ITDP

Institute for Transportation & Development Policy

Options for Financing Bus Rapid Transit in China

Walter Hook, PhD
Karl Fjellstrom
Oscar Edmundo Diaz

With critical input from
The China Academy of Urban Planning and Design

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Contents

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I. Executive Summary

The majority of municipal governments in China's major metropolitan areas have the financial means on their own to build Bus Rapid Transit (BRT) systems without the help or approval of the central government. However, the manner in which financing is raised will affect the efficiency and quality of the system, and these issues should be paramount in making decisions about appropriate sources of financing.

For planning BRT systems, most major municipalities have highly qualified transportation planning and/or urban design institutes, and BRT planning can be done as part of their normal duties or as a special project. The cost from the government's point of view is nominal. The use of international financing for BRT planning is helpful less because of financial constraints, than because international funding agencies are more familiar with qualified international consultants, and international consultants are more comfortable working with international donor agencies.

For infrastructure, currently all BRT projects going forward in China are being financed from public sources. Normally, a municipally-owned corporation under the City Government is responsible for raising the necessary financing. These corporations are eligible for receiving paid-in capital from their own profits, from the sale of long term land lease rights by the municipality, and other sources. They are also eligible for taking loans from both banks and the national government. Some new systems like Hangzhou are being financed by a municipal financing company with no bank loans. Others, like Shijiazhuang, are using bank loans. The bank loans sometimes come from state banks and sometimes from the World Bank via the national government. As this structure of financing does not pose any particular problems, and it is the most familiar financing mechanism for Chinese municipalities, we recommend that it be utilized for new BRT infrastructure as well.

Where this structure of financing is not possible, private sector financing can be explored. There is a growing level of private sector involvement in urban transport infrastructure both in China and internationally. Though no BRT systems to date have fully financed the infrastructure from private investment, a few examples have emerged recently where private-sector investment was secured for some element of BRT infrastructure, and more projects are under discussion. Typical and uncontroversial has been private sector investment into bus stop infrastructure in exchange for controlling related advertising revenue, as was done in Kunming. Private sector investment has been secured for major BRT transfer terminals in exchange for land concessions and development rights at the terminal, as was done in two terminals in Belo Horizonte, Brazil, and is being discussed in Porto Alegre. Most recently, TransSantiago, which has some elements of a BRT system, has secured private sector investment into a variety of modest infrastructure improvements in exchange for a long term monopoly concession.

The desirability of private sector financing for BRT infrastructure depends on local circumstances. Private sector financing of BRT infrastructure offers roughly the same risks and opportunities as private sector financing for other types of transport infrastructure, with some minor differences. Toll roads in China have proven in some cases to be profitable investments, with toll revenues able to fully cover the cost of infrastructure and ongoing maintenance. Fully-privately financed metro and light rail projects in Asia have generally ended in bankruptcy, and ultimately ended up costing governments more than traditional public sector financing methods. In China, recent public private partnerships for metro construction are financed by the de-facto donation of state land to private developers in exchange for the infrastructure investment: the metro fare revenues are not expected to fully finance the infrastructure construction. In no case are fare revenues sufficient to cover the cost of the infrastructure. Contracts are not public, however, so the clear apportioning of risks is not possible.

With both metros and BRT, in a context like China where fees collected from private motorists generally do not fully cover the cost of normal road infrastructure construction and maintenance, it is generally not socially desirable to expect transit passengers to fully finance the infrastructure cost, as this will tend to increase fares and create a perverse incentive for people to use private individual modes of transport. As the metro and toll road projects have shown, however, there are many ways in which private investment into BRT can be combined with public funds that insulate transit passengers from higher fares.

While no fully privately funded BRT project has yet been built, experience from the rail transit sector indicates that private investment into BRT infrastructure is likely to increase the public cost of a BRT project. Limited experience to date with private sector financing in BRT makes this approach risky, as the risks and potential pitfalls of different contract structures are not yet well known by either public administrators or private investors. These risks tend to increase financing costs. A private concessionaire for BRT is also likely to require a monopolistic concession over which the municipality will have limited control over the ongoing quality of service. This private monopolist is likely to be a consortium of construction companies, bus manufacturers, banks, and bus operators. Evidence suggests that such private monopoly consortiums tend to increase construction costs, bus procurement costs, finance costs, and bus operating costs significantly above what could be achieved through separate competitive tendering of these activities. There is also significant risk that these increased costs would be passed on to low income transit passengers.

On the other hand, public sector financing of BRT projects has not been free of problems, and private investment into BRT infrastructure offers some potential benefits. First, for a government where sufficient public financing is not available, private investment provides some promise of project financing. Private investment into the infrastructure may also increase the probability that the BRT system will be designed properly and in a location where it will attract sufficient passengers to ensure that the operations are financially self-sufficient. The emergence of private sector BRT consortiums would also help to increase private sector interest in BRT, helping to build the necessary political will for implementation. However, achieving such a positive outcome without compromising the public interest will require sophisticated public administrators, transparency in contracting, and systems of accountability that in many countries are unfortunately lacking.

Private sector investment into the bus procurement and operations is less controversial, and is generally recommended. In China, to date, most of the municipal governments are currently procuring BRT buses using public revenue. This public revenue either comes from the same sources of financing as the infrastructure, mentioned above, or it comes from investments from the subsidised public bus companies. Transit operations in China are at different states of reform, with some cities like Shanghai and Guangzhou already allowing foreign private bus companies to operate both independently and in cooperation with a domestic state owned company. Experience with private investment into bus operations in China has generally been positive, with service quality and frequency increasing. It has also reduced the need for government subsidies for bus operations and bus procurement.

Ticketing systems are another area where private sector involvement is common. An increasing number of international banking institutions are teaming up with smart card ticketing system providers to provide ticketing systems and financial clearing operations. This will not be discussed in this report, but more information is available from the Institute for Transportation and Development Policy (ITDP).

As such, it is recommended that BRT projects in China take the opportunity to attract private investment into the buses and to invite private sector participation in bus operations. This is the international norm in countries where bus operations can be done profitably, as is the case in China. This should be done through competitive tendering to multiple bus operators even within a single corridor, and should include strict contractual penalties for failing to meet quality of service standards. Ideally, this private investment into bus operations should not have government guarantees, where the demand risk rests primarily on the private operator in order to give them a stake in maintaining and increasing the number of passengers.

A principal advantage of requiring private investment into the buses is that it helps to force the design process to face a hard budget constraint for bus operations. Currently, many of China's BRT systems are not being designed in a way that makes it possible for them to be financially self-sufficient. To make private investment into bus procurement and bus operations possible, a new BRT system has to be designed from its inception to be financially viable, and the business model has to be made clear to investors. The final chapter of this document explains the first steps in this process.

II. Introduction

Rapidly worsening traffic congestion and air pollution have become clear barriers not only to the quality of life in China's major urban centres, but also to sustained economic growth. The importance of investment in urban public transport as the main solution to this problem is clearly reflected in several government decisions.

On July 24, 2004, Vice Premier Zeng Peiyan instructed the Ministry of Construction to take further measures to prioritize the development of public transport to promote the healthy development of cities. On June 25, 2004, Premier Wen Jiabao also prioritized the development of urban public transport as a key strategic objective. The Ministry of Construction, in "Recommendations on Prioritizing the Development of Urban Public Transport" (No. 38 of 2004) states clearly its objective to build up the leading position of public transport in urban transportation in five years.

The rapid growth of urban infrastructure projects, some of them of dubious economic viability, and the growth of debt held by municipalities and municipal owned corporations, has led China's national leadership to try and bring more rationality to the planning process, and to attract more private investment and market rationality into the provision of public transit services.

Given the growing needs and importance of urban mass transit, and the growing financial burden that this need has created, several municipalities have taken the initiative to explore Bus Rapid Transit (BRT) as a less expensive mass transit option either as a complement to or instead of metro and light rail systems.

Because the capital costs of BRT systems are modest relative to metro and light rail systems, costing anywhere from 1/5 to 1/50 of the price of a metro, raising the necessary funds to plan, develop and operate BRT is not a significant obstacle to implementing BRT systems in China.

Municipal governments in China are wealthy by international standards, and most of the wealthier cities that are considering BRT have the capacity to finance BRT construction out of various financial mechanisms available to them. They do not require financial help from the national government, nor do they necessarily require the approval of national authorities. The power of Mayors in China to raise money for major infrastructure projects with or without the authorization of the national government is enormous. Therefore, with the possible exception of Mayors from poorer parts of Western China, lack of governmental financial resources is not an absolute condition but rather the result of the existing political priorities.[1] Resolving the BRT financing issue therefore should begin with a rational decision-making process regarding the use of scarce public funds for infrastructure development.

When deciding on how best to finance BRT in China, therefore, it is important that political decision-makers agree on the objectives that should drive the decision-making process. The following decisions need to be made at the very beginning of project implementation:

[1] Data from the National Bureau of Statistics showed that in January and February 2005 investment in urban public utilities in China was dominated by urban roads (68.9%) while 8.1% went to rail transit and just 2.1% to public transport facilities other than rail.

- How important is BRT relative to other uses of scarce public funds available for infrastructure development and how will the BRT system relate to any ongoing metro or light rail or road improvement projects?

The way in which BRT systems in China are financed will have a significant impact on the quality of the BRT systems developed. The leading BRT systems in the world achieved success not only because the physical infrastructure was well designed and constructed, but also because bus operations using the system were planned from inception to be financially viable. Although the infrastructure was funded by the state, and the service is regulated and managed by the state, the system was designed for operations based on the market principle, and the private sector plays a key role in each system's development and operation.

Furthermore, different approaches to financing BRT presuppose different institutional structures, and not all of these structures are equally likely to yield good quality transit service to the public over the long term. The way in which capital is raised for the BRT project will have profound effects on the way the system is institutionalized, managed, and ultimately on the quality of service the system is likely to provide, and the speed with which the system can be expanded into a viable network.

There are no BRT systems yet in existence where the initial cost of the infrastructure has been financed fully through ticket sales, though TransSantiago covers part of the intrastructure through ticket sales. There are not yet any examples of Build-Operate-Transfer (BOT) BRT systems in existence. BOT, broadly defined, in BRT is certainly possible, as it is for roads which are not fully self-financed from toll revenues, but this should be considered as one financing option among many for the infrastructure, and as a general rule the benefits of BOT for BRT are outweighed by the costs. As a general rule, then:

- Construction of BRT infrastructure and maintenance should be paid for by the state when possible.

It may be that on some highly profitable systems the profits would be high enough to cover some part of the infrastructure construction and maintenance costs. However, the elements to be paid for by the ticket sales should be carefully identified. The procurement of the ticketing system, for example, is frequently paid for out of the farebox revenues. The maintenance of the infrastructure, for example, would be the next thing to pay for under the ticket revenue if the profitability of the system is high, because poor maintenance of the BRT roads will adversely affect the bus operators, so they like more control over this. This would be followed by maintenance of the stations, then construction of the stations, and road improvements only as a last resort.

Based on the bus volumes that exist in China's major cities, and the success of privately operated bus operations even in mixed traffic conditions, there is little justification in the Chinese context for subsidizing the bus procurement nor BRT operations. Once taken out of traffic congestion and designed for high speed service, there is no reason why bus-based transit systems cannot fully cover the cost of bus procurement and the operational expenses from ticket sales. If a BRT system is designed where the ticket sales are insufficient to cover the cost of bus procurement and operating costs, then the system has been badly designed, and we would recommend that the project not go forward. As a minimum criteria for initiating a BRT project, we recommend the following:

- The BRT system should be able to cover its operating costs within one year of operation, inclusive of the cost of financing the bus procurement and ticketing system procurement, and their depreciation.

Because transit volumes are high and incomes are also rising, there is no reason why the cost of bus procurement, ongoing bus maintenance, and BRT operations cannot be covered out of ticket sales without significant increases in bus fares. There are a lot of reasons why it is good to have private operators be responsible for bus procurement and operations above and beyond the fact that the government does not then have to pay for these elements of the project. If the cost of the buses and operations cannot be covered out of ticket sales, then there is a problem with the system's design.

However, there may be some instances where the government may want to require a very high technical standard on the bus; for example, requiring very low emissions because the buses are operating in an area in violation of existing Chinese ambient air quality standards. In this case, it may be reasonable to have the government indirectly subsidize bus procurement by paying private bus operators a higher amount per bus kilometer, but private procurement is still preferable.

'Operations' is also a fairly broad category, and whether some ongoing system costs are paid for by the government or covered by the ticket sales depends on the profitability of the system. A major expense, for example, is generally security services. While security is less of a problem in China than elsewhere, security is a major reason why BRT systems appeal to customers more than normal bus services. Whether the BRT system should pay for its own security services or whether these should be picked up by the government can vary depending on the profitability of the system. Cleaning and maintenance of the stations and depots also can be paid for by the system or externalized. But certainly the cost of bus operations should be fully self financing.

Therefore, as a general rule, we recommend that;

- All new BRT systems in China should be designed so that the ticket sales will be sufficient to cover the cost of basic bus procurement, ticketing system procurement, ongoing bus maintenance and replacement, and ongoing operations.

Raising the necessary financing for a BRT system should not be the last decision made after the project has already been designed. Rather, the type of financing that will ultimately be used must drive the decisions of the system's designers and engineers, and not the other way around. ***If a BRT system is not engineered from its inception to be financially viable, it won't be***.

Because BRT usually aims to create a secure long term market for bus operations, the business model for the BRT system as a whole must be developed, and this business case has to be built up from the business case of the separate components of the system: the trunk operations, feeder bus operations, ticketing systems, possibly security services as well. The development of the system's business model will require some initial analysis of projected operating costs and projected revenues. This analysis will help identify the conditions in which operating companies can reach profitable (and thus sustainable) revenue levels. The calculation of operating costs and projected revenues will also allow initial estimates of the tariff levels that will allow the system to cover its operating costs.

How BRT systems estimate the likely demand on the specific BRT system being proposed, which serves as the basis of the business model, is the subject of the last chapter. This business model will already presuppose a specific approach to project financing. We recommend that political decision makers select the business model and source of financing that:

- maximize the quality of the service over the long term
- minimize the cost of the service over the long term.
- maximize the level of private sector investment over the long term.
- minimize the public cost of financing.
- Will mobilize the necessary resources in a timely manner that suits the political needs of the decision makers.

Defining what exactly can be paid for by ticket revenues and what needs to be paid for by the government should be determined by the business plan for the BRT system as a whole. Normally these cost calculations are done by financial experts, usually management consultants in close cooperation with the system's designers.

III. Financing BRT Planning

III.1. Municipal transport planning and budgeting in China

By international standards, mayors in China have enormous discretion in terms of transportation planning and budget. It is fully within the powers of the mayors of all but the poorest cities in China to plan, develop, and finance BRT systems in their city without any approval or help from either national or international sources. The main obstacle to BRT financing in Chinese cities is not the lack of funds, but rather an incentive structure which rewards mayors for short term economic growth at the expense of long term economic, social, and fiscal prudence.

Until very recently, mayors in China were primarily rewarded for delivering rapid economic growth and attracting foreign direct investment to their city. Unlike in many other countries, Chinese mayors are responsible not only for the provision of urban public services, but also for the performance of the urban economy, including, among other things, reforming the state-owned enterprises, and running indirectly a host of municipally owned companies in banking, transportation, real estate, and other sectors.

