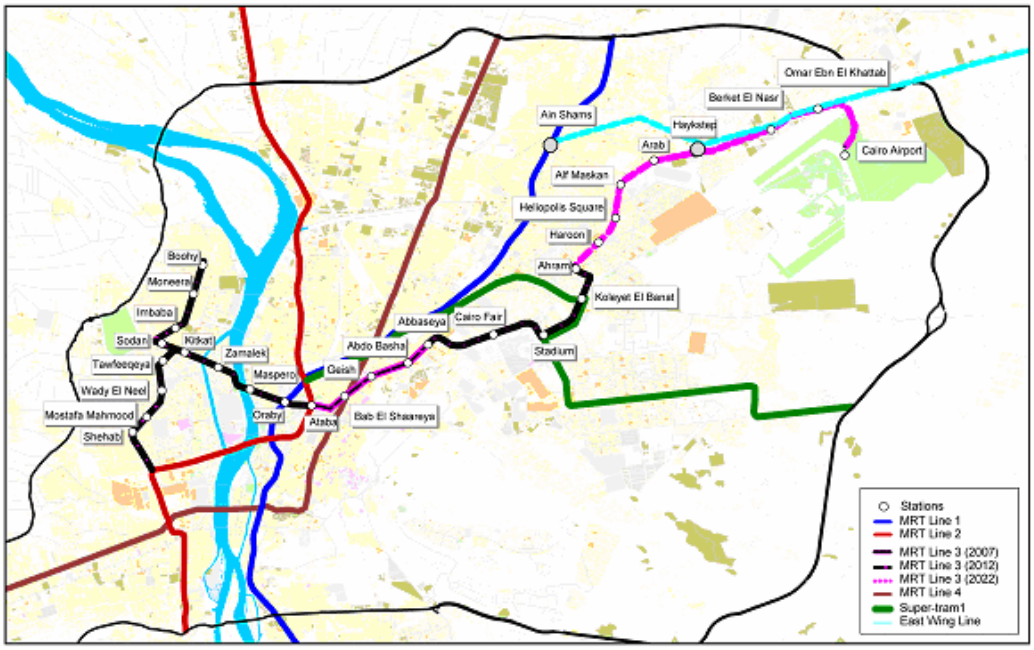
The Heliopolis Metro and CTA Tram network is severed by the construction of Supertram Line 1. The remaining elements of this network are shown in Figure 1.8.1. The staging of Metro Line 3 is as shown in Figure 1.8.2. The staging of the Toll Expressway Network is presented in Figure 1.8.3.

The only significant difference between the Master Plan network and that of the network for Feasibility Analysis is that the existing road based public transport is used for the Feasibility Study analysis rather than that proposed in the Master Plan in 2022.



Source: JICA Study Team

Figure 1.8.1 Supertram Line 1 and Remaining Elements of Heliopolis Metro



Source: JICA Study Team

Figure 1.8.2 Staging of Metro Line 3

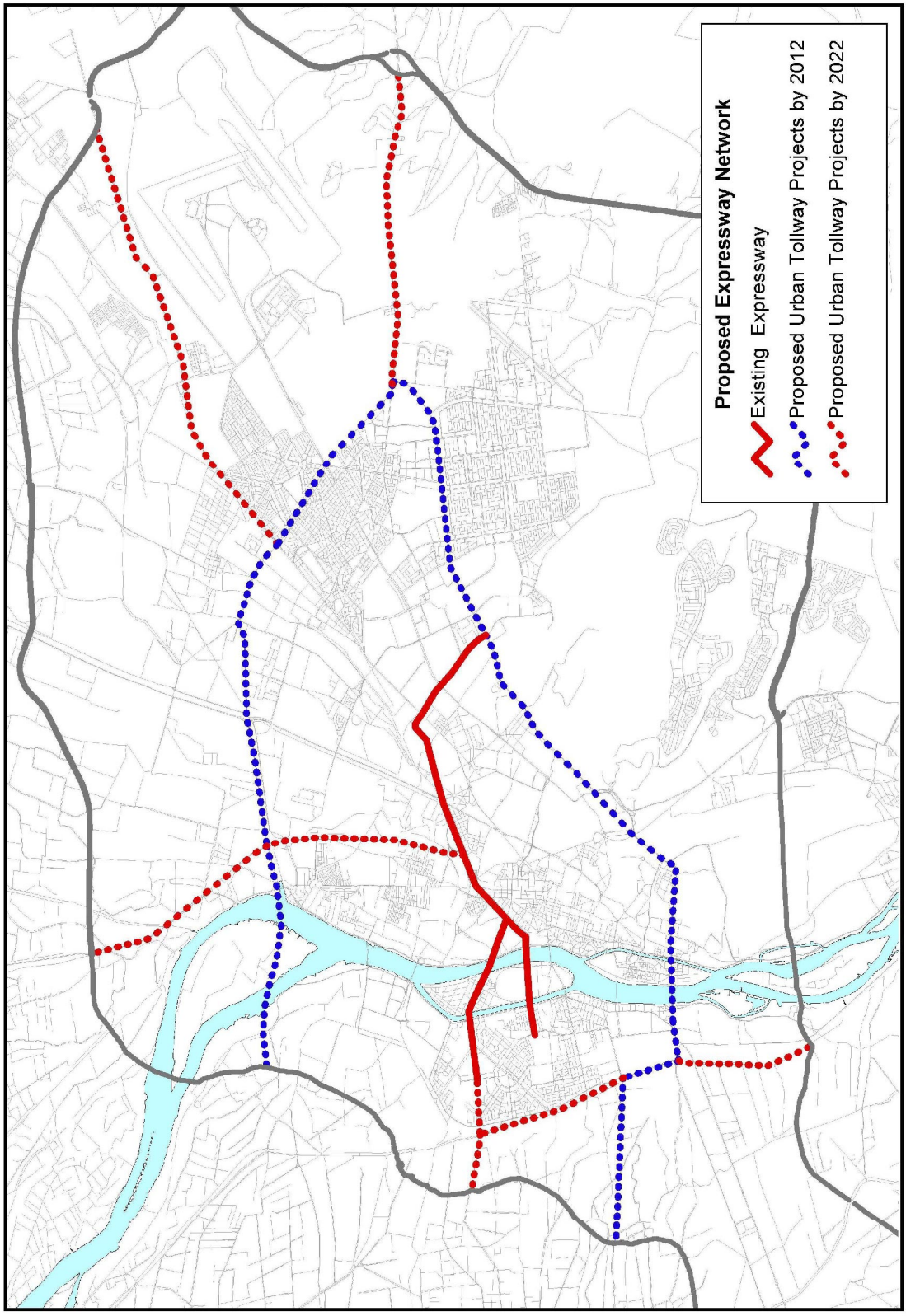


Figure 1.8.3 Urban Expressway Network

Source: JICA Study Team

1.8.3 Model Protocol

In each of the three time horizons developed for the transport model, a full model run including distribution is produced for the base case in each year. The distribution convergence required several runs of the full model. A flowchart describing this process is presented in Figure 1.8.4.

In the convergence process the objective is to minimize the difference between the input and output model statistics such as network travel time and travel distance. As an example the last three iterations of the convergence procedure are tabulated in Table 1.8.2 for the year 2012. The difference in value of the parameters is less than 1% between the last two iterations.

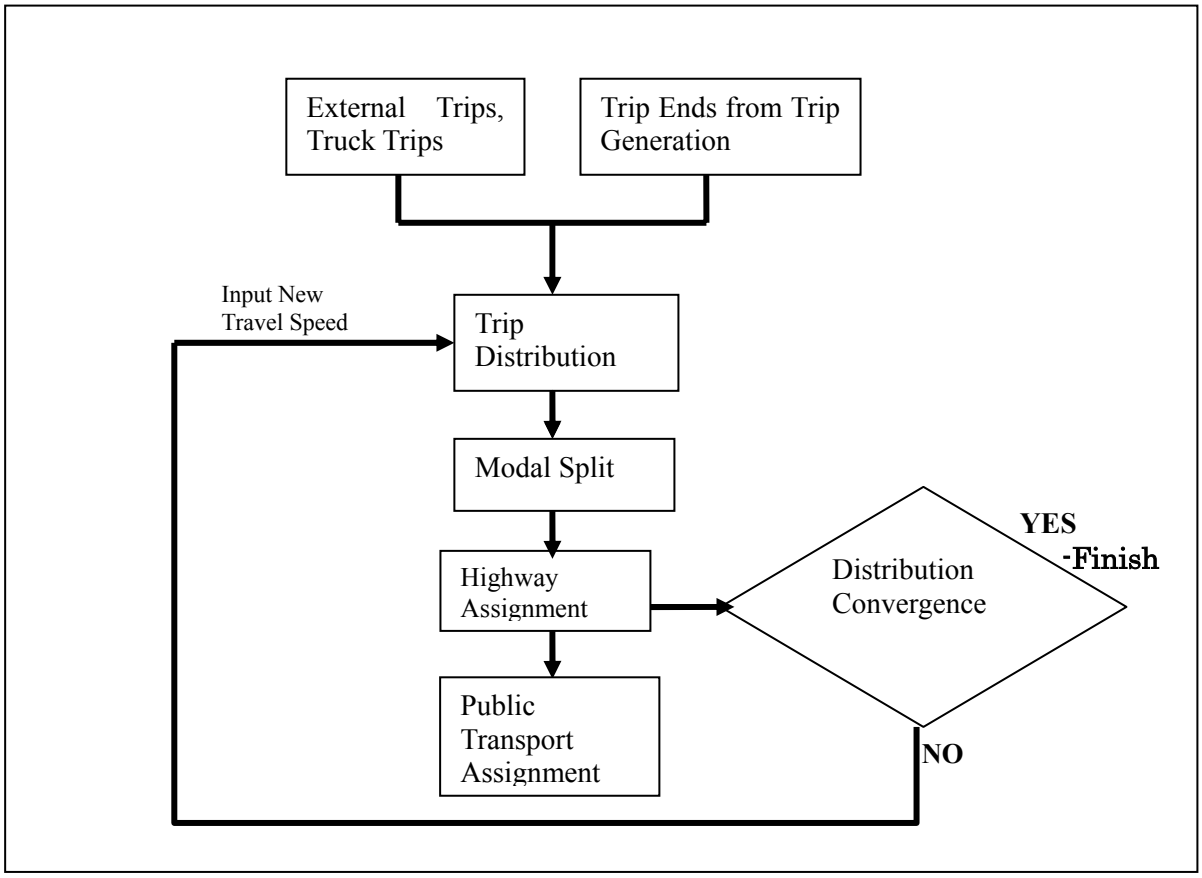
The global parameters used in the convergence test include PCU(Passenger Car Units) of travel for the daily representative hour of travel. This is the hour of travel actually assigned to the network to represent the daily travel.

The protocol is that the distribution convergence is done only for the base which are tabulated in the next section on indicative results. For all sensitivity analysis including the series of economic runs the model, is executed starting with the modal split. The distribution is assumed achieved already and the analysis is done against that base.

1.8.4 Economic Testing

The model scenario for the Base Committed Network is the scenario against which each infrastructure project is tested during the economic analysis. The network specification for economic evaluation is shown in Table 1.8.3.

The Without Case for economic evaluation is the base case. In the case of economic evaluation a total of 20 sets of results are interpreted in this analysis. These runs include the loading of the 2012 demand on the 2007 network as well as the loading of the 2022 demand onto the 2012 network.



Source: JICA Study Team

Figure 1.8.4 Convergence Flowchart

Table 1.8.2 Distribution Convergence Parameters in 2012

Operational Characteristic	Iteration 1	Iteration 2	Iteration 3	Difference(%)
Daily Million PCU Kilometers of Travel (Representative Hour)	6.531	6.495	6.513	0.3
Daily Million PCU Hours of Travel (Representative Hour)	0.2859	0.2799	0.2811	0.4
Daily Million Metro Boardings	5.760	5.693	5.709	0.3
Peak Million PCU Kilometers of Travel (Representative Hour)	5.088	5.065	5.059	0.1
Peak Million PCU Hours of Travel (Representative Hour)	0.1953	0.1927	0.1920	0.3

Source: JICA Study Team

Table 1.8.3 Economic Evaluation – Network Specification

Description of Scenario	Projects included in Economic Cases		
	Supertram	**West Wing**	**East Wing**
Without Project Case	Committed Projects	Committed Projects	Committed Projects
With Project Case	Supertram	West Wing	East Wing

Source: JICA Study Team

1.9 INDICATIVE RESULTS

The results from the transport modeling analysis are discussed in detail elsewhere in the Main Reports of Program A and Program B. In this section and the next section of this Attachment, only a limited number of results are presented in this for purposes of completeness. Additional details are available in the Main Reports of Program A and Program B. The indicative results are in essence the results of the base analysis for each year.

1.9.1 Project Patronage by Year

The number of passengers boarding each infrastructure project is presented in Table 1.9.1 for three base cases for each time horizon.

In the case of Supertam Line 1, there is not a significant increase in ridership between 2007 and 2012. This is a direct result of the fact that the second stage of Metro Line 3 is expected to be complete by 2012. Both Metro Line 3 and Supertram Line 1 have an overlapping catchment. However by 2022, there is a significant growth in the ridership of this project. Also by 2022, there is a large increase in the population of New Cairo at the Eastern Terminal of Supertram Line 1. In 2022 the ridership on Supertram Line 1 is expected to reach 430,000 passengers per day.

For the West and East Wing, there is a significant growth in the number of riders between time horizons. In 2022 the ridership on the West Wing is expected to reach 447,000 passengers per day whilst on the East Wing the ridership is expected to reach 472,000 passengers per day.

The maximum load points for the three infrastructure projects are also shown in Table 1.9.1. In the case of the West Wing, the maximum load point is at the eastern terminal. The West Wing has only one connection to Giza and hence to Central Cairo whereas in the East Wing there are two connections to Cairo at Metro Line 1 and Metro Line 3. The East wing exhibits a more balanced load over the whole route.

Travel on other major modes in the Study Area is shown in Table 1.9.2. For the presentation of this table, Mini Co-op Buses are included with Shared Taxi. Under

the network scenario presented in this report the largest growth in usage occurs on the Metro. The patronage on the Metro grows at a rate of nearly 7 % per annum between 2007 and 2022. Within this same time frame, the assumption is that Metro Lines 3 and 4 are completed by the end of 2022.

Table 1.9.1 Daily Passenger Ridership for the Three Infrastructure Projects - Base

Ridership Indicator	Year	Supertram	West Wing	East Wing
Passenger Boardings	2007	284,000	22,000	95,000
	2012	292,000	156,000	138,000
	2022	430,000	447,000	472,000
Passenger Kilometers (Million	2007	3.028	0.704	2.582
	2012	3.358	4.590	3.575
	2022	5.698	12.900	12.933
Maximum Load (Location Shown in Brackets)	2007	105,000 (Heliopolis Club)	11,000 (Cairo University)	36,000 (Salam City)
	2012	104,000 (Cairo Stadium)	82,000 (Cairo University)	58,000 (Salam City)
	2022	172,000 (Cairo Stadium	217,000 (Cairo University)	198,000 (Salam City)

Source: JICA Study Team

Table 1.9.2 Daily Passenger Ridership on Other Major Modes

Ridership Indicator	Year	All Bus	Shared Taxi	Metro
Passenger Boardings	2007	6,410,000	3,981,000	3,552,000
	2012	5,825,000	4,323,000	5,709,000
	2022	4,456,000	4,653,000	9,449,000

Source: JICA Study Team

1.9.2 Impact in 2022 for Station Design

For station design, in particular, there is need to detail the access to the major stations by mode. The access overall to all the stations of Supertram is presented in Table 1.9.3 in 2022. In the case of the West and East Wing there are two major inter-modal stations at Cairo University and Ain Shams, respectively. At both of these stations the major transfer is between the Wings infrastructure project and the corresponding Metro Line.

In the case of Cairo University on the West Wing in 2022, an estimated 180,000 passengers will transfer daily from West Wing to Metro. A further 265,000 passengers arrive at the station daily. The major arrival mode at this station is 62% by Shared Taxi.

In the case of Ain Shams on the East Wing in 2022, an estimated 82,000 passengers will transfer daily from East Wing to Metro. A further 130,000 passengers arrive at the station daily. The major arrival mode at this station is 58% by Shared Taxi.

Table 1.9.3 Overall Access to Supertram in 2022

Access Mode	Access Percentage of Trips
Walk	35.6
Shared Taxi	18.3
Bus	16.6
Heliopolis Metro	2.7
Metro	23.3
Park and Ride – Ring Road	3.5
Total	100.0

Source: JICA Study Team

For completeness the number of boardings and alightings at each Metro station for the 4 Metro Lines in 2022 is included in Table 1.9.4.

Table 1.9.4 Daily Passenger Boardings on Metro Lines in 2022

Boardings in Year 2022 for Metro Line 1, 2, 3 & 4

Metro Line 1

Station	Boarding	Alighting
New Al Marg	119,000	120,000
AL Marg	104,000	114,000
Ezbet El Nakhl	53,000	50,000
Ain Shams	190,000	183,000
El Mattaria	100,000	98,000
Helmeyet El Zeitoun	53,000	60,000
Hadaeq El Zaytoon	24,000	26,000
Saray El Qobba	5,000	2,000
Hammamat El Qobba	11,000	9,000
Kobry El Qobba	71,000	71,000
Mansheyet El Sadr	180,000	148,000
Demerdash	61,000	62,000
Ghamra	153,000	165,000
Mubarak	342,000	367,000
Oraby	51,000	50,000
Naser	198,000	181,000
Sadat	203,000	212,000
Saad Zaghlool	68,000	77,000
Sayeda Zeinab	147,000	142,000
Malek El Saleh	65,000	66,000
Mar Gerges	6,000	7,000
Zahraa	63,000	61,000
Dar El Salam	66,000	73,000
Hadaeq El Maady	10,000	11,000
Maady	69,000	65,000
Sakanat El Maady	26,000	25,000
Tora El Balad	9,000	9,000
Kozeka	23,000	23,000
Tora El Asmant	49,000	50,000
Maasara	24,000	24,000
Hadaeq Helwan	68,000	67,000
Wady Hoaf	29,000	27,000
Helwan University	25,000	28,000
Ain Helwan	50,000	40,000
Helwan	71,000	73,000

Metro Line 2

Station	Boarding	Alighting
Qalyoob	121,000	134,000
Abo El Gheit	99,000	65,000
Shobra El Kheima	85,000	108,000
Koleyet El Zeraa	164,000	166,000
Mazallat	21,000	20,000
Khalafawy	2,000	1,000
Saint Theresa	50,000	50,000
Rod El Farag	100,000	50,000
Masarra	45,000	70,000
Mubarak	315,000	355,000
Ataba	230,000	230,000
Mohamed Nageeb	65,000	40,000
Sadat	201,000	209,000
Opera	38,000	25,000
Dokki	1,000	1,000
Behoos	279,000	253,000
Cairo University	420,000	433,000
Feisal	1,000	1,000
Giza Station	206,000	215,000
Om El Masreyeen	16,000	15,000
Saqyet Mekky	44,000	47,000
Moneeb	137,000	152,000

Metro Line 3

Station	Boarding	Alighting
Behoos	230,000	245,000
Shehab	270,000	227,000
Mostafa Mahmood	21,000	29,000
Wady El Neel	38,000	40,000
Boohy	115,000	115,000
Moneera	100,000	100,000
Imbaba	80,000	80,000
Matar	1,000	1,000
Sodan	9,000	5,000
Kitkat	200,000	224,000
Zamalek	50,000	15,000
Maspero	148,000	91,000
Naser	181,000	229,000
Ataba	181,000	187,000
Ain Shams University	195,000	220,000
Bab El Shaareya	39,000	54,000
Geish	29,000	28,000
Abdo Pasha	1,000	1,000
Abbaseya	35,000	35,000
Cairo Fair	1,000	1,000
Stadium	76,000	77,000
Koleyet El Banat	44,000	42,000
Ahram	8,000	8,000
Haroon	51,000	54,000
Heliopolis Square	4,000	2,000
Alf Maskan	35,000	38,000
Arab	37,000	36,000
Ain Shams 1	1,000	1,000
Ain Shams 2	109,000	106,000
Omar Ebn El Khattab	22,000	13,000
Cairo Airport	59,000	66,000

Metro Line 4

Station	Boarding	Alighting
Mena House	58,000	65,000
Tereat El Mansoreya	129,000	123,000
Haroon St.	106,000	104,000
Talbeya	118,000	117,000
Giza Motsyan	222,000	214,000
Morad St.	3,000	3,000
Manyal	23,000	82,000
Sayeda Zeinab	145,000	127,000
Magles El Shaab St.	61,000	67,000
Magles El Shaab St.	1,000	1,000
Ahmed Maher	62,000	39,000
Bab El Shaareya	222,000	189,000
Sakakiny	13,000	12,000
Ramsees St.	151,000	159,000
Ghamra	52,000	54,000
Port Said St.	1,000	1,000
Sharekat El Betrol St.	1,000	1,000
Mansheyet El Wayly	92,000	94,000
Abd El Qader El Gelany	2,000	2,000
Kablat St.	91,000	98,000
Madinet Naser	1,000	1,000
Mostorod Br.	33,000	32,000
Mostorod	16,000	18,000
Ring Road	49,000	49,000

	Metro Line 1	Metro Line 2	Metro Line 3	Metro Line 4
Total Boardings	2,786,000	2,640,000	2,370,000	1,652,000
Max. Daily one way Load	573,000	545,000	537,000	385,000
Location	Demerdash	Mubarak	Maspero	Talbeya

Source: JICA Study Team

1.10 SENSITIVITY ANALYSES

1.10.1 Overview

The sensitivity tests are considered in three groups namely those that tested the basic network assumptions, those that tested the impact on changes in Supertram and finally those that tested alternative in the two Wings projects.

1.10.2 Common Sensitivity Tests

In the common tests, the sensitivity analysis tests the impact of the Shared Taxi Area License Scheme at each time horizon and the impact of not modifying the CTA Bus routes[9] in 2007.

In the later case the impact on Supertram line 1 of not modifying CTA routes (see Table 1.10.1) is only 5%. There is no significant change on any other mode.

Table 1.10.1 Daily Passenger Ridership on Major Modes in for the Test Case without Modified CTA routes

Year	Mode	Base	Test Case
2007	Supertram	284,000	271,000
	West Wing	22,000	22,000
	East Wing	95,000	93,000
	All Bus[10]	6,410,000	6,449,000
	Shared Taxi	3,981,000	3,981,000
	Metro	3,552,000	3,515,000

Source: JICA Study Team

The impact of not having the Shared Taxi Area License scheme is presented in Table 1.10.2. In case of the supertram, this is further discussed in Section 3.5.2 of the main report.

The impact on the development of the Wing is modest. In most years the impact is less than 5%. The impact on the Metro ridership is around 5% for most years.

The most significant impact is on the distribution of public transport passengers between Bus and Shared Taxi. Without the Shared Taxi Area License Scheme, Shared Taxi carries more passengers daily. Whereas when the area license scheme is operational, the situation is reversed.

[9] The modification of the CTA routes refers to the small changes in the CTA route structure to support Supertram Line 1.

[10] For the purpose of this table, Mini Co-op Buses are included with Shared Taxi.

Table 1.10.2 Daily Passenger Ridership on Major Modes in for the Test Case without Shared Taxi Area License Scheme

Year	Mode	Base	Test Case
2007	Supertram	284,000	236,000
	West Wing	22,000	23,000
	East Wing	95,000	89,000
	All Bus[11]	6,410,000	3,928,000
	Shared Taxi	3,981,000	6,104,000
	Metro	3,552,000	3,401,000
2012	Supertram	292,000	246,000
	West Wing	156,000	159,000
	East Wing	138,000	134,000
	All Bus	5,825,000	3,532,000
	Shared Taxi	4,323,000	6,228,000
	Metro	5,709,000	5,302,000
2022	Supertram	430,000	412,000
	West Wing	447,000	455,000
	East Wing	472,000	455,000
	All Bus	4,456,000	2,309,000
	Shared Taxi	4,653,000	7,018,000
	Metro	9,449,000	8,989,000

Source: JICA Study Team

1.10.3 Supertram Line 1- Station and Intermodality Tests

In the case of the Supertram Line 1, three additional sensitivity tests were conducted, namely:

- Number of stations;
- Integrated fare structure; and,
- Feeder bus services.

In the case where two new stations are added along the western section of the alignment, the daily ridership in 2022 increased by 5% to 452,000 passengers. The assumption was with two new stations the operational speed of Supertram Line would decrease to 30kph.

However when the number of stations is increased along the whole alignment from 19 to 26 stations, implying a revised operational speed of only 25kph, this resulted in the ridership decreasing by 16% to 360,000 passengers in 2021. This

[11] For the purpose of this table, Mini Co-op Buses are included with Shared Taxi.

analysis implies that the selection of 19 stations on a purely demand basis is close to the optimum number of stations.

In reviewing the integration of buses and Supertram, a series of alternative optimization measures were tested with a view to identifying a bus plan that benefits both the supertram and East Cairo in general. This is presented in detail in Section 4.3 of the Main Report of Program B.

The discussion of various types of fare structures is presented in Section 4.4 of the Main Report of Program B.

1.10.4 Wing Sensitivity Tests

The sensitivity tests undertaken for the Wings are a Fare Analysis and a test of an alternative alignment on the West Wing. These tests were all developed for the year 2012.

The fare sensitivity is presented in Table 1.10.3. All monetary values in this table are in 2001 Egyptian Pounds. The maximum revenue for the East Wing is achieved with the Base Fare. However in the instance of the West Wing, the maximum revenue is obtained at a higher fare level. For the West Wing, it is shown that the 'Base plus 50%' will achieve the maximum revenue whilst reducing the number of passengers by 25%. This in fact will also extend the life of the busway as the maximum load point is also reduced in this scenario.

Table 1.10.3 Daily Statistics on Wings, Fare Sensitivity

Project	Fare Scenario	Fare (Pt)		Passengers	Revenue (LE)	Average Fare (Pt)
		Boarding	Distance			
West Wing	Base – 50%	37	2	207,000	195,000	94
	Base	74	4	156,000	299,000	192
	Base + 50%	111	6	118,000	345,000	292
	Base + 75%	130	7	86,900	302,000	348
East Wing	Base – 50%	37	2	241,000	236,000	98
	Base	74	4	138,000	245,000	178
	Base + 50%	111	6	48,000	109,000	227
	Base + 75%	130	7	28,000	71,000	254

Source: JICA Study Team

For the West Wing, a test was developed to estimate the impact of an alternative alignment. This alternative alignment is shown in Figure 1.10.1. This is the case where the 6th of October is connected to the Ring Road with a new spur link from Metro Line 3 to the Ring Road terminal station. The result is a decrease in the ridership of 5%. The shortened route results in even a decrease in the passenger kilometers of 25%. The overall revenue decreases by around 20%.

The impact on Metro Line 3 is not insignificant. The daily ridership increased by 12%. The maximum load point shifts from Imbaba to Sudan Station and increased significantly by 25%.

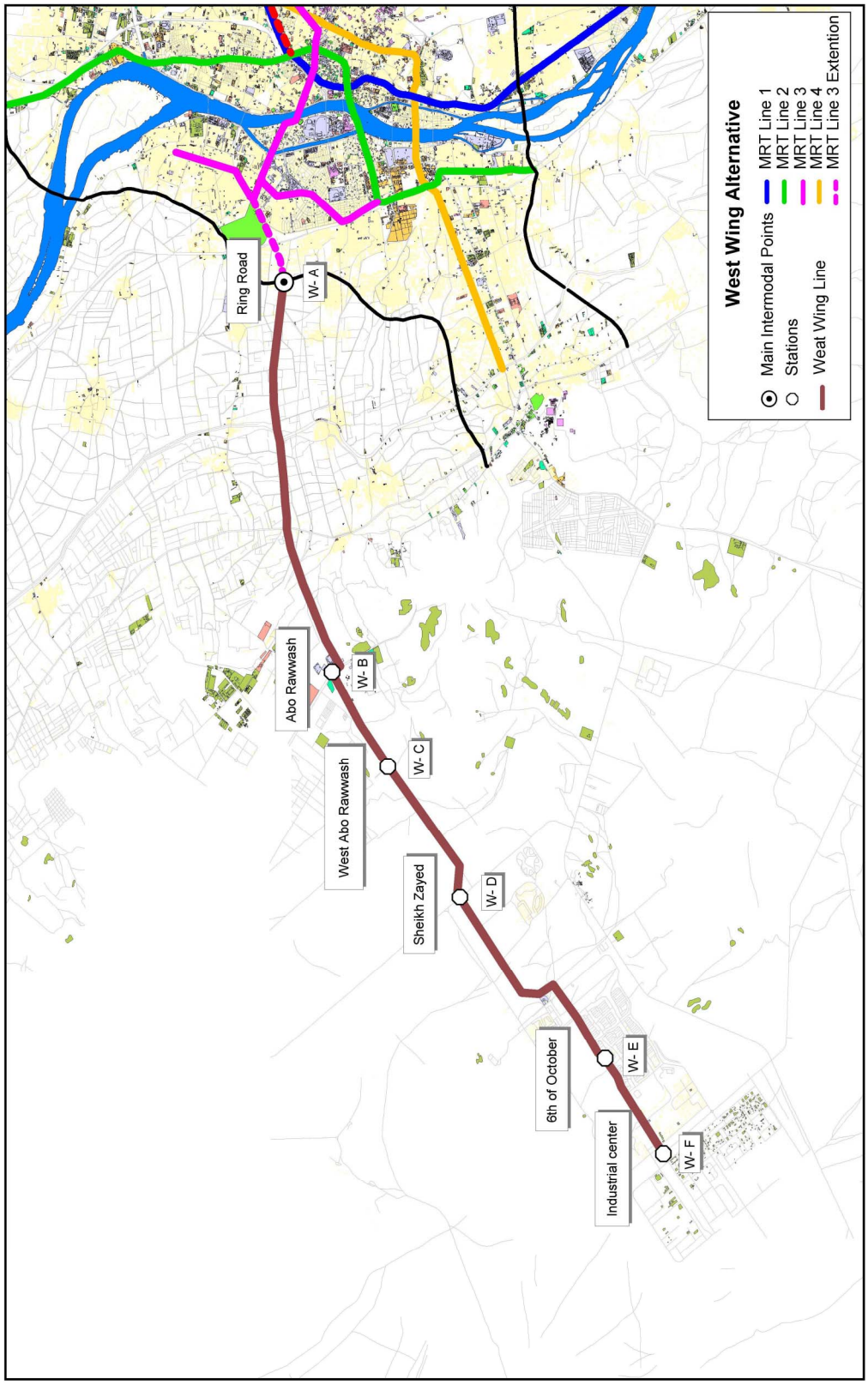


Figure 1.10.1 Alternative Alignment for West Wing

Source: JICA Study Team

CHAPTER 2: INTERMODAL THEORY

2.1 INTERMODAL VIEWS AND CONCEPTS

2.1.1 Introduction

The role of public transport is to offer citizens ***sustainable mobility***. *Good transport is essential to an enhanced quality of life, to a strong economy and to a better environment. Improving public transport is also vital in reducing social exclusion, particularly for people who have less access to a car including women, the old, the young and disabled people. It will also help create a fairer society*[1].

Increased congestion upgrades public transport as a valuable alternative for the private car. Public transport can achieve this objective only if the public transport offer meets a number of qualitative objectives at a reasonable price. Competing with the private car means that public transport services need to be ***flexible, efficient and reliable***.

In the final report of the CREATS Study (Phase I)[2], it was made explicit that when addressing public transport from an intermodal perspective, the key points of attention are:

- Integrated use of different transport modes;
- Efficient connections;
- Improved coordination; and,
- Available information.

The above key-success factors, identified in the CREATS Study, are in line with various public policies and project conclusions around the world.

[1] *Transport 2010: The Ten Year Plan*: Department of the Environment, Transport and the Regions: London; July 2000, p 12.
[2] *Transportation Master Plan and Feasibility Study of Urban Transport Projects in Greater Cairo Region in the Arab Republic of Egypt - Phase I Final Report, Volume III – The Transport Master Plan*, op. cit.

2.1.2 Policy views on Public Transport

Already in 1995, the European Commission emphasized in its introduction to the *Green Paper*[3] on the development of a Citizens' Network the need for efficient public transport systems as a cornerstone in guaranteeing people's mobility, including the mobility of the disadvantaged people in society.

"The convenient, economic and safe movement of people must be at the core of transport policy making and provision. An integrated approach is therefore essential - and that must include a strategy for increasing the use of public passenger transport. If public transport is made more attractive by improving standards of service and organisation, and more accessible to people whose mobility is limited, large numbers of people will be encouraged to continue to use or to return to using it regularly".

The Green Paper made it explicit that the "…better coordination of sub-systems such as bus, tram, metro and rail operations is essential for fulfilling the potential offered by public transport. This applies to both hardware (terminals, multiple use of rail tracks) and software (combined ticketing, information systems, tariff-systems) improvements. In order to make the most of improvements in each individual transport mode, transport planning should be integrated between all the modes, so that for example, a passenger can buy a ticket covering the whole of the journey - even if that includes a change from, for example, tram to bus. Transport planning should include the use of intermodal techniques (for example, easy change terminals, through-tickets), establishment and use of measures to give priority to public transport such as separate bus lanes and a mix of measures designed to encourage people to use public transport ("pull" measures) and, where appropriate, measures to reduce the use of private cars ("push" measures)" (Green Paper, p 13).

The intermodal public transport system aimed at by the European Commission should combine all the public passenger transport modes into a common operating environment. In other words, that the different public transport modes: tram, suburban train, metro, bus, jointly operate within a network. For the transport experts of the European Commission, achieving this objective is only possible if concrete and sustainable results can be accomplished is the three most important elements of such intermodal system are coordinated timetables, through ticketing, and multimodal terminals.

But before any real progress can be made in individual components of the public transport system, it is imperative that public transport as a whole becomes more accessible.

Accessibility to public transport is determined by a number of quality components, as depicted in Table 2.1.1.

Table 2.1.1 Quality Requirements of Public Transport System

[3] *Transport Green Paper: The Citizens Network*, European Commission; Brussels, 02/1996

Item	Parameter
System Accessibility	• Needs of People with Reduced Mobility • Physical Design of Rolling Stock • Design of Intermodal Stations • Link Trip Generators with Pub. Transport • Link Rural and Peripheral Regions
Affordability	• Fare Levels • Socially Desirable Services
Safety and Security	• Safety Standards • Quality of Lighting • Qualification of Staff • Number of Staff on Duty
Travel Convenience	• Journey Times • Reliability and Frequency • Clean and Comfortable • Information Dissemination • Integrated Ticketing • Flexibility
Environmental Impact	• Emissions • Noise • Infrastructure

Source: EU Green Paper,op. cit., p 6

In its latest White Paper on transport[4] European decision makers reaffirmed the same priorities for (intermodal) public transport:

"In passenger transport, there is considerable scope for improvements to make traveling conditions easier and facilitate modal transfers, which are still highly problematic. Far too often passengers are put off using different modes of transport for a single journey. They have problems obtaining information and ordering tickets when the journey involves several transport companies or different means of transport, and transferring from one mode to another can be complicated by inadequate infrastructure (lack of parking space for cars or bicycles, for example). … priority should be given in the short term to several fields of action:

Integrated ticketing to facilitate transfers from one network or mode to another, encouragement needs to be given to the introduction of ticketing systems which are integrated (and thus ensure transparency of fares) between rail companies or between modes of transport (air - coach - ferry - public transport - car parks) . Some railway companies, as in the Netherlands, are already offering an integrated "train & taxi" service in a single ticket. … Integrating the services offered by different operators within a single tariff band and with a single ticket …offers users greater flexibility and so makes public transport more attractive …

Continuity of Journeys has to be thought of as continuous, which means land-use and town planning policies will play a vital role. The main metro, train and bus

4 *Transport White Paper: European transport policy for 2010: Time to Decide*, COM(2001) 370, European Commission; Brussels 12/09/2001

stations and car parks should be geared towards exchanges between the car and public transport and should offer related services (e.g. shops), and so encourage the use of public transport, which causes less pollution. Providing car parks on the outskirts of towns (and also near railway, underground, bus and tram stations) where motorists can leave their cars and link up with the main means of public transport (including taxis) is an option already implemented in a number of cities, such as Munich and Oxford.

Adapting public transport to carry bicycles is another way of encouraging a certain form of intermodality over short distances. It should be recognized that the bicycle is still too often neglected as a mode of transport, even though some 50 million journeys (i.e. 5% of the total) are made by bicycle each day in Europe. The proportion is as high as 18% in Denmark and 27% in the Netherlands. The success of intermodality also requires recognition of the role of taxis…".

The White Paper re-emphasizes the opinion expressed in the 1996 Green Paper where the Commission argued that "…effective integration of individual modes (including walking and cycling) and public transport operations is essential. In particular, the construction of interconnecting transport infrastructure (e.g. multi-modal terminals, park and ride facilities) and the establishment of an information and traffic management system (incorporating the use of transport telematics) which allows for the reassessment of travel choices before and throughout the journey".

Also the European Conference of Ministers of Transport (ECMT) has a clear opinion on how to develop urban transport and the role of public transport in that development (including its important link to private car use)[5].

"Much is being done to enhance public transport solutions, for example improving service quality and integrating public transport networks into a more individualized "door-to-door" approach to urban mobility. It is widely accepted, however, that public transport cannot solve the problem alone and complementary pricing measures (including for parking) are essential as an incentive for more optimal use of private cars. Recent European research and the experience with planning guidelines of several countries … have highlighted the importance of coherence between policy towards the development of urban planning, public transport and parking".

Intermodal public transport is not only a topic of discussion in Europe. Improving public transport systems is a concern for public decision-makers worldwide. In many cases, public transport development is directly associated to improving urban transport in general.

According to the World Bank[6], improving the efficiency of urban transport includes that "…*the needs of each mode must be addressed—the road system, NMT, public passenger transport, and mass transit*" (p.13). An integrated and

[5] *Sustainable Transport Policies*; ECMT, Paris, 2000
[6] *Cities on the Move: A World Bank Urban Transport Strategy Review*, World Bank, Washington, 2002.

comprehensive approach to urban transport that includes particular attention to the role of public transport is imperative. According to the World Bank, the "*... number of mega cities—cities with over 10 million inhabitants—is expected to double within a generation. More than one-half of the developing world's population, and between one-third and one-half of its poor, will then live in cities. Per capita motor vehicle ownership and use continue to grow by up to 15 to 20 percent per year in some countries. Traffic congestion and air pollution continue to increase. Pedestrian and other non-motorized transport (NMT) continue to be poorly served. Increased use of private vehicles has resulted in falling demand for public transport and a consequent decline in service levels. Sprawling cities are making the journey to work excessively long and costly for some of the very poor*" (Executive Summary p.11).

Critical for a future sustainable urban transport development is the change in perception that the continued increase of good road infrastructure is not sufficient. A sustainable urban transport system needs to combine land use policies with public transport expansion. This expansion can be achieved by either restrictive measures by which the use of private transportation means inside the urban area is restricted (e.g., Singapore and London by means of road pricing) or by pro-active measures that favor public transport (e.g., Bogota or Brazil by different types of busway systems). Independent of the policy approach, the World Bank argues that the public transport system should not be "…*viewed as only for the poor, as the importance of public transport to all income groups in many rich European cities demonstrates. Improving efficiency in public transport must be concerned not only with keeping costs down but also with providing a flexible framework within which the less poor as well as the very poor can use public transport with confidence and comfort*" (Executive Summary p. 14).

Also in Australia, developing efficient public transport is high on the political agenda. Within the expected expansion of Melbourne City, the Minister of Transport Peter Batchelor reconfirmed the opinion of the Australian Prime Minister that public transport development is a critical condition to guarantee the quality of life also for the generations to come. "*It intends that by the year 2020, the proportion of motorized transport trips taken on public transport will more than double, from the present 9 per cent to 20 per cent.*"[7]. To achieve this ambitious goal, Melbourne 2030 intents integrating land-use and transport policies, in order to create a balanced and workable city. The public transport strategy that is conceptualized in Melbourne 2030 focuses on a better use of available public transport resources, while simultaneously improving and developing the necessary infrastructure to expand the network of the under-performing bus system so that it effectively integrates with the existing radial railway and tram services. More concretely, the public transport policy emphasizes two complementing approaches; On the one hand, trips "*... that use high-quality public transport services for long-distance fast travel to get to and from activity centers – traditionally, this has meant rail transport and commuting to Central Melbourne, but, increasingly, it will include light rail, tram and*

[7] *Melbourne 2030: Planning for Sustainable Growth*; State of Victoria, October 2002, Minister's Messages , Message by the Minister of Transport Mr. Peter Batchelor.

express bus services on nonradial routes connecting Principal and Major Activity Centers" and on the other hand trips "*… that use frequent local public transport for travel to Neighborhood Activity Centers and to provide easy connections to Principal Public Transport Network routes – improved bus and taxi interchanges and coordination of timetables and fares will build better links with this network.*"[8]

A recent review by the United Nations[9] on transport development in Asia concluded that the growth rate of cities generated an increased demand for transport facilities, a demand that in many cases has not (yet) been met, due to an absence of structured development planning that led to transport infrastructure and services falling behind a constantly growing demand. But at the same time, some positive trends are emerging. There is a growing interest in rail-based public transport, leading to several major infrastructure developments in, e.g., Bangkok, Beijing, Kuala Lumpur, Manila or Seoul. Also bus transport is increasingly seen as a very efficient means of public transport in cities as Bangkok, Kuala Lumpur or Shanghais, where innovative and highly efficient bus transport systems have been introduced. In many cases, the introduction of these innovative and efficient public transport systems is accompanied by the implementation of the system integration theory, using Intelligent Transport Systems to improve the quality of traffic management, information exchange and ticketing. Finally, the Report argued that "*...increased private sector participation in the provision of transport infrastructure and services is an encouraging feature in many Asian cities such as Bangkok, Dhaka, Kuala Lumpur, Lahore and Manila.*"[10] However, at the same time, the report makes a case that private sector participation is difficult and in many cases impossible: "*For various reasons, many governments have found that it is difficult to fund transport infrastructure projects by charging the users directly. Consequently, transport infrastructure development has remained mainly the responsibility of the public sector, putting an enormous financial burden on national and urban local governments.*"[11]

All above policies and opinions indicate that, while developing a public transport-oriented policy is one issue, financing the concrete implementation of that policy is a very different issue. In spite of the many difficulties, World Bank experts as well as their European colleagues remain convinced that private sector participation is imperative because experience has shown that an ad-hoc and opportunistic infrastructure development generally results in a low outcome and a very costly burden for the public budget, in particular when developing mass transit systems. But the focus of private sector involvement could be reconsidered: "*In addition, the role of the private sector as a means of promoting efficiency deserves special attention*"[12]. In particular, the operational efficiency of public transport systems could improve with the effective involvement of the private

[8] *Melbourne 2030: Planning for Sustainable Growth*; State of Victoria, October 2002, p 135
[9] "*Review of developments in transport and communications in the ESCAP region 1996-2001: Asia and the Pacific*", United Nations, Economic and Social Commission for Asia and the Pacific; New York, 2001
[10] *Ibid*, p 11
[11] *Ibid*, p. 46
[12] *Cities on the Move: A World Bank Urban Transport Strategy Review*, World Bank, Washington, 2002, Executive Summary p.13

sector and the better utilization of their expertise. According to the World Bank experts, "…*technical regulation should be separated from procurement and economic regulation. A clear legal framework should be established for competition in public transport supply, either in the market or for the market. Operations should be fully commercialized or privatized, and the development of new competitive private suppliers of service encouraged through legal recognition of associations, and so on. The public sector should develop strong service procurement and contract enforcement skills*" (Executive Summary, p 21).

But government involvement should not be neglected. On the contrary, it remains imperative for governments to provide subsidies, in particular in large public transport infrastructure developments[13].

2.1.3 Expert Views on Public Transport

Above policy perceptions are also worldwide reflected in expert studies and transport research projects aimed at improving urban transport and the functioning of public transport systems.

A recent review of German and Swiss urban and public transport, for example, demonstrated that institutional activities (e.g. land use planning measures) as well as "soft-policy" measures and innovative mobility concepts (e.g. mobility information services) should be seen as long-term strategies, while the implementation and benefits of transport policy activities (improving public transport) could be achieved within a short time[14].

The Padeco study[15] on public transport discussed public transport development in a wide range of cities and showed with the Singapore case that maintaining and developing coordinated public transport (alongside car restraint measures) contributes to the success of public transport. Buses provide feeder services to MRT and fares and timetables for rail and bus services are integrated. Singapore boasts the world's first stored-value fare card that can be used interchangeably for bus and rail travel, therewith demonstrating that fare integration is possible.

The Padeco Study argued that "connectivity and the integration of public transport networks is particularly important for public transport users. A certain degree of transfer between trains and buses may be inevitable but it is important that they are well connected and systems are integrated so that destinations can be reached by public transport alone"[16].

But the study also concluded that "… institutions for urban transport policy making and administration are relatively weak in developing countries. There is a lack of sufficient staff with technical and financial competency in both the public

[13] *Study on Urban Transport Development - Final Report*; Padeco Co. Ltd, Japan, August 2000, p. 1.24.
[14] *Urban Transport Strategy Review: Experiences From Germany And Zurich*, Deutsche Gesellschaft Für Technische Zusammenarbeit (Gtz) Gmbh, Eschborn Division 44, Environmental Management, Water, Energy, Transport; Germany, January 2001
[15] *Study on Urban Transport Development - Final Report*; op. cit.
[16] *Study on Urban Transport Development - Final Report*; op. cit.; p 14

and private sectors. Policies are often not well coordinated; bus services may compete with railways. There is also a chronic shortage of financial resources…"[17].

Every effort to improve and / or integrate the public transport system therefore needs **public awareness** to gain acceptance of the required measures. New measures therefore need to be efficient, easy accessible and supported by a comprehensive information and communication effort to make passengers aware of the new measures and / or systems. Experts therefore emphasize that "… *improved public transport is no doubt the backbone of urban transport policy. Higher frequencies, improved regularity, more effective communication with passengers, the provision of new busses, trams or entire LRT systems, as well as competitive and easily comprehensible fare levels, are principal elements of the various packages of urban transport policies*"[18].

But one important element that is frequently left out of the discussion is the role of public transport operators and more in particular, the personnel operating, monitoring and managing integrated public transport systems. As the above discussion clearly demonstrates, integration requires a very high level of operational expertise because that integration needs to be coordinated at various operational and managerial levels, including:

- Pricing (including distribution of costs and revenues between the various operators within the public transport system);
- Ticketing (including control and distribution);
- Routing and network development (including operations at inter-connecting stops and intermodal terminals); and,
- Information exchange between operators and towards the passengers;

In the developed world, the problem is frequently addressed by providing internal training programs when new technologies are introduced and / or by outsourcing operations and management to private companies who have the necessary expertise in house. In developing countries, the implementation is more complex because of social and historical conditions that slow down a swift change towards integration. A key factor for success is undoubtedly the introduction of a structured human resources development program, running parallel to the technological and managerial changes in the public transport system.

2.2 PUBLIC TRANSPORT SYSTEM INTEGRATION

An important objective in the development of Supertram Line 1 and of both Wings is to establish an efficient interconnection with existing public transport services. In that context, all parties involved look at these projects as projects that intent to establish an intermodal public transport system. However, there are two

[17] *Study on Urban Transport Development - Final Report*; op. cit.; p 19
[18] *Urban Transport Strategy Review: Experiences From Germany And Zurich*, Deutsche Gesellschaft Für Technische Zusammenarbeit (Gtz) Gmbh, Eschborn Division 44, Environmental Management, Water, Energy, Transport; Germany, January 2001; p 26

critical components that require a clear definition. The first is the concept of "intermodal public transport" and the second is the concept of "(public) transport system". Although closely interconnected, there are important differences that require the necessary attention.

Intermodal public transport refers to the way different public transport services work together. In accordance with the definition of Prof. Gerhard Muller, intermodal transport (including public transport) is "… *the concept of transporting passengers and freight on two or more different transport modes in such a way that all parts of the transportation process, including the exchange of information, are efficiently connected and coordinated*"[19].

Thus, the intermodal view emphasizes the passenger needs and focuses on the coordination and interconnectivity of processes and information exchange as to offer passengers easy travel from origin to destination, independent the type of transport mode used. In other words, intermodal transport requires the integration of the different transport modes in such a way that public transport operations run as a single service to passengers and as a single **system**.

Transport integration can therefore be viewed as the practical and concrete implementation of the intermodal transport vision. This integration can only be achieved if and when the individual public transport services are considered as parts of a public transport system. Taking this view one step further would mean that the quality of the intermodal public transport offer is defined by the efficiency of the individual public transport components working together in a public transport system.

In other words, the effectiveness of the integration of the different components of the public transport system is the critical factor that determines the quality of intermodal public transport.

Consequently, the focus should not be on the concept of intermodal public transport, but on the level of integration of the different components into a single public transport system. At this level, visions and perceptions differ and the concept of *integration* is often used with different connotations.

A coherent "definition" in its fullest of **integration** is[20]:

- Coherence between transport, land use and other social and economic policies;
- Consistent resource allocation criteria between transport modes;
- Consistent budgeting across all modes and services;
- Rational pricing, including externalities;

[19] *Prof. Dr.Gerhardt Muller: "Intermodal Freight Transportation - 4th Edition"; ENO Transport Foundation; 1999.*

[20] *Review of Urban Public Transport Competition*, Halcrow Fox, Department for International Development; London, May 2000; p 87

- A coherent multi-modal system of regulation;
- Design of services and facilities to reflect their individual strengths;
- Facilities for easy interchange between modes and services; and,
- Common fares and ticketing.

Although it is with this definition very clear what should be understood under **system's integration**, it is less clear how this integration should be achieved.

According to one study, system's integration is equal to service quality, which makes the authors conclude that "…a basic requirement for transportation services quality is the system's integration:

- Physical integration: passengers transfer approach, to shorten transfer distances and how they are carried out.
- Operations integration: lines, stops, …frequency, timetables…
- Tariff integration: it is intended to allow traveling in different transit systems with a single combined ticket to avoid the use of new tickets or, generally, additional cost. This can be achieved in different ways that enclose from combined tickets that allow traveling in different transport systems during a set length of time or multiple tickets and even monthly personal travel passes that authorize any number or type of trips within a specific area"[21].

Even in competitive markets with various transport modes competing, integration can be achieved although regulatory intervention and public control is imperative[22]. "*Where cities have a range of types/modes of public transport there can be substantial benefits from operating these in concert. To achieve integration of this kind requires:*

- *Bus service patterns which complement the rail network;*
- *Reliable multi-modal information;*
- *Easy interchange facilities;*
- *Tariff structures which do not penalize interchanging compared with through journeys; and,*
- *Multi-modal ticketing.*

It will usually not be in the interest of individual bus operators to adapt their services and fares to promote integration with rail. Even if it were, the complexity of getting all the interested parties to act together is such that the transport authority must establish and maintain the arrangements needed to provide this integration. This does not mean that there cannot be competition – there certainly can – but its operation must be regulated so as to promote, rather than thwart integration where this has been established as being in the interests of the traveling public." (p 35 - 36)

[21] *Urban Public Transport Systems Integration and Funding*; Prointec - Inocsa - Stereocarto, Spain, 2000.
[22] *Review of Urban Public Transport Competition*, op. cit.

A more comprehensive approach of integrated transport attempts to connect transport to land use and public decision-making. The many case studies discussed in the before mentioned Padeco study[23] argue in that context that efficient public and urban transport come from an integrated approach to transport system development, land-use planning and good governance (efficient and integrated public policies). It herewith comes close to the most recent declarations of the European Commission in respect to transport.

In its White Paper on Transport[24], European policy makers argue that:

"The objective - never yet achieved - of shifting the balance of transport involves not only implementing the ambitious programme of transport policy measures proposed in the White Paper by 2010, but also taking consistent measures at national or local level in the context of other policies:

- economic policy to be formulated to take account of certain factors which contribute to increasing demand for transport services, particularly factors connected with the just-in-time production model and stock rotation;
- urban and land-use planning policy to avoid unnecessary increases in the need for mobility caused by unbalanced planning of the distances between home and work;
- social and education policy, with better organisation of working patterns and school hours to avoid overcrowding roads, particularly by traffic departing and returning at weekends, when the greatest number of road accidents occur;
- urban transport policy in major conurbations, to strike a balance between modernisation of public services and more rational use of the car, since compliance with international commitments to curb CO_2 emissions will be decided in the cities and on the roads;
- budget and fiscal policy to achieve full internalisation of external - in particular environmental - costs and completion of a trans-European network worthy of the name;
- competition policy to ensure that opening-up of the market, especially in the rail sector, is not held back by dominant companies already operating on the market and does not translate into poorer quality public services;
- transport research policy to make the various efforts made at Community, national and private level more consistent, along the lines of the European research area." (p 12)

The above approaches can be considered "supply-side perspective", by which transport system integration is **pushed** via a wide variety of measures of which the effectiveness of some is far from being proven.

Other experts see transport system integration from a "demand-side perspective" where system-design should be based upon commuter-based requirements and perceptions. From a demand-side perspective, any "… *integrated public transport system will feature:*

[23] *Study on Urban Transport Development - Final Report*, op. cit.
[24] *Transport White Paper: European transport policy for 2010: Time to Decide*, op.cit.

- *Common fares and ticketing;*
- *Multi-modal information;*
- *Easy transfer between modes; and,*
- *Design of routes/networks to optimize the use of the system as a whole.*

Integration facilitates the provision of a 'seamless' public transport network. Demand can be focused on modes with low marginal costs and spare capacity, for example metros, improving the efficiency of public transport. … Effective integration ideally requires that a single local transport authority is responsible for the main service features of all transport modes within an urban area. With multiple transport authorities effective integration is still possible but is considerably more difficult. Efficient integration in smaller towns and cities is probably best achieved by franchising all public transport services to one operator, as in Rouen. In larger cities, such as Stockholm, gross cost contracting is probably the most effective means of maintaining integration and efficiency."[25]

The above statement also discusses the complexity of transport integration in relation to privatization and outsourcing of public transport services to private operators.

The above discussion on the difference between on the one hand "intermodal (public) transport" and on the other hand the concept of "integrated public transport systems" is very relevant for both Supertram Line 1 and the Wings.

When taking the (limited) intermodal view, the development of Supertram Line 1 and the East and West Wings will concentrate on efficient connections / links between the two new public transport offers and other available public transport modes. Indirectly, and conform to Prof. Muller's definition, attention will have to be paid to the exchange of information.

However, the CREATS team has opted to embrace the broader system's view on public transport, thus focusing not only on the infrastructure and information exchange, but also including all hardware, software and humanware components that are relevant for achieving the full integration of the new services in the existing public transport system of Greater Cairo. This approach is also in line with the majority of recently completed or ongoing public transport projects both in the developed and the developing world (refer Section 2.3 and Section 2.4).

CREATS Phase II efforts therefore focus on a wide range of issues, including:

<u>Intermodality</u>

a. Intermodal terminals and stops
b. Infrastructure development and use
c. Information exchange between operators

[25] *Review of Urban Public Transport Competition*, op. cit.

Integration of operations

a. Time tables
b. Routing
c. Ticketing technology

Integration of management and control

a. CTA organizational restructuring
b. Human Resources Development (training and re-orientation)
c. Control technology (automation and *e*-technology)
d. Long term public transport system integration on the GCR level
e. Financial management

Customer service

a. Passenger information (information technology and public relations)
b. Ticket distribution systems
c. Intersection control technology for guaranteed services
d. Pricing policies

2.3 INTEGRATED PUBLIC TRANSPORT: OVERVIEW OF BEST PRACTICES

2.3.1 Introduction

Interesting examples of public transport integration efforts can be found in the study by Halcrow Fox[26], the Padeco study[27] and others. Particularly interesting for the public transport system in Greater Cairo is the analysis of public transport systems in Madrid and several French and German cities as well as in several cities in developing countries[28].

This section provides a brief overview of several efforts worldwide.

Public transport integration is not new. Already in 1959, the "Syndicat de Transport de Paris" was established with the objective of integrating / linking the variety of public transport services. In 1965, Hamburg inaugurated the first integrated public transport association, the "Hamburger Verkehrsverband". The HVV introduced an integrated timetable and worked out a collective fare system. For that purpose, the organization planned / restructured the entire public transport network of Hamburg, spread the fare revenues over the operators involved and marketed the service to the public[29].

2.3.2 Tokyo

The urban transport system of Tokyo can be ranked among the most highly developed in the world. The system focuses on an intensive use of high-speed, frequent, and reliable rail services. Comprehensive development planning for Tokyo Metropolitan Area is largely based upon long-term land use policies, controlling population and employment concentration in central Tokyo. Also Tokyo's car ownership is controlled via various motor vehicle taxes (including a vehicle acquisition or excise tax, an annual automobile registration tax, and a surcharge based on vehicle weight), relatively high gasoline taxes and constraining car ownership according to the availability of an off-street parking space. The rail system in Greater Tokyo has benefited from terminal (re)development. Station plazas with pedestrian-friendly environments and intermodal facilities such as bus terminals and taxi stands were constructed to enhance public transport integration. In addition, the development added commercial functions/space to the terminals and was supported by improvement of traffic management in the surrounding area. These infrastructure developments were further enhanced by an improved rail services and integrated feeder services.

[26] *Review of Urban Public Transport Competition* op. cit., Annex A (consists of descriptions of a high number of public transport services worldwide)
[27] *Study on Urban Transport Development - Final Report*, op. cit.
[28] *Urban Public Transport Systems Integration and Funding*, op. cit.
[29] See for more details *Hamburger Verkehrsverbund HVV: 30 Jahre HVV*; HVV, Hamburg, 1995. More details on additional schemes can be found in *Urban Transport Strategy Review: Experiences From Germany And Zurich*, op. city.

Using rail stations as centers of suburban development increased transit ridership and improved the financial performance of the urban transport system.

Tokyo's metropolitan public transport system consists of different public and private operators and their networks are extremely well connected. If necessary there is, for example, agreement to run the same train on the rail lines of different operators to eliminate the passengers' need for changing trains. Buses are operated both publicly and privately and complement the rail network in providing feeder services. Bus operations are therefore strictly regulated by the government particularly in terms of the fares as well as entry into and exit from a particular route or area.

2.3.3 Nagoya

Nagoya, with a population of 2.16 million, is located in the center of the Chukyo Metropolitan Region, one of the three major metropolitan regions in Japan. Contrary to most other Japanese cities, Nagoya has a high share of private cars in its modal split. Automobiles account for almost 70% of total trips, compared to 24.5% by rail and 2.5% by bus. This modal split has led to relatively light use of public transport systems. The rail network in the city of Nagoya totals about 174 km of route length, and as with other large cities in Japan, the bus route systems in and around Nagoya are operated both publicly and privately primarily as a mode to complement the rail network or to provide feeder services.

In the late 1970s, the city of Nagoya initiated the introduction of new bus rapid transit systems. The system was not intended as a feeder mode to railways but as an independent public transport system with following efficiency improvement characteristics:

- The use of center lanes as exclusive bus lanes with the bus stops constructed in the median space;
- Installation of bus priority signals;
- Bus stop spacing substantially longer (800-900 m) than that of ordinary buses, thereby increasing average speed;
- Use of higher capacity (larger) vehicles.

A total of 81.4 km of route length was proposed (divided in 8 bus routes), and the city's Transport Bureau began operating the first route (10.5 km) in 1982. This first system used side lanes, not achieving expected average speed and on-time performances.

The use of center lanes began in 1985 with the inauguration of the 10.2 km long Shin-Dekimachi Route which had following operational characteristics:

- High-frequency operation with 1-2 minute peak-hour headways and about 3-minute headways during daytime of-peak hours;
- Exclusive use of the lanes during peak hours (7:00-9:00 and 17:00-19:00 on weekdays) and priority use during off-peak hours;

- Use of the integrated commuter passes and coupon tickets for both Municipal Bus and Meitetsu Bus services (private operator);
- Flat fare along the route with discounts for transfers to other routes.

The effect of this system was generally favorable and quickly demonstrated

- An increase in bus ridership along the route (from 20,200 riders per day to 23,500);
- An increase in the average operating speed from 15 km per hour to 20 km per hour;
- Modal shifts from other transport modes to bus;
- Decrease in automobile traffic along the route by about 20 percent.

A Committee was established composed of the representatives of all concerned agencies to deal with engineering problems such as the installation of bus stops in center of the road, the use of exclusive bus lanes, bus fleet specification and traffic control systems.

As a result of these discussions, it was decided in the 1990s that one of the remaining routes would be developed as a "Guideway Bus System" where buses run on an exclusive busway (guideway) constructed above the median strip of existing roads. The system offers high-speed and high-capacity bus transit services and on-time performance guarantees. The Guideway Bus System optimized the use of available transport infrastructure by separating bus operations from other road traffic in the city center while outside of the city center, buses run on existing roads and integrate with existing bus routes in suburbs. The "dual" system allows:

- Guideway infrastructure development in stages;
- Extension when warranted by increased demand;
- Reduced capital requirements; and,
- Future conversion of the existing system to LRT system..

It is estimated that system will accommodate about 36,000 passengers per day in 2008.

2.3.4 Hamburg

Public transport integration in Hamburg was achieved in 1965 with the establishment of Hamburger Verkehrsverband (HVV). Its policy was condensed in the slogan "**one timetable, one tariff, one ticket**". The HVV is run and controlled by public authorities (structured in the Board of Directors and the Supervising Council) and is advised by a formal Advisory Council with representatives of the various operators and an informal Users Advisory Committee that represents the users of the public transport network.

HVV represents the common interests of the public transport system. It therefore draws up infrastructure development plans, regulates and plans operations (lines, routes, transfer stations), defines quality stations and controls and coordinates the different operators.

With the integration of the public transport system offer in mind, the HVV draws up the system's plans, identified required services and sets tariffs based upon a zoning system. A significant feature of HVV is the Competenz-Center Wettbewerb or KCW which promotes and controls free competition between the various operators. KCW therefore closely monitors evolutions in that field in Germany and Europe.

The public network is operated by a private company (Regieorganisation HVV GmbH) with following shareholders:

- Freie und Hansestadt Hamburg (Gesellschafteranteil: 83.5%)
- Land Schleswig-Holstein (2%)
- Landesnahverkehrsgesellschaft Niedersachsen mbH (1%)
- Kreis Herzogtum Lauenburg (2.5%)
- Kreis Pinneberg (3.5%)
- Kreis Segeberg (2%)
- Kreis Stormarn (5%)
- Landkreis Harburg (0.5%)

At present, HVV has achieved full integration of public transport at all levels (hardware, software and humanware). The HVV integrated network and tariff zoning system is depicted in Figure 2.3.1. Commuters access the system with one single ticket.

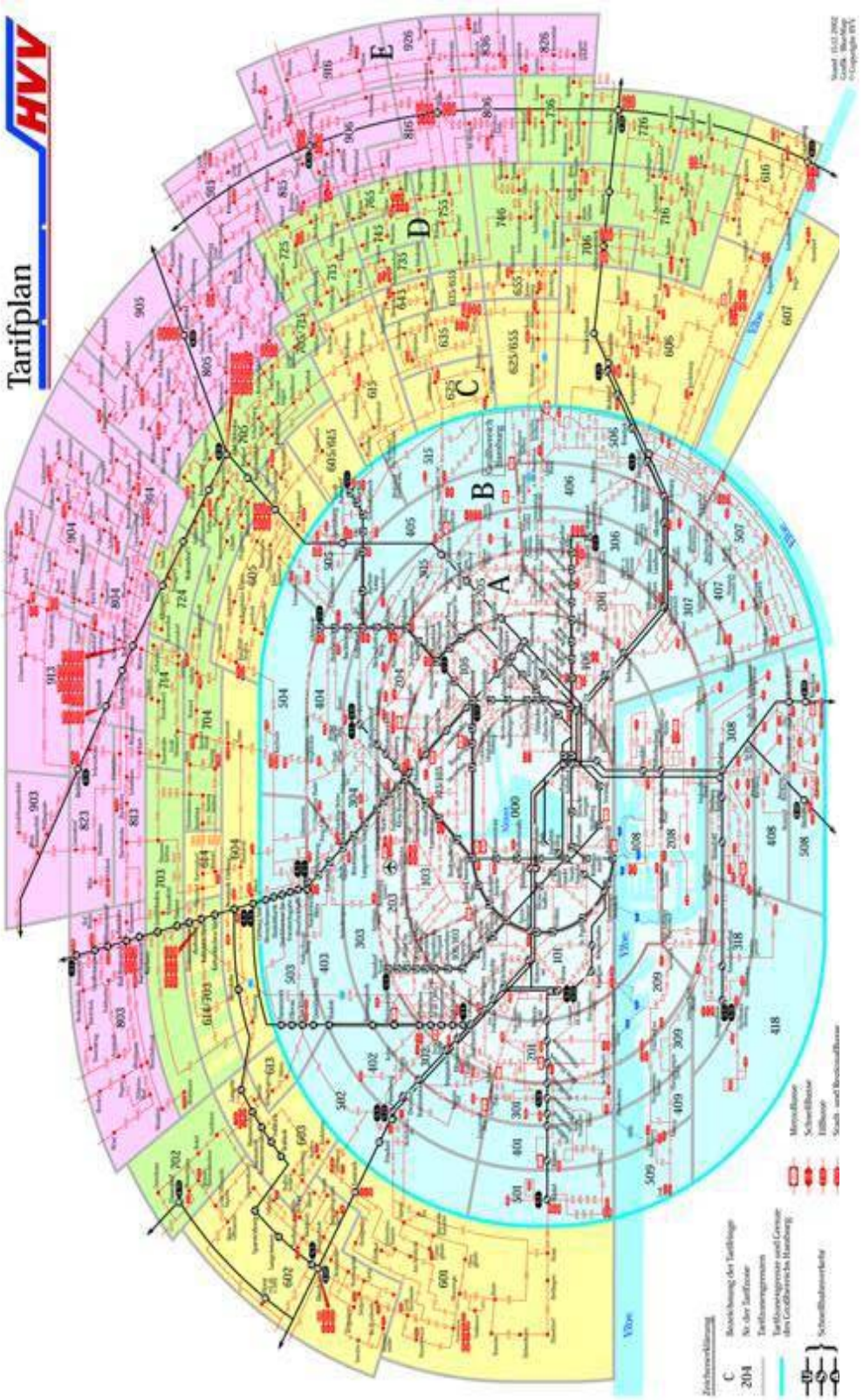


Figure 2.3.1 HVV Integrated Public Transport Network

Source: HVV –2003, op. cit.

2.3.5 Madrid

Public transport in Madrid is operated by three large operators:

- The Madrid Metro (underground rail transit system) owned by the Madrid Transport Consortium
- The EMT (Madrid Municipal bus services) owned by the Madrid Municipality.
- Renfe-Cercanías (suburban railways) owned 100% by RENFE, the Spanish National Railways System, a Government-owned Company.

There are also a number of concession-holders for interurban coach services and the Transportes Ferroviarios de Madrid, (TFM) a privately owned railways transport system that operates the Arganda Railway.

The responsibility for scheduled public transport of passengers in the Madrid Community has been assigned to the Madrid Transport Consortium (CTM), which was established by Law 5/85 of 16th May 1985 of the Madrid Assembly to build an integrated transport system in the Autonomous Community aimed to improve the technical, administrative and management co-ordination between the different transport modes and the various operating companies.

The Consortium was aimed to centralize in a single agency responsibilities of different government levels (autonomous and municipal) that, as an autonomous institution, would be the sole authority in the field of scheduled public transport passengers services, while avoiding any encroachment in the management area for which operators are responsible.

Since the establishment of CTM, public transport improved significantly, an improvement that was accelerated when the transit multi-mode “Commuter card" became available in 1987. Since than, CTM is the sole authority in questions related to passengers that include:

- Overall planning of passengers transport infrastructures;
- Definition of coordinated operations programs for all modes of transport; and,
- Provision of an integrated tariff scheme for the system, through the establishment of tickets or cards valid for all the companies.

The integrated ticketing system is controlled by CTM, which is allowed to apply mix modes commuter tariffs, introduce changes in private operator concessions and if necessary, unify the different concessions to ensure that the fixed objectives are achieved.

Integrated tariffs for all services and operators was and remains a prime target for CTM and is organized according to “transport zones” on which a multimode tariff system is applied (Figure 2.3.2).

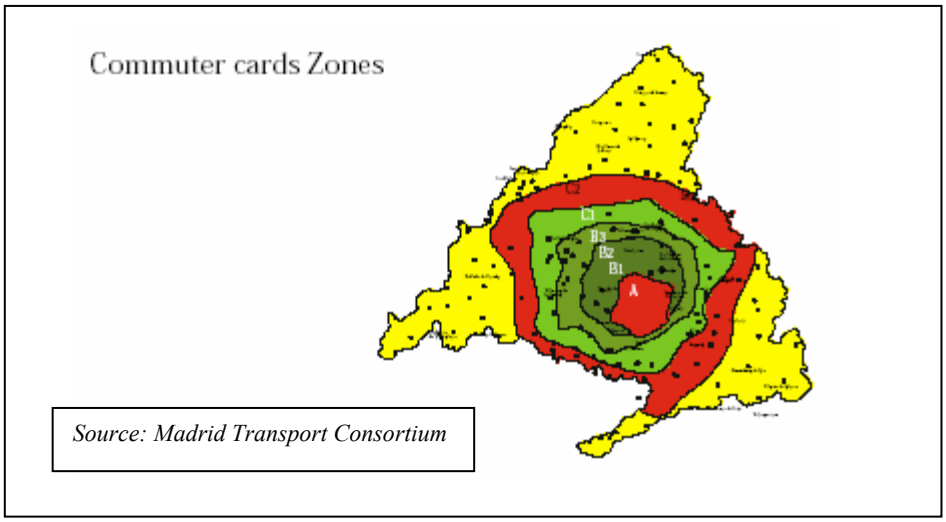


Figure 2.3.2 Madrid Public Transport Zoning System

The tariff scheme is fully integrated and tickets of the following types are used:

- Single tickets, depending on the transport company and zone connections;
- 10-trip tickets for inter-zones connections, which is an integrated or mix mode that entitles passengers to ride on the underground transit system (Metro) and Madrid Municipal Buses (EMT). Ticket use is expanded by companies for use outside Zone A.
- Commuter cards, a multimode-type ticket that allows unlimited use while in effect (monthly or annual).

CTM receives all revenues from multimode tickets and redistributed to the participating transport operators, to keep the revenue situation as it was before this mix mode ticket was introduced.

2.4 INTEGRATED PUBLIC TRANSPORT: PRACTICES IN DEVELOPING COUNTRIES

2.4.1 Introduction

Mega-cities in developing countries are confronted with escalating traffic problems that directly affect the environment, economic development and social welfare. "*Service quality is hampered by the deregulated, unplanned and disarrayed service supply…. As for the routes, these are established …by the operators based on their convenience…. [To] catch more passengers, operators resort to zigzagging routes that penalise most of the other passengers*"[30].

A common feature of many public transport systems is their complete absence of integration. Inner-city and inter-city public transport systems have no interconnecting terminals and passengers on inner-city public transport need to

30 *Master Plan for the Municipality of Managua*, JICA, 1998; cited from *Urban Public Transport Systems Integration and Funding*, op. cit.

walk long distances when changing from one mode to another. Ticket integration or organizational cooperation is lacking (or boycotted) to initiate (partial) integration of public transport.

Important funds are therefore made available by donor countries and agencies to stimulate / improve public transport as a means of reducing congestion. Although errors are made and initiatives fail, many prove to be highly successful, as will be demonstrated in the few examples hereafter.

2.4.2 Bangkok

To tackle Bangkok's congestion problem, the Government took various measures to improve bus services among which exclusive bus lanes and reverse lanes, resulting in a considerable increase in average bus speeds and a reduction in travel times of 38%[31].

Bangkok is presently served by a wide variety of transit types[32]:

- Buses of various configurations including full-size standard and articulated vehicles (with and without air-conditioning), minibuses and microbuses. The Bangkok microbus actually provides an upper-end service with air conditioning, guaranteed seat, reading materials and video.
- Para transit modes among them tuk-tuks (three wheeled vehicles largely used in small side streets), silors (vans typically operating away from main roads) and soengtaw buses (in essence, light trucks with bed converted to hold two facing rows of seats, and operating primarily in outer suburban and fringe rural areas).
- Taxi services provided by both passenger cars, vans and motorcycles (the latter being a legacy of Bangkok's notorious traffic jams).
- Ferries on the Chao Phraya River.
- Urban rail mass rapid transit services along both elevated and below-ground alignments.

The Bangkok bus system has evolved along a layered concept with services provided by both the public and private sectors. Each layer of services is typified by an implied quality (size and type of vehicle, air conditioning, service philosophy, guaranteed seat) and range of fares. Approximately 10,000 buses operated in Bangkok at the end of year 2000. This fleet included 4,197 buses owned and operated by the Bangkok Mass Transit Authority (BMTA), 3,428 buses operated by private subcontractors to the BMTA, and a further 2,413 buses

[31] *Study on Urban Transport Development - Final Report*, op. cit.

[32] *Technical Report (3): Urban Public Transport Perspectives* as part of *Transportation Master Plan and Feasibility Study of Urban Transport Projects in Greater Cairo Region in the Arab Republic of Egypt*, prepared for the Japan International Cooperation Agency and the Higher Committee for Greater Cairo Transportation Planning, by Pacific Consultants International, May 2002.

licensed by the Land Transport Department. The fare structure can be seen in three generic groupings[33]:

- Flat fare, low. Typically non-aircon services (3.5 Baht) and a limited number of aircon vehicles (5 Baht).
- Flat fare, high. Typically premium services with fares ranging up to 20 Baht. For example, the 863 luxury microbuses operate within Bangkok on selected principal routes. This service directly competes with BMTA services but it can be see the fixed fare is relatively high (i.e. 20 Baht) but the average trip length on these buses is 18.2 km. Until about a year ago the fare was 30 Baht but the decline in economy forced this downward fare revision.
- Distance proportional. The majority of aircon services levy a distance proportional fare ranging from 8 to 18 Baht. The segmentation is approximately eight Baht for the first six trip kilometres, plus two Baht per additional two kilometre sector up to the stated maximum.

Since December 5th 1999, the first 23.5 km long urban rail transit system, the Skytrain, links the city center to the north and the east and to the south. The system is operated under a 30 year concession contract by Bangkok Mass Transit System Co. Ltd. (BTSC), a subsidiary of Tanayong Group. Although originally proposed as a light rail network, it is now a heavier system, elevated 12 meters above street level with 23 stations. In February 2000, the Thai Cabinet approved three extensions that will add 20 km to the existing system. BMTA has not (yet) responded in any way to the introduction of MRT either in the establishment of feeder bus services, modifications to existing routes or reallocation of buses to other routes. This management hiatus in BMTA can be gauged from the fact that the new MRT service has introduced its own integrated feeder bus service at a number of stations.

Parallel to it, the Metropolitan Rapid Transit Administration (MRTA) is presently constructing an MRT system that includes two interlinked sections (the Blue Line), one running east-west in the southern part of central Bangkok, and the other going from south to north and then towards the west. Over a total length of 20 km of route, 18 stations have been constructed. Originally planned to be an elevated system, it was transformed into an underground network for passing the city center. The MRT system will be operated by the private sector under a 25 year concession agreement. In 1995, Thai cabinet already approved a further extension of the blue lines towards the northwest and southwest but it is still unclear whether it will actually be constructed or whether the project will remain on the drawing board.

Although public transport is well developed in Bangkok, the level of system integration is low, due to several reasons. Historically BMTA has adopted only an operational policy and has refrained from introducing policy measures which reflect changing community requirements. It is true that there has been a gradual switch towards air conditioned services and a reduction in non air conditioned (fixed fare) services. However, for the most part the BMTA has continued its

[33] Passes are also available on the BMTA system.

present bus operations with no apparent regard to the introduction of MRT services. This situation could change in late 2003 or early 2004 when a MRT system is introduced. A second issue is the problem of overlapping responsibilities among the various agencies responsible for urban rail transit development. The three MRT projects in the 1990s are under control of different agencies and Expressway and Rapid Transit Authority of Thailand (ETA) still can undertake rail mass transit projects although it has historically put more emphasis on expressway development. Consequently, transport (master) planning is superficial and uncoordinated and lacks integration, therewith hindering any effective integrated system development.

2.4.3 Bogota

Santa Fe de Bogotá, the capital city of Colombia, is experiencing urban transport problems caused by insufficient transport facilities and a rapid growth in population. Since Bogotá does not have an urban railway transport system, road traffic is becoming heavily congested due to increasing car ownership. Urban public transport services function under the jurisdiction of the Secretaria de Transport y Transito (STT) of City of Santa Fe de Bogotá. The Public Transport Unit (UTP) of the STT has jurisdiction over public transport administration in Bogotá, and is composed of four divisions: Transport Legalization Division, Route Division, Cost/Tariff Division and Transport Company Division. The transport enterprises are in charge of the public transport services for passengers. There were 93 companies licensed for public transport in 1995, who operated a fleet of 21,695 buses of varying configurations.

Two generic types of public transport operations exist in Bogotá: passenger mode and mixed mode.

- The passenger mode allows exclusive transport of passengers under different kinds of vehicles.
- The mixed mode allows for the simultaneous transport of passengers and cargo (boxes, bundles and packages) in buses and busetas (minibus with an average capacity of 28 passengers); additional charges are levied depending on the types and quantity of cargo.

Different types of service categories and vehicles are employed in the transport of passengers:

- Ejecutivo: Service that is provided using relatively new buses or busetas at reasonable levels of comfort. No standing passengers are allowed. Different levels of service are stratified by type, model and comfort of the vehicles. In general, ejecutivo class implies vehicles less than seven years old, and super ejecutivo vehicles less than five years old.
- Corriente: Service using buses and busetas of different makes and models. In general, vehicles are older and of less comfort than those used for ejecutivo class service. Standing passengers are allowed, but may not exceed authorized

capacity. The fare levied is dependent upon the vehicle and service type offered.

- Taxi Colectivo (or microbus) are vehicles employed in regular service with an average capacity of 13 passengers.
- Taxi: Regular sedan taxicab with the capacity of four passengers.

The fare structure is pegged to vehicle type and service class. In 1995, the basic daytime corriente class fare ranged from 100 Pesos (very old vehicle) to 300 Pesos (very new vehicle), while the daytime fare for the super-ejectivo class reached 370 Pesos. Night time fares were some 30 Pesos higher than daytime fares. Night rates are levied between 2000 hours and 0500 hours, as well as for all Sunday and holiday operations. Flat rates are universally applied following an agreement between the Administration and the companies which represent the different unions. The present agreement increases fares in steps, with a maximum increment of 18 percent in any one year, according to the Pacto Social. Microbus and vehicles for higher levels of service such as ejecutivo and super ejecutivo have a limited library of fare setting.

Fares are reviewed quarterly by the STT and increased, in general, in line with the unit price index. The Alcadia Mayor de Santa Fe de Bogotá and the STT are in charge of implementing the fare policy for the mass transport system in the Capital District. The city has had a policy of differential fares since 1985, so that the users will have different alternatives and to promote investment in new vehicles and improvement of the quality of the service.

The STT is the entity that is in charge of authorizing the routes to the companies by resolving the alignment by direction of circulation for each route, schedule, frequency, type of vehicles and level of service. Routes are classified by type of journey as:

- Circulation Route; anchored at a single terminal and using either an open route (looping one-way service along multiple roads) or a closed route (point to point two-way operation along the same roads or within the same catchment area).
- Diametric Route; anchored at two terminals that are placed at both ends of the route and serving a single catchment area.
- Peripheral Route; generally linking various catchment areas.
- Mixed Services Route; generally anchored to one or more of several wholesale markets.
- Informal Transport; being a transportation mode that serves those catchments in which formal public transport is inadequate or non-existent. This service generally consists of older vehicles or colectivos, whose owners are organized into small companies and operate under their own conditions and fares without any control by the authorities. This service is illegal; yet while it catalyzes major problems, it also provides a valuable mode of transport for residents of those catchments in which no alternative forms of public transport exist. Schedule depends upon the operator and route, with some being active 24

hours per day, others only early in the morning and late at night. Headways are generally very good and fine-tuned to needs of the traveling public.

Four main problems were identified for the current bus system in Bogotá. These include routes which are too long, a proliferation of routes, need for rationalized services and fares being too low. In response to these concerns, a two-phased approach was implemented with the initial task being the conduct of a Transport Master Plan Study[34] whose output addressed a variety of multi-modal needs including bus priority measures, in particular the implementation of a trunk bus route system. The second phase[35] involved the actual planning of the trunk bus system, its near-term and far-term implications in terms of demand and effectiveness, impacts upon transport in Bogotá and finalization of initial engineering plans.

With introduction of the trunk bus system, it was demonstrated in the Master Plan Study that operating speed can be improved up to 20 km/h for trunk bus operation and 30 km/h (or more) for express bus operations. The bus track is planned both in the center of the road (median) and along the sides (lateral), depending on the road width, physically segregating buses and other traffic along their entire length using curbs or fences. In order to reduce dwell time at bus stops, a flat fare plus additional far at every transfer was recommended. A high reliance on automation, fare cards and other intelligent systems is further expected to reduce dwell times and optimize boarding/alighting procedures. At present, two trunk busways are operational, being the Autopista Norte - Avenida Caracas and Calle 80 roads. Peak hour volumes has totaled more than 34,000 persons, total both directions of travel[36].

2.4.4 Curitiba

There has been a clear preference in Brazil for policies that give priority to bus transport as it is assumed by all levels of government that it is possible to improve bus transport capacity through different measures. Many successful schemes result from a combination of measures such as trunk and feeder systems, better on-board or off-board automatic fare collection systems, bus priority traffic signal systems etc…. Findings from a survey of 19 busways confirm that recent average bus operating speeds ranged up to 40 km/hr (Anhanguera busway in Goiania) while highest recorded one-way bus flows were 431 inbound buses per hour (morning peak) and 359 outbound buses per hour (evening peak) along the Santo Amaro / de Julho busway in Sao Paulo[37]. This particular facility features single

[34] *The Urban Transport Master Plan Study in Santa Fe de Bogotá in the Republic of Colombia*, prepared by the Japan International Cooperation Agency for the Municipality of Santa Fe de Bogotá and the Government of Colombia, 1996.

[35] *The Feasibility Study on the Project of Highway and Buslane of Santa Fe de Bogotá in the Republic of Colombia*, prepared by the Japan International Cooperation Agency for the Municipality of Santa Fe de Bogotá and the Government of Colombia, 1999.

[36] See for more details on the Bangkok and Bogotá public transport system: *Technical Report (3): Urban Public Transport Perspectives,* op. cit.

[37] *Update on Busway Priority Systems in Brazil*, published in Smart Urban Transport, Volume 1, Number 2

lane operation using high-capacity buses and with overtaking opportunities at bus stops.

With the 1965 Master Plan, Curitiba outlined as one of the first the main goals of limiting central area growth and encouraging commercial and service sector growth along two structural north-south transport arteries, radiating out from the city center. The structural transport axes guaranteed linear development of the city and reduced transport focus on the downtown area. The plan promoted the integration of traffic management, transportation, and land- use planning to achieve its goals. The Master Plan also resulted in the creation of the Institute of Urban Research and Planning of Curitiba (IRPUC).

The City of Curitibia was one of the first in Brazil to plan and implement bus priority facilities. Even with one of the highest automobile ownership rates in Brazil and with a significantly higher per capita income than the national average, around 70 percent of Curitiba's commuters now use transit daily to travel to work. In 1980, a social fare was established by which the shorter routes subsidized the longer routes, allowing all passengers to pay a single fare and make transfers on the entire system with their tickets. In order to fulfill the goals of the Master Plan in providing access for all citizens, the arteries were modified over time to give public transport the highest priority.

Because vehicle movements are unimpeded by traffic signals and congestion, fare collection prior to boarding, quick passenger loading and unloading, Curitiba has one of the most heavily used, yet low-cost, transit systems in the world. But the most innovative feature of the Curitiba network, which has allowed it to reach LRT capacities, are the tubular boarding stations on the main routes (Figure 2.4.1). Fares are paid at a turnstile in the tube before boarding the bus over a nearly level ramp. Passengers board at the front and exit at the rear, which has reduced stopping time and increased peak capacity.

The popularity of Curitiba's Bus Rapid Transit system has led to a modal shift to public bus in spite of the high rate of car ownership. Bus Rapid Transit reduced private transport with about 27 million auto trips per year. In particular, the Bus Rapid Transit system carries 50 times more passengers than they did 20 years ago, generating at present negligible emissions levels, little congestion, and a pleasant living environment.

2.4.5 Izmir

The 1.5 million residents of Turkey's third-largest city Izmir are near using a multimodal smartcard payment system developed by systems integrator Kent Kart ('City Card' in Turkish). The deployment follows an earlier decision to upgrade and promote more effectively the mass transportation network of the city.

Figure 2.4.1 Curitiba Tube Station Concept

Apart from its resident population of 2.1 million – projected to rise to 3.5 million by 2025 - Izmir plays host each year to hundreds of thousands of tourists taking advantage of its climate and the opportunity to visit nearby classical sites such as Ephesus. At the same time, business traffic is attracted to the country's main export port and the Izmir International Fair Complex, the home of the largest annual trade fair in the Middle East.

The smartcards are valid on over 1,500 buses run by six operators, ten stations on the first phase of Izmir's new light Metro, six ferry terminals and five gates of the Izmir International Fair Complex. The initial 11.6km metro line, on which some 80,000 passengers a day now use Kent Kart, opened in May 2000 from Bornova, at the north eastern edge of the city's built-up area, to Uçyol, three stations southwest of the main Basmane terminus of Turkish State Railways. A significant percentage of metro passengers start their commuting journey by bus or ferry and take advantage of new interchanges which the Greater Izmir Municipality has developed, such as by reorganizing bus routes. "*All of them*", reports Ibraham Koç, general manager of Izmir Metro AS, "*are helped by the new multimodal ticketing system. Based on this early success, we have clearly started on the*

process of reducing Izmir's dependence on the bus and private cars for peak-time travel"[38].

The Kent Kart system has also boosted numbers of passengers using ferries to cross Izmir Bay, in preference to making long bus journeys round its perimeter. Passenger numbers have risen from 22,000 to 45,000 a day. The Municipality is currently planning a network of park and ride sites, alongside the five parking garages which it currently operates, and these will be integrated into the card system. The system also has retail capability.

Fares are structured to encourage the use of Kent Kart cards in preference to paper tickets, with savings on all modes, including the city's four distinct bus route mileage categories – all of which charge the same paper-ticket price. In the interests of reducing road congestion, savings are greatest on the Metro, ferries and the new short-haul feeder bus routes. Kent Kart holders using a feeder-line service pay less than half the long-route fare. The Municipality plans to use the system to encourage multi-modal travel by introducing transfer benefits. Passengers using Kent Kart will pay either nothing or a discounted rate for a second ride within an hour of their first.

Card formatting is completed by Kent Kart's private bank partner, which allocates fare revenues between the city's various operators. Cards can be loaded and reloaded at Kent Kart's own office in the city's main square, as well as at 280 points located throughout the city that transmit loading data to the company's host computer. Usage data from ten bus depots (where buses download revenue data) the ten metro stations, six ferry terminals and the fare complex are sent to another computer in the headquarters of the Greater Izmir Municipality. The two computers exchange data each night after midnight.

The launch of the system was heralded by an extensive awareness campaign, involving publicity on buses, face-to-face meetings with commuters and specially-commissioned films on card usage that were shown on local TV and on large screens in the city centre.

[38] *Izmir Goes Multimodal*, published in Smart Urban Transport, June 2003.

CHAPTER 3: A VIEW TOWARD POTENTIAL FINANCING MECHANISMS

3.1 INTRODUCTION

This attachment examines possibilities for financing the proposed transport projects considered under the CREATS Master Plan, in particular the proposed Supertram Line 1 as well as the East and West Wings public transport corridor projects. These have been discussed in previous chapters of this Final Report and, as indicated, investment costs required for realization are large. The magnitude of such an investment and the current scarcity of government funding for public transport projects requires that an examination be made of alternative sources of funding. The main component of this chapter is therefore to address the following questions:

- Given the constraints of government budget allocations, how can the main project components be financed?
- Can the private sector contribute to the financing of these proposed projects and what form does this participation take?

It is noted that all Phase II projects have been subjected to rigorous economic and financial feasibility reviews, findings of which are presented in the main body of this report. This attachment provides a broader perspective as well as background and focuses on four typical models of financing the capital investment and operations of public transport systems.

An evaluation of the types of mechanisms that could be made available to fund these models is a complex issue. This chapter confines the discussion to general principles only. In practice, finance from various sources could all be combined for one project. As an example, it is perfectly possible for a government and an international development bank to be involved in a private sector initiative such as a BOT (build-operate-transfer) project. At the conclusion of the discussion in this attachment, some initial recommendations are tendered regarding the most appropriate form of financing, in terms of the models stated above, for Cairo public transport at this present time. Although three types of public transport projects are considered (busway to 6th October City at the beginning of the master plan period followed by upgrading to rail technology when demand is sufficient and towards the end of the master plan period; a rail line to 10th Ramadan City;

and the proposed new Supertram Line 1 in the East Sector of Cairo), the major investments required for each system indicate that the financing patterns will follow similar patterns. This is even the case for the proposed busway. The types of vehicles ultimately envisaged for such a scheme, in order to fulfil demand, are expensive and will need to be imported. Where reference is made to the Supertram line, the same principles can also be generally applied to the other proposed projects under investigation.

3.2 TRADITIONAL FORMS OF GOVERNMENT SPENDING IN PUBLIC TRANSPORT

In the past and throughout the world, urban public transport funding for large infrastructure projects has tended to come from state or municipality sources. Finance for this is either from government sources or, and more particularly in the case of developing countries, loans or grants from international development banks, which are channeled through the government. In both cases, however, this necessitates either a one-off appropriation from current government budgets or a loan repayment from tax revenues over a period of years. Revenue deficit has also been funded from government sources. Similarly, urban public transport operations were the responsibility of and were carried out by state or municipality enterprises.

Three types of finance are available to the government. These types of finance are

- Internal funding from government sources
- Loans and grants from international development banks
- Bond issues for financing infrastructure projects

3.2.1 Internal funding from government sources

Funding from purely government sources for the proposed transport projects could come from two areas:

- From budget allocations from the Ministry of Finance
- From grants or loans from the National Investment Bank, which is now part of the Ministry of Finance

At present, the funding of revenue deficits for the CTA is the subject of negotiation between the authority and the Ministry of Finance. Annually, the authority prepares a statement of the shortfall between revenues, particularly from tickets, and the cost of operations. It is believed that, in general, the authority does not receive sufficient amounts to fill this shortfall gap. Therefore, cost savings are required and this is reflected in an inferior quality of service being given.

The CTA does receive finance annually, for example, from the National Investment Bank for the purchase of new buses but interest rates charged for this are high.

Past experience has demonstrated that finance has been difficult to obtain for public transport for Cairo. The construction of Metro Line 1, with the exception of rolling stock, was financed by the government of France. Metro Line 2 was funded by the Egyptian government, through the then Ministry of Transport and Telecommunications. It may well be that part of this finance may have come from non-transport sources i.e. from finance generated from the more prosperous telecommunications sector. Currently, there are some uncertainties regarding the financing of the proposed Metro Line 3.

The Egyptian government has reduced it's debt exposure over the past twenty years, according to World Bank statistics. In 1981, the ratio of all debt to GDP was 94.3%. This decreased to 67.3% in 1991, and to 29.2% and 28.6% in the years 2000 and 2001 respectively.

The level of gross domestic investment to GDP has also decreased. Also according to World Bank statistics, the ratio of gross domestic investment to GDP was 29.5% in 1981, decreasing to 21.2% in 1991, and to 18.3% and 16.9% in the years 2000 and 2001 respectively.

At the same time, the share of the private sector as a percentage of GDP has been steadily increasing from 63.3% in 1993 to 74.9% in 1999. More recent figures, which cover the period when economic growth has been slower, may reflect a reversal of this trend but, in the long term and if the government's privatisation process continues, the contribution of the private sector is likely to remain at the 1993-99 levels or increase.

Overall, a reasonable conclusion is that finance drawn from government sources, for financing public transport expenditure, is much more unlikely at present than twenty or so years ago when the government took a much more direct role in the economy. A further conclusion is that the private sector will have much greater role in the future.

3.2.2 Loans from Development Banks

Loans from development banks form one of the most desirable measures of funding capital investment projects. Typically, loan terms and conditions are extremely favourable. Although conditions will vary from project to project, the loans from the World Bank (IBRD), for example, will generally be over a period of 22 years (5 years grace period, followed by a 17 years repayment schedule). Of interest, however, is the requirement of the proposed project to fit into a development bank's wider objectives and strategies. Institutional reform within a country is one component of the World Bank's overall objectives and an investment project that contributes towards this is more likely to be acceptable than a project that does not. In addition to this, the IBRD can provide guarantees where the private sector is exposed to risk which it may not be able to manage. In the case of concessions where there is a possibility that a government cannot meet it's obligations, and where it is either the regulator or the purchaser of the services provided, the Bank is able to provide project-based partial risk guarantees to lenders for private debt.

The Japan Bank for International Cooperation (JBIC) has favorable terms, of the order of 1.3%, with a 7 – 10 year grace period and an overall repayment period of over 30 years. Also as part of the financial package, a grant element of 25% or higher is provided.

The international development banks are often crucial to developing multi-financing for projects. The commitment of the development bank, even though the level of financial contribution may be small, may be the deciding factor in encouraging other potential financers, such as private banks or private investors, to participate.

Funding from international development banks provide the most promising recourse for obtaining finance. As shown above, the terms and conditions are highly favourable and allow the government to allocate much needed resources to other sectors of the economy. It should also be stated, however, that it is often the case that development loans come attached with some form of conditionality. Therefore, it may be that a requirement of such a loan is conditional on the government showing that it is also undertaking some form of institutional reform in the same sector as the proposed project.

The funding of revenue deficits, for public transport, is unlikely to come from an international development bank.

3.2.3 Bond Issues

Although not extensively used throughout the rest of the world, the United States being the noteworthy exception, the issuing of bonds may form one element by which a transport investment project is funded. Alternatively, the use of bonds may be used in conjunction with other loans and equity shares. Over $200 billion of public finance bonds were issued in the United States in the year 2000. This is much greater than elsewhere (Canada and Europe) where total issues were less than $30 billion in individual countries.

An example of part funding public transport infrastructure through bond issues is that of the New York Metropolitan Transit Authority (the MTA). A five year, $17.5 billion program, for the period 2000 – 2004, has been proposed by the Authority for an upgrading and expansion of the city's transport system. The program is composed of $6 billion from government sources (mainly federal and New York city), $3 billion from restructuring existing bond issues and a further $8.3 billion from the issue of revenue bonds. Revenue bonds are bonds which are backed by an identifiable stream of revenues. In the case of the MTA, the revenues are mainly from ticket fares and toll roads.

This recourse to bonds has, in the example of the MTA, been due, in particular, to a reduction in state funding. This level of support has decreased over time. During the 1980's to the mid 1990's, direct government support (including both state and federal authorities) to the MTA was just under 60%. For the 1995-99 program, this support was 40% of the program and under the 2000-2004 program, decreased even further to 32% of needed resources.

It should also be stated that some controversy has been generated by the MTA's financing plans, particularly concerning the pressure that would be put on operating budgets from the high levels of debt service.

In addition to New York, a current debate is taking place in the United Kingdom regarding how the London underground system is to be financed in the future. The UK government intends that a public private partnership should run the city's metro system. However, alternative proposals, prepared by the mayor of the city, have been presented, with one of the main sources of finance coming from the issue of revenue bonds. These proposals have been based on the arguments that bonds are cheaper than using the private sector for accessing additional funds and that also greater managerial efficiency could still be introduced in the current system. Bond issues have also been used to arise money for French railways.

In Egypt, the bond market has increased considerably over the last ten years. The first bond issued in the country was in 1951, by a real estate bank. The duration of the bond was over 50 years. The first treasury bonds were issued in 1995, as part of the government's reform program. In that sense, the government financed it's expenditures through borrowing rather than increasing the money supply. The nominal value of this first treasury bond was 3 billion LE, over a period of 5 years. The nominal value of this bond was increased in 1996, at an interest rate of 7.2%.

Private banks also started major issues of bonds in 1996/97. The real estate bank mentioned above had an issue with a nominal value of 100 million LE, interest rate of 12% and a period of 7 years. The bond issue was over-subscribed, demonstrating that a demand for differing types of bonds existed in the country. From 1998, private companies began to make significant issues of bonds. The Arab Contractors company issued a corporate bond with a nominal value of 40 million LE, for a 3 year period and with an interest rate of 10%. Following a government decision, and in order to encourage more bond transactions, a company is allowed to issue bonds at a greater value than it's asset value.

As an indication of the size of the Egyptian bond market, the nominal value of all bonds (both listed and unlisted) in issue was 19.89 billion LE in April 2002. Approximately 71% of these were government bonds. Corporate bonds accounted for 14% of the market.

The use of bonds has several attractions over the use of concession type projects. Firstly, governments generally have access to cheaper finance. Therefore, a bond either guaranteed by a government or fully backed by a strong stream of revenues would have a low interest rate, perhaps at rates below 5% - 6%. This compares with equity returns, required by shareholders, of often 2-3 times higher than this rate. A second advantage could be that the government would retain control over all aspects of the investment and operations, whilst ensuring that better management is in place to implement the investment. A third advantage would be that there are some significant development cost savings from raising funds through capital markets rather than the often complicated and costly contract negotiations that are required when developing concessions.

Disadvantages include the substantial level of debt that must be paid off over the lifetime of the project. In the case of the New York MTA, annual debt service costs were estimated to increase from $600 million in 1998 to $1.4 billion in the year 2004. A second disadvantage would that financing investment through bonds does not necessarily increase efficiency incentives. These incentives are more likely to be established under a regime, such as a public private partnership, where sponsors require greater rates of return on investment, which would put pressure on greater efficiencies to be enforced.

In summary, the main drawback to the principle of issuing bonds for financing proposed public are two-fold. Firstly, the magnitude of the proposed investments would entail significant levels of debt service over a very long period, perhaps twenty to thirty years. In such a case, this would constrain financing in other sectors of the economy and would detract from government funding of likely revenue deficits in the field of public transport. Secondly, bond issues would have to be accompanied by sufficient guarantees that would create the most encouraging environment for potential investors. For a revenue bond, a guarantee would have to be given that the government is willing to provide additional finance to make up for any shortfalls in revenues from fares. Where a guarantee is not given then the amount of the bond issue will be much smaller and will be dependent on only ticket revenues received.

3.3 PRIVATE SECTOR PARTICIPATION

Trends worldwide, and particularly over the last ten years, have indicated that the traditional government approach is changing. In particular, there has been a much greater reliance on the private sector, both for financing projects and for the carrying out of operations. This trend is not confined to urban public transport but can be observed in many sectors including transport in general, utilities (electricity, water etc), health and education.

The driving forces behind such a change of approach can be considered as comprising of two main factors:

- Constraints on public funds and a desire to attract private finance; and,
- The harnessing of the greater productive efficiencies of private sector companies.

In the light of a framework of constrained access to public funds in Egypt, further examination must be made of the alternative sources of finances which are available to fund proposed public transport projects. This will concern both the financing of infrastructure and rolling stock (capital investment) and the operation of the proposed systems. At the same time, the question of the most efficient allocation of resources must also be evaluated. This particularly concerns whether an operation can be transferred to the private sector or whether it remains under state control.

This new approach is now commonly defined under the generic term Public Private Partnerships (PPP). This is where the public sector specifies the service requirement and, usually through tender, this is met by the private sector. PPP's are designed for situations where government's wish to retain a strategic role but also wish to utilize the greater efficiencies of the private sector and it's access to capital markets. A key concept of PPP's is ensuring that risk is correctly devolved between the public and private entities. Where the private sector is better able to contain risk, for example, construction, then this risk is transferred on the principle that 'risk should be allocated to whoever is best able to manage it'.

This concept of PPP differs from privatization whereby ownership of an asset is transferred from public responsibility to a private one and the state's role is withdrawn or transferred to a role of regulation only.

3.3.1 Attracting Private Finance

The main attraction for a government to encourage the use of PPP's is that the costs of an investment project can be spread over the lifetime of the project. This then is not recorded on the government's balance sheet as a one-off investment cost.

The main issues that are important to consider for private sector financing are:

- The level of foreign/domestic financing i.e. is there insufficient private capital available in Egypt and do the right conditions exist for the involvement of foreign companies.
- The debt/equity ratio i.e. can the right balance be achieved between the cheaper finance obtained through borrowing and the higher risk exposure, and therefore required higher level of rates of return, due to equity share?
- Co-financing/syndicates i.e. are there sufficient private investors willing to share in the risks of the project ?

From limited evidence, obtained from interviews undertaken during this Phase II study, it is clear that, in the long-term, there are sufficient private investors in Egypt who are willing to participate in capital investment projects. The section on BOT projects demonstrates that, if the conditions are right, there are significant possibilities for the private sector participation. Attracting foreign finance is more difficult, but not impossible, if the conditions are right. However, for a foreign private company to investment sufficient funds in a sector where revenues streams are less annualised cost streams, such as the public transport sector, the government will have to provide revenue guarantees.

It should be recognised that the private finance comes at a price. Government has access to cheaper finance, because of the inherent risk-free status of such an institution. In general, transport projects contain more risk than projects in others sectors of the economy. For example, the average level of debt to equity, in developing countries, for power projects has been estimated to be about 80:20. For transport projects, this ratio is generally lower, of the order of 50:50,

emphasising the risks involved. Debt (borrowing) is also generally cheaper than equity share, as company's are exposed to more risk. If too much risk is transferred to the private sector then participation from that source is unlikely to take place.

Co-syndication, spreading the risk between partners, will be important if the private sector participates in both investment for infrastructure and operations. However, private banks tend to have shorter lending time-horizons than government and this is a disadvantage when public transport projects are considered. For a power plant project, the payback period may be a period of 5-10 years, in which case a private bank may consider lending. Public transport projects often need periods of between 20-30 years before the payback period is attained.

When PPP's are considered as a from of project finance, the evaluation of risk is an important component. Within a traditional public works infrastructure project, the government will carry all the risks involved. For the example of a public transport project, this will entail the government taking responsibility for the project preparation risk, construction risk (although there will be some risk shifted to the private sector if a private contractor is used), revenue risk and, if appropriate, foreign exchange risk.

However, the private sector is better able to bear certain risk components. The main reason for this is because of it's greater managerial and productive efficiencies in certain key areas. In order to understand and identify the different types of risks involved in a concession project, Table 3.3.1 sets out the main risk involved, in concession agreements, for both the government and the private sector.

3.3.2 Introducing Competition to Produce Greater Efficiencies

One feature of the move to greater private sector participation is the awareness that a simple transfer of ownership from the state to the private sector does not necessarily improve productive efficiency if, in the process, a private monopoly is created. There is a need to create an environment where competition exists, in order to ensure that there is an incentive to cut costs. Similarly, there are trade-offs that must be made between the productive efficiency that can be gained and the allocative efficiency concerning wider social objectives, such as improving mobility for the poor. To ensure that levels of service are maintained and excessive profits are not gained, in certain circumstances, regulatory controls, enforced by the state need to be introduced. Furthermore, in some situations, particularly in cases of natural monopolies, enterprises have retained their existing legal status, with the introduction of incentives to managers and cost recovery targets, to ensure that the governing authority preserves its control of a sector.

Publicly managed enterprises tend to suffer from inefficient monitoring of managers, a lack of managerial incentives (to increase revenues and cut production costs), availability of funds which fluctuate due to budget constraints,

and often an adherence to a set of objectives (social and political) which interfere with the running of the main business.

Table 3.3.1 Identification and Allocation Of Risks in Concession Agreements

What is the risk?	How does it arise?	How should it be allocated?
Design and Development Risk		
Design defect	Design fault in tender specifications	Public sector to bear risk
	Contractor design fault	Liquidated damages to be paid by contractor; once liquidated damages are exhausted, erosion of project company's returns
Construction risk		
Cost overrun	Within construction consortium's control(inefficient construction practices, wastages, and so on)	Contractor to bear risk through fixed-price construction contract plus liquidated damages; once liquidated damages are exhausted, erosion of project company's returns
	Outside construction consortium's control: changes in the overall legal framework (changes of laws, increased taxes, and so on)	Insurer risk if insurance is available; once insurance proceeds are exhausted, erosion of project company's returns
	Outside construction consortium's control: actions of government that specifically affect the project(delays in obtaining approvals or permits, and so on)	Public sector to bear risk
Delay in completion	Within construction consortium's control(lack of coordination of subcontractors, and so on)	Liquidated damages to be paid by constructor; once liquidated damages are exhausted, erosion of project company's returns
	Outside construction consortium's control (force majeure, and so on)	Insurer risk, if risk was insured; once insurance proceeds are exhausted, erosion of project company's returns
Failure of project to meet performance criteria at completion	Quality shortfall, defects in construction, and so on	Liquidated damages to be paid by constructor; once liquidated damages are exhausted, erosion of project company's returns
Operating cost risk		
Operating cost overruns	Change in practice of operator at project company's request	Project company to bear risk
	Operator failure	Liquidated damages to be paid by operator to the project company; once liquidated damages are exhausted, erosion of project company's returns
Failure or delay in obtaining permissions, consents, and approvals	Public sector discretion	Public authorities to bear risk
Changes in prices of supplies	Increased prices	Allocation of risk to the party best able to control, manage, or bear it (supplier, project company, or users)
Nondelivery of supplies on the part of public authorities	Public sector failure	Public authorities to bear risk

What is the risk?	How does it arise?	How should it be allocated?
Revenue risk		
Changes in tariffs	In accordance with the terms of the contract(for example, indexation of tariffs leads to reduced demand)	Project company to bear risk
	Government breach of the terms of the contract	Public sector to bear risk
Changes in demand	Decreased demand	Project company to bear risk
Shortfall in quantity, or shortfall in quality leading to reduced demand	Operator's fault	Liquidated damages to be paid by the operator; once liquidated damages are exhausted, erosion of project company's returns
	Project company's fault	Liquidated damages to be paid by the project company to public authority
Financial risk		
Exchange rates; interest rates Foreign exchange	Devaluation of local currency; fluctuations	Project company to bear risk(hedging facilities might be put in place)
	Nonconvertibility or nontransferability	Public sector to bear risk; in case of contract termination, compensation to be paid by government
Force majeure risk		
Acts of God	Floods, earthquakes, riots, strikes, and so on	Insurer risk, if risk was insured; otherwise, risk to be borne by project company
Changes in law	Changes in general legal framework(taxes, environmental standards, and so on)	Normally, project company to bear risk(public sector could bear risk when changes are fundamental and completely unforeseeable; for example, switch from free market to central planning)
	Changes in legal or contractual framework directly and specifically affecting the project company	Public sector to bear risk
Performance risk		
Political force majeure	Breach or cancellation of contract; expropriation, creeping expropriation, failure to obtain or renew approvals	Insurer's risk, if risk was insured; otherwise risk to be borne by public sector; in case of contract termination, compensation to be paid by government
Environmental risk		
Environmental incidents	Operator's fault	Liquidated damages to be paid by the operator; once liquidated damages are exhausted, erosion of project company's returns
	Pre-existing environmental liability	Public sector to bear risk

Source: Concessions for infrastructure. A guide to their design and award, The World Bank

Privatisation or greater private sector participation, in its many forms, seeks to overcome these deficiencies by liberalising markets, in order to impose a financial discipline on managers and allow them to concentrate on their core business, with greater incentives to cut costs. This, also, allows access to private sector financing. In order to ensure against anti-competitive practices, a strong regulatory

framework is necessary. This framework can, also, be used to allow for the entry of private operators, providing a means of access to public subsidy.

Full privatisation can be defined as the transfer of ownership, of an enterprise, from the public sector to the private sector. The question of privatisation, of the public transport in Cairo, as a realistic option cannot be excluded in the long-term but, for the immediate future, there are some constraints which would work against this option.

Introducing competition takes two forms:

- Competition within the market; and,
- Competition for the market.

Competition in the market essentially refers to companies competing with each other for market demand. Competition in the market works best when there is no natural monopoly. In the transport sector, this would relate to such examples as shared taxis where passengers can choose between different operators and make decisions concerning the price and quality of service offered.

Competition for the market refers to a situation where potential operators bid for the right to serve the market. This is more often the case where there is some form of natural monopoly. In the Cairo situation, it is difficult to imagine the advantages of allowing two tram operators to compete on the same network. Thus, a concession for the right to operate the network must be tendered for. It is not always the case that the lowest price offered by a competitor is the best option. Considerations of the potential performance of the companies and the reputations of the companies must also be considered.

3.4 TYPES OF CONCESSION FINANCING

This sub-section denotes the types of financing that could be available to alternative operating regimes. These models are:

- Maintaining the status quo;
- Transforming the state enterprises into commercial companies;
- Initiating concessions for the operating of the proposed projects; and,
- Build-operate-transfer type projects.

The principles for funding these regimes are discussed below.

3.4.1 Maintenance of the Status Quo

In this case this would mean that the current organizations responsible for public transport continue with these same responsibilities. Financing for both capital investment and operations would come through the state, either from own funds or finance from international development banks channeled through the state. The funding of operations would continue to be made through budget allocations. As

has been perceived in the present situation, there are differences of opinion between the organization disbursing money, the Ministry of Finance, and the state company, as to the required amounts of money needed. This has led, for example, to the CTA continuing with insufficient funds and operating at levels which contribute to a poor quality of service offered. This alternative is not recommended for the future if public transport is to improve it's performance.

3.4.2 Transformation of State Enterprises into Commercial Companies

This would entail the creation of companies that would have some form of autonomy from the state and which would be run on commercial lines. Financing would still come from the state but a performance agreement would need to be made between the state and the autonomous company. A more in-depth examination is being undertaken as part of Program B, Component B-2 of the possibilities for commercializing the CTA. This sub-section deals more exclusively with the potential for a state autonomous company to undertake the operations for the proposed public transport projects.

Through the implementation of a re-organization process, transport enterprises will operate on commercial lines. The organization would remain in state control. The internal transformation of the enterprises will be of critical importance. The management, the organisation structure, cost accounting procedures, marketing and passenger information would have to be improved.

A core element will be the provision of a contract, or performance agreement between the government and the newly created autonomous company. Such a contract is an instrument to create a clear structure of responsibilities between these two parties.

The duration of the contract could be three years. A longer contract period could be considered as more favourable to the company but the currently changing economic circumstances dictate that a three year period would allow for a review of the public transport situation, at the end of this period.

It is essential for the contract to indicate which contract partner (the state or the public transport company) is responsible for deficits. In an ideal situation, the enterprise is responsible for the conduct of business and, therefore, responsible for profits and deficits. However, given that the fare level will continue to be fixed by the government, the funding of revenue deficits will have to be incorporated in the contract.

As an incentive to improve performance, incentive bonuses could be incorporated into the contract and would be triggered whenever the company either meets or improves on agreed performance indicators.

The benefit of such a contract would that a transparent framework of responsibilities could be established. This transparency would most likely be achieved if either separate autonomous companies are established to operate the proposed CREATS projects or, in the event of this not happening, the delineation

between the parent organizations, for example the CTA, and the business unit operating the proposed system is clearly defined.

3.4.3 Operating Concession

This model would involve the preparation of a concession agreement to allow a private sector company to operate the proposed project over a specified period of time. Several possibilities exist for concession arrangements and these are outlined in Chapter 4, *Volume III* of the *Phase I Final Report*. In principle, this would require that the funding mechanism for the initial investment costs would not be the responsibility of the concessionaire, who would be responsible for operations only.

There are some differences between the use of the terms franchise and concession.

- Franchise: Under a franchise, the control exercised by the project sponsor is much tighter. Often the corporate logo of the sponsor is maintained along with other elements of the sponsors corporate policy. This a reasonable alternative if it is wished that a general identity needs to be employed across the city i.e. all public transport is marketed under the same label. This would allow for a combined marketing strategy, for attracting users to public transport, to be employed.
- Concession: The operating company is much freer to adapt its own style and policies. A good example of this is the Ramses Hilton hotel. In this case, the hotel is owned by a private investor, which is the Arab International Bank. The operating company uses its own logo and the Hilton group corporate identity. All staff are employed by the Hilton group. At the end of each year, profits are split between the operating company and the investor, according to an agreed contract.

The use of concessions is not new to Egypt. The concession for rubbish disposal, for the city of Alexandria, is now in the hands of a private French company. Similar plans are underway in Cairo and Giza, although in this situation the concession is split between several companies.

Consideration must be made of what the operating company is expected to provide. In the case of rolling stock, there are two alternatives. Firstly, the sponsoring agency will purchase the rolling stock with the operating company providing only staff. The main risk for the operating company involves start-up costs and the cost of terminating staff contracts. The second alternative involves the operating company purchasing the rolling stock, as well as providing staff. In this case, the duration of the contract will need to be lengthy, in order to allow the operating company to make a reasonable return on the initial rolling stock investment.

Given the high investment costs involved and the likely low rate of return on capital due to the low fare levels, it is unlikely that the private sector can be encouraged to make outlays on rolling stock. Therefore, the most likely option at

the present time would be that the government will also have to purchase the rolling stock. Management and staffing would then be provided from the private sector.

3.4.4 Build-Operate-Transfer Concession

Technically, a BOT type project could be considered as a concession agreement and, in Egypt, it is believed that the use of the term concession is preferred to the term BOT. It is distinguished from other forms of concession because all finance would come from private sources. From discussions during the study, it is believed that aall legislation is in place for BOT projects in Egypt to be implemented.

Over the last ten years many BOT projects have been submitted to government for approval. A few examples are given below.

- Rapid transit rail system from Alexandria to Burj al-Arab (approximately 50 km in length). At present, there is an existing single line rail track, with very low numbers of trains operated by ENR. The proposed project would also have converted the existing line to double track and high speed. Modification would also be made to the existing rail stations. An arrangement was made with a British leasing company for new rolling stock. The leasing company would also be responsible for training railway staff. The main revenue earned would be through shopping malls and ticket revenues. The project would be cost neutral for the government. This project was never implemented.
- Alexandria sewage project. At present, effluent is discharged into the sea, although there are 4 sewage stations (2 primary, 2 secondary). The proposal was to treat the sewage and also use it for the cultivation of 70,000 hectares of desert land. The sole revenue received would be from this cultivated land. This project was never implemented.
- Alexandria – Al Fayyum toll way. Corporate bond issues were prepared to part finance this project. Revenue would be received from developing adjacent land along the road. Government did not respond to proposals. This project was never implemented.
- Ain Sukna port. This port is currently operated as a concession. The government built and owns the infrastructure. A private company built the superstructure. This company pays a flat fee for the concession plus a payment per tonne handled. This is part of the concession agreement. Entrance and exit fees (for pilotage) are paid to the Port Authority. The company's revenues come from handling fees and is free to vary it's handling charges. Some additional profit for the company comes from a very efficient logistics management company that handles freight world-wide.
- Sidi – Krier electricity power plant. The power plant was built by Bechtel and is currently under operation. The power plant has a contract with the government to supply electricity, so revenues are secured. The big problem is

that these payments must be made in foreign currency, whereas consumer receipts are in local currency.

One other interesting fact should be mentioned i.e. the Suez Canal was essentially a BOT project, with a 99 year concession. Therefore, in general terms and also historically, the culture of private participation is not unknown in Egypt.

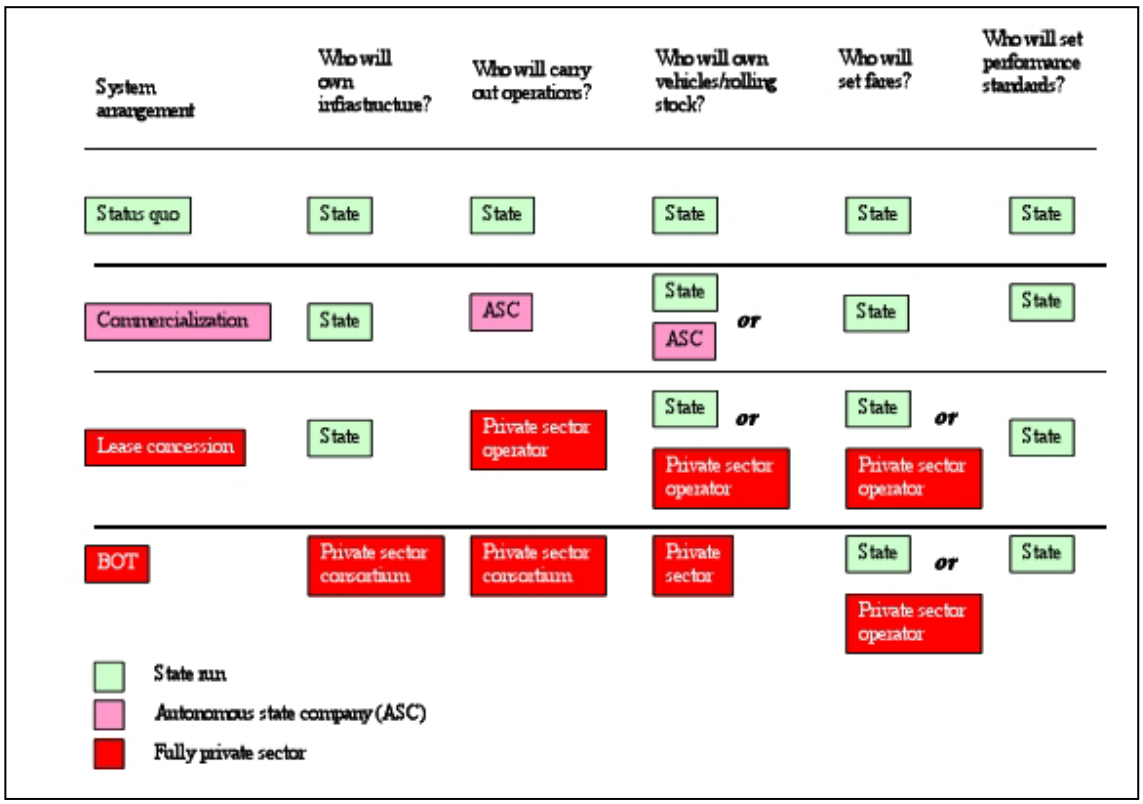
A very important factor is that a private company would need to have some physical assets that it could realise some returns. Therefore, in the Alexandria railway project above, the company would get additional revenues from a shopping mall, and the Alexandria sewage project from the proposals for cultivated land. Regarding the Supertram project, this would mean that the government would have to transfer/lease some land for retail development, to supplement the ticket revenues. The only other alternative would be for the government to enter into a contract to pay agreed subsidies to cover a revenue deficit.

3.4.5 Summary of Concession Financing Regimes.

Figure 3.4.1 illustrates the arrangements that could be foreseen under the different models described above. Figure 3.4.2 illustrates the likely funding options.

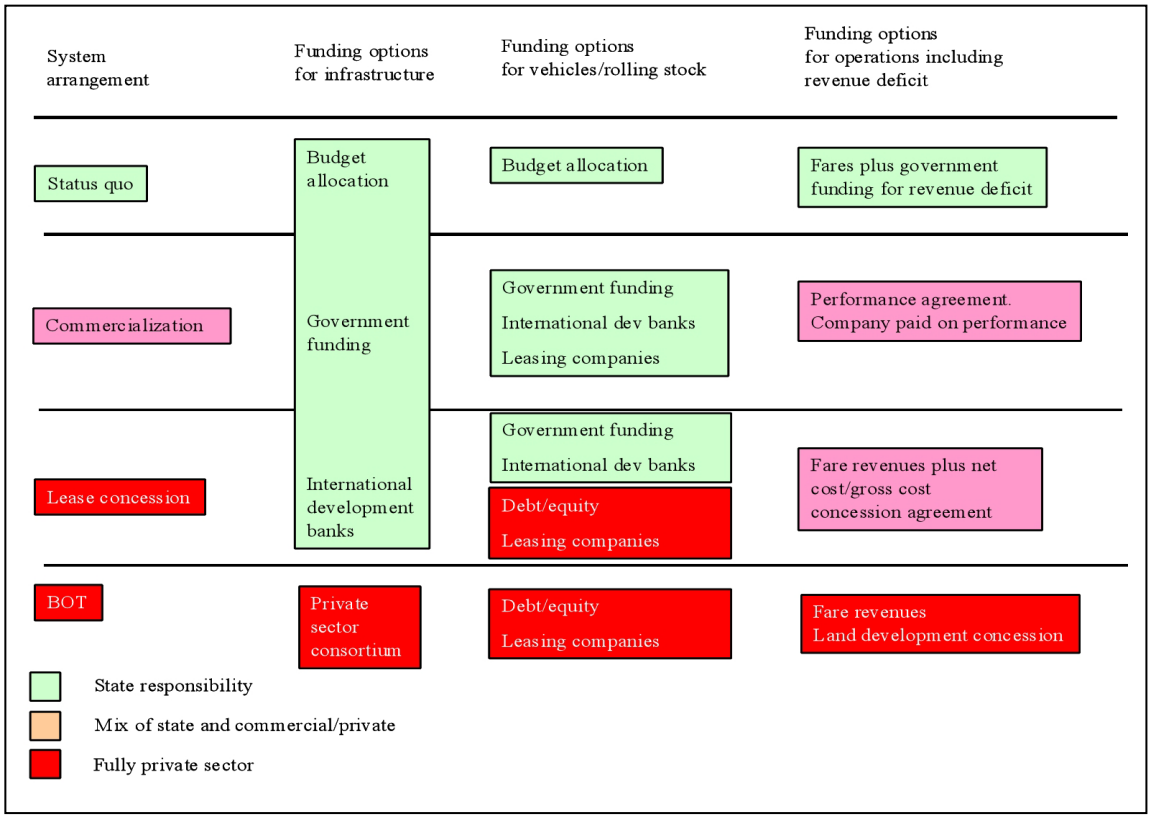
The most important point to make, however, is that investment in infrastructure and vehicles/rolling stock is most likely to be the function of government. This is due to the high costs involved.

For two significant reasons, one possible step might be the creation of state autonomous companies to begin operating with the proposed new systems. Firstly, as has been demonstrated previously in this sub-section, there is still a gap between the willingness of the government to create the conditions, such as providing private companies with alternative means to supplement revenues, and the willingness of private sector companies to enter a market which still entails certain risks. In this sense, the possibility of the government entering into a legal contract whereby payments would be to subsidise passengers, including those travelling on privileged tickets, is still in question.



Source: JICA Study Team

Figure 3.4.1 System Arrangements



Source: JICA Study Team

Figure 3.4.2 System Funding Options

A second and equally important reason would be that bringing in the private sector would call for some job-cutting for those already employed in Heliopolis Metro tram operations. As an interim measure, perhaps for the first three years of operation of the Supertram, a commercialised business unit of the CTA would take responsibility for operations. As a further step towards improved transparency, the most preferable option would be the establishment of a separated but autonomous state company. This separation would enable performance to be more easily to be assessed and would also provide better information for the next stage in the tendering process. A franchise could be tendered for after this three year period.

The direction of government policy for urban public transport in Cairo, for the period after the three year contract, will depend on the success of the enterprises, in achieving the proposed performance targets. After the first three year contract has ended, further refinements of the contract can be made, based on past experience. Alternatively, the responsibility for undertaking operations could be transferred to the private sector, through the use of concessions. A procedure for comparing private sector bids against the cost of operations of the autonomous state company, using a Public Sector Comparator, is briefly shown in Table 3.4.1.

As has been outlined, Gross Cost Service Contracting and Net Cost Service Contracting could be utilized where either a franchise or concession is used. In the case of the Gross Cost Service Contracting, all revenues would be received by the project sponsor, with the operating company incurring no revenue risk. Project performance monitoring becomes more important in this situation to ensure that, for example, the operating company attracts sufficient passengers.

Under Net Cost Service Contracting, the operating company keeps the revenues collected and, thus, incurs a revenue risk and, therefore, has the incentive to attract more passengers. As a component of the Net Cost tendering procedure, the most successful outcome would be on the basis of the least subsidy that would be required by the operating company.

Should a concession be awarded, the recommended option would be for a Net Cost franchising option to be used for the Supertram or the proposed new rail lines. Rolling stock would be purchased for the operating company, with agreed contractual terms made for the maintenance of the vehicles. The corporate identity of the Cairo Transport Authority would be retained. The government would then need to enter into negotiations with the successful bidder to determine the required level of subsidy support. In such a way, it would be possible to introduce concessions to the operations of heavy and light rail in Cairo.

For the propose busway, evidence has shown that the operation of air-conditioned buses by the CTA demonstrate that profits can be made. The most suitable operation in this case would be for a Gross Cost Franchise to be introduced. Companies would then bid for the right to operate the buses, which would have been purchased by the state. The winning company would be the company offering the highest rental concession fee, subject to consideration being made about the ability of the company to provide sufficient service quality.

Table 3.4.1 Procedure for Comparing Private Sector Bids against the Cost of Operations of the Autonomous State Company

Public Sector Comparator

The purpose of constructing a Public Sector Comparator is to enable private sector bids to be compared with that of a state-run operation. The PSC can be defined[1] as:

'*A benchmark against which value for money is assessed. It is typically a cost estimate based on the assumption that assets are acquired through conventional funding and that the procurer retains significant managerial responsibility and exposure to risk.*'

Therefore, estimates are required to be made of the cost to the public sector of a proposed investment and it it's continued operations and investment. A PSC can be used to compare private sector bids against the raising of finance through government funds or from long-term bonds.

For the London Underground proposals for using PPP's, a PSC was prepared for assessing private sector bids against the public sector alternative. The main tasks involved are shown below in Figure 3.4.3.

3.5 ADDITIONAL FUNDING SOURCES

Supplementary to the above discussion on funding mechanisms, additional funding sources may be available to the proposed transport projects and these are discussed below.

3.5.1 Development Potential

Residents who live in the vicinity of a proposed transport development are likely to benefit in two ways. Firstly, the transport development will improve accessibility to other parts of the city. Secondly, it is anticipated that the greater accessibility delivered by the improvement will be felt through higher residential property prices. Similarly, commercial and industrial enterprises will also benefit. This benefit may take the form of better accessibility to offices and factories. Owners of commercial and industrial premises will benefit through the possibility of higher rents charged. Finally, there is the possibility constructing commercial facilities at the entrances to stations. The geographic location of such facilities would be favourable and would enable, in particular shop owners, to have access to a wider market of all passengers entering the station.

[1] 'The Financial Analysis of the London Underground Public Private Partnerships', December 2000, The National Audit Office, United Kingdom.

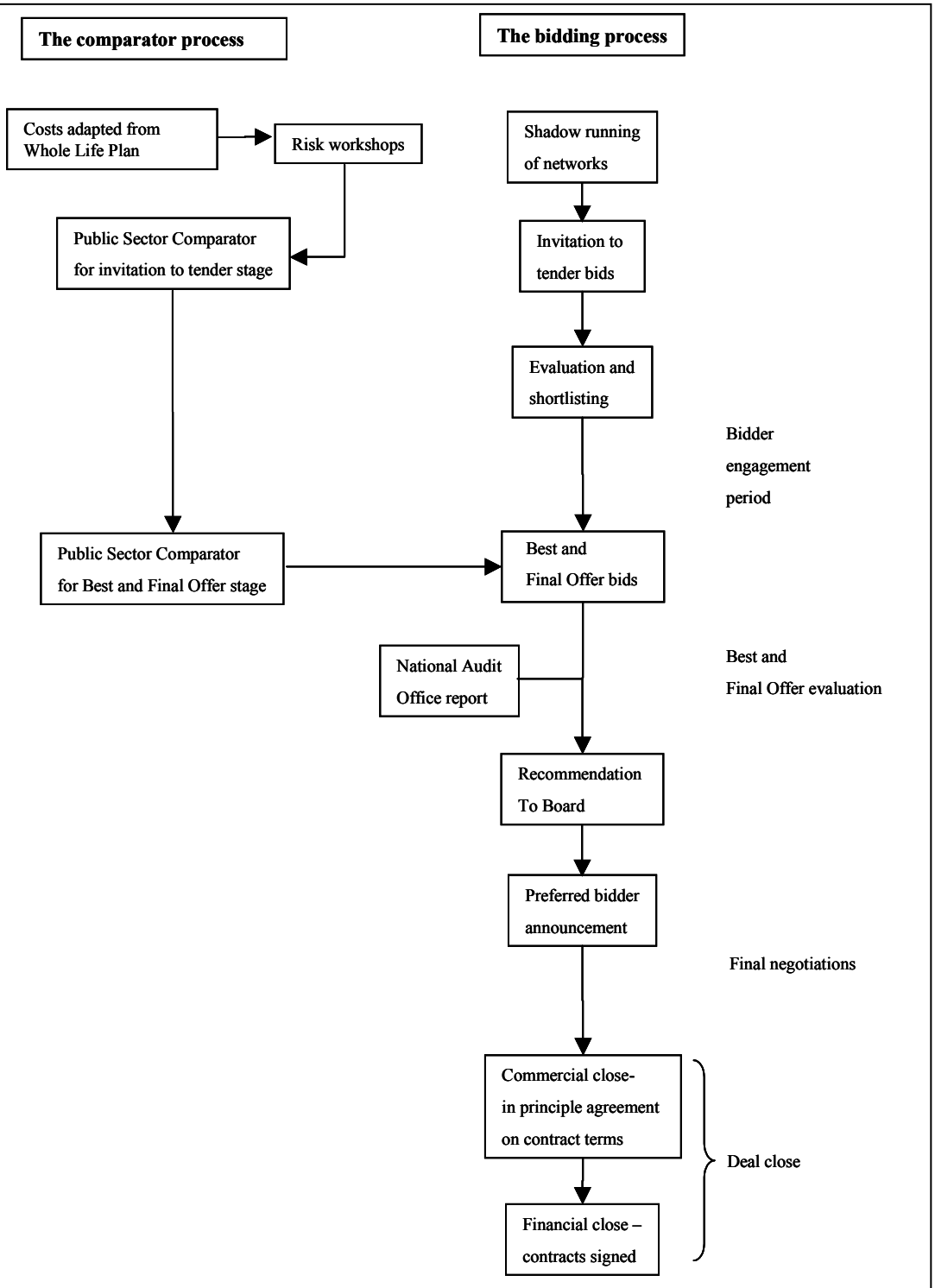


Figure 3.4.3 Public Sector Comparator Used for London Underground Proposals

Given that many could benefit from the proposed scheme, it is logical to suggest that some appropriate recompense should be made towards either the capital cost of the project or the running of it's operations.

This scenario has not really been developed in Cairo. Firstly, there is presently a financial depression in the country and developers do not have the means to make any additional contributions towards a new transport development. Currently, they are having problems repaying loans to commercial banks, particularly because property prices have dropped recently.

Inhabitants of the city of Cairo already have experience of paying additional taxation for improvements to the environment in their immediate vicinity. For example, should a road be asphalted the immediate residents would have to make a contribution in the form of an additional sum on their real estate taxes. This contribution goes directly to the Governorate. The levels of the contribution are often low, typically of the order of 2 LE per annum. Although this sum is extremely low it should be noted that many households also on low incomes or have unemployed or underemployed adults within that household. From limited discussions, it is however observed that such a measure, i.e. introducing a development benefits tax would be unpopular. A further disadvantage is that some residents who do not directly benefit from the proposed transport improvement, such as car users or severely disabled persons, would have some cause to complain.

One advantage of using such an approach is that the mechanism already exists for collecting the tax and, therefore, there would be minimal administration costs involved. Set against this, is the need to ensure that a suitable administrative procedures are set in place to guarantee that the revenue collected by the Governorate is passed on to an appropriate transport fund. A similar tax could also be imposed on both commercial and industrial premises.

A further possibility concerns the expected increase in property prices, given a transport project is implemented. As stated in Chapter 13, *Volume III* of the *Phase I Final Report,* the construction of Metro Line 2 had an upward impact on property prices in the area of Shoubra Street. Owners make some compensation through an improvement tax but this amount is known to be very low. Clearly, the residential owners of properties will benefit from a higher price when the property is sold. A tax on property sales would be a payment for the increase value of the property, due in part to the transport improvement. Such a tax would obviate the requirement to impose a continual tax on residents who may at certain times be unable to afford payments because of difficult financial circumstances. This tax would be progressive if it takes the form of a percentage on the property sale price i.e. the higher the income of the household owner (who is more likely to live in a higher value property) the more is paid in tax. The disadvantages of such a tax would be that there would be an uncertainty regarding the revenue flow i.e. the number of properties sold in a year may vary and also property prices are subject to fluctuations.

It can be can concluded, however, that collecting sufficiently large volumes of funds through the taxing of residential and commercial properties may not be a feasible solution.

Further examples of potential Supertram Line 1 joint development, or "transit oriented development", are presented in Section 3.5.7 in the main body of this volume. These examples draw on overseas experiences.

3.5.2 Advertising

Experience elsewhere has demonstrated that advertising can contribute up to 10% of annual revenues for public transport companies. This is particularly the case where the system is modern and has a good public image. Buses in Cairo do not present such an image. From unconfirmed sources, it is believed that current revenues received for advertising on buses is low. Concession fees, for advertising along the outside of buses, as low as LE 800 per annum per bus are presently the norm and this figure excludes the production cost involved in actually placing the advertisement. However, for a revitalised tram network with new rolling stock, this figure may be considerably higher, perhaps in the order of four to five times the present concession fees.

3.5.3 Parallel Uses of Right-of-way

The owner of a continuous right-of-way through an urban area as dense as Cairo possesses an asset of considerable potential value to other developers of network utilities, such as telecommunications companies. With some advance planning, ducts for fiber-optic or copper cable can be integrated into the design of the civil works and revenue may be derived by leasing the space. An alternative is to build an oversized fiber-optic network as part of the project and to lease bandwidth not needed by the transit system for internal signaling and communications.

No precise figures, during this present study, were able to be obtained regarding the potential revenue to be raised by laying telephone or fibre-optic cables alongside the new tram and rail tracks. It is known that telecommunications companies are looking at ways to increase capacity in Cairo and, therefore, this would present unique opportunities. At present, the main agency responsible for implementing such lines is Telecom Egypt. It should be noted, however, that the current status of this company, which is still fundamentally under state ownership, would indicate that some pressure may be brought to bear, simply because it is a government agency, to reduce the possible rental fees.

3.5.4 Retail Concessions

Stations and terminals can also be designed to accommodate leasable space for small businesses catering to users, including convenience stores, branch banks and automatic teller machines (ATMs), coffee shops and snack restaurants, newspaper

and magazine vendors, etc. In Bangkok, Thailand, the BTSC has been particularly aggressive with this concept by including space for up to five ATMs and six or more concession spaces at each mass transit (The Skytrain) station. As a result, it has been able to derive more than seven percent of its operating revenue from advertising and retail concessions, substantially exceeding an industry average of one to five percent.

3.5.5 Park-and-Ride Facilities

Commuter parking facilities are also a potential source of revenue for mass transit operations, particularly under the CREATS scheme which visualizes more peripheral metro park-and-ride within the Ring Road corridor. As noted in a previous chapter, the Ring Road park-and-ride station for Supertram Line 1 is seen as being a particular vital element in terms of catalyzing ridership. In addition to generating revenue from parking fees, parking lots reserved for transit customers expand the service area of a given rail line beyond walking distance to the station and feeder bus routes. Because of their role in attracting additional ridership, provisions for park-and-ride should be included in the final design of major transit, in particular rail-based, projects. For the same reason, careful consideration should be given to the setting of parking fee levels. The inter-related effect of parking fees and total system revenues needs to be considered in setting pricing policies.

3.5.6 Contracting Out

Although contracting out would not attract further funds, the possibility of contracting out services is mentioned because it forms a means of reducing costs. Two possibilities that exist are contracting out vehicle maintenance and the printing and distribution of tickets. In the case of vehicle maintenance, the proposed new depot facilities for the tram and rail projects give an opportunity to increase private sector involvement by allowing private companies the right to bid for a concession to operate the facilities. The winning company would then enter into an agreement with the operating company to service rolling stock.

The provision of an integrated ticketing system, particularly critical if operating concessions are awarded to private companies, would present an opportunity for further private sector involvement. Ticketing concessions could be awarded to private companies to install and operate the new ticket machines and to develop fare structures that would maximise the potential advantages to passengers who wish to undertake multi-trip journeys.

3.5.7 Congestion Charging

One approach to financing new infrastructure, and at the same time reducing motor vehicle movements, has been through the introduction of congestion charging schemes. A successful example has already been operating in Singapore for some time. Recently, on 17 February 2003, a congestion charge was

introduced for vehicles entering the center of the city of London, in the United Kingdom. The daily charge for entering the zone (21 km^2 in area) is £5 (approx. LE 45). Payment can be made at retail outlets or through telecommunication means (telephone, text message of through the internet). The hours of operation of the scheme are 7 am to 6.30 pm,

Monday to Friday. All two-wheeled vehicles and taxis, buses and coaches are exempt from the scheme.

Seven hundred cameras at 230 sites are located around the zone and these send video-stream signals to an Automatic Number Plate Recognition computer system. The vehicles are checked against a database of vehicle numbers that have paid to enter the zone. The penalty for non-payment is £80 (approx. LE 720).

Three hundred new buses were purchased and six new bus routes were introduced to cater for the increased demand for people shifting their transport mode. The forecast demand was 20,000 car drivers to transfer to public transport.

The system has been successful. Traffic flows have been reduced by 15% - 20%, although in some locations just outside the zone the congestion has increased. The scheme has generated interest in other cities, both in the United Kingdom and elsewhere, who will now have more confidence to implement similar schemes. Public opinion, initially against the scheme, is now more positive, particularly because inhabitants are happy with the principle that money raised through such schemes are earmarked for transport improvements rather than being channeled into general state funds. The Greater London Authority Act 1999 stipulates that all revenues (after costs have been taken into account) must be invested in the city's transport system. Possible candidates for funding are two new tram systems on the outskirts of the city and a new tunnel and a new bridge across the Thames.

The cost of setting up the scheme was in the region of £200 million (approx. LE 1.8 billion). The capital costs of the system are expected to be recouped within 18 months of the start date of the scheme.

Clearly, in Cairo, the investment costs required and the daily fees at London levels, would not be acceptable. However, the question of introducing such schemes will continue to be raised, particularly in cities in developing countries where traffic levels are reaching unsustainable levels and it may well be that more low cost schemes can be introduced, which would have similar effect. The success of the schemes in Singapore and London have demonstrated that the benefits of congestion charging are increasing favorable to the public, who can observe less vehicles on the road network and are confident that the finances raised are used for other transport improvements. However, in both cases, it must concurrently be noted that the introduction of congestion zones clearly requires the availability of a public transport systems whose quantitative and qualitative aspects are sufficiently developed in order to absorb additional passengers whose mode switch is catalyzed by the congestion charge. There is considerable doubt that Cairo has such a public transport system in place at present.

3.5.8 Rolling Stock Leasing

One way of spreading the cost of capital investment over a period of years is to lease rail cars over a period of years rather than make a one-off payment at the start of the project. As part of the project *Extension of Trans-European Rail Freight Freeways*[2] a survey of the possibility of leasing freight wagons, by state-owned operators, in Eastern Europe was carried out. Some relevant results from this survey are shown below:

- Leasing companies contacted were keen to get involved in leasing freight wagons but needed to be paid in foreign exchange. This is a particular problem for state organizations. Another problem encountered in dealing with state organizations was that a) personnel kept changing and b) it was difficult to find someone prepared to make a decision.
- Different types of leasing are pure leasing, sale leasing, leasing back, cross-border leasing. A leasing arrangement, whereby the client ends up in possession of the wagons, could be possible.
- Some loans were required to be guaranteed by states for their railways; this is not always easy and may change with privatization.
- A leasing company was in the process of buying a rail car plant in Poland and financing a fleet rehabilitation plant in Romania.

This would suggest that leasing of new rolling stock could have some potential disadvantages. For example, leasing payments would need to be paid in foreign exchange. At the present time, the exchange rate of the Egyptian pound is depreciating against the US dollar. This would create problems and uncertainties for a situation where revenues are in local currency.

Two options are available. Firstly, a financial lease could be obtained, whereby the government would retain ownership following the end of the lease period. The duration of the lease period tends to be about five years. Operating leases involve the government paying the leasing company on a monthly or quarterly basis. At the end of the lease period, typically ten years, the company takes back the vehicles.

Telephone interviews conducted as part of Phase II investigations with representatives of leading rail leasing companies tended to concur with the general conclusion that the participation of leasing companies in Egypt is difficult at this present time. In general, leasing companies had expanded their markets in Europe (particularly Western Europe) because the conditions were suitable and a reasonable rate of return could be achieved on the capital employed. Although companies were strongly intent on expanding their markets, rail leasing in the Middle East, particularly in a potentially unstable environment, did not seem an attractive proposition. Furthermore, depending on the

[2] *Extension of Trans-European Rail Freight Freeways*, Phare Multi-Country Transport Programme, Ove Arup & Partners, November 1999

privatization/commercialization of the CTA and the legal status that it acquires, there could be problems in underwriting leasing contracts with state guarantees.

3.6 GUIDELINE CONCLUSIONS

The discussion contained in the preceding sections sets out the possibilities for the financing of proposed public transport projects, with a particular view toward priority projects contained in CREATS Phase II investigations. These conclusions should be seen as an input toward the more rigorous programs detailed in the main body of this volume.

Very few possibilities exist for the capital investment required for infrastructure to be undertaken by any other organization than government. This capital investment could optimistically be acquired through loans from international development banks.

It is recognized that institutional reform takes time to implement and is subject to wider considerations than just cost constraints. It is believed that a step-by step approach is necessary in this respect. At the same time, the difficulties with obtaining finances from other sources than government is recognized. The large investment sums required for the purchase of rolling stock present problems for the private sector to raise sufficient capital in a situation where the return on such capital is uncertain. It is concluded, therefore, that the creation of autonomous companies, which can act independently, and which have performance agreements as part of their contract with the government, are the organizational forms in the short-term to operate the proposed new systems. As with infrastructure, the purchase of vehicles/rolling stock will remain the responsibility of the state.

It is also recognised that the trend towards greater private sector involvement is accepted in Egypt today. Therefore, it is recommended that preparations for the implementation of concession agreements, whereby private sector companies would be invited to tender for the concession to operate the proposed systems, should be undertaken. This would mean that, after three years of operation of the system, a concessionaire would be in a position to commence. The bids of the potential concessionaires should be compared with the operational costs of the incumbent autonomous company, using the Public Sector Comparator described above.

The financial involvement of the private sector concessionaire would initially be limited, confined to the provision of manpower and management. However, the duration of the concessions awarded should be of sufficient length, 10-15 years, to encourage potential concessionaires to provide evidence that some fleet renewal will continue to be undertaken during the concession period. Therefore, some financial risk is gradually transferred from the government to the private sector.

Given the need to supply a good quality public transport service, it is likely that the government will be required to continue funding public transport operations through a contractual agreement to finance the revenue deficit, at least in the

short-term i.e. the period of operations when the state autonomous company is responsible. Through competition for bids and the acknowledged greater productive efficiencies of the private sector, the deficit should be reduced as much as possible. Although evidence suggests that there is unwillingness on the part of the government to concede potential development possibilities, future proposals to develop retail centres in the vicinity of or at public transport inter-modal stations which may be used to offset, or even negate, revenue deficits should be encouraged. In this respect, there is considerable experience with the Egyptian private sector to carry out such an undertaking.

As an alternative to providing such retail development potentials, the government has the option, in the future, to financing public transport operations through funds from congestion charges and dedicated local taxes. Again this requires a political willingness on the part of the government to enforce such measures, and may be considered for inclusion within the mandate of the CREATS-proposed *Central Organization of Transport for Greater Cairo Region*. It is highly likely that successful examples of the use of congestion charging in cities will become evident in the future and this will enhance the possible public acceptability of this measure, particularly when it can be demonstrated that the revenues raised can be seen to used in the improvement of the public transport system, both through new capital projects and the improvement in quality of existing public transport services.

Given the need to continually determine methods to improve the efficiency of public transport operations and to augment the trend of greater private sector participation, the possibilities for contracting out services should be considered. This is particularly the case where a state autonomous company continues to be responsible for public transport operations.