IMPLEMENTING INTERMODAL PUBLIC TRANSPORT IN THE DEVELOPING WORLD

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Abstract

The paper demonstrates that introducing intermodal public transport in the developing world does not necessarily conflict with the increasing demand for fiscal efficiency and operational effectiveness of public transport services. An (intermodal) public transport system, founded on the core principle that the need to move people must take precedence over the desire to move (private) vehicles, can find a balance between economic and financial constraints, social obligation and providing mobility for all.

This paper draws upon the Cairo experience within the context of intermodal public transport. Following a definition of intermodality, current socio-economic and transport relationships in Cairo are briefly summarized, as are the main shortfalls from an intermodal perspective. This, is turn, leads to a discussion of strategic approaches used in the formulation of the intermodal master plan. A more specific case study involving a high-priority public transport project is presented; specifically, implementing state-of-the-art Light Rail Transit technology in an urban corridor currently served by antiquated trams. The adopted intermodal approach integrates hardware (infrastructure), software (intermodal coordination, integrated ticketing) and humanware (organizational restructuring, training programs) requirements with potential implementation under the umbrella of a public-private sectors partnership.

Keywords: Intermodality; Urban public transport; Transport master plan; Cairo; Egypt; Urban transport; Integrated transport policy
Topic Area: B1 Transport Systems: Public Transport and Intermodality

1 Introduction

The Japan International Cooperation Agency (JICA) and the Higher Committee for Greater Cairo Transport Planning have cooperated in the conduct of the *Transportation Master Plan and Feasibility Study of Urban Transport Projects in Greater Cairo Region in the Arab Republic of Egypt* (CREATS – Cairo Regional Area Transportation Study). Pacific Consultants International, headquartered in Tokyo, Japan, was the designated lead consultant for the study. The CREATS was divided into two phases with Phase I dedicated to formulating a multi-modal and integrated Master Plan which addresses the transport needs of Greater Cairo over the next 20 years[1], and

1 Phase I Final Report - Transportation Master Plan and Feasibility Study of Urban Transport Projects in Greater Cairo Region in the Arab Republic of Egypt; Volume I (Executive Summary), Volume II (Urban Transport Policy and Strategy), Volume III (Transport Master Plan), and Volume IV (CREATS Urban Transport Data Base), prepared for the Japan International Cooperation Agency and the Higher Committee for Greater Cairo Transportation Planning, by Pacific Consultants International, et. al., November, 2002.

Phase II focused on more detailed feasibility studies for five high-priority projects identified within the framework of the master plan[2].

This paper draws upon the Cairo experience within the context of intermodal public transport. Following a definition of intermodality in Section 2, current socio-economic and transport relationships in Cairo are briefly summarized in Section 3, as are the main shortfalls from an intermodal perspective. This, is turn, leads to a discussion in Section 3 of strategic approaches used in the formulation of the intermodal master plan. A more specific case study involving a high-priority public transport project is presented in Section 5; specifically, implementing state-of-the-art Light Rail Transit technology in an urban corridor currently served by antiquated trams. The adopted intermodal approach integrates hardware (infrastructure), software (intermodal coordination, integrated ticketing) and humanware (organizational restructuring, training programs) requirements with potential implementation under the umbrella of a public-private sectors partnership. Broad conclusions are subsequently contained in Section 6.

2 A strategic framework for intermodal public transport

The role of public transport is to offer citizens *sustainable mobility*. 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*. Achieving these objectives requires an integrated vision on public transport, a vision where intermodal integration is primordial at all levels. This integration includes not only joining available transport infrastructure (in particular via intermodal terminals), but also the services and the equipment.

Already in 1996, the European Commission emphasized in its Green Paper on the development of a Citizens' Network that the better coordination and integration 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 and use of roads and tracks) and software (combined ticketing, information systems, and tariff-systems) improvements. A similar vision was made explicit in later years by the ECMT and the World Bank, among others.

Public transport integration is often used within different connotations. A coherent "definition" of integration relies on three core elements[3]:

• Physical integration: the approach to passenger transfers, with key objectives being to shorten transfer distances and to enhance how the transfer is carried out;

• Operations integration: lines, stops, frequency, timetables; and,

• Tariff integration: allow traveling on different transit systems with a single combined ticket to avoid the use of multiple (additional) tickets or, generally, added cost. This can be achieved in different ways; for example, combined tickets that allow traveling in different transport systems during a set length of time or monthly personal travel passes that authorize any number or type of

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2 Draft Phase II Final Report - Transportation Master Plan and Feasibility Study of Urban Transport Projects in Greater Cairo Region in the Arab Republic of Egypt; Volume I (Summary), Volume II (Program A: Strategic Corridors, Areas Transport Management and Development Program), and Volume III (Program B: CTA Transport Improvement in East Sector of Cairo), prepared for the Japan International Cooperation Agency and the Higher Committee for Greater Cairo Transportation Planning, by Pacific Consultants International, et. al., October, 2003.

3 See for example: Urban Public Transport Systems Integration and Funding; Prointec - Inocsa - Stereocarto, Spain, 2000

trips within a specific area.

Developing intermodal or integrated public transport in Cairo will require action to achieve a physical separation of public transport from other transport (segregated lanes and priority signaling at intersections) and at the same time a closely controlled operational integration of services (ticketing, time-tables) and equipment (information systems, transport vehicles and ticketing equipment).

The above vision can be considered a "*supply-side perspective*", by which transport system integration is pushed via a wide variety of measures. It is also possible to perceive transport system integration from a "*demand-side perspective*" where system-design should be based upon commuter requirements and perceptions. From a demand-side perspective, the main components of the integrated system are common fares and ticketing; full and up-to-date information; easy transfer between modes and the design of routes/networks to optimize the use of the public transport system as a whole4. Several success-stories exist, both in the developed and developing world. Municipalities that have a city-wide integrated public transport network that is also connected and coordinated with inter-city public transport include, for example, in the developed world:

• Hamburg, Germany, with the Hamburger Verkehrsverband (HVV) whose policy is condensed in the slogan "one timetable, one tariff, one ticket";

• Madrid, Spain, where the Madrid Transport Consortium (CTM) is the sole authority in the field of scheduled public transport passengers services;

and, in the developing world:

• Bogotá, Colombia, where urban public transport services function under the jurisdiction of the Secretaria de Transport y Transito (STT) and where the Public Transport Unit (UTP) of the STT has jurisdiction over public transport administration in Bogotá;

• Curitiba, Brazil, where the bus rapid transit system has led to a modal shift to public bus, reducing private transport in the city with about 27 million auto trips per year.