Faced with an explosion of traffic congestion, Chinese mayors have addressed the problems with capital-intensive solutions like road infrastructure expansion and metro systems, using a host of creative financing mechanisms. However, these measures alone have proven incapable of addressing the growing problems of congestion and air pollution, while creating their own problems of rapidly growing public debt, urban sprawl, and the rapid loss of state land assets.

Because of this structural imperative to increase Gross Domestic Product (GDP), mayors tend to favour large infrastructure projects like major roads and metros, which create short term increases in regional GDP due to the burst of public spending, while ignoring the long term impact of the specific public investments on the process of capital accumulation, or on the quality of life in the city.

By international standards, Chinese mayors have enormous discretionary power with regards both to what transport infrastructure is planned and how it is paid for. China's urban transportation planning and investment decision-making is almost entirely in municipal hands. China's urban transportation infrastructure planning process is currently guided by 20-year urban master plans, five-year implementation plans, and usually one or more transport master plans and implementation plans. Often there are two or more competing agencies in a municipality responsible for developing the urban transport plans, a transport planning research institute usually under the planning commission, an urban design institute under the construction commission, and a public transport regulatory body under the communications commission. Major projects then need approval from the municipal development and reform committee, but ultimately the plans are decided by the mayor. The mayor of the major city in a province is normally a high ranking member of the Provincial Communist Party, and the Communist Party also has considerable influence over the decision-making process.

While the municipal master plans have to be approved by the central government, urbanization, rising personal incomes, and motorization have grown so rapidly in many cities that actual construction related to the master plans is implemented ahead of schedule, so the long term plans become only guides to broad policy. Land development and infrastructure development in most cities has outstripped the limit and expectation set by the master plans, and it is within the power of the mayor to implement projects not fully identified in the master plans so long as it is consistent with broad policy.

Though national government approval is supposed to be required for large projects, in practice it is not always required, as there is frequently a backlog of projects to review by the National Development and Reform Committee (NDRC), and central government policies are sometimes contradictory. While in theory the routing of major road projects and metro projects needs to be approved by the Ministry of Construction and their feasibility approved by the NDRC, in practice municipalities have gotten around these requirements. Therefore, frequently municipal projects proceed even without national government approval.

The 5 year implementation plans developed by the planning bureau or specific projects developed by the construction commission are reviewed by the municipal government finance bureau, which evaluates how much income the project is likely to generate. If the project is not going to generate any income, like for major urban highways without tolls, then it must be financed out of general budget revenues. In some cases, some of the money will come from general municipal revenues, and some of it may come from loans.

Once the investment decisions are made via the planning process, mayors do not have to subject their proposed budgets to any legislative body for approval. The budget frequently changes throughout the year, and it is fairly easy for the mayor to increase it.

The initial rigidity of parcel by parcel urban master plans is giving way in many cities, with Guangzhou Municipality somewhat ahead of the process, to a strategic planning approach, putting the future development of urban spatial structure in a much broader context of globalization, regional integration, and ecological preservation. The strategic plan allows a higher level of flexibility by focusing on spatial structure and cluster development instead of the specific use of every land parcel.

As BRT was relatively unknown in China as an option, it is not reflected in most longer term master plans. However, as national government approval is only necessary for rail projects, as master plans are not rigidly enforced, and municipal budgets are largely discretionary and under the control of the mayor, BRT projects can be planned, financed, and implemented without national government approval or legislative approval so long as they have the support of the mayor and local Party leadership.

III.2. Financing BRT Planning

III.2.1. Financing BRT Planning in China

The first thing that needs to be financed in a BRT project is the planning. Frequently, in China as elsewhere, municipal governments will skimp on the provision of resources to the planning process, and rush the process to ensure rapid implementation deadlines determined by political imperatives. The proper financing of a BRT system's design can mean the difference between a profitable system and one that loses hundreds of millions of yuan every year, so skimping on the planning is a misallocation of public resources. As one BRT planner put it, BRT is performing heart surgery on your city's clogged arteries. You should not go to the cheapest surgeon you can find; you should go to the best surgeon you can find.

In China, technical support for the first median busway system in Kunming came originally from the Swiss Government via the Zurich Sister City Project, with matching funds from general municipal government budget revenues. Technical support to Shijiazhuang came from municipal general budget revenues, with some loan funds from the World Bank.

Technical support to Beijing, Chengdu, Xian, Jinan, Hangzhou, and Kunming is coming from the Hewlett Foundation and the Energy Foundation, often with matching funds for municipal government staffing and surveying from the municipal government. Technical support from ITDP to Guangzhou, where the BRT planning is being funded by the City Government's Construction Commission, came originally from the Rockefeller Brothers Fund and is now coming through the Hewlett Foundation. The municipality is financing the balance.

Gaining access to the time of talented municipal planning staff and convincing the municipality that a BRT system is not just a physical design problem but also a business planning and system design problem is generally more difficult than finding the financing for the planning. The planning resources are tightly controlled by the mayor, and if political support is not strong, planning agency staff will not dedicate the necessary time. Planning is thus often difficult in the early stages before a firm commitment has been made, and it is in these early planning stages that international planning support and financing are important. Once a decision is made resources for physical planning is rarely an issue.

More frequently neglected is the funds necessary to develop a good business model and institutional structure for BRT operations. If the mayor is committed and understands what is required, a city can find the level of resources required to hire top quality consultants.

Project preparation grants from the World Bank or the Asian Development Bank may also be used if a World Bank loan is being prepared. The World Bank also has a grant fund for the preparation of public private partnerships, and is sponsoring a Global Environmental Facility multi-year grant under GEF IV that will provide some funds for planning at the municipal level in the future. The Volvo Foundation and SIDA also financed some preliminary work in Suzhou.

III.2.2. Financing BRT Planning Internationally

Selected recent or best practice examples

The cost of planning and engineering of the first phase of a BRT system can cost anywhere from $100,000 to $6 million. It is much cheaper to plan a system that is going to be fully subsidized by state funds for construction, rolling stock procurement, and operations, though it is much more expensive to build and operate such a system.

Bogota, Colombia spent around $6 million because it faced a rigid political time constraint, had no previous experience in BRT planning, and many of the financial and contractual arrangements were being developed for the first time. Now that many new things were learned in the Bogota TransMilenio project, $6 million is no longer necessary, though probably $500,000 is not enough. It depends on the size and complexity of the city and the system, the quality of existing data, and the skill level of local experts. Some $2 million for planning is now a reasonable rule of thumb. In practice, if there are talented municipal government employees equipped with the necessary data, the marginal cost of planning a BRT system can be close to zero. Planning the system in-house is always the least expensive and the fastest, but requires municipal planning staff to be highly skilled. Quito, Ecuador probably spent the least money on planning, using only the existing budget and resources of the City Planning Agency, costing only about $100,000, but some costly mistakes were made. In the best case, some supervision by international, and increasingly by Chinese experts, may be sufficient. Planning costs will drop as greater familiarity with BRT spreads.

Bogota spent the most on planning and designing the system. The costs are as below:

Bogota Planning Costs, Phase I

Firm contracted	**US$**	**Paid by**
McKinsey Investment Bank	3,569,231 192,308	UNDP Department of Transport
Steer Davies Gleave	1,384,615	Department of Transport
Landscape Designs	115,385	Department of Transport
TOTAL	**5,261,538**	

While this may seem expensive, the Bogota system is highly profitable, and requires no operating subsidies, nor subsidies for bus procurement.

In Bogota, the largest contract was for a management consultant firm (McKinsey), to manage the whole project and set up TransMilenio, the operating authority. This was about $3.6 million. For about three years the City of Bogota had an agreement with UNDP that the Municipality would pay a fixed amount of money into a UNDP account for international technical assistance for a range of support needs. The amount did not change, it was already allocated, and its use was simply defined to hire a management consultant for the BRT system. The source of the funds was general municipal budget. The planning, design, and engineering work (another $1.5 million) was paid for largely out of the ongoing budget allocations of the Department of Transportation, but it was sub-contracted out to a world-class transportation planning firm, (Steer Davies Gleave) who in turn subcontracted some experts from Brazil (Logit). There were few costly mistakes in Bogota that have had to since be corrected, and the system is fully financially self financing and even profitable, so the money spent on planning has in fact saved the city millions of dollars into perpetuity.

Like Bogota, Quito used ongoing budget resources to finance all of the planning. Other than for one international UNDP expert brought in during Phase II, all of the planning and design work was done in-house by the Planning Department of the Municipality of Quito under the leadership of Cesar Arias. The costs were much lower than in Bogota, and are difficult to control for, as they were covered by the normal ongoing budget of the planning department, but informal discussions with Mr. Arias indicate it was in the order of $100,000. In Quito, on the first BRT corridor, there were three mistakes made that have cost the Municipality millions of dollars and have consumed an unnecessary amount of road space. First, the first system used electric trolleybuses. This cost some $3 million per kilometer (Maybe $30 million in total) more than had they used clean diesel, largely due to the cost of the vehicles and the conduit. Secondly, because electricity prices have since increased, the system is not profitable. As a result, the municipality had to pay for the buses, rather than the private operators, costing the taxpayers another $20 million or so. Third, the operating company is not self financing since electricity prices were increased with price decontrol. As a result the operator is making deficits every year. Thus, more money should be spent on proper planning to ensure the system was self financing and appropriate technology selected.

Planning for a BRT system in Mexico City has attracted considerable international donor support. Total spent on planning was roughly $1 million. The detailed planning work for two BRT corridors in the Federal District and very preliminary analysis in the State of Mexico was financed by a World Bank-sponsored grant from the Global Environmental Facility. The Federal District used this money to hire local consultants to develop designs on the Insurgentes (Getinsa) and Eje 8 (Eteysa). The Shell Foundation and the Hewlett Foundation paid for the review of the plans in the Federal District by international experts, primarily through WRI-Embarq's Center for Sustainable Transport, and partly (for the pedestrian access) through ITDP. The State of Mexico plans were paid for initially by GTZ which subcontracted Cali-Mayor. ITDP paid for international experts to review these plans, and to prepare a financing plan for the system. The State recently contracted the firm of Jaime Lerner, former Mayor of Curitiba, to do another pre-feasibility study, but it is not yet a detailed engineering design.

In Delhi, about $500,000 has been spent on planning the Delhi High Capacity Bus System. The financing for planning in Delhi came roughly from three sources: the Delhi Government's general tax revenues, a grant from US AID to ITDP, and a general grant from the Volvo Foundation to the Indian Institution of Technology's Transportation Research and Injury Prevention Program (IIT TRIPP). The funds from the Delhi Government (now about $300,000 for the seven corridors) were used to contract out to IIT TRIPP, and to RITES, a parastatal planning firm for detailed engineering. This was supplemented by funds from US AID through ITDP to IIT TRIPP and to international consultants. The municipality did not initially accept the need for a demand analysis and operational plan prior to the infrastructure design process. The Delhi HCBS has not yet been constructed, so evaluation is pending.

Jakarta's TransJakarta system was planned with funds from the DKI Jakarta government supplemented with US AID funds to ITDP for review of the plans by international consultants and for study tours. The municipal government contracted out three local consulting firms, Pamintori Cipta, Ernst and Young, and the University of Indonesia's Center for Transportation Studies (UI CTS) for different elements of the planning. Total spending on planning and detailed engineering will total around $1,000,000 for the whole system. US AID funds to ITDP financed all the international expert review of the local plans, as well as sub-contracts to the UI CTS to complete the demand modelling, as well as support to the NGO Pelangi for public relations and socialization of the project. There are technical problems with the TransJakarta system, but they did not result from a shortage of funds.

In Dar es Salaam, planning for the new BRT system is being financed by four sources. The largest share, roughly $1.5 million, is coming from a loan from the World Bank as part of a larger loan package for a Central Roads Corridor Improvement Project. Another $500,000 is coming from a Global Environmental Facility of UNEP to ITDP for the planning of the institutional and business model, capacity building, and non-motorized transport facilities planning. The Municipality has dedicated another $300,000 per year for planning for two years in a row, and US AID donated another $100,000 via ITDP.

In the US, BRT planning is generally financed either by the public transit authority, municipal departments of transportation (if one exists), state departments of transportation, and/or the US Federal Transit Administration's BRT program which is funded from the Federal Government budget. It provided several million dollars in matching funds for BRT planning in 10 pilot cities around the country, including Los Angeles, Honolulu, Pittsburgh, Charlottesville, and Eugene. The New York City Department of Transportation (DOT) issued the Terms of Reference for a $2.5 million BRT study for the New York Metropolitan Region, half of which is being paid for by the Metropolitan Transit Authority (MTA) and half by the City DOT.

IV. Financing BRT Infrastructure

IV.1. Urban Infrastructure Finance in China

Roughly the same financing options exist for BRT infrastructure as exist for other major municipal public works projects such as metros and major urban roads. To date, all international BRT projects and all of those that have gone forward in China have financed the infrastructure primarily from public sources. A few sub-BRT transit systems used private investment for modest infrastructure improvements, and a few full BRT systems have used some private investment for stations and terminals. For the time being, therefore, predominantly public financing of BRT infrastructure is recommended. As such, the bulk of this chapter reviews public sector financing options in China. However, growing private sector investor interest in BRT and other mass transit systems warrants a review of experience with this option, and its risks and opportunites.

In China, with the decentralization of financial responsibility from the national government to the provincial and local level, responsibility for financing urban infrastructure has largely devolved down to the municipal level. This devolution has occurred in an ambiguous legal framework, which has led to creativity in finding financing from a wide variety of sources.

One source of funds is national government loans. National government loans may come from national budget sources, national bonds, or from loans from the World Bank. Because the municipality itself is not allowed to get loans, they have to set up a municipal corporation to be the recipient of the loan, but these municipal corporations are largely controlled by the Construction Commissions. In the case of the Guangzhou Inner Ring Road, for instance, the financing came from the World Bank, which went to the national government, which then loaned the money to a special municipal corporation tasked with the construction of the road.

Even though World Bank loans are given to the Central Government, for city projects, after the city creates the company that borrows the money from the Central Government, cities must demonstrate their financial capacity to repay a loan (debt capacity, revenues, and expenditures), the source of funds available for financing the project, and the list of other projects in the following five years. The World Bank finances up to 60% of the project's cost. The loans are given for twenty years, including five years of grace period. The Ministry of Finance (MOF) sets the criteria to provide these loans to cities. In the case of some Western cities, they do not have the capacity to obtain loans.

The Asian Development Bank (ADB) has to date primarily financed inter-provincial roads and some local roads, twenty seven loans in total. The loans have been repaid by the provincial governments, since its payment capacity is higher than that of municipal governments. The ADB is interested in entering the urban sector as well. The highway loans are paid with toll revenues, and where traffic has increased there has been no problem to collect the necessary funds. ADB finances 20% to 30% of the total project's cost. Poor areas do not have access to transportation systems, so that ADB finances few local public transportation systems and transport services; they have not been involved in bus systems, only in a bus terminal. ADB negotiates a package with China every year. After a project is identified the ADB sends an exploratory mission. Afterwards they send international and domestic experts to do preparatory and economic analysis. From the time the project is identified, obtaining the loan can take two years. ADB rates are at 3.4% - 3.5% compared to the rate of commercial banks at 5%-6%. Loans are given for 20 years with a 4 to 5 year grace period.

A sample survey by the Ministry of Construction indicated that, among the sources of investment in urban public infrastructure construction in twelve of China's major cities from 2004 to 2005:

- the domestic loan component decreased by 6.3%, down to 40.9% from 47.2%
- the central government financing increased by 0.6%, up to 9.7% from 9.1%
- municipal government's own funds and private investment into municipal corporations increased by 5.7%, up to 49.4% from 43.7%

Detailed investigations in Jiangsu and Shandong Provinces also indicated the same trend. To some extent, the increase in self-financed funds and other funds represents the result of reform in the public utilities industry, leading to more private investment being mobilized.

Because the loans have to be repaid, at least in theory, ultimately the source of financing is the municipal government.

Municipal government finance in China is non transparent. There are several sources of municipal government finance according to interviews:

- income and some other smaller taxes (1/3 of the income tax goes to the municipal government)
- land taxes and the sale of long term land lease rights
- income from municipally owned enterprises
- enterprise taxes
- fees.

In practice, all municipal revenues are put into a common fund under the control of the Finance Bureau, and then redistributed. There is a distinction, however, between budgeted and non-budgeted revenues and expenditures.

Most major transportation infrastructure expenditures are financed from 'extra budgetary' revenues. These extra budgetary revenues are used to capitalize municipally owned special purpose companies, like the metro companies and toll road companies, the precise mechanisms of which need to be further explored.

As a trend, municipal financing in China has seen a dramatic increase in non-tax extra-budgetary revenues and off-budget expenditures.[2] The decision-making process which governs the use of these funds is not transparent and whether criteria for project prioritization exist or not is unclear. Land sales have been the most important source of municipal government extra-budgetary revenue for road and metro projects. Urban land is owned by the central government, but its use is managed by the municipal government. Central control, monitoring and supervision through administrative means is fairly weak. Rural land is collectively owned by individual villages. Land acquisition for urban use and infrastructure development is the activity of the municipal government and is governed by the Land Management Law. However, the replacement cost of the rural land is calculated on the basis of its agricultural use, without the premium reflecting the proximity to urban centers. Thus, rural land at the edge of the cities is seriously under-priced, leading to a strong incentive for the conversion of rural land into urban land. Many municipal governments

[2] The following section is taken largely from Zhi Liu, (Draft) 2004. "Planning and Policy Coordination in China's Infrastructure Development" The World Bank.

engage in massive land acquisition activities under the guise of meeting the rapidly growing demand for urban space driven by urbanization, industrialization, and preference for low-density lifestyle that is increasingly made possible by personal income growth and motorization. Municipal governments acquire the rural land at city edge at very low prices, service the land with basic infrastructure, and then sell the land use right to real estate and industrial developers at much higher prices, reaping the financial gains that do not pass through the formal budgetary process. These gains are a major portion of the extra-budgetary revenues which are mostly used as extra-budgetary expenditures, going to infrastructure, industrial parks, social sector, etc. Because the municipality benefits directly from the increased land values resulting from the infrastructure serving these areas, there has been a tendency to prioritize highways and metros that serve these newly developing areas, while initiatives to improve the rapidly deteriorating congestion conditions in the city centre have received less attention.

Municipal governments also own many state owned companies, and some of these state owned enterprises earn profits. The Shanghai Urban Investment Company for example, is a municipally owned corporation which generates revenues. In the past, these revenues from state-owned enterprises were the major source of government revenues, but they still constitute a significant share of the revenue. Some municipal corporations cross-subsidize less profitable investments with profits from more profitable investments.

Privately owned and foreign owned enterprises also pay enterprise taxes. Almost all cities collect funds including IOUs from state-owned enterprises and local businesses through the so-called extra-budgetary process, which is neither disciplined nor transparent.

Fees are another important source of revenue. These 'fees' are sometimes quite specific and arbitrary. For example, funding for the first line of Guangzhou subway system was partly raised by a local surcharge on hotel bills. Funding for Shanghai's subway lines was partly raised by the district governments through 'donations' from enterprises. Some local governments just set toll booths on existing highways simply for the purpose of raising local revenues.

There are also taxes on the purchase of automobiles, licensing fees (980 yuan for small cars in Guangzhou) and fees to enter the city if the vehicle is licensed in another city. Parking fees too can generally be increased. There are also infrastructure construction taxes paid by developers.

Because of the broad discretion that municipalities have to impose various fees, in principal at least these fees could be systematically imposed on motorists to discourage private motor vehicle use. In other words, it is well within the powers of Chinese municipal governments to impose special tax assessments on motorists such as congestion charges, and elevating parking charges, to encourage higher levels of public transit use, should the political process see the wisdom of such incentives.

An obvious source of municipal government financing for infrastructure would be the fuel tax. To date, however, there is no tax on fuel in China. Hai Nan province initiated a pilot project to impose a 10% tax on the government fixed fuel price of 3.96 yuan per liter. The pilot project will last for five years. The price of gasoline in general is the same in the country; however it changes because of its transportation cost. Evidently, introduction of a fuel tax has been delayed until now by debates about how the revenues would be shared between the national and provincial governments. There is no discussion of giving the municipalities a share of such a future fuel tax, to our knowledge.

Currently there are no municipal bonds floated in China. This is under discussion, but until now it has not been a priority, as credit has been readily available at low interest rates from state banks and other sources.

Property taxes are also little used in China. Recently, some municipalities have experimented with property taxes, and property taxation could be another source of municipal funds for infrastructure. Special tax assessments on property owners where land values are likely to appreciate as a result of specific infrastructure improvements such as the construction of a metro or BRT system are well within the powers of the mayors.[3]

Once an infrastructure project has been planned and approved by the mayor, the finance commission makes a determination of whether or not that infrastructure can be self-financing, partially self financing, or not self financing at all through revenue generating activities.

If a project has the potential to earn significant revenues, such as a toll road or the subway, then the project may be financed for up to 70% of the cost through bank loans. While the 30% of public investment would be raised by the above mentioned means, the loans would come largely from banks. Governments themselves are not allowed to borrow money from banks, but they can set up municipally owned corporations which can in turn take out loans not only from private banks but from banks owned by the same municipality. If there is private investment or foreign investment, for example, there is more likely to be private or foreign bank involvement.

IV.2. Financing Municipal Toll Roads

The way municipal toll roads are financed in China may offer some insights into possible financing mechanisms for BRT systems. The primary difference between toll road financing on the one hand, and metro and BRT financing on the other is that some toll roads are able to finance the entire construction and maintenance out of toll revenues, whereas none of the metro or BRT projects can hope to finance the entirety of the infrastructure out of fare revenues. Nevertheless, the private toll roads in China provide useful insights relevant to BRT financing.

There are several forms of highway companies in China that differ primarily on the amount of public versus private investment, and on the level of risk exposure assumed by private investors. These creative forms of financing have led to an explosion of toll highway construction at the municipal level. Despite a historically unprecedented expansion of highway kilometers by as much as 9% per year in some regions like the Pearl River Delta, (most countries can manage perhaps 1% to 2% growth per year), the congestion problem continues to worsen due to increases in the motor vehicle fleet in the range of 15% per year for almost a decade.

Private financing for highways began in 1994, when the Quanzhou Municipal Government of Fujian Province opened to private capital investment the Citong Bridge, which was 1530m long, 27m wide, six lanes in two directions, and with a total investment of 250 million yuan. "Mingliu (The Celebrities) Company", a joint-stock company shared by 15 private-owned companies, took a 60% share. This was the first time that considerable private capital was invested in infrastructure with little national investment.

[3] Chinese city governments have the authority to collect reasonable charges from those land developers who benefit from the construction of transfer hubs, for example. It is allowable to set up benefit estimation zones or to collect development charges, connection charges, and mandatory charges of land development.

After the precedent was established, there was a rapid increase in private toll road financing in China, especially in Shanghai and Zhejiang and Guangzhou, which have become the model for using private investment to finance highway construction around China. The involvement of private investment considerably accelerated highway construction in Shanghai. By the end of 2005, the total mileage of highways in Shanghai broke through 540km. At that time, Shanghai highways will have 108 lanes directly linking to Jiangsu and Zhejiang Provinces. Some 70% of these highways linking every major destination in the Yangtze Delta have been built with private capital. By purchasing 99.35% of the shares of Hu-Hang Highway at a price of 3.207 billion yuan, the private Shanghai Fuxi Investment Company became the first fully private capital investment into large infrastructure in Shanghai. The A5 (Jiading-Jinshan) expressway was the largest investment by 2003, 65km in total length and with a budgeted investment of nearly 6 billion yuan, including 5.1 billion yuan invested by Fuxi. According to the contract, the company will generally be responsible for the investment & financing, construction, and operation of the highway for 25 years before the highway is returned to the government.

Before 1995, the government guaranteed the revenues to the investors, but after 1995 this practice was stopped. Without having access to the specific contracts, the exact apportionment of risk in these contracts and the specific level of risk exposure to the government is difficult to know.

Some of these projects are fully privately financed without loan guarantees. These "4-Self" (Self loan, self construction, self toll collecting, and self loan repayment) projects are popular in Zhejiang. By the end of 2002, there had been 211 "4-Self" road projects in Zhejiang approved by Zhejiang Provincial Government. For such projects employing the "4-Self" investment & financing mode, the investment was about 58.6 billion yuan in total. Internationally, “4-self” projects would generally be one of a family of financing structures called “build-operate-transfer” or BOT.

A more typical pattern is for the municipality to start a highway company, borrow money from state banks for up to 70% of the financing, and match this with 30% of municipal funds, usually generated from land sales. In the case of Guangzhou, there are several highway companies that are owned by the Construction Commission of the Municipality of Guangzhou, most of them are joint ventures with Hong Kong companies. The Guangzhou Northring Freeway Co. Ltd, for example, is a joint venture with New World Co, HK. The East, South, and West portions of the ring road are in joint venture with Long River (HK) and Hehe (HK). There is also the Guangdong Fanyuan Group, Guangdong Huiyu Group, Guanddong Expressway Corp, Guangdong Traffic Investment Corp, and the National Transport Corporation Ltd. The Northern section of the ring road generates enormous profits, which are then used to cover the losses on the less profitable sections of the road network.

Currently in Guangzhou, these toll road companies are only allowed to borrow up to 60% of the investment from state banks. Typically, there is a consortium of banks led by the largest bank. There are two state ‘development banks’ in China, the Construction Bank and the Commercial Bank, and these two banks offer lower interest rates than the more commercial banks, most of which are also state owned unless they are foreign owned. The Bank of China and the Agricultural Bank are also heavily involved in toll highway loans. In the case of the Guangshen Expressway between Guangzhou and Shenzhen, the lead bank is a Japanese bank.

While these loans are not formally guaranteed by the municipal government, as the companies are owned by the municipality’s construction commission, there is a tacit guarantee to private investors. The commercial bank, for example, is generally owned entirely by the Municipal Government. As such, even though the project itself may have no guarantee, the majority of the risk may be absorbed by the municipally owned bank, so the state is in any case at risk for the majority of the value of the project. The contracts may insulate the private investors in any number of ways that cannot be precisely known without reviewing the actual contracts.

It is an important question to clarify, as some of these highways have almost no traffic and are no doubt facing serious deficits. Generally, the pattern seems to be that foreign private investors are investing in the highway links that have reasonable traffic levels, while those with less clear traffic demand have a lower participation of private capital, or no private participation, and are borrowing entirely from state banks. Because it is quite easy for the Mayor to put pressure on the municipal bank to finance government-sponsored infrastructure projects with very poor financial rates of return, these state banks are generally carrying a significant amount of bad debt. These bad debts, however, can be partially compensated for by profits from the more profitable state owned toll roads. Given the lack of transparency, the precise level of credit risk guarantee is difficult to know.

IV.3. Financing Municipal Metros

The other obvious precedent for possible BRT financing is the current financing structure of Chinese metro or subway projects. In the last two decades, realizing that building out of the congestion was impossible, many Chinese cities have turned to metros. Recently, some new metros are being constructed with private investment financing. This private investment is being attracted not, however, primarily by the promise of collecting the fare revenue. Rather, the private investment is generally provided in exchange for long term lease rights for municipal land in desirable locations adjacent to the new metro lines.

Throughout the whole country, the cities with subways existing or under construction include: Beijing, Shanghai, Guangzhou, Tianjin, Dalian, Shenzhen, Nanjing, Wuhan, Chongqing, Chengdu and Changchun. The cities which have formally expressed their desire to construct subways include: Chengdu, Hangzhou, Shenyang, Xi'an, Harbin, Qingdao, and Suzhou. Now nearly 30 cities have completed planning for subway and light rail projects, including those in the regions with developed economy such as Yangtze Delta, Zhujiang Delta, and Bohai Sea Region, as well as large cities in Northeast China, Middle China, and Southwest China. The investment in subway projects under construction in China has increased to more than 100 billion yuan. Adding those to be constructed, the total investment will be over 200 billion yuan.

As indicated by data from China Ministry of Construction, the overall cost for subway is about 550 million yuan/km. Funds for projects in a single city may reach several or over 10 billion yuan. In the next 15 years, these cities plan to construct over 4500km of metro lines. Approximate estimation indicated that the investment will be as high as 1,300 billion ~ 1,900 billion yuan, equivalent to the total GDP in Beijing 4~6 years from now. The challenge of financing these systems was and will be one of the barriers for local governments to continue to construct subways.

Although listed in mid 1990s, Qingdao Subway and Chongqing No. 1 Subway were dropped due to lack of funds; and Shenyang Subway listed at the beginning of 1990s has never found the way to construction, also due to funds. The efficiency of subways is based on their ability of providing high capacity high speed services on high demand corridors but to be effective must be part of a network. If it fails to form a network, the overall benefit will remain low.

The fact that much of the financing for these subways is coming from loans taken out by municipally owned corporations means that the financial risk exposure of many municipal governments is significant, and the lack of transparency makes it extremely difficult to know exactly the level of debt. The three subway lines constructed in 1990s in Guangzhou, Shanghai, and Beijing employed a vast quantity of imported locomotive equipment, resulting in the overall cost averaged to 600 million – 800 million yuan/km, even higher than the average level of subway constructions in many countries and regions around the world.

Data from China National Planning Commission indicated that China's urban transport investment would be up to 800 billion yuan during the "Tenth Five-Year" period, including at least 200 billion yuan for subway construction, and the majority of the rest spent on highways, and another 200 billion yuan is needed to complete many of these systems. As Beijing carries out its "rail" expansion, there is a gap of funds over 60 billion yuan. China is rapidly increasing its financial deficit in recent years, from 0.78% (the proportion that the deficit contributes to GDP) in 1997 up to over 3% in 2002, a high debt ratio by international standards.

Since the upsurge of subway investments, the State has tried to impose strict regulation and control over the approval of subway projects. In its Document No. 60 of 1995 ("Notice to Suspend Approval for Rapid Transit Projects"), the State Council announced that it would, "approve no more subway projects to be listed". In a State Council office meeting held in mid-October 2002, listing of subway projects in all cities was frozen and it was stated that, "The (subway) listing should be frozen. The urgent issue right now should be a detailed investigation of the subway construction around China".

Although the approval authority for ` many urban construction projects has been transferred to local authorities, the State still holds the approval authority for rail transit, including subway projects. Due to the burgeoning debt problems, the State Council released a series of new policies regarding the approval of subway projects, "generally to improve the macro-control over subway projects and to address the funding challenges in domestic subway construction". A detailed analysis of the rate of return on investment for subway projects should be conducted before such massive projects receive national government authorization. The listing of subway projects in 20 cities was frozen.

Despite these efforts to restrict this unchecked expansion of local government debt, cities have managed to get around these restrictions. Although the state suspends or strictly restricts the listing of urban subway projects, local governments have found ways of getting around these restrictions. Dalian, for example, never gained approval from the government for their metro, but began construction anyway by constructing it under the name of expressway reconstruction. On the widened grade the rails were installed. Now the project has been put into service.

The metro and road projects are both massive capital intensive projects that have powerful interests supporting them. For the benefit of their departments, the subway offices in some cities do everything to forbid not only BRT projects on their most profitable corridors, but also standard express bus services.

However, more enlightened municipal leaders realize that the profitability of the metro system depends heavily on expanding the catchment area of the metro by its integration into a larger network. In Guangzhou, for example, the new BRT system is planned to integrate with the metro system by serving corridors not included in the long term metro plans.

Because of the enormous difficulties of raising the enormous sums required for subway construction and operation, a variety of creative financing mechanisms have been used.[4] Below are reviewed the financing mechanisms used in Beijing and Guangzhou.

IV.3.1. Beijing

In the next 10 years, Beijing rail transit will increase by 40km per year and the rail transit mileage by 2008 will be up to 300km. In the urban area 20 subway lines are planned to be installed. In the next 20 to 30 years, the annual investment for rail transit construction in Beijing will be around 10 billion yuan. By 2020, the total mileage of Beijing rail transit will be over 1,000km.

The Beijing Subway currently has 4 lines (113km long) in operation. Line 1 is 30km long, with 23 stations. As the first subway that was constructed and put into service nationwide, it was opened in 1969. Loop Line (Line 2) is located at the center of the city, running beneath the old Beijing city wall. On the 23km-long Loop Line, there are 18 stations. Loop Line was opened in 1982. Line 13, 41km long, with 16 stations, was opened in January, 2003. Batong Line, 19km long, with 13 stations, was opened on December, 2003.

In 2004, Line 13 carried 42 million passengers, raising 100 million yuan from fares. On average it transported 100,000 passengers per day. In 2005, the passenger flow has increased to 150,000 passengers/day. The line has a low operating density of 2,800 passengers/km, resulting in a loss of 65 million yuan in 2004. It is estimated that the whole line will build up its passenger flow in 4 or 5 years. In 2004, Batong Line carried 16 million passenger trips, raising 20 million yuan from fares, resulting in a loss of 60 million yuan. The passenger flow is 50,000 per day. The low operating density is only 2,400 passengers per kilometer. In 2004, Lines 1 & 2 carried 547 million passengers, averaging 1.5 million per day with a transportation density up to 28,000 passenger per kilometer. Fare revenue for the year was 693 million yuan, generally breakeven with the total expenditure of 696 million yuan and a financial subsidy of 70 million yuan. Both lines have built up their passenger flow.

As planned, the urban Beijing area will be equipped with 22 rail transit lines with 700km to form a network by 2050. Adding to the 300-400km suburb railways surrounding the city, the rails will be 1,000km in total length. At the central area the route density will be 1.5-2km/km^2, comparable to that in Tokyo, New York, or London. By 2008, 300km is planned to be constructed. Each year 20km of new rails will be constructed. Even after 2008, the construction will maintain a high speed, exceeding 10km/year. Currently Beijing is constructing or will construct Batong Line, East City Rail Line, Line 5, Line 4, Line 10, and Olympic Branch Line. Preparation is underway for some suburban light rail projects, which are expected to finish before 2008.

In the beginning Beijing subway construction generally relied on investment from the municipal government, in addition to the State's financial subsidy of operations of no more than 30%. Due to the tremendous financial burden brought about by the expanding subway construction in Beijing, the government began to seek private sector investment

[4] One method of financing metros used in Chongqing and most recently Nanjing is to auction the naming rights for stations. By 2004 Chongqing city had sold the naming rights for seven of its Metro Line No.2 stations for a total of 4.05 million yuan. Nanjing metro has set a floor price of around 10 million yuan for the naming rights of the main Xinjiekou station, which will be auctioned in 2006. Conditions imposed in Nanjing include that the titles must have the sponsor's name and the station name, and the sponsor can show no more than five characters of its name in the final name. The naming rights will last for 4 years.

opportunites. At the end of 2003, Beijing Municipal Government issued "Recommendations to Implement Deepened Reformation of Investment & Financing System for Urban Infrastructures in Beijing" by Beijing Municipal Development & Reformation Commission, which expressly indicated that private investment may participate in the construction of rail transit projects on a basic ratio of government to private investment 7:3.

The total mileage under construction for Beijing Subway Lines 4, 5, 9 & 10 is 103.54km, with the total investment estimated to be 49.92 billion yuan. Beijing divides all the construction into two parts: Part A & B. Part A generally consists of civil construction, contributing 70% to the total investment in the projects. Part B generally consists of trains and mechanical and electrical equipment such as signalling and auto toll gate equipment, with the investment contributing 30% to the total investment in the projects. Beijing Municipal Government opens the bids to global investors for the operating part of all the four lines on a basic ratio of government to private sector of 7:3. The government will invest 70% (about 35 billion yuan) of the total investment in the four lines and designate Beijing Infrastructure Investment Co., Ltd. (BII) as the governmental investor, who will be responsible for the investment and construction of the projects. The assets ownership of this portion is held by the government. However, the governmental investor will not share in the profits. 30% of the total investment will be collected from private investors. Within the franchise period, the private investors should pay rent to the governmental investor to get the right to use tunnels and rails; their responsibility for the projects should include operating management, and maintenance and updating of tunnels, stations, and equipments; and they may receive gains from the fare revenue as well as the operating revenue of station ads and communication and commercial facilities.

In 2004, MTR Corporation, BII, and Beijing Capital Group concluded an investment agreement in principle in Beijing to jointly establish a firm to invest in, construct, and manage Beijing Subway Line 4 in a public-private partnership (PPP) mode. The Beijing Municipal Government will cover 70% of the cost, mainly the civil works, track work, and part of the E&M work. The remaining 30% of the project to receive private financing amounts to around 5 billion yuan. Of this, with a registered capital of about 1.5 billion yuan (hence requiring loans of around 3.5 billion yuan), the firm is shared by Hong Kong's MTR Corp. and Beijing Capital with 49% each. The remaining 2% is owned by BII. Beijing Municipal Government will require BII to conduct investment and construction including land takeover, re-housing, and civil construction. The joint firm will invest in and construct trains and mechanical and electric equipments, and manage Line 4. As the 30-year franchise operation period expires, the franchisee shall transfer the part B facilities of the project in their good conditions to a department designated by the municipal government without any charge, and return the part A facilities of the project to the Line 4 Company.

Investment in Beijing Subway Line 4

Percentage	Sources of funds	Invest by	Purpose & gain
40%	Beijing Municipal Govt. and District Govts. along the route	Cash/Capital cash	Construction tasks
30%	BII	Cash/Capital cash	Government-offered policies and resources
30%	Private foreign investors (MTR Corp of Hong Kong)	Cash/loan	Gain from the project

When going into operation, Line 4 will have its tariff defined by the government. The tariff will be distance based. Within the franchise period, the municipal government will observe relative codes and regulations, to define and release the tariff policy for Line 4 in operation according to the principle that the same tariff shall be applied in the same network. The government will also readjust the tariff whenever it is appropriate for the social and economic development condition.

The demand risk is partially borne by each party. In theory the private operator is supposed to repay the government company that financed the construction of the infrastructure in the form of rent. If passenger demand is lower than anticipated, the government will reduce rent payments and taxes, and if demand is higher than anticipated the government will share in the profits. Details are not available, however, as the concession agreement is not a public document, so whether a mechanism exists to accurately determine the profitability of the operating company is unclear. Normally in this situation the operator never ends up paying any money for the use of the tracks.

Concession agreement for Beijing metro Line 4 project signed

Press release, MTR Corporation, 12 April 2006
http://www.mtr.com.hk/eng/corporate/file_rep/PR-06-028-E.pdf

Beijing MTR Corporation Limited, the joint venture company between MTR Corporation (MTR), Beijing Infrastructure Investment Co. Ltd. (BIIC) and Beijing Capital Group (BCG) today officially signed the Concession Agreement for Beijing Metro Line 4 with the Beijing Municipal Government.

The Concession Agreement was initialled in February 2005 by the joint venture partners and was subsequently endorsed by the State Development and Reform Commission in October 2005. MTR Corporation and its Public-Private Partnership (PPP) Partners, BIIC and BCG have then established a joint venture company with business license issued on 16 January 2006. Tenders for the provision of trains and related electrical and mechanical systems for Beijing Metro Line 4 are underway, together with the other preparation work for the operation and management of the new line.

Beijing Line 4 is the first metro project carried out in the form of a PPP in the Mainland of China. The Beijing Municipal Government started its land acquisition and civil construction works in October 2003. Lease Agreement has also been signed for the PPP joint venture company to use the assets of Beijing Metro Line 4 for 30-year operations. […]

The Concession Agreement for Beijing Metro Line 4 has a term of 30 years. Total investment for Beijing Metro Line 4 is about 15.3 billion yuan, 70% of which (approximately 10.7 billion yuan) will be funded by the Beijing Municipal Government. The PPP project company, with a registered capital of approximately 1.5 billion yuan, will invest around 5 billion yuan. Both MTR and BCG will each own 49% of the company. Approximately two thirds of the investment in the PPP project company will be funded by non-recourse bank loans. The equity investment by MTR will be approximately 735 million yuan.

BIIC is wholly-owned by the Beijing Municipal Government. Its business scope covers investment, financing and capital management for municipal infrastructure projects, mainly rail transportation. BCG, also owned by the Beijing Municipal Government, covers property development, finance and infrastructure. Together with MTR, which has comprehensive experience in the construction and operation of metro lines, the three parties form a strong partnership for the project.

The 29 km line is an underground metro line running from Ma Jia Lou Station (? ? ? ?) on the South Fourth Ring Road to the north west Hai Dian District and terminates at Long Bei Cun Station (? ? ? ?). There are 24 stations along the line including major stops at Beijing Nan Station (? ? ? ?), Xuan Wu Men (? ? ?), Xidan (? ?), Xi Zhi Men (? ? ?), Xue Yuan Nan Lu (? ? ? ?), Zhong Guan Cun (? ? ?), Yuan Ming Yuan (? ? ?), Yi He Yuan (? ? ?). Threading through Feng Tai (? ? ?), Xuan Wu (? ? ?), Xi Cheng (? ? ?) and Hai Dian (? ? ?) districts, Beijing Metro Line 4 will be the main north-south traffic artery of Beijing.

The Industrial and Commercial Bank of China will loan 8 billion yuan to Line 4. The startup funds will be financed corporately by the government and the beneficiary organizations (real estate developers) along the route. The franchisee company shares the construction investment amounted to 4.6 billion yuan during the construction period of the project. On the other hand, under the franchise mode, the government will offer no subsidy for the Line 4 operation. During the operation period of the contract, this means the governmental subsidy payment savings will amount to an estimated 1.06 billion yuan. In addition, under the franchise mode, the government will receive about 910 million yuan income tax income during the operation period.

Line 4 developments and financing arrangements are summarised in the text box below, drawing from an MTR press release from April 2006.

Subway Line 9 will be operated in the DBFO (Design-Building-Financing-Operation) mode. Within the franchise period, social investors will be responsible for the design, building, financing, and operation of the project. To promote the complex development of rail transit and the land along the route, relative departments of the government will control the land resources within a certain range along Line 9. A detailed plan is defined from the control aspect based on the direction, station distribution, and entrance and exit locations of Line 9 to integrate the development and utilization of land along the route and the investment for construction of the line. The value-added income from land transfer is used as the government investor's investment in the construction of Subway Line 9. In other words, the government will transfer some land to the company at a price below the market value, which will compensate the company for their infrastructure and operational investment.

Line 10 will be the first in China's subway industry financed by bonds, the 2 billion yuan bond issue goes forward as planned in the next year.

IV.3.2. Guangzhou

According to the "Guangzhou Rail Transit Route & Network Plan", which has been submitted to State Council for approval, the total scale of Guangzhou rail transit construction will be 717km, including 15 urban rail transit lines 610km in total length; 40km Guangzhou Section of Zhujiang Delta Inter-City Transit Rail; and 67km suburb train rails.

Guangzhou Subway has two operating lines, 36.8km in total length. A 246km rail transit network is planned to be constructed before 2010. Therefore, it may be estimated that 209km routes will be constructed and put into service from 2005 to 2010, averaging nearly 35km per year. Since 1993 when the subway construction was commenced, Guangzhou Subway has constructed and put into service two subways: Line 1 & 2, with 36.8km-long rails and 32 stations. That is to say, the subway to be constructed in each of the coming years will be equivalent to all of the past 12 years. To realize such a goal, construction of all the lines in Guangzhou is planned to be commenced before 2007.

CCP Guangzhou Committee and Guangzhou Municipal Government offer enhanced support on the construction funds for the subway construction. The State requires that governmental investment in a subway construction shall be no less than 40%. Guangzhou Municipal Government has invested more than 60% of the capital funds for each of the past few years. Since 2002, the municipal government invested no less than 4 billion yuan in subway construction. To accommodate the speed of subway construction from 2005 to 2010, it is necessary to increase the funds support for subway construction by 1 billion yuan per year. The municipal government will invest funds up to 5 billion yuan in subway construction per year. An example is the Guangzhou Subway Line 2, which was constructed and put into service in last year. Investment in the first phase of the project was estimated to be 10.663 billion yuan. Investment in the first phase of construction was financed by from three sources, including the local municipality, domestic commercial bank loan, and foreign governmental loan or export credit. The domestic commercial bank loan for the construction period contributed about one third, i.e., 3.036 billion yuan.

In addition, Guangzhou Municipal Government offers many preference policies for Guangzhou Subway. The first is about the construction funds. Guangzhou Subway Line 1 & 2 is completely invested by Guangzhou Municipal Government, which offers 24 sections of land to finance for the construction of Line 1. Since all the domestic and foreign loans are assumed by the municipal government, the subway company has no risks for repayment of principal and interest. The second is on the operating. Since subway operating is a electricity-consuming process, electricity charge contributes nearly one-third of the total operating expenditure. Guangzhou Municipal Government offers a preference on the electric price to the subway company (the standard of electric price is the general industrial price with exemption of urban gas price); Since the initiation of service on Subway Line 1, the municipal government has actively coordinated the interface between public bus transport and subway to optimize the routing to maximize the demand on the subway. The third is on the taxation policy. The huge underground structure of subways are treated as civil air defense constructions to reduce the charge to be collected from the building aspect. The final policy is on codes and regulations. On December 1, 1999, Guangzhou began to execute the "Guangzhou Municipal Subway Ordinance" to ensure the smooth construction and safe operation of subways.

Since its commencement of construction in 1999, Guangzhou Subway generally reached its breakeven line at 2002. The asset-liability ratio of Guangzhou Subway has been decreasing year by year, down to the current value of 38%~40%. Multiple types of related business operations including communication, commerce & trade, and advertisement have enabled Guangzhou Subway Line 1 to gain profit over 100 million yuan. From the overall aspect of both Line 1 & 2, the profit containing depreciation is expected to reach 65 million yuan, which will be used to compensate for the operating cost.

In 2001 the fare income was 186 million yuan, resource development earning 47 million yuan, and other earnings of 40 million yuan; operating expenditure 235 millioni yuan; resulting in a loss of 13.19 million yuan after the 51 million yuan depreciation was accrued. In 2002 the fare income was 186 million yuan, resource development earning 61 million yuan, and other earnings 30 million yuan; operating expenditure 224 million yuan; resulting in an after-tax profit of 2.2 million yuan for the first time after the 55.1 million yuan depreciation was accrued. In 2003 the fare income was 206 million yuan, resource development earning 68 million yuan; operating expenditure 217 million yuan; resulting in an after-tax profit of 3.06 million yuan after the 55 million yuan depreciation was accrued.

The largest bank involved in the infrastructure sector is probably the National Construction Bank, but the National Agricultural Bank is also involved. The municipalities have no specific debt ceiling, but such caps may be imposed by the banks themselves.

IV.3.3. Hangzhou

"A Notice to Request for Approval on Hangzhou Urban Rapid Rail Transit Construction Plan" published by State Development & Reform Commission on June 6, 2005 was the first "Permit" that State Council issued since September, 2003 when it suspended the approval on subway projects. It is expected that formal commencement of the project may be possible in the coming year. The entire Hangzhou Subway Project would require 100 billion yuan for construction, including the cost for the first phase of 45 billion yuan.

A contract was concluded on April 26, 2002 to design the 50.68km-long Subway Line 1 construction of Hangzhou Subway Project, with the cost estimated to be 15.2 billion yuan. For the entire investment of the project, the financial internal return rate would be 4.20%, the investment recovery period would be 21.38 years, and the internal return rate of national economy would be 15.09%. In 2002 Hangzhou's total financial revenue was about 25.7 billion yuan. Burden would be obvious as compared to the 15.2 billion yuan investment in the subway construction period and the unavoidable financial subsidy during the operating period.

IV.3.4. Chengdu

Chengdu has completed detailed planning and construction plans for its subways. It also constructed some pilot sections. As planned, the city will construct subways and light rails and reconstruct existing railways (to offer railway-based public transport) to establish a rapid rail transit network about 493.3km in total length within the 12,300km^2 plus grand-Chengdu area. The network will realize direct transport within one hour between all the districts, cities, and counties within the grand-Chengdu area. Subway Line 1 will run from Zoo Station on the north, to Huayang on the south; Line 2 will start from Chengguan Passenger Station to Chengyu Passenger Station; Line 3 will begin at Liujianian and end at Liulichang; Line 4 from City-South Passenger Center to Zhuziqiao; and Line 5 from Chengya Passenger Station to Chengda.

In July, 2002, a transportation consultancy company won the bid for "Assistance in Planning for Chengdu Urban Rail Transit System" to build a cost-effective Chengdu subway system for the city. Review of the existing feasibility report was completed at the end of 2003.

Details on the financing for the Chengdu subway were not available as of this writing.

IV.4. Public financing of BRT Infrastructure

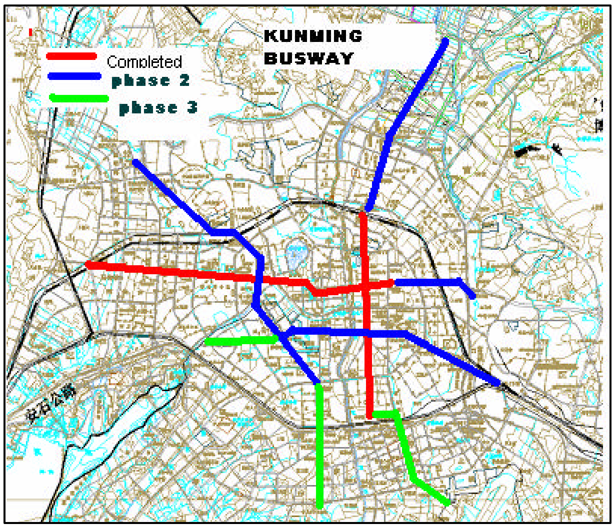
All BRT systems constructed to date both in China and all full BRT systems around the world have been financed predominantly through public revenues, though the specific mechanism for public financing varies considerably.

IV.4.1. Chinese Experience to Date

To date, four existing bus systems in China might be broadly defined as BRT systems: Kunming, Shijiazhuang, Beijing, and Hangzhou. Several others, including Jinan, Chengdu, and Guangzhou, are in the detailed planning stages.

-----Kunming and Shijiazhuang

Kunming was the first BRT system to be built in China. Kunming from 1994 – 1996 tried to put in a surface rail system or a tram like Zurich, an LRT. They didn't originally think of a BRT. They did all the necessary research for this on line #1 along Beijing Road, which is the main North South arterial. They had technical support from the Municipality of Zurich sponsored by the Swiss Development Corporation. The Mayor was about to approve the LRT and had already announced it to the media, but then the Mayor was changed, and the new Mayor was against the project. As they did not yet have formal approval from the National Government, this killed the LRT project. When in 1998-99, the SDPC (State Development Planning Commission) agreed to fund 6 metro systems, Kunming asked to have their LRT plans funded. Despite having very advanced plans, it was not included. Without the approval of the national government, and with the coming of the International Horticultural Exhibition, they decided to adopt the surface LRT plans to be a busway instead, along the same corridor, because it required no outside financing from the National government. The system, designed with Swiss help, really looks like a tram system and could be easily upgraded to one.



Kunming opened the first 5 kilometers of exclusive center lane busway in 1999 on Beijing Road, the major North South arterial. In August of 2002 they added 11 kilometers of exclusive busway down Dongfang Rd, the main East West corridor. Another 25km are already planned. (see Map I) The first line connects the Central Railway station to an old 1919 French build narrow guage railway line which is now a sub-center, bedroom community. They built a new road to this residential area. The bus line was extended over to the World Horticultural Exposition during the exposition, but after it finished it was re-oriented back to the original North South conception.

The Kunming BRT system is an 'open' convoying BRT system. Its principal attributes include an exclusive but not physically separated bus lane in the center of the carriageway. Ordinary buses enter and exit the carriageway. After the busway ends, buses continue in the lane adjacent to the median strip separating the carriageway from the standard 3 meter wide grade separated bicycle lane, or where there is no bicycle lane adjacent to the curb lane.

The system cost 20,620,000 yuan (about $2.6 million) for engineering and construction, and 40 million yuan (about $5 million) total. Half of this was for bus shelters, and this half was paid for entirely by advertising revenues alone. Excluding the time spent collecting information for the related LRT line, they prepared for only 6 months. As a result of the implementation of the bus way, public transit mode share rose from 6% to 13%, with a significant share of the mode shift coming from bicycles rather than from motorized modes. However, because of the great efficiency improvements within the bus system itself, the busway reduced total fuel consumed by the buses by 7.7 litres per passenger. Bus speeds increased from 10km/hr to between 15km and 18km per hour in the corridor. The bus lane is now moving 7500 passengers per hour compared to 1500 passengers per lane per hour before the busway was implemented.

Prior to the construction of the BRT system, bus operations and bus procurement were subsidized by the government. However, with the completion of the BRT system, this subsidy has been removed as it is no longer necessary. However, the fares are regulated at 1 yuan per trip regardless of the distance or the type of bus, and all buses are owned by a public bus company. The revenue generated is not sufficient to significantly upgrade the quality of the buses, let alone to finance the expansion of the BRT infrastructure.

The infrastructure in Shijiazhuang was paid for as part of a loan from the World Bank. The World Bank loan went to the national ministry of finance, which in turn loaned the money to a municipal corporation in Shijiazhuang. The building of the BRT was treated as a standard public works project.

-----Beijing

The cost of the first phase of 5.5km which opened in December 2004 was 38 million yuan. The road investment was made by the Beijing Government and the bus procurement, stations and bridges were paid for by the BRT Company which is majority owned by the state-owned and subsidised Beijing General Bus Company. The revenue is collected by the BRT Company. The BRT Company has 5 shareholders of which 2 are private. Some of the shareholders still own old buses.

Of the five companies making up the Beijing BRT company two are state-owned and three are private. The majority owner, with more than 50%, is the Beijing General Bus Company, the near-monopoly bus operator in Beijing. One of the private companies is foreign owned: the Shanghai Automobile Air-conditioning Company Limited.

The city government is assuming the project's entire financial risk. The government needs to subsidise its operation, though the amount of subsidy is regarded as confidential. The BRT is not required to meet any documented service standard or profitability goals.

The Beijing BRT when it first opened in December 2004 was only 5.5km long and carried less than 1,500 passengers daily during its first year. The expensive fleet of BRT buses largely languished in the depot, as only a handful were needed and with only left-side doors they could not be used outside the BRT corridor. After expanding the first corridor to 16km and cancelling several competing bus lines in January 2006 the situation has greatly improved. Ridership has increased to around 75,000 passenger boardings per weekday in March 2006, and on some days has reportedly exceeded 100,000 passengers.

Peak passenger flows in late March 2006 were around 4,500 passengers per hour northward in the morning peak, and around 5,000 passengers per hour southward in the evening peak. This is substantially lower than the forecasts of system planners of a peak ridership of 6,000 to 8,000 passengers per hour per direction. However, although peak passenger ridership is lower than predicted, the BRT fleet of 40 articulated buses has been insufficient to meet demand, and 50 regular buses have been allowed to use the BRT stations to try to alleviate severe peak period overcrowding of the buses and some of the stations. Around one third of peak period passenger demand is carried using non-BRT buses operating within the BRT infrastructure - see photo. An order has been placed for 40 additional BRT buses. (The new buses are from a different manufacturer than the original BRT fleet of BRT buses, which had several mechanical and design problems.)

Passengers waiting to board regular buses operating in the BRT corridor.

The passenger waiting time at congested stations in the evening peak typically exceeds 15 minutes and can be up to half an hour. Although in future these waiting times will be reduced with the deployment of additional BRT buses, it is likely that station design shortcomings will then come to the fore, and will begin to erode operational speeds after the additional buses enter the system.

The peak period, peak direction operational speed is currently around 22km/hr, slightly faster than the speed of regular buses in the same corridor. The corridor is not currently congested (apart from the northern section, which does not have segregated bus lanes, and some queuing delays at a few intersections), but congestion can be expected to increase in future, leading to more significant travel time savings for BRT passengers compared to regular buses.

At the northern Qianmen terminus and the central portion of the corridor, the BRT buses account for only around 20% or less of the total bus flows in the corridor (though a higher proportion of passenger flows given the higher capacity BRT buses).

The second Beijing BRT line – starting in the Chaoyangmen CBD area and extending westward along Chaoyang Rd to Dingfuzhuang – has already been identified and as with the first BRT line is excellently placed to capture significant passenger demand. Station locations are currently being discussed. A third BRT line to the north of the city centre will serve the Olympic Park area.

To finance BRT systems the Beijing Center for Sustainable Transportation, a non-governmental institute supporting the BRT planning, is proposing that carmakers pay for the pollution produced by cars. Other options that have been mentioned are congestion charging, parking and related traffic fees.

-----Hangzhou

In Hangzhou, the new BRT system is being financed by a municipally owned company under the construction commission called Hangzhou Urban Construction Assets Management Co. Ltd. Phase I of the BRT system will cost 150 - 200 million yuan for the first phase of 28km, around $24 million, or $0.86million per kilometer. This includes infrastructure construction and bus procurement. Some 40% of this cost, or around $9.6 million, is for the purchase of buses.

The first phase is regarded as a test, so the government will provide 80-90% of the finance for the total cost. The other 10-20% will come from the General Bus Company, which is owned by the Hangzhou Urban Construction Assets Management Co. Ltd. The system will be operated by the public bus company, General Bus Company, which will provide 10% - 20% of the bus procurement investments. There will be no bank loans for the first phase of BRT.

The first 10km segment of Hangzhou's 28km Line 1 BRT commenced commercial operation on 26 April, served by articulated BRT buses in a striking red color. Construction started last September and the first batch of 10 out of a total order of 50 BRT buses placed by the state-owned Hangzhou Transport Group with Jinhua Neoplan last August was received and tested earlier in April.

Passengers pay before entering the station, and enjoy level boarding and alighting. In keeping with Hangzhou's rich cultural history, stations are attractively designed, although the absence of passing lanes will limit future expansion. Stations are located on a median adjacent to impressive bicycle lanes. The eastern portion of the corridor, ending at a new industrial park and university complex, currently has little traffic or public transport demand but is expected to rapidly develop.

Several routes have been diverted off the corridor, presumably resulting in more transfers and offsetting some of the time saving benefits of the system's extra speed. With an initial peak headway of 3 to 4 minutes between buses – 6 to 8 minutes off peak – there is a perception that the lane is underutilized, especially given the heavy congestion in the remaining mixed traffic lanes. Passenger demand is low, and while demand and operational planning appear not to have been priorities in the initial design, planners will focus on addressing these issues now that the infrastructure is in place.

IV.4.2. International BRT Infrastructure

In all cases but TransSantiago, discussed in the following section, BRT infrastructure has been paid for with public rather than with private funds, and the financing mechanisms do not differ greatly from the way that any road or bridge construction is financed.

Because Bus Rapid Transit exists in something of a netherworld between a Metro and a simple busway, the relevant role of the national government in BRT remains a subject of debate in a growing number of countries. Outside of China, where some municipalities are wealthy enough as a result of land sales to finance metro projects without national government help, metro projects almost invariably involve high levels of national government investment or they are impossible to implement. With BRT, the necessity and advantages of involving the national government depends on local circumstances.

-----Bogota

Bogota's TransMilenio by many measures is the state of the art system, and it is also by far the most expensive. Phase I of Bogota's TransMilenio cost $6.9 million per kilometer. Phase II is costing over $13 million because they decided to build some new bridges, a new highway interchange with the BRT system, some tunnels, and had to do some land acquisition. These items can dramatically escalate costs.

As with planning, while the costs of implementation will vary considerably based on local circumstances, probably only a fairly poor system can be built for less than $2 million per kilometer, and in most cases more than $5 million is usually not necessary.

BRT cost breakdown for TransMilenio in Bogota

Component	**Total cost (US$ million)**	**Cost per kilometer (US$ million)**
Studies and designs	4.01	0.09
Exclusive running ways	36.69	0.87
General traffic lanes	36.13	0.85
Public space	28.29	0.67
Stations	25.51	0.6
Pedestrian overpasses	16.57	0.39
Terminals	15.72	0.37
Parking and maintenance areas	17.16	0.40
Properties	29.18	0.69
Network services	18.57	0.44
Maintenance	18.57	0.54
Roads for feeder buses	15.28	0.36
Control center	3.33	0.08
Others	22.85	0.54
Total trunk lines	292.2	6.89

One of the major considerations is the volume of transit traffic the busway has to accommodate. Bogota's TransMilenio required a capacity of over 45,000 passengers per direction at the peak hour, which required two full lanes in each direction, and multiple stations at each stop, which increased the construction cost. Another major consideration is whether or not to reconstruct the entire roadway. BRT systems do impose heavy wear and tear on roads, and because repairs often require shutting down the system for a time, it is advisable to use materials able to withstand a maximum axle load with minimal repairs. Concrete is sometimes used for the entire roadbed if an entirely new roadway has to be built. At a minimum the roadway in front of the stations should be in concrete. Often BRT systems are put in when a major road is due for a scheduled rehabilitation. In this way, the majority of the cost can be covered from the ongoing capital budget. Another factor is the quality of sidewalks, bike paths, public space, street furniture and other amenities in the corridor. Bogota dramatically improved the TransMilenio corridors, not only for buses but also for cyclists, pedestrians, and for public parks. All of these costs are folded into the overall cost per kilometer. These measures make a big difference in terms of the attractiveness of the system.

In Phase I of Bogota's TransMilenio, which is currently the most expensive BRT system and also the best, a combination of international, national and local sources were used to finance the infrastructure, with the vast majority of funds coming from local sources. As Bogota is moving on to Phase II, the level of international and national level financing has increased dramatically.

The details of local financing for Bogota are as follows:

- **Local fuel surcharge (46%)**: There is a Colombian national law that allows City Councils to approve a surcharge on gasoline. In 1997, the maximum a municipality could charge was 25%. However in Bogota, the City Council had set it at only 10%. When Penalosa was elected Mayor, he convinced the City Council to take the surcharge to its maximum, and earmarked the extra 15% to go to the construction of Mass Transportation solution. The city law approved a surcharge of 25%, of which 15% would go the Mass Transportation system. In 2003, President Uribe raised the maximum surcharge to 30% and Bogota has already increased it to this new level, assuring resources for the future phases. Other Colombian cities are doing the same, especially those in which BRT systems will be built.
- **General Local Revenues and De-Capitalization of the Power Company (28%):** The Power Company is 51% owned by the municipality and the rest is private. In 1997, the company had an excess of cash, and decided to de-capitalize it. Some of these sources financed TransMilenio infrastructure.
- **World Bank credit (6%):** This was an initial credit given to the City of Bogota (with the authorization of the national government) to build a low-grade busway on Calle 80. They had to change the terms of the loan in order to be able to use it to build a TransMilenio corridor.
- **National Government (20%):** Penalosa signed an agreement with the National government to finance Bogota's Mass Transportation system in which the National government secured sources to pay for TransMilenio's infrastructure. For Phase I, it only accounts for 20%, but for the upcoming phases the National government should pay for 60% of the infrastructure and the city the 40% left.

-----Brazilian BRT Systems

Today, in Brazil, there are currently no national grant funds available for the construction of BRT systems, though there are extensive funds available for the Brasilia, Rio, and Sao Paulo subway systems. This has been a source of ongoing political contention, and there are possibilities that the law may change. With decentralization of financing in Brazil, however, the national government has played a much less pronounced role in urban financing in general since 1988. Low interest loans from the state development bank (BNDES) are available.

When BRT was first developed in Curitiba in the 1970s, Mayor Jaime Lerner was developing a system that had never been developed anywhere in the world, so the financing was difficult to secure, and the municipality had to rely on its own resources for financing. With the success of the project, the Inter-American Development Bank agreed to provide the financing for Phase II with national government approval. Curitiba is a fairly wealthy city in Southern Brazil, with per capita incomes similar to southern Europe.

In Sao Paulo, there are BRT systems under both the control of the municipality and of the state, depending on who financed them. There is no shared financing, and coordination problems are a serious issue. There has been no direct national level grant support for BRT in Sao Paulo. There is a state infrastructure bank, however, called BNDES, which provides low interest loans for infrastructure, and BNDES is financing several of the new BRT corridors in Sao Paulo.

-----Mexico City

The BRT system in Mexico City opened in 2005. This system is currently carrying about 250,000 passengers a day. Because of the financial crisis several years ago, the cost of getting international loans is very high. For this reason, the Federal District of Mexico, when it paid for the infrastructure, took out commercial loans from private banks, which are cheaper than loans from the World Bank after the national bank BanObras adds all their national charges.

In the Estado do Mexico, which is so heavily indebted that it cannot get loans from a commercial bank, three sources of potential financing for the BRT infrastructure were identified. First, the municipalities in the State of Mexico through which the busway passes still have viable credit, and they will pay for roughly 30% with either loans from commercial banks or from the World Bank channelled through the state development bank BanObras. Secondly, roughly 30% would be paid for by a special loan facility at BanObras set up to facilitate Public Private Partnerships. Third, the possibility is being explored of using the projected farebox revenue to back a bond issued by an investment bank and guaranteed by the smaller municipalities and by the national development bank BanObras. This is all being done because the State is bankrupt, and because the State does not want to impose tolls on some new motorways being planned in the State.

-----Infrastructure Financing Discussions in African Cities

In Dar es Salaam, the municipality does not have the financing to build the Dar Rapid Transit System (DART) on its own. The most likely scenario for financing the BRT infrastructure is a World Bank loan to the national government channelled through the national roads agency TanRoads. TanRoads will no doubt have to match these loan funds with some funds from the national road fund, which controls the national gasoline tax revenue. These funds will probably be matched by municipal funds and sub-municipal funds (there are three sub-municipalities in Dar es Salaam) for some complementary infrastructure. The details have yet to be worked out. It is also possible that the European Union, or a bi-lateral lending agency, perhaps one with interest in the bus procurement, will also make loans available for the infrastructure. Likely candidates include the Danish (DANIDA), which is already financing in conjunction with the European Union some major road projects in Tanzania, the Japanese Bank for International Cooperation, and the KfW bank from Germany. The African Development Bank has not recently been involved in many road projects in Tanzania, but it might also be approached. When the detailed plans are completed in January and the system costs known, they will be presented at a donors conference to see whether other sources of bilateral aid may be faster than going through the World Bank.

In Dakar and Accra, the most likely source of financing is a new World Bank loan, coupled with Global Environmental Facility (GEF) funds for project preparation. In the case of Ghana a pdf.b. has already been approved under the auspices of the World Bank, and in Senegal a medium size grant from the GEF is pending approval. In Dakar, the French Agency for Development has shown interest in financing the project, but most likely is a World Bank loan.

-----Jakarta

In Jakarta, the infrastructure was all paid for by the DKI Jakarta Government. DKI Jakarta is a special administrative district with the status of a province, but there is no viable sub-municipal government structure. The Regional Parliament voted on and approved the financing. The infrastructure in the first phase cost around $10 million. It is widely accepted that this was not enough money to improve the sidewalks, change the intersection configurations, and make other necessary changes. An appropriation for about $70 million for the second corridor was approved by the Regional Parliament in November 2005 following the national elections, and the second and third corridors opened in mid-January 2006. There were no national or international funds involved in financing the infrastructure.

-----India

Chinese municipalities should carefully watch BRT developments in India, as its heavily state-controlled banking system has certain parallels to conditions in China.

Currently, the national government in India is financing the Delhi metro, with 40% of the financing coming from the national government, 40% coming from the Delhi government, and 20% from private investors. While the national government and state governments assumed most of the debt burden, most of the actual financing came from the Japanese Bank for Reconstruction and Development, with some minor participation of French and German financial institutions. The system is currently making significant operating losses, though the financing of the company is not transparent and not a matter of public record. Calcutta already has a metro, and Bangalore is set to be the next major Indian city with a metro that is likely to enjoy a similar level of national government financing.

Currently, the policy of the ministry of finance is to restrict to 20% the capital that the national government is willing to subsidize the capital costs of any Build-Operate-Transfer mass transit or highway concession. The remaining financing has to come from provincial and municipal governments. Bangalore is likely to be an exception to this new policy, according to sources inside the urban development ministry, and the reasons are largely political.

In many Indian cities, including Hyderabad, competing plans for BRT, MRT, monorail and skybus are moving forward, and the lack of coherent planning guidelines or financing criteria has led to a free-for-all between project promoters. In Hyderabad, the government issued a competitive tender for a Build-Operate-Transfer project to provide mass transit services in three critical corridors. Expressions of interest were received from monorail companies, the Delhi Metro Rail Corporation, and other private investors, but no details on the financing have been released. The fact that there is no existing consortium of BRT companies that can compete in a BOT tender is in fact undermining the chances that BRT will be built in India.

Currently, there are only two BRT systems still moving forward: Delhi and Ahmedabad. In Delhi, the Delhi Government has approved the financing of the first High Capacity Bus System (HCBS) corridor, a roughly 18km stretch. The Delhi government has allocated roughly $30 million of general budget revenues to finance the construction. Construction has already been submitted to public tender, but the bid has not yet been won. This HCBS system is mainly a road construction project, and its connection with a new bus procurement is marginal.

When BRT was still being considered in Hyderabad, the plan in Hyderabad was for the Provincial Government of Andhra Pradesh to secure loans from state banks. State bank loans are cheaper and less complicated than securing financing from either the World Bank or the ADB, both of which have expressed interest in lending for BRT in India.

The next most active project in India is in Ahmedabad. Ahmedabad is a poorer city than Hyderabad or Bangalore, and it is ruled by the opposition BJP. The fact that metro financing from the national government is exceedingly unlikely is a major factor why BRT is being actively developed. The state of Gujarat is very keen on exploring public private partnership financing options. The detailed project plans have yet to be completed, but they are currently considering World Bank loans, ADB loans, JBIC loans, and are exploring the possibilities of private sector investment.

-----The US

The US BRT systems that have been built (Honolulu, Eugene, Pittsburgh, Los Angeles) and those being planned have been financed with a combination of national government subsidies and municipal and state bonds. Some 2% of the national gasoline tax revenues are earmarked for urban mass transit, and administered by the US Federal Transit Administration (US FTA). US FTA provided some capital grants for these BRT projects. The rest of the money came from state and municipal governments. State and municipal governments in the US finance most capital projects through municipal or state bonds. These financial instruments are less used in developing countries, but they are gradually spreading to emerging markets. Prague and Krakow have recently issued municipal bonds for urban mass transit projects.

IV.5. Opportunities for Private Sector Investment in BRT Infrastructure

An increasingly popular mechanism for financing road infrastructure in developing countries is through various forms of public-private partnership, or PPP. There is no inherent reason why PPP financing cannot be used for a BRT project, though thus far there is limited actual experience. Experts in the field are of mixed opinion regarding PPP's relevance and importance to future BRT financing. However, there is growing interest in the subject, and some very preliminary experience is emerging. Transantiago has utilized a PPP financing scheme to pay for part of the infrastructure, though Transantiago is not a full BRT system, and the infrastructure costs were low (discussed below). Private sector real estate investment into BRT transfer terminals has been implemented in Belo Horizonte, and is under discussion in Porto Alegre. Private bus operator investment in some bus related infrastructure in Sao Paulo was also tried, but with poor results. Some major problems with PPP mass transit financing in Malaysia are also discussed as a cautionary tale.

Unlike with toll roads and metros, BRT systems do not usually operate on new, stand-alone facilities, but operate on pre-existing city streets, though with reserved rights of way. The construction of the facilities usually affects not only the BRT system itself but also often involves changes in the sidewalks and mixed traffic lanes, and often the infrastructure under the road such as power lines and drainage. Unlike with a toll road or a metro, it generally does not make sense to divide the management and financial responsibility for constructing and maintaining a BRT corridor from the management and financial responsibility for maintaining the rest of the roadway.

There are a few stand-alone BRT facilities, such as the new Orange Line in Los Angeles and the Pittsburgh BRT system, which are built over old rail lines, and the elevated busway under construction in Sao Paulo, but most of what is being considered and should be considered in China is not for fully grade separated BRT facilities.

Also unlike with toll roads, where the users tend to be high income motorists and trucks, the intended users of a BRT system tend to be low and moderate income people. If a PPP is structured in such a way that there is the expectation that the bus fares will pay for all or part of the infrastructure, this is likely to increase fares, depressing ridership, adversely impacting low income users, and creating a perverse incentive for people to use private modes of transport, if the mixed traffic lanes continue to be supplied free of user charges.

Some PPP methods for BRT are emerging, however, where the fare price is at least partially insulated from the construction costs. These are discussed below.

IV.5.1. International Experience with PPP for Bus Infrastructure

-----Trans antiago, Santiago de Chile

Santiago (Chile) is the first city attempting to use PPP financing for what might be called BRT infrastructure. In the case of Transantiago, the private sector operators are financing 69 percent of the Phase I infrastructure costs and 100 percent of the vehicles and the fare collection equipment. Construction of Phase I began in 2005 and is expected to be completed by the end of 2006. The public sector is contributing US$103 million to Phase I infrastructure while the private sector is contributing $229 million. The Phase I infrastructure is being applied to a total of 81 kilometers of which only 22 kilometers will be segregated busways.

Transantiago is a bit different from a full BRT system. The system will extend to most parts of the city during Phase I through feeder services, which will be somewhat similar to the existing bus services. The trunk vehicles will operate both on and off the busways. All fare collection will be conducted on-board the vehicles. Thus, the Transantiago operators will be operating concessions capturing a large amount of the city's transit demand, but the physical infrastructure improvements are limited to a few specific corridors. The trade-off is a lower-speed service than a full BRT system and a less-metro like performance overall.

If successful, Transantiago may do much to prove the viability of PPP financing for BRT applications. The challenge for Transantiago's private operators is to gain sufficient fare revenues to cover the system's operating costs while simultaneously repaying the initial investment. The current fare level for bus services in Santiago is a flat rate of 320 pesos (approximately $0.53). This fare level is somewhat higher than many developing-nation cities, and thus may help Transantiago's operators achieve a successful PPP.

-----Belo Horizonte, Brazil

Belo Horizonte has a low grade central lane BRT corridor which is currently being upgraded and extended to a second corridor. This corridor originally provided direct bus services with buses operating both on and off the BRT corridor, but the routing structure is now being shifted to a trunk and feeder service. As part of the shift to a trunk and feeder service, the municipality negotiated an arrangement with a private real estate developer that if the developer paid half of the cost of the bus station construction, that the developer could have the public land on the station to build a shopping mall. The project was successful, the mall is successful, and the collocation of shopping and bus transfer terminal has been convenient for shoppers. With the establishment of this successful precedent, a similar deal is now being negotiated at another bus transfer terminal, where the municipality has successfully convinced the developer to pay the full cost of the terminal. While the private developer got a very good deal on public land, they also provided much needed investment capital to the municipality.

-----Other Private Investment in Bus Infrastructure

There were two efforts in Sao Paulo to convince private bus operators to invest in bus infrastructure. In exchange for a monopoly concession in one corridor, a private operator agreed to build some new bus stops and provide nice street furniture and other amenities. This did not include construction or maintenance of the roads, nor was it a full BRT system. In the end, the municipality did not enforce the company's monopoly, and they could not win any compensation from the city for violation of contract. This dispute led to rioting on the part of the bus company's employees. This experience has soured the idea of Public Private Partnerships in BRT infrastructure provision in Brazil.

There is also a case in the State of Sao Paulo where the private monopoly bus concessionaire is also responsible for maintaining, though not for constructing, the roads and electric conduits in the BRT corridor. However, the financing for this is not coming from the bus company itself. Rather, it is just a fee for service contract that the bus operator took over because it was dissatisfied with the quality of public maintenance of the corridor, which was damaging their buses and disrupting service.

There were discussions in San Salvador with the International Finance Corporation to initiate a turnkey BOT BRT project, and there have been early discussions on this topic in India, in Addis Ababa in Ethiopia, and in Lagos, Nigeria. In most cases, these projects have been initiated by private bus operators. To date, none of them have come close to being implemented.

IV.5.2. Lessons from Malaysian Experience with BOT mass transit systems

There is extensive experience with private sector involvement in mass transit systems in Asia. Most of this experience is in Malaysia, Thailand, and Japan. While this experience did lead to the construction of new mass transit facilities, most of these systems went bankrupt, and had to be taken over by the state at enormous cost to the taxpayers. Paraphrased below is from Townsend, Craig, PhD Thesis, 2004

> "Private investment in rail mass transit in Kuala Lumpur began in the early 1980s. As early as 1985, a $300 million turnkey proposal to build the first 18 km phase of LRT was submitted by a French/Belgian joint venture to the government company in charge of implementing the total proposed 53 km LRT system. In 1987 an Australian consortium backed by the Australian Trade Commission won the project management contract to build the first stage of a light rail system then referred to as Metrolink, which involved the operator of Melbourne's extensive tram system. These proposals never made it to implementation, being hampered by the federal government's reluctance or inability to commit to the large capital expenditure for rail mass transit demanded by the concessionaires.
>
> Kuala Lumpur's first successfully-implemented LRT project began in 1990, when a UK-German Consortium of Taylor Woodrow International and AEG Rail Systems proposed to develop the first LRT system on a privatised basis. In late 1991, a private company, Sistem Transit Aliran Ringan Sdn Bhd (STAR), was formed in order to promote the construction, ownership, and operations of this project for a renewable 60-year build-operate-own-transfer concession. The project proceeded further than its predecessors due to government guarantees that eliminated the possibility of disastrous financial risk for the concessionaire. The complexity of implementing one of the world's first private rail projects in the late twentieth century became apparent when it took eighteen months to negotiate thirty-two separate legal agreements in order for the project to proceed (Dunstan, 1994). Taylor Woodrow was both an

equity stakeholder in the consortium as well as the lead contractor responsible for design and construction, including all electrical and mechanical work covering supply, installation and testing of trains, power supply, signaling and telecommunications. Taylor Woodrow was also contracted to earn a management fee on the entire project which eventually cost RM 3.5 billion.

As construction on the first 12 kilometer phase progressed, STAR negotiated to build a second, 15 kilometer route to the proposed site of the 1998 Commonwealth Games. The deal led Taylor Woodrow to inject about $38 million in equity into the project. Corresponding with previous plans, costs of construction of the STAR-LRT were kept low by utilising unused rail rights of way; however, while keeping the costs low, this also decreased the potential catchment areas of the system.

As these light rail plans went forward, however, the lack of a clear master plan for integrating these two light rail lines, another proposed monorail, and the existing bus and minibus services, was undermining the security of these investment.

As STAR LRT phase one began operations in 1996, the company successfully convinced the municipality to phase out the minibuses, as the Commercial Vehicle Licensing Board was directed to stop renewing minibus permits (*Sun Magazine*, 11 April 1996). By mid-1998, they were completely gone. However, the larger buses continued to compete with the LRT rather than serving it, and soon STAR began running its own feeder services, at a financial loss.

In 1994, a second LRT project was initiated by a private company formed by Renong. While the STAR consortium had the substantial participation of foreign companies with interests in building, equipping, and managing the system, Projek Usahasama Transit Ringan Automatik (PUTRA) was officially executed by a wholly-owned subsidiary of Renong. The company did not have the expertise or technology to build a rail system, so it entered into a turn-key arrangement with Canada's Bombardier which provided the expertise and equipped the system which was turned over to PUTRA to run. PUTRA was less constrained by considerations of land expropriation because it was elevated and underground (for a 4.4 kilometer section in the central city) for most of its route, although construction cost more as a result. The 30 kilometer fully-automated PUTRA system linked up the KLCC in central Kuala Lumpur with suburban areas (Plate 6.4). Like STAR, it responded to a lack of coordination with the two major public bus operators (although one was owned by Renong) and operated feeder bus services within a 3 kilometer radius of each station. By 1999, the KTM Komuter trains, STAR, and PUTRA were all in operation, but early ridership on all three systems was far lower than projected.

The LRTs fell short of expectations. The most visible sign of the lack of physical and fare integration between the two systems is in the centre of Kuala Lumpur at Masjid Jamek station. Two stations were built side-by-side, but to transfer between the lines was extremely inconvenient.

Renong, the second LRT system's operator, also had parallel real estate investments in the corridor. A new central railway station was built with the involvement of KTMB, the national railway, in a consortium with HICOM and Renong. In exchange for building the station, the consortium was given rights to commercially develop 72 acres (29 ha) of formerly public lands owned by the railway surrounding the complex. Renong's 2001 annual report attributed a 14% boost in PUTRA ridership to the opening of the Sentral station.

In 1997 the Malaysian government awarded a 30 year concession to a private company, Express Rail Link Sdn. Bhd, to plan, build, and operate a fast rail link between the new Kuala Lumpur International Airport and central Kuala Lumpur. The project was built in a turnkey arrangement by Siemens of Germany and handed over to the Malaysian operating company in 2002. The rail line is 57 kilometers and links with a terminal where airline passengers can check in their bags at Kuala Lumpur's Central Station. As in the Projek Usahasama Transit Ringan Automatik (PUTRA) concession, the building and equipping of the system was carried out by a foreign partner, which turned over the project to the Malaysian concessionaire once it was built.

All of these public-private partnerships got into serious financial trouble during the 1997-1998 financial crisis. In a scramble to devise measures to save strategic economic sectors and the conglomerates by domestic initiatives, the state established three institutions to deal with the financial system (Khoo, 2001). One of these was the Corporate Debt Restructuring Committee (CDRC) which managed debt restructuring of Malaysian companies. One of the CDRC's most publicised and controversial applications came from UMNO-affiliated Renong, which through its subsidiaries owned the concessions for the NSE, PUTRA, and a number of expressway concessions in greater Kuala Lumpur.

In late 2000 PM Mahathir announced that the government would buy out the two LRT systems, "in order to integrate the systems" and improve public transportation. The LRT concessionaires were given 5.6 billion RM in late 2001, and the government then leased the operations back to the two firms. However, as of late 2002 when the buy out was completed there had yet been no major changes to operations. This led some government critics to point out that the rationalisation of integration and better public transport was being used to obscure a massive bailout of an UMNO-linked company.

The fundamental problem facing the infrastructure concessionaires (both the expressways and the rail systems) was the large debts incurred to construct the systems, complicated by the lack of coordination between new lines, and the lack of careful physical integration with real estate developments in the corridor.

In spite of the problems surrounding infrastructure privatisation in Malaysia which came to light in the wake of the 1997 financial crisis, the government of Malaysia under UMNO and Dr. Mahathir remains committed to privatisation. The official reason now is that privatisation has resulted in faster (and cheaper to government) construction of expressways and LRTs than would otherwise have been the case. The Eighth National Development plan for 2001-2005 has reiterated the government's commitment to privatisation on the basis that it has increased efficiency and productivity, benefited the public, and spurred economic growth. In addition, its contribution to enhancing *bumiputra* participation in business and commerce is cited (Malaysia, 2001). Specifically, it was argued that the construction of highways was faster (speed taken as a measure of efficiency and productivity) than would have otherwise been the case. (Townsend, C.)

In addition to this documented history, some less well-known insights were provided by an internal and unpublished, confidential review in 1998. Problems to afflict the Malaysian BOT experience with LRTs included overestimation of demand, inadequate financial control of weak project financing structures, the absence of complementary transport policies, and inadequate institutional focus amongst planning and regulatory institutions. Each of these issues is outlined briefly in turn, drawing from the 1998 review.

Inadequate financial control in both project finance structures and within the larger context of government budgetary exposure reflect weak risk management. In the absence of a competitive process, the negotiated rail concessions required strong risk allocation elements and technical and financial due diligence on the part of government. This was lacking. Given key contractors' equity participation in some of the concessions, coupled with the Government's ultimate support – which was recorded off-budget – there was inadequate motivation to scrutinize revenue projections or control costs. As a result, the rail concessions reflected inadequate provisions to control costs, over-optimism about property development, and systematic and significant over-estimation of ridership and associated fare revenues. The problem is that, because invested amounts are eventually guaranteed by the Government, investors had little incentive to control project costs, particularly when shareholders were large participating contractors. Moreover, project oversight was lax due to technical limitations at the Ministry of Transport (MOT) and possibly because the "Independent Checking Engineer" (ICE) was paid by the concessionaire. In PUTRA's case, the ICE appeared to have an affiliation with the concessionaire's shareholders, thereby creating at least the appearance of a conflict of interest. For example, a recent ICE report for PUTRA did not clearly indicate cost problems or the reasons for them, despite substantial overruns experienced up to and during that period.

There was an absence of either integrated transport and land use planning, public transport system integration or private vehicle restraints; complementary transport policies which would have boosted mass transit system ridership.

Institutionally, decisions tended to be made based on a general government imperative of raising more investment from the private sector rather than within the context of a comprehensive urban plan for the city of Kuala Lumpur.

The postscript to Malaysia's experience with mass transit BOTs in the 1990s is that both STAR and PUTRA went effectively bankrupt and were nationalised in November 2001, with the Ministry of Finance taking full ownership in August 2002 and retaining ownership to this day. Outstanding debts of more than $1.2 billion in the case of PUTRA (after just 3 years of operation) and more than $300 million of STAR, were met by the government.

IV.5.3. Emerging Issues with PPP in BRT

The growing prevalence of private sector led consortiums pushing governments around the world to implement PPP metro projects has in many cases provided competitive pressure that has successfully killed competing BRT proposals. Governments lacking the capacity to implement a complex mass transit system may be strongly attracted to the idea of having a private consortium come in and design, build, and operate the mass transit system, even if this is at a high cost to the municipality.

Whether it would be in the overall interest of increasing the number of good quality BRT systems to develop consortiums of companies able to offer to a municipality a package that would design, build, and eventually transfer a complete BRT system and even the mixed traffic lanes, sidewalks and bike lanes, to the government in exchange for some form of government subsidy for the construction, remains an open question.

A typical structure might be that the private consortium agreed to pay for the bus procurement, and some percentage of the infrastructure in exchange for a monopoly concession to operate the BRT system for a period long enough to ensure a reasonable rate of return on their investment, and perhaps also in exchange for some real estate development rights in the corridor.

It might also be possible to include in the concession contract an understanding that the company when building the BRT system would also substantially upgrade the quality of the street, with nice street furniture, bicycle lanes, wide sidewalks, and nice landscaping. If the BOT BRT concessionaire also had some opportunities for real estate development along the corridor, this might also give them an incentive to improve the streetscape.

The greatest concern with such a theoretical turnkey private BRT system would be the ramifications of introducing a single monopoly private concessionaire. Some of the problems with turnkey private sector light rail systems in Malaysia are discussed to illustrate the main issues. This private monopolist is likely to be a consortium of construction companies, bus manufacturers, banks, and bus operators. The practical result of forming such a company is to increase construction costs, bus procurement costs, finance costs, and bus operating costs significantly above what could be achieved through separate competitive tendering of these activities. These additional costs would ultimately be reflected in the fare, with adverse consequences for lower income transit passengers and ridership levels.

In theory, it might be possible to structure the concession agreement in such a way that the financial risks are carefully balanced between public and private sectors, where the taxpayers are carefully protected against massive defaults by responsible public servants mandating carefully scrutinized demand forecasts from independent auditors, and where stiff penalties are written into the contract for poor service or delayed implementation.

In practice, achieving this sort of transparent contracting that protects the public has been elusive in similar light rail projects, and the problems with this sort of financing provide useful object lessons for anyone considering a similar approach in BRT.

On the other hand, there would be certain benefits of having one or more powerful private sector BRT concessionaires competing for contracts internationally and in China. Right now, the lack of such companies tends to lead to a focus in Asia on metro and light rail projects where the powerful private promoters of these projects have enormous influence over the political decision-making process. In the case of Hyderabad, for example, private sector consortiums have been invited to bid on a mass transit system in a particular corridor. The lack of a private sector consortium ready to offer a turnkey project for BRT has significantly restricted the chances that BRT will be built in Hyderabad. Such a structure might also help to alleviate the problem of badly situated, planned and implemented BRT systems with very little demand.

Certainly, the risk of massive defaults from a BOT system, such as occurred with the Mexico toll road concessions, the Hungarian toll road concessions, and all of the Malaysian light rail concessions, are far lower for BRT than they were for these toll and metro projects simply because the amount of capital investment involved is far less. Therefore, if private sector participation is possible for rail based mass transit schemes, it is even more possible in the potentially more profitable BRT sector.

Securing private sector financing into BOT for BRT projects primarily requires a government reputation for honouring contracts, and private investor confidence in the ability of the government to honor their financial commitments under the contract. Certainly, the success of numerous private sector concessions in China has created a fairly secure investment climate for BOT projects in China that would extend to BRT projects.

Ultimately, governments seeking financing for BRT infrastructure should weigh up the relative benefits and problems related to BOT financing. Ultimately, most BOT projects in mass transit end up being an extremely expensive method of financing new mass transit systems, and are primarily used to get around municipal or national government borrowing restrictions. Usually this additional private sector financing is purchased at the expense of the taxpayers assuming a heavy financial risk. Before considering BOT in BRT, it is advised that decision-makers familiarize themselves with the highly problematic history of private investment in rail mass transit projects in Asia.

V. Trends in Municipal Finance for Bus Operations and Rolling Stock

V.1. Background on Chinese Bus Operations

China's bus operators were all largely state owned monopoly enterprises into the early 1990s. They were more or less self-financing for many years until the combined processes of rapid motorization and worsening traffic congestion began to reduce their ridership and increase their operating costs. As a result, these transit authorities entered into the classical downward economic spiral that confronts bus operators that do not implement BRT the world over, where increasing bus fares to meet ridership declines and increasing operating costs per passenger lead to further declines in ridership, etc. By 1994, the government was providing 2.9 billion yuan per year in subsidies to transit authorise, and these authorities were operating at an annual losses of around 1 billion yuan. (Chang, T. 1999. A new Era for Public Transport in China)

Faced with mounting deficits, the state decided to 'corporatize' these transit authorities, giving them a hard budget constraint, opening them up to private capital investment, and also opening up the sector to competition. The degree to which transit sector deregulation progressed was not uniform across Chinese cities, ranging from Beijing which retained a single large public operator, under a three tiered 'contract responsibility system', to Guangzhou where multiple companies compete for routes assigned to them by the transport commission, under a concession arrangement which is renewed every so many years. These companies have a wide diversity of ownership arrangements. Some are state owned enterprises, and some are joint stock companies, and some are joint ventures. Some of them are the old municipal bus companies that have been broken up. Some of them are owned by private local companies, some are owned by taxi companies. In Guangzhou, Fushun, and Anshan, some routes have been concessioned and competitively tendered, and the tenders have been won by Hong Kong-based private bus companies, and others by joint ventures with Chinese companies. In some cities, the public transit company operates some routes, and contracts out other routes.

Transit fares remain tightly regulated, but are supposedly based on a cost-plus formula that allows a reasonable return on investment.

These reforms were fairly successful in both lowering the level of government subsidy and in attracting private investment into the bus sector. The total number of buses in Guangzhou expanded substantially after the reforms, and the quality of service improved.

This relatively flexible regulatory structure for public transit is ideal for the development of BRT, and will significantly reduce the headaches of establishing viable, profitable and competitive BRT operating companies.

V.2. International Experience with Private Investment in BRT Bus Operations

Buses used in BRT systems range in cost from standard buses (as low as $30,000 in India to as high as $250,000 in the developed world), to articulated buses such as those used in Bogota (between $100,000 and $250,000), to di-articulated Euro III buses used in Curitiba (over $500,000), to hydrogen fuel cell bus driven bi-articulated buses with optical positioning systems (over $1 million).

Financing options for bus and ticketing system procurement for BRT systems are quite different from the options available for the planning and construction of the system. The main difference is the much greater role played by private investment, private banks, and bi-lateral export credit agencies.

Not all BRT systems invest in new buses. Some of them simply use the existing buses and give them special bus lanes and special treatment at traffic signals. However, generally higher-end BRT systems are used to modernize bus fleets.

In those systems where new buses were procured, in Bogota, Curitiba, Leon, and in the second line in Quito, private operators paid all of the cost of bus procurement. These private operators in turn secured financing from export credit agencies (Bogota Phase I), local commercial banks (Bogota Phase II), and national development banks (Curitiba Phase III)

-----Bogota

In Bogota, the Municipality was committed from the very beginning to forcing the private bus operators to pay for the buses and for the private ticketing system operator to pay for the ticketing system, and it was determined not to provide a credit guarantee to the operators. This was not, however, a simple task. The bus companies that won the bids to become the trunk and feeder bus operators in Bogota were newly formed companies that hitherto were just loose affiliations of small independent informal sector bus operators. They had no credit history, and it was difficult to secure bank loans.

Despite the personal appeals of the Mayor, the Colombian banks refused to finance their bus procurement. Ultimately, the ***loans were procured from the Brazilian export credit agency, as the buses being procured were initially assembled in Brazil***. As it turned out, all of the bus companies that were able to supply buses that were in compliance with the technical specification set by TransMilenio were assembled or manufactured in Brazil, in the end, the Brazilian export credit agency provided the loans, largely at the behest of Daimler Chrysler's Brazilian subsidiary. This Bank also required that the bus operating companies secure insurance on the rolling stock from local sources, which imposed an additional cost to the operator, but after many headaches, this was arranged.

After the financial viability of TransMilenio was proven, it was much easier for private operators with a contract to operate a TransMilenio trunk route to get financing for bus procurement from commercial banks. By the time Phase II began, the private operators were able to get commercial bank loans for bus procurement without municipal guarantees without any difficulties.

-----Curitiba

In Curitiba, by the time the BRT system was built, the private bus operators had already been formed into formal sector bus operators during an earlier round of bus sector reforms in the early 1960s. As such, these bus companies already had a relationship with private banks and had been operating profitable companies for many years. Curitiba's BRT system awarded the operating contracts for each trunk line to the same bus companies that had for more than a decade had a monopoly over bus operations in the same corridor. As such, the private bus companies had more investment capital of their own, and more ready access to bank loans.

When Curitiba recently decided to upgrade to Euro III vehicles and to a di-articulated bus, for which there is only one monopoly supplier (Volvo), the cost was prohibitive nonetheless for the bus operators. At this point, the private operators got loans from BNDES, the national development bank, to finance the bus procurement.

-----Quito

In Quito's Line I, the municipality decided to go with electric trolley bus, which was much more expensive for both the vehicles and the electric conduits. Because of these costs, it proved impossible to find private investors for the vehicles. They were paid for and sourced by the Municipality. Quito held a competitive bid, and part of the cost determination was whether the vehicle came with financing and ongoing service support. Russian, Spanish, and Brazilian companies bid. The Spanish won the bid largely because they secured very low cost financing from the Spanish export credit agency.

In Quito Line II, standard diesel articulated buses were used, as in Bogota. The private bus operators consortium that was awarded the contract to operate Line II did not agree to pay for the buses, so the contract for the operating company requires that a percentage of the profits be repaid to the Municipality for leasing the buses. Because demonstrating the operating companies profitability has proven difficult, there are ongoing disputes between the operating company and the Municipality about the profit levels, and the private operator thus far has refused to pay anything for leasing the buses.

-----Other BRT Systems

In Jakarta in Phase I of TransJakarta, the buses were procured by the DKI Jakarta government from general budget revenues. In Phase II, scheduled to open in January of 2005, most of the buses will be procured by private bus operators, though the details have yet to be worked out.

In Delhi, very few new buses (6) have been included in the first phase of the High Capacity Bus Project, and they were paid for by the Delhi Government. The possibility of receiving loans for bus procurement from a national development bank ICICI has been discussed, but there is no movement on this.

V.3. Public transit authorities in wealthier countries with low bus demand[5]

In developed countries like the United States, Japan, Canada, Australia, and the countries of Europe, where BRT has been implemented, bus system operations fall into two broad categories: those bus systems operated directly by public authorities or public transit agencies, and those operated by private operators but under public service contracts with public authorities. Throughout the developed world there is a gradual transition away from direct transit authority operation towards private operation through tightly regulated public service contracts, but the process is quite gradual and non-linear.

These systems are structured this way, frequently despite a strong ideological predisposition towards privatization and deregulation, primarily because *bus ridership is so low that profitable bus operations is nearly impossible, and closing down the service would deprive transit dependent populations from basic mobility*. The right to a reasonable level of service for the elderly, for the poor, the deaf, the blind, school children, and the remainder of the 'transit' dependent population remains a reasonably widely recognized 'right' and hence a

[5] Source: Fairness and the Fare: Equity and Adequacy in the Financing of the Operating Agencies of the Metropolitan Transit Authority: Briffault, R., E. Sclar, and W. Hook, 1998. Legislative Drafting Research Fund, Columbia Law School, New York.

part of society's welfare apparatus. While this 'right' is being eroded, even in the United States most of the debate focuses more on how to provide the service the most efficiently rather than whether the 'right' is justified in the first place.

In these countries, the maximum number of passengers per hour per direction that a BRT line is likely to carry is in the 5000 range, but BRT in the US is considered 'viable' if it moves even 5000 passengers per ***day***. At these very low demand levels, it is almost certain that all but a very limited number of routes will never be financially viable as private operations. This means that from an economic perspective, financing bus operations is always going to be in a 'second best' scenario, where the best that one can hope for is private 'competition for the market' established by a transit authority. As such, privatization efforts have concentrated on contracting out of bus services on routes set by a transit authority, at fares set by a transit authority, and following a schedule set by a transit authority.

For the BRT systems that are being introduced in developed countries, even in the best scenarios, none of the system's designers or sponsors believes that the ridership will increase so substantially or costs reduced so dramatically that even ongoing bus operations can be fully financially self sufficient, and hence the benefits of contracting out operations to private operators are not that significant.

As such, none of the BRT systems built or under development in the developed world have been accompanied by significant institutional or regulatory reforms. Hence, there is no connection between the US BRT program that started in the late 1990s and the efforts in the 1980s and 1990s to privatize bus operations through contracting out of unionized transit operations to non-union private firms as a result of political pressure from the Reagan and Bush dominated Federal Transit Administrations.

In China, however, where demand on the BRT system could easily run greater than 20,000 passengers per direction per hour during peak periods, there is no reason why the system, once constructed, should require operating subsidies of any kind even at fare levels equivalent to current fares. Normally, a BRT system with greater than 5000 – 6000 passengers per direction per peak hour is able to fully recover its costs.

In all of the Latin American systems, transit fares at least cover the operating cost of the system. We would strongly argue that in a BRT system there is absolutely no justification for charging a fare that is below the cost of operating the system. There is rarely a justification for public subsidy of bus procurement either. However, when there is a gap between revenues from ridership and the cost of operations including the cost of bus depreciation, government capital subsidies for rolling stock can be considered.

While the US system of transit system financing is inappropriate and mostly irrelevant for Chinese cities, nonetheless, some basic information about this financing structure is provided. The description will be based on New York City, which is the largest transit system in the United States.

The New York Metropolitan Transit Authority (MTA) is the largest public transit agency in the United States. In 1996, the subway, bus and rail facilities provided 1.7 billion paid rides, roughly 1 out of 4 rides in the United States. The MTA has several subsidiaries: the New York City Transit Authority (TA), which operates the subway and bus system, the Commuter Railroads (CR), namely the Long Island Railroad and the Metro-North Commuter Railroad, the Triborough Bridge and Tunnel Authority (TBTA), and a few smaller agencies.

As a whole, the NYCTA in 1996 ran an operating deficit of $1.264 billion, and the commuter railways a deficit of $764 billion. The TBTA, which only collects tolls on the bridges and maintains these bridges, ran a surplus of $606 million in 1996. The TBTA surpluses cover roughly 1/3 of the combined TA and commuter railway operating deficits. Fares cover almost none of the cost of the rolling stock replacement or infrastructure.

Operating subsidies are covered by some federal government money, but it accounts for only 3% of total operating subsidies. This federal money is from a 2% earmark on all fuel tax revenues which is dedicated to transit system operations and then distributed based on a political formula that basically penalizes large systems. Most of the operating subsidy comes from the State of New York. There is a matching fund called 18-b, which must be matched by the City of New York, that subsidizes transit operations out of general government budget. In 1996, the TA and CR received $188 million of 18-b funds, but they are falling due to the unwillingness of the City of New York to provide the match.

The rest of the operating subsidy is covered by special State-level earmarked taxes. The TA received $703 million and the CA received $324 million in earmarked taxes for operating subsidies in 1996. These earmarked taxes are paid into a special fund called MMTOA (Metro Mass Transportation Operating Assistance Account) of the State's Mass Transportation Operating Assistance Fund. The sources of these taxes are as follows:

a. A special earmarked ¼ of 1% sales tax imposed on the New York Metropolitan area for transit system subsidies.

b. A regional franchise tax, a type of corporate taxation, earmarked to transit,

c. A long lines tax, imposed on trucking, telecommunications, and logistics companies

d. The petroleum business tax, (PBT) imposed on gas stations and oil companies. This one is by far the largest and most important.

e. Mortgage taxes (MRT-1 and MRT-2) and other real estate assessments.

For capital subsidies, there is another financing structure. In New York, 'capital' costs include rolling stock and even maintenance, and a large share of the capital subsidies in both the TA and the CR underwrite the cost of vehicle procurement and maintenance. Most of what in the New York is called 'capital' investment is in fact 'maintenance and rehabilitation', as virtually no new transit infrastructure has been built in New York in the last two decades.

According to the MTA, in 1996, 25% of the capital costs of the New York City subways were paid for by federal government subsidies (the same 2% earmarked share of gasoline tax, but under a different category), 11% was covered by the City of New York (mostly metro station maintenance and rehabilitation), and 60% came from the MTA's own revenue, largely in the form of bonds issued directly by the MTA. Some of these bonds are backed by the general tax revenues of the State of New York, some of them are backed by priority access to the fare revenue, and some of them are backed by the revenues from the Triboro Bridge and Tunnel Authority's tolls. As the MTA has been accumulating deficits for decades, the expectation is that the State will bail out these debts with some new earmarked taxes in the future, but certainly after 2000 the increase in fare-backed bonds coming due has contributed to the dramatic increase in the fare price, which is now $2.00 per trip.

V.4. Financing BRT buses in China

Currently, in China, all the BRT systems that have been constructed or are under construction are considering public procurement for the buses. In the case of Beijing, a BRT company was created. This company is 46% owned by the Beijing Bus Corporation, a publicly owned near-monopoly bus provider. There are 4 other companies that co-own the BRT company, 2 of which are private. In Beijing, the buses cost more than 2.2 million yuan (around $250,000), including tax. There are 40 BRT buses. The cost of the ticket is 2 yuan, twice the cost of a ride on a regular bus and two-thirds of the cost of the metro ticket, which is 3 yuan. However, a significant proportion of passengers use monthly tickets which are substantially discounted. The ticketing system is regulated by the local NDRC. The ticket is purchased in a booth or a smart card can be used, however there are no turnstiles, so several attendants are needed to ensure that people do not enter the stations without paying.

In Hangzhou, Jinan, and other Chinese cities with the exception of Guangzhou, phase I of the BRT systems are all moving forward under the auspices of BRT companies owned by public bus companies, with the bus procurement being financed by the municipality and the bus company, with some marginal involvement of private investment being considered.

Ideally, these systems should shift bus procurement to private operations. Ideally, these private bus operators should be paid on a bus kilometer basis by the BRT company which would get out of direct bus operations. Ideally, the contracts would be between the private bus company and the BRT company, would be competitively tendered, and would include penalties for providing poor quality service.

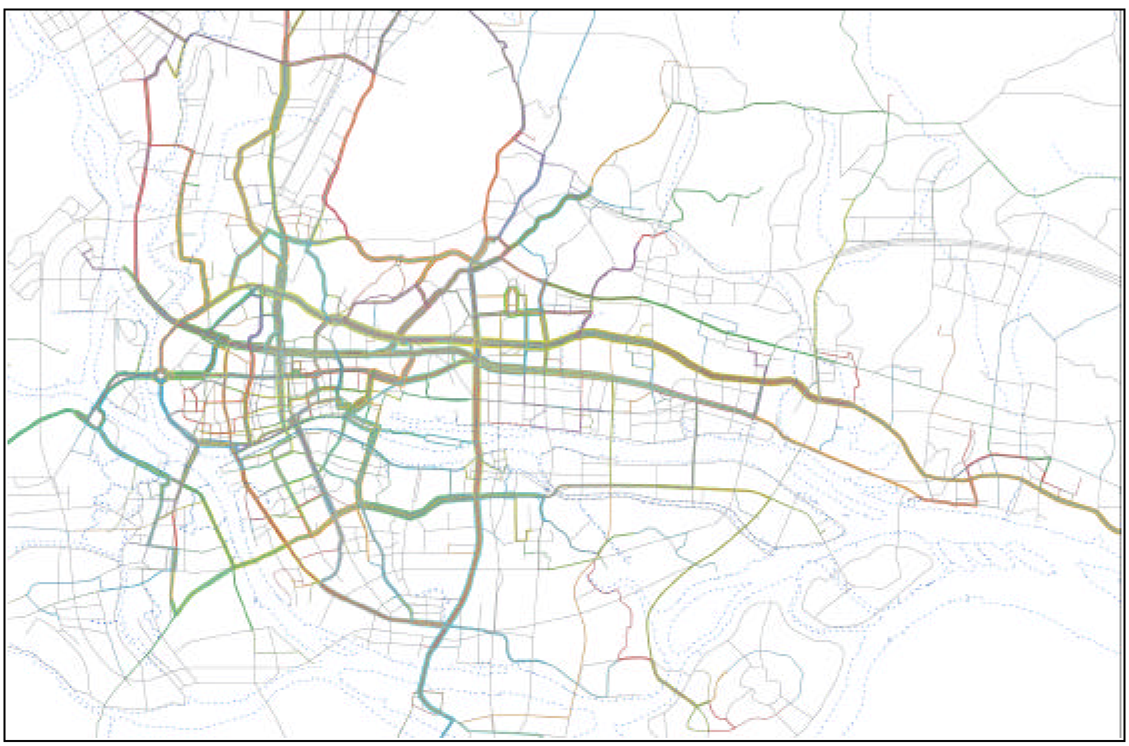
VI. Planning BRT Systems to be Financially Viable: Preparing the Business Case for the BRT System

Securing financing for BRT buses should start with the system's design. Nobody can attract private sector financing to a system that has very few customers. While designing a system that can be self financing is discussed at length in the BRT Planning Guide, the following guidelines are taken from that Guide to at least begin to build the business plan for a public private joint venture BRT company.

The most difficult part of creating a business plan for a new BRT system is to estimate the potential revenues, and this is of course based primarily on the level of demand.

VI.1. Early Planning: Estimating Demand

The first estimate of existing transit demand on main corridors usually begins with a map of existing transit routes. Usually a map of all existing transit routes will tell you a lot about which transit routes are likely to have high levels of demand. While the roads which carry the most bus routes do not always correspond to the highest number of transit passengers on a given corridor, usually there is a strong correlation