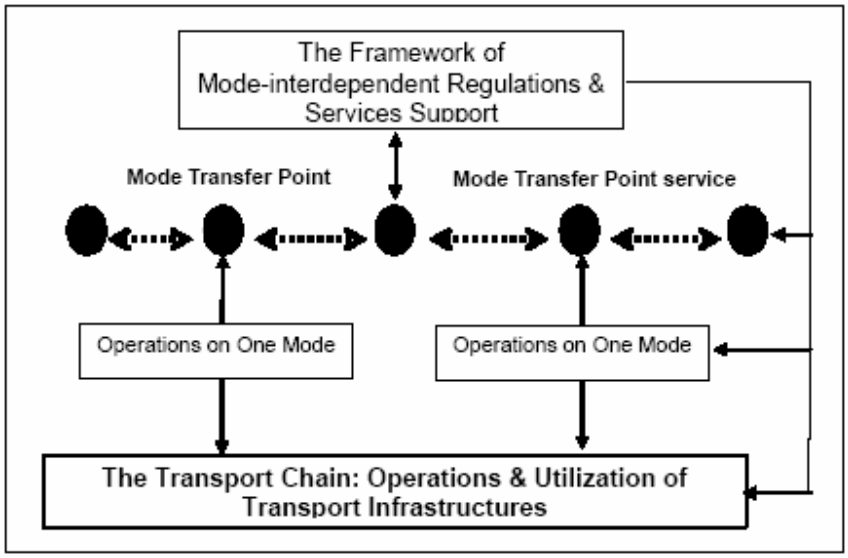

Figure 1: Intermodal Public Transport Framework

4 See for example: Review of Urban Public Transport Competition, Halcrow Fox, Department for International Development; London, May 2000

Keeping the above principles in mind, the future intermodal public transport system within the Cairo metropolitan area should be based on a ***multi-level feeder system*** in which the main inflexible lines (railway, tram and metro) are supplied with passengers using the flexible public transport system, consisting of bus, mini-bus and shared taxi (also the private taxi could play a role). Important in this vision is that with the redesign of the present public transport system into an integrated intermodal system, ***service duplication*** (multiple modes providing, for example, the same services in a corridor) should be avoided as much as possible. Based on the principle of ***intermodal public transport***, it is possible to develop a structural framework for the future public transport system of Cairo (Figure 1). The concrete implementation of this concept needs to consider the public transport system from a perspective that is based upon three principles: intermodality, interconnectivity and integration.

The framework conditions for the public transport re-organization for Cairo are therefore:

• Create an integrated system with co-ordination and optimization of the interconnectivity of transport modes;

• Extend the use of existing fixed transport (metro, rail, tram) by creating efficient feeder services to these lines. Speed and regularity of the feeder service will be a critical success-factor;

• Introduce the hierarchy-principle into the public transport system where low-capacity services provide support to the high-capacity public transport system;

• Restructure the shared taxi network in such a way that the effectively operate as end-line service providers and do not compete with long-haul public transport services;

• Improve the service level of public transport, both on the lines as at the interconnecting points; and,

• Optimize the cost effectiveness of public transport by avoiding redundant services.

3 Cairo: the current public transport profile

The provision of public transport services is intrinsically linked with the form and extent of the urban fabric; there exists a direct dynamic interaction between transport and the nature of the metropolitan economy. The CREATS study area, whose boundaries extend some 30-40 kilometers from central Cairo, is extensive and includes Cairo Governorate, parts of Giza and Qalubia Governorate, as well as five large urban agglomerations comprising eight new communities, among them the potentially massive 10th of Ramadan and 6th of October Cities (Figure 2). These two precincts are expected to ultimately accommodate some two million persons each. Population within the study area breached 14 million persons during year 2001, while forecasts suggest a population of over 20 million persons by year 2022. The number of households, which was 3.5 million as of 2001, will likely increase to some 5.1 million in 2022. The study area contains roughly half of all vehicles registered in Egypt, near 1.1 million cars, buses and trucks. The relative rate of 76.1 vehicles per 1,000 persons, while high by Egyptian standards, is still modest when seen in an international context. Vehicle ownership in the study area is expected to more than double over the next 20 years, thus exceeding the growth rate of average household income, which stood, per results of CREATS surveys, at roughly 700 LE[5] per month in year 2001. Roughly two-thirds of study area households had a monthly income of under 500 LE in that year.

5 At time of Phase I, 1.00 US$ = 4.58 LE (Egyptian Pounds). One LE is subdivided into 100 Piasters.

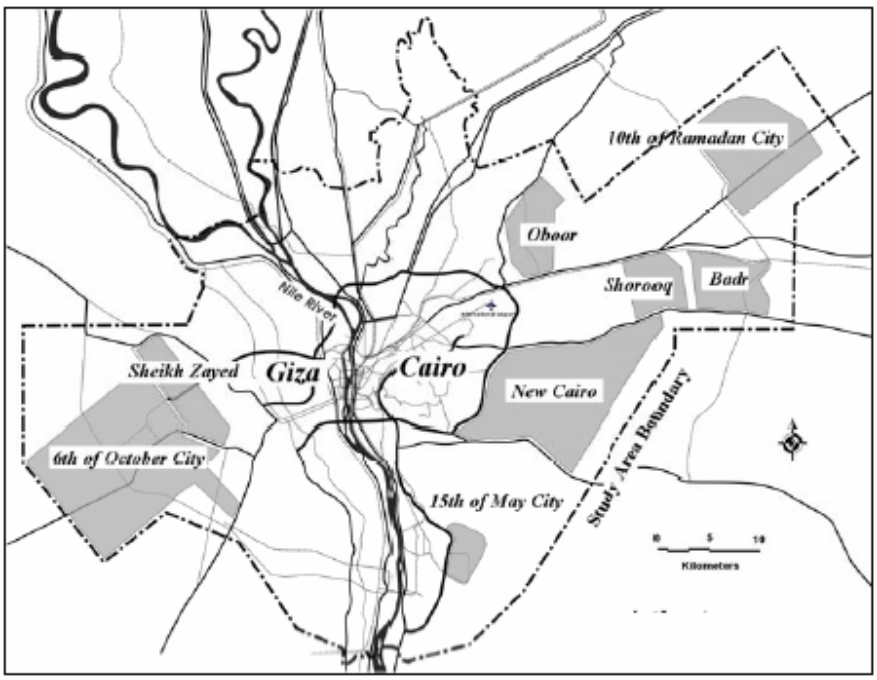

Figure 2: CREATS Study Area

Public transport services in Cairo may, at present, be categorized as consisting of two generic groupings; namely, formal services and informal services.

• Formal urban public transport services are provided by the public sector. The CTA (Cairo Transport Authority), and its subsidiary GCBC (Greater Cairo Bus Company), provide bus services throughout Greater Cairo using standard-sized buses and mini buses. The CTA also operates tram services as well as the water-borne Nile ferries. Other major elements of the formal urban public transport sector include the Cairo Metro Organization (CMO), which provides urban rail mass rapid transit services (the Metro) and the Egyptian National Railways (ENR), sponsor of suburban commuter rail services.

• The informal sector consists of route-specific shared taxis operated by the private sector using microbuses with typical capacities of eleven or fourteen seats. This mandate has been expanded and some services are also being provided via private-sector Transport Cooperatives using minibuses of up to 30 seats, although the scale of these services remains very modest vis-à-vis the shared taxi industry.

Public transport services carried a total of 12.436 million daily trips during a typical 2001 weekday. This represents 68 percent of all motorized trips generated within the CREATS study area. Shared taxis (microbuses) carry some 6.5 million daily passengers, or roughly one-half of daily motorized public transport trips. Public buses (CTA/GCBC bus/minibus) account for a further 3.5 million daily trips, and the Metro slightly over two million trips per day. The contribution of other modes aggregates to about 0.4 million trips per day (Figure 3).

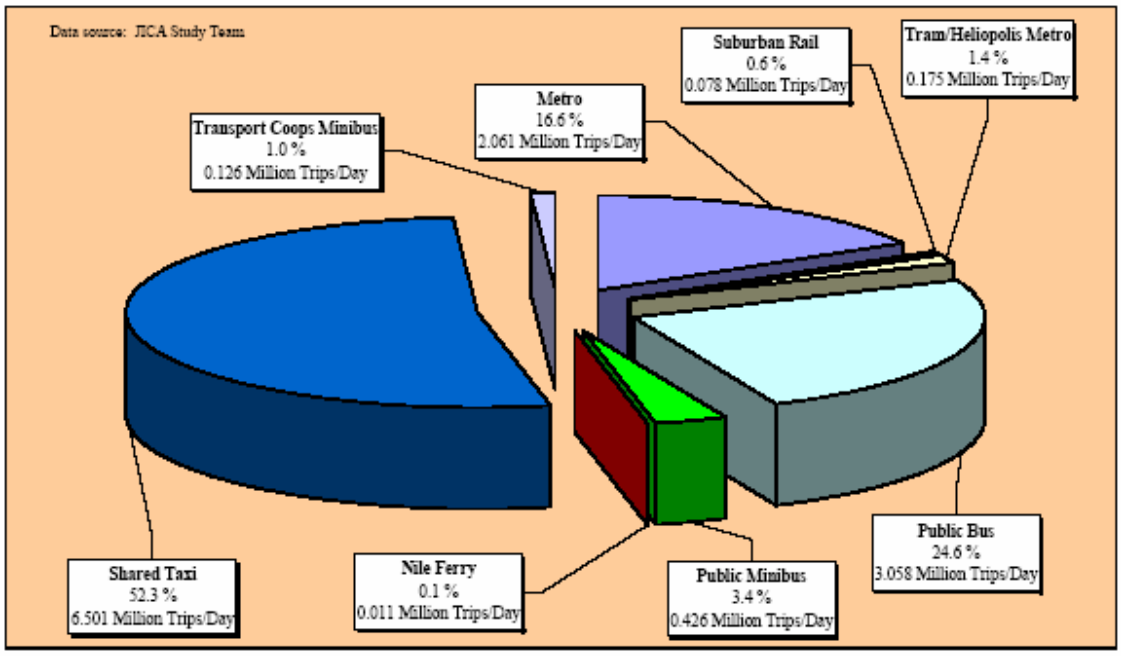

Figure 3: Existing Modal Preferences Daily Motorized Unlinked Public Transport Trips-CREATS Study Area

Thus, public transport usage dominates in terms of absorbing daily motorized trips. By year 2022, motorized trips are forecast to increase by a factor of 1.75. However, even with anticipated increases in the ownership of private vehicles, public transport is still expected to absorb from 50 to 60 percent of motorized trips. It is therefore abundantly clear that, in terms of both current and future transport planning, **the need to move persons must take precedence over (but not to the exclusion of) the desire to move (private) vehicles.**

The evolution of public transport supply and demand in Greater Cairo over recent decades suggests that formal sector public transport services have, with notable exception of the Metro, suffered a decline in market share. The experiences of Cairo are, however, not dissimilar from those of other large cities in emerging countries. A primary “pressure” is, of course, continuing growth in the rate of motorization and shift to private modes of transport at the expense of public modes. However, a further contributor may be the state of the formal public transport system itself. As government-owned entities, operators find themselves constrained by controlled fares (in response to political/social goals) which, in turn, catalyzes a shortfall in revenue thus contributing to lack of maintenance and, ultimately, the inability to replace aging vehicles. A deficient fleet implies cutbacks in levels of service and eventually reductions in service. Shortfalls in public bus operations, and liberalization of regulations pertaining to private sector participation in public transport operations have, and continue to, create market opportunities for the informal bus sector (primarily shared taxis).

The realization of a balanced and multi-modal environment presents a continuing challenge for Cairo. Coordination among the different public transport modes and between public transport and private cars is minimal. Independent scheduling, uncoordinated route structure, and independent fare structures do not facilitate interchange among the various urban public transport modes. Thus, services tend to be duplicative leading to inefficient application of increasingly stressed resources. Two significant barriers seem to prevent such coordination. First, there is little

institutional cooperation among the different agencies planning and operating public transport services, in particular, among CMO, CTA and shared taxi services. Secondly, current fare policies of the individual modes do not facilitate cooperation among the various operators. Fares and subsidy structures of the different modes are set in isolation of each other. The CREATS surveys have identified that almost half of all person trips use two modes, and a further 13 percent three modes; thus, in light of the lack of operational and fare coordination, public transport passengers are considerably disadvantaged from both trip expediency and comfort points of view.

A rationalization of public transport systems is desperately needed, with each system allocated in such a manner that utilizes its relative strengths, be they speed, capacity or type of service, to the fullest. Intermodal connectivity under such a scenario is absolutely essential.

4 The Cairo approach for enhanced intermodality

In Cairo, as in other major cities of the world, future growth in income will inevitably catalyze an increase in trip making, as well as changes in the types of modes used to accomplish such trips. It is expected that private modes of transport, such as passenger cars, will continue to become increasingly popular with Cairenes, yet public transport, both at present and in future, will serve as the backbone of urban mobility carrying some two-thirds of daily person trips made within the urban area. The key issue is therefore how to realize an intermodal public transport system which concurrently manages growth in transport demand by developing transport systems that ultimately enhance economic productivity, increases personal mobility, improves the urban environment and ensures financial viability.

4.1 Building an integrated network

Public transport systems exhibit a wide range of capabilities (Figure 4). Bus lanes/busways can carry to near 20,000 persons per hour per direction with bypass opportunities at critical junctures such as loading/unloading areas. Light rail transit can accommodate up to 30,000 persons per hour per direction in segregated alignments. Mass rapid transit can accommodate 30,000-90,000 persons per hour per direction at much higher speeds. The capacity of one motorway lane is, at 2,000-3,000 persons per hour, comparatively low.

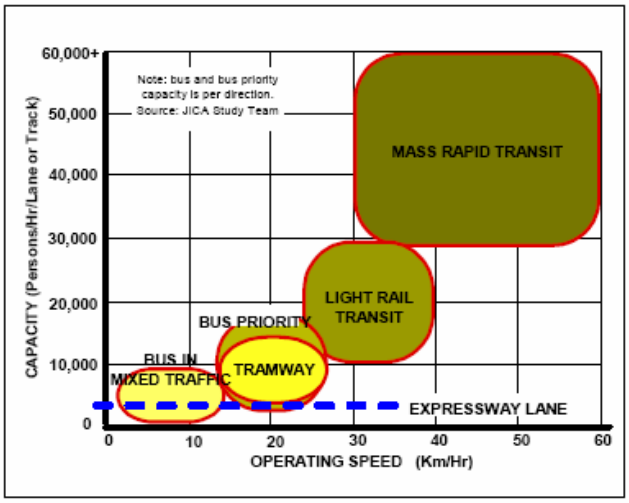

Figure 4: A Hierarchy of Public Transport Systems

Coordination among the different public transport modes, and between public transport and private cars, is minimal at present in Cairo. In order to achieve a fully integrated and efficient public transport network, planning for future public transport systems has been carried out according to a clear functional hierarchy. Each mode is allocated to specific corridors or functions as deemed appropriate for meeting forecast demand at acceptable capacity and speed. Each mode thus has its own domain where it can operate under optimal conditions, in complement with other modes, as part of a multi-modal system. Under this approach, fixed-route and high capacity systems are given priority in the scheme, while other more flexible public transport systems are superimposed to create an integrated network. Conversely, low capacity but highly demand-responsive and flexible systems such as shared taxis could be considered end-line service providers, arrayed under an area franchising scheme but not necessarily operating under a (currently ineffective) fixed route constraint (Figure 5).

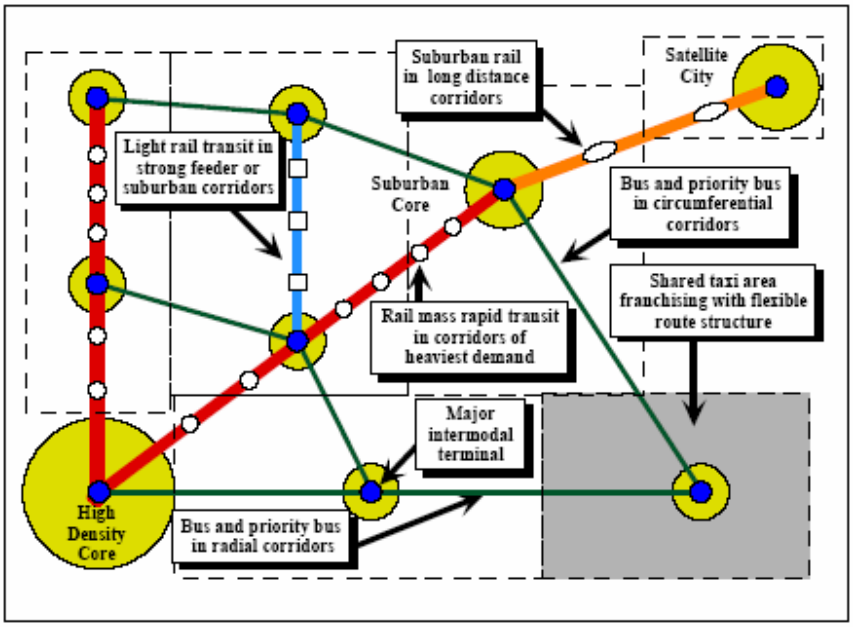

Figure 5: A Model for Integrated Public Transport

4.2 Ownership and sustainability

Costs of the Cairo formal public transport sector, with few exceptions, exceed revenues. Conversely, the private sector is anecdotally seen as having largely achieved positive cash flow. The decline in ridership for some public operators, in combination with growing costs and politically frozen fares, is catalyzing a need for ever-increasing subsidies from public coffers.

A program of reform of surface public transport should therefore be developed with two principal and inter-related goals. First, it should strive to create an efficient and effective sector capable of meeting the social and public policy needs of Greater Cairo with as little public subsidy as possible. Such a goal is not meant to imply that subsidization of service is not desirable, only that for a given policy goal, the amount of subsidy needed should be as small as possible. Second, the program should aspire to make the sector as commercial as possible, and responsive to potential private sector participation and capital, thereby freeing scarce public resources for other purposes.

The ultimate goal is to provide the best service at the least cost to government developed around a model where the government's eventual role is that of strategic planner, coordinator and

regulator, and that the private sector is increasingly responsible for the actual operation of services under minimal regulation and in a competitive environment. A series of steps are proposed (Figure 6) which re-shape the current industry into a more effective structure and encourage gradual transition toward the ultimate goal and privatization. These include the immediate commercialization of the CTA, area franchising of the shared taxi industry, and the eventual integration of service contracting and line tendering.

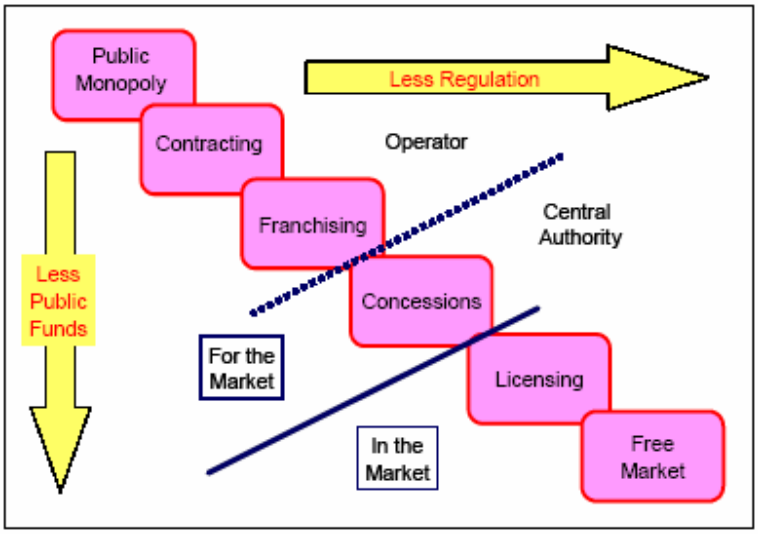

Figure 6: The Path to Bus Sector Privatization

Two important supporting recommendations are included within the Master Plan in support of the gradual commercialization of public transport operations. Firstly, a Cairo Metropolitan Transport Bureau is proposed (and currently in the process of being enacted by the Government of Egypt) as a central mechanism for integrating transport policy, systems and organizations (but not operations) into a unified entity that transcends the current fragmented approach to transport planning and problem solving. Secondly, given the budgetary constraints of public resources, the increasing involvement of the private sector in the provision of public transport services should be actively encouraged.

4.3 Integrated ticketing and fare structure

To provide additional insight into likely quantitative benefits associated with enhanced intermodality, the CREATS transport model was applied to test the sensitivity of public transport utilization. At time of study, three different types of fare structures existed in the formal public transport sector. These were distance proportional (Metro), flat (trams) and route specific (public bus). The latter case somewhat combines flat and distance proportional concepts in that pricing for a given bus line, for example, could vary depending on length, perceived service or type of equipment provided. The weighted average public sector fare for the recommended master plan, year 2022 conditions, is on the order of 6.6 Piasters per kilometer. The test therefore has two elements: (a) that all public sector operations use a common fare structure, and (b) the average unified public fare ranges from five to 10 Piasters per kilometer. Findings are presented in Table 1.

Table 1: Variation in Year 2022 Public Transport Passenger Demand Fare Structure and Fare Amount Sensitivity Analysis

	Million Daily Boardings, Master Plan Scenario[2]			
Mode[1]	Unified Public	Segregated	Unified Public	Unified Public
	5 Piasters/Km	Public Fares	7 Piasters/Km	10 Piasters/Km
Public Bus	3.668	3.910	3.508	3.165
Tram, supertram	2.050	1.129	2.017	1.869
Metro	8.711	9.082	8.398	8.142
ENR[3]	2.007	1.438	1.953	1.865
Subtotal Public	16.456	15.561	15.899	15.068
Private[4]	3.936	4.761	4.091	4.517
Total	20.392	20.322	19.990	19.585

(1) Nile ferry not shown due to small ridership vis-à-vis other urban modes.
(2) Unified public defined as all public modes of transport having an identical distance proportional fare at unit rates of five, seven and 10 Piasters per kilometer. Segregated public fares defined as current fare structure with real growth in fare amount; weighted average approximated at 6.6 Piasters per kilometer. Private fare unchanged in all scenarios; reflects current fare structure with real growth in fare amount. All amounts in 2001 constant Piasters.
(3) Suburban operations including services to 10th of Ramadan and 6th of October Cities.
(4) Shared taxi and transport cooperative minibus.
Source: JICA Study Team.

These findings carry three important implications for the formal sector; namely that (a) the use of a common fare policy is likely beneficial in terms of ridership; (b) that a fare applied uniformly to all public operators can be a catalyst for increased ridership, and (c) that opportunities exist for increasing (commercializing) absolute fare levels with modest impacts upon ridership.

4.4 The intermodal transport master plan

The recommended CREATS infrastructure strategy integrates several modes and technologies into a cohesive, intermodal plan (Figure 7).

Core elements of this plan include:

• In addition to the existing Metro Lines 1 and 2, and Line 3 whose implementation has been committed by the Government of Egypt, the construction of a much needed Line 4 linking heavily populated Giza city with central and northern Cairo precincts.

• The realization of three LRT lines and modernization of the remaining elements of the tram network. The LRT lines are to be cost-effectively achieved by re-using rights-of-way and facilities of the existing tram network.

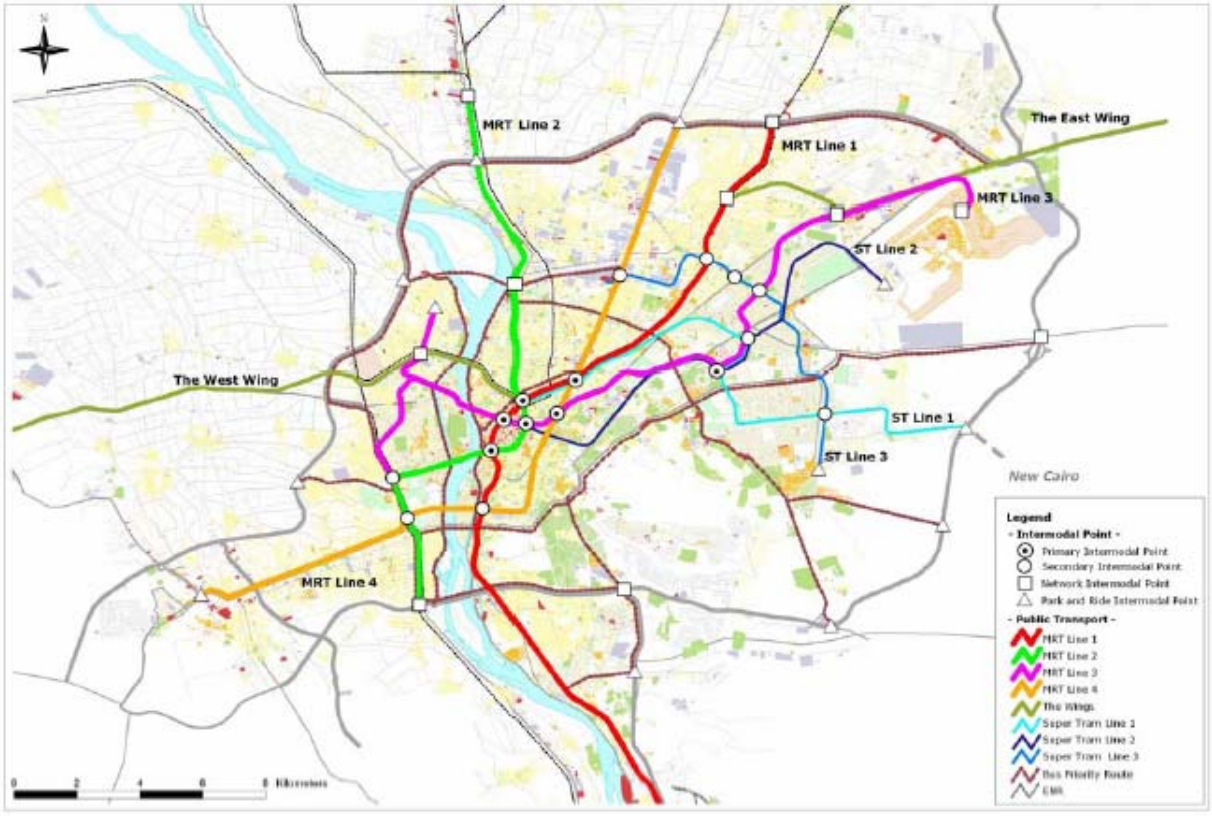

Figure 7: The Recommended Year 2022 Public Transport Element of the Master Plan

• Modernization of the suburban rail system, including new services to 10th of Ramadan and 6th of October Cities. In the latter case, a stage wise approach is adopted in which a segregated busway is initially constructed, based on design and alignment considerations which permit conversion to rail technology when warranted by demand at a later date.

• Modernization and expansion of the urban bus fleet in line with demand and acceptable norms in terms of service standards and operations. The realization of bus priority treatments is seen as being particularly promising.

• The introduction of a series of modal interchange points at which passenger flows between the various modes of public transport, or between public and private modes, are enhanced and encouraged.

The hardware, software and humanware elements of the Master Plan include approximately 60 projects and programs. While the overall economic benefit of the Master Plan is very favorable, achieving and economic internal rate of return of 20.1 percent and benefit-cost ratio of 1.77, the need for project prioritization is vitally important in terms of assisting the Government to implement projects or programs in line with technical need, social policy and financial resources. A goal achievement matrix (GAM) was adopted for this purpose. The GAM process relies upon the identification of a set of objectives (goals) that the recommended projects/programs should achieve. The broad objectives are further refined using quantifiable criteria against which the objectives can be assessed. The process allows for the weighting of both the objectives and criteria to ensure that those considered most "important" are given a suitable and equitable evaluation. The process allows assessing the level to which any particular

project is able to achieve the goal(s). GAM is also a useful tool for the consideration of projects whose benefits and costs are not able to be totally quantified in monetary terms and are therefore unable to be included in a conventional benefit-cost analysis. The assessment of some criteria is necessarily subjective but introduction in GAM allows for a comparison against nominated key criteria. As far as possible, the scores allocated to each of the projects are based on quantitative data. Qualitative assessments are made and the attributing scores reflect the relative merits of the projects, considering the scope and scale of the work and the expected results.

The individual projects and programs were measured against 20 different criteria, arrayed into five categories: (a) operational indicators: person demand, supply utilization, cargo transport facilitation; (b) performance indicators: improved governance, enhanced market mechanisms, public private partnership potential, knowledge based management; (c) implementation indicators: right-of-way, financing potential, project approval procedures, legal framework, stakeholder involvement, development cost, cost recovery potential; (d) socio-economic indicators: regional economic development, transport access, social integration; and, (e) environmental indicators: quality of life, aesthetics, transport safety. Each of these criteria reflects to issues which are important to assess the overall quality and need of the recommended projects and programs. The criteria are attributed a weight indicating its level of importance. Several sensitivity tests were conducted with different weight variations to asses their individual impacts on the priority of the list of projects and programs.

In addition to developing a prioritized list for staged implementation of the roughly 60 Master Plan project and programs, the GAM procedure also proved invaluable as a tool via which the Study Team and Egyptian experts could jointly define a list of priority projects whose further review is conducted as part of the Phase II efforts. Five priority projects were identified, all of which are related to public transport:

- Upgrading and modernization of public transport systems in East Cairo, with a particular focus being the realization of Supertram (LRT) Line 1 (please refer Figure 7) and restructuring of urban bus routes in the catchment area of Supertram Line 1;
- Organizational and institutional reform plan for the CTA;
- Public transport system (suburban rail) linking Cairo with 10th of Ramadan City;
- Public transport system (segregated busway) linking Giza with 6th of October City; and,
- Short term traffic management and bus priority plan in the urban corridor which will ultimately house Metro Line 4.

The initial priority project, focused realization of Supertram Line 1, is presented in more detail as a case study in the following section of this paper.

5 Case study: intermodal enhancements in east Cairo

The role of Supertram Line 1 must be seen in the context of recommendations contained in the Phase I CREATS Master Plan. That document recommends, in support of the Cairo Metro network and to enhance transport between suburban sub-centers, the realization of three Supertram lines. These lines are to function as light rail transit (LRT) systems in their own rights-of-way. Project prioritization procedures employed during Phase I confirmed that Supertram Line 1 is the line exhibiting highest priority, and was thus selected for further feasibility reviews during the Phase II investigations.

5.1 The intermodal perspective

The future development of Supertram Line 1 offers an interesting opportunity for Cairo to introduce intermodality and integration into the public transport system. During the Phase II analyses, the Study Team applied the intermodal transport definition of Prof. Dr. Gerhard Muller which was adopted during Phase I of CREATS. This definition reads: "***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***"[6].

But a theoretical concept needs at one point in time to be translated from a theoretical view into a practical implementation plan. This transformation implies that the intermodal view on public transport needs to be converted into an integrated system that simultaneously addresses hardware, software and humanware components. At the ***hardware level,*** the project elements focus on the technology and alignment of Supertram Line 1, as well as siting of terminals and stops. On the ***software leve***l, interlinking the services of the various modes and operators, in particular the integration of urban bus and Supertram Line 1, and the provision of intermodal terminals, constitute the software component of the analyses.

The evaluation also addresses the ***humanware component*** when it formulates plans and recommendations for the organizational as well as institutional reforms of the CTA and proposes the framework for a sustainable and dedicated training program linked with, on the one hand, the actual realization of the Supertram concept and, on the other hand, the planned reform of CTA.

5.2 Hardware elements

Supertram Line 1, a modern LRT system, embodies many desirable characteristics: human-scale planning, environmentally friendly operation, convivial image, medium-capacity urban transit capability and cost efficiency. It is seen as the optimum solution to meeting transport demands and criteria promulgated in the CREATS Phase I Master Plan. The total line is 22 kilometers in length and includes 19 stations, including four intermodal points. At these locations, intermodal connection with other forms of urban transport are facilitated to include the Cairo Metro, ENR suburban rail, trams, buses, shared taxis, and private modes of transport such as park-and-ride. It is noted that the supertram should also be seen as a strategic asset to assist Egypt in hosting the 2010 Football World Cup. The National Stadium, the anticipated flagship hosting site, is immediately adjacent to the supertram (Figure 8).

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6 Prof. Dr. Gerhardt Muller: *Intermodal Freight Transportation - 4th Edition*; ENO Transport Foundation; 1999.

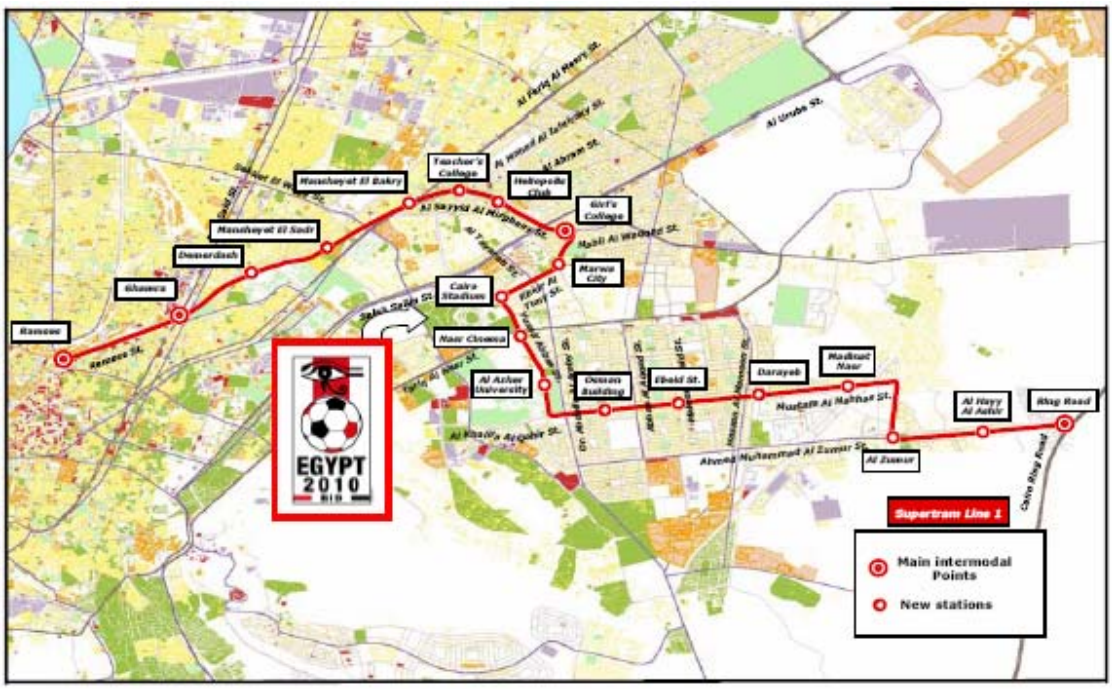


Figure 8 Supertram Line 1 Alignment and Station Locations

Cost of rolling stock is an important consideration in the selection of a preferred technology. Vehicle configuration, floor type, tractive power, speed, furnishings and other specifications all play a role in this regard. The Study Team has taken a practical and conservative approach in order to minimize outlays and to provide an effective transition from the current antiquated technology (Figure 9). A modular design, capable of being expanded with additional modules in line with evolving passenger demand, is a preferred solution (Figure 10). This approach reduces costs and space compared with the selection of more traditional dual-powered car sets linked as trains. It is also easy to upgrade, and keeps maintenance and repair costs low. In terms of interior layout, mixed floor design is sufficient for the needs of the supertram.


Figure 9: Existing Antiquated Tram Technology

Figure 10: Potential Supertram LRT Technology

The majority of stations, with exception of intermodal terminals will retain their current focus: that is, located within the median of roadways. However, several changes will have to be instituted from current deficient station designs. These relate not only to providing a more passenger friendly environment appropriate to a modern LRT system, but also ticketing and security issues since the preferred ticketing approach is to move ticket purchase and validation off-vehicle. Figure 11 depicts a prototypical median station. Barriers control platform access by pedestrians, while turnstiles control system ingress and egress. A pleasant, pedestrian friendly station with sufficient considerations of the handicapped and elderly is seen as totally appropriate and fitting in light of the modern, convivial image presented by the supertram. The station features passenger amenities, ticket sales booth, limited seating, protection from the elements and information. Possibilities exist for the presence of vending machines. Bus stops should be strategically sited to facilitate interchange between the supertram and its designated feeder bus services (or any bus, for that matter). Pedestrian crossings, possibly signalized, are needed to ensure that passengers can reach the supertram station safely and quickly.

Figure 11: Prototype Supertram Median Station

5.3 Software elements

An intermodal system needs to be formulated in association with the development of the Supertram system. This requires (a) rational development/improvement of intermodal centers (stations); (b) feeder service systems of bus and other trams; and (c) integrated ticketing system. Supertram Line 1 features 19 stops; from an intermodal perspective, four are designated as intermodal terminals and the remaining 15 as regular stops (please refer Figure 8). While the regular stops, as shown in Figure 11, have a limited intermodal function, the four terminals are each important interconnecting points with other major public transport services or private modes of transport. The four intermodal terminals are Ramses, Ghamra, Girl's College and Ring Road stations. Due to space limitations, the Ring Road Station concept is briefly presented as a typical example.

Ring Road station is the eastern terminus of Supertram Line 1, and is located in what is now vacant land adjacent to the Cairo Ring Road, a major multi-lane, motorway-class, limited access facility. The Study Team considers Ring Road station as an excellent opportunity for realizing a multi-use development combining both transport and commercial functions. An innovative new approach to financing and implementing Ring Road station will facilitate realization of this flagship undertaking. The core Supertram facilities (tracks, station, fixtures, systems, etc) would, for example, be provided for within project costing, potentially sourced via international donors or lending agencies. A governmental entity, or public-private partnership group, would provide financial resources for land, parking and public transport feeder facilities. The private sector, in turn, would be responsible for commercial development. Finally, joint development ("transit oriented development") principles should be applied in terms of asset development, management, revenue sharing and sustainability.

The station concept includes the principal road facilities (Al Zumur Street and the Ring Road) as well as public transport facilities encompassing the Supertram station, shared taxi terminal, urban bus terminal and public transport information center (Figure 12). Parking is provided via park and ride spaces, as well as parking spaces for commercial activities. Planning for the convenience and comfort of pedestrians has been a major input to station design. Facilities include a pedestrian deck, pedestrian plazas north and south of Al Zumur Street, stairways and elevators linking various activity precincts, landscaping and other pedestrian amenities. In short, moving between different elements of the station can be done with minimum interaction with road traffic. Finally, the bulk of commercial and shopping space is allocated to the south of Al Zumur Street. To the north, and near the bus/shared taxi terminals, are a series of small-scale commercial establishments.

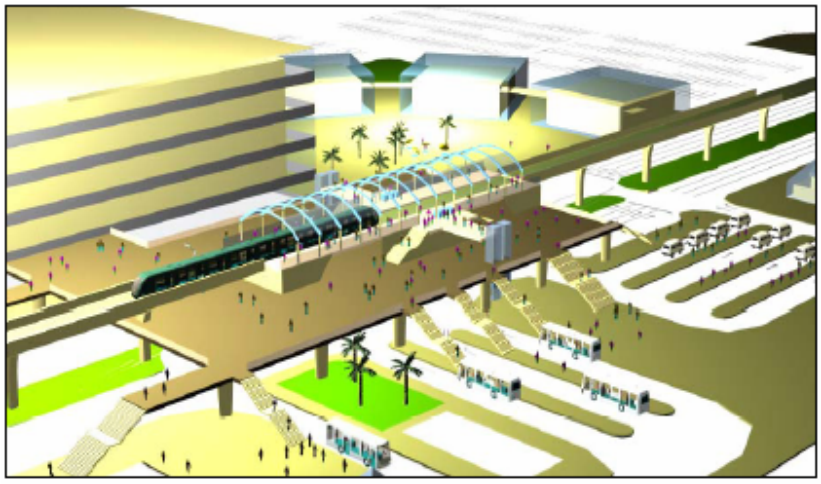


Figure 12: Aerial View of Ring Road Intermodal Station

Other key aspects of the software concept include:

• Feeder bus services: The recommended plan includes three elements: (a) The optimization of 20 bus routes in East Cairo. The proposed route structure is intended to serve both East Cairo and to enhance intermodal connectivity with the supertram. This approach is consistent with governmental objectives in that services which enhance transport options for low-income residents of the metropolitan area are expanded. Service would likely be via full-sized, modern buses (Figure 13). (b) Three shuttle routes, with service likely via air conditioned minibuses. The intent is to enhance supertram access via a series of urban circulators anchored to existing bus terminals. (c) Feeder routes from Ring Road terminal into New Cairo new community, which is ultimately expected to house some three quarters of a million persons. A longer term potential, already endorsed in principle at present by Government, is the extension of the supertram east of the Ring Road into New Cairo.

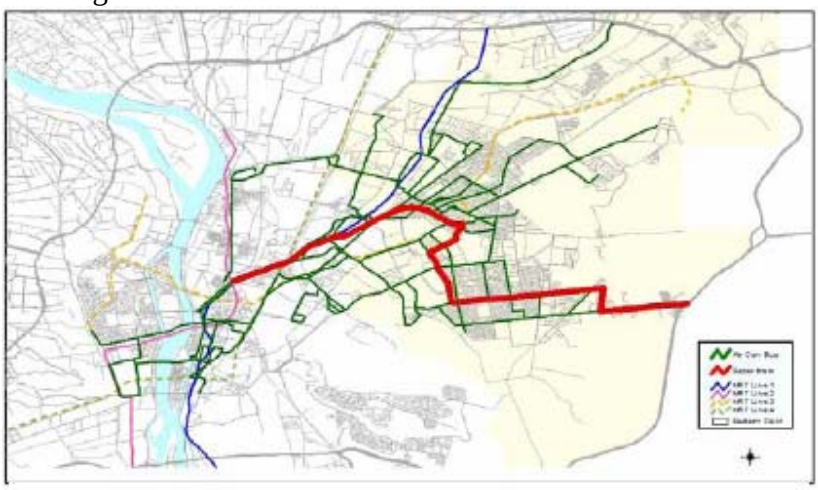


Figure 13: Twenty Optimized Bus Routes in East Cairo

• A commercial fare structure for the supertram consisting of single-journey tickets and multi-journey passes. It is anticipated that the fare level will be on the order of one to 1.25 LE in 2007 monetary terms, but the final determination of fare levels should be undertaken nearer to

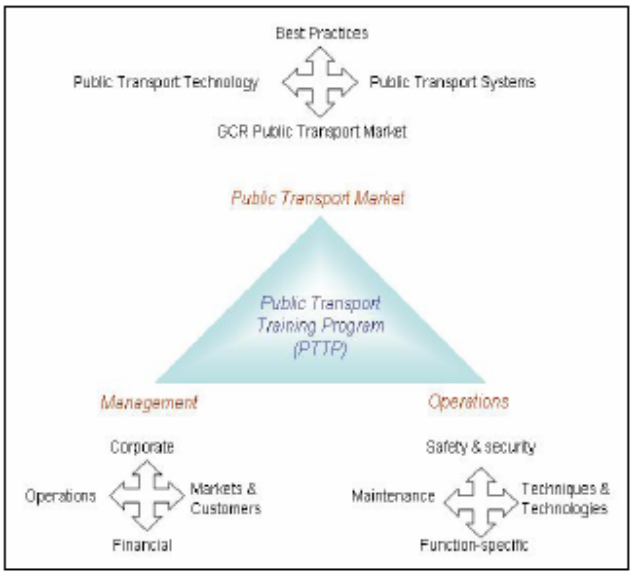
that time period sensitive to then-existing economic realties, competition from other modes and market conditions.

• Coordinated fare between supertram and feeder buses. If history teaches any lessons, it is that integrated ticketing between separate operators is problematic within a Cairo context, despite best efforts. However, in the case of the Supertram, a unique opportunity exists for integrated ticketing between the Supertram and its feeder buses, both of which are foreseen at present as being under the jurisdictional umbrella of the CTA. Thus, initial efforts in this regard are the first step in integrated ticketing, paving the way for more widespread application among different operators.

• A further consideration relates to concession tickets, that is, privileged passengers whose price structure reflects their status, employment, age or physical condition. Such discounts are widely available at present, although not uniformly on all operators. The goals are understandable; the Government of Egypt strives to give certain benefits to some segments of society, or to its (possibly underpaid) employees. However, the Study Team would disagree that passing this responsibility unilaterally to public transport operators, as is being done at present, is an equitable or efficient approach. In terms of the Supertram, it is proposed that the nominated ticket structure (commercially priced single journey or multiple journey tickets) serve as the basis of operation. In that light, any organization, whether private or public sector, Ministry or not, is free to negotiate a contract of carriage for its employees or its charges with the Supertram operator based on commercial, competitive prices. A fairly direct way of addressing this is for the purchaser (say a Ministry) to purchase a given quantity of commercially priced tickets from the Supertram operator and then distributing these tickets to its employees or its charges either free or for some discounted amount.

5.4 Humanware elements

The public transport system of Cairo is anticipated to undergo an in-depth restructuring and reorganization program. The program foresees over time the introduction of new services such as Supertram; new operational techniques among which modern ticketing technology; corporate restructuring that includes a reduction of staff through re- allocation and lay-offs; and introduction of new expertise for new services. The time is therefore right for developing an adapted and comprehensive training program to support these dramatic changes. A Public Transport Training Program (PTTP) should enclose all relevant components of the public transport system, both at the operational and managerial level (Figure 14). Within the PTTP, and tailored to the unique needs of the supertram, is a Supertram Training Program (STP). Given that the supertram can be operational by late 2007, the actual establishment of the STP is foreseen for 2005, giving the STP time to prepare sufficient personnel to guarantee efficient Supertram Line 1 services from the beginning. Starting training in 2005 will also be beneficial for the implementation of the CTA restructuring program, allowing redundant personnel to follow high quality training that will assist in their (forced) career re-orientation. Public transport modernization in Cairo is not complete with Supertram Line 1 and the CTA restructuring program. Other initiatives and modernization programs will be necessary and integration of services will be required, thus necessitating an on-going human resources development program.



Source: JICA Study Team

Figure 14 Human Resources Development Program

5.5 A recommended business model

Three core options are conceivable for the implementation of the Supertram Line 1:

• Option 1 (Government Initiative): The government takes full responsibility for the construction and operation of Supertram Line 1. This option is rational, because the project itself is economically feasible. However, the government will be reluctant to shoulder full cost under current budgetary constraints. Project costs, considered outlays necessary for realization of the supertram such as new infrastructure, systems, rolling stock, depot, control center, ancillary improvements, engineering, construction management, administration and contingencies, are estimated at 2,332.64 million year 2003 LE[7] (of which some 42 percent is allocated to rolling stock acquisition). Partnership costs, considered outlays for feeder bus fleet and facilities, land acquisition (supertram depot and Ring Road station are the only land acquisition needs of the supertram project), upgrading of remaining elements of the tram network, park and ride facilities, engineering, construction management, administration and contingencies, are estimated at 297.33 million year 2003 LE.

• Option 2 (Privatization): A private sector participation scheme is pursued with but one option being a BOT (Build, Operation and Transfer) mechanism. However, a BOT scheme is not recommended due to several reasons: (a) the private sector is unlikely to assume the requisite financial risk inherent to a relatively large, long-term investment; (b) the private sector fund raising capacity is subject to the performance of the national economy, hence, the private sector cannot guarantee the implementation timeline; and (c) a lengthy negotiation process will likely be required until (if) all parties can reach agreement; in the interim, potential accrued benefits will have been foregone.

• Option 3 (Public-Private Partnership): This flexible option is appropriate for the Supertram, and recommended by the Study Team. The government sector, as owner, assumes responsibility

7 At time of Phase II, 1.00 US$ = 6.00 LE (Egyptian Pounds). One LE is subdivided into 100 Piasters.

for infrastructure development. A private company (or joint venture company) assumes responsibility for the provision of rolling stock as well as supertram operation and maintenance, while leasing (for a fee) the infrastructure from the owner (the government) under a concession agreement. The owner may procure funding via the balanced allocation of domestic resources and a soft loan scheme from international lending agencies or donors. PPP is considered a particularly attractive scenario given that supertram operating costs, exclusive of interest and depreciation, are estimated to exceed costs by a factor ranging from 1.4 in year 2007 to 2.4 in 2022.

As indicated in Table 2, the interplay of average supertram fare, concession fee and off-rail revenue (supertram company income from sources other than the farebox) can combine to yield attractive financial rates of return and return on equity for the supertram company, while concurrently minimizing eliminating) investment neowner to year 2030.

Table 2: Alternative Structuring: Supertram Business Plan under a Public-Private Partnership Scenario

Case	Condition	The Partner Operate, Maintain, Provide Rolling Stock		The Owner (Government) Provide Infrastructure		
		Financial Internal Rate of Return (%)	Return on Equity (%)	Cum'tive Outlay (Mill LE)	Average Annual Outlay (Mill LE)	Cum'tive Net Profit in 2030 (Mill LE)
A	Base Case (ST Fare = 65 Ps, Fee = 5%)	3.6	2.4	1,589	59	-955
B	(A) + ST Fare= 1 LE	8.8	16.9	1,527	57	-893
C	(A) + off-rail revenue 20% of income	6.2	10.0	1,589	59	-955
D	(A) + off-rail revenue 30% of income	7.3	13.1	1,589	59	-955
E	(A) + (B)	11.6	24.2	1,527	57	-893
F	(A) + (C)	12.9	27.6	1,527	57	-893
G	(F) + Fee = 20%	11.0	22.5	903	33	-269

6 Conclusions

The authors come to the conclusion that such as intermodal planning modern equipment and rollong stock, coordinated services and integrated ticketing for public transport services are important, if not vital. The calculations and simulations also lead to the conclusion that intermodal public transport does not need come at the expense of its social obligation. Key factors toward these conclusions rely on the essential elements of intermodality: hardware (infrastructure), software (policies and systems) as well as humanware (training and education). Key subsidiary considerations in this regard include:

- The need to focus on the movement of persons, rather than the movement of vehicles, via the provision of an affordable, effective and "human" public transport system.
- An investment focus on an intermodal transport system reliant upon a public and private partnership and offering efficient integration and interconnection of the different public transport elements. Each mode within the public transport system should be so allocated so that it utilizes its relative strengths, be they speed, capacity or type of service, to the fullest.
- Intermodal terminals play an important, if not critical, role in the efficiency of the system and

determine for a large part the level of direct and indirect impact on the total operation. The quality of intermodal public transport is therefore determined by the efficiency of the terminals that link the different systems. This efficiency is the results of, on the one hand, available connections and, on the other hand, the quality of the terminals.

- Achieving efficient intermodal public transport requires, in addition to the physical assets, the commercialization of different operators to better manage the public man resources expertise development will be needed. Both are considered by the authors as transport offer; the interconnectivity of the different services via integrated ticket systems, time table alignment and increased reliability; and, improved exchange of information, both internal between operators and external towards the passengers.
- In the context of an intermodal development plan, institutional change and human resources expertise development will be needed. Both are considered by the authors as key success-factors for the establishment of a sustainable intermodal transport system. Institutional reform was considered essential for the future integration of public transport in an intermodal environment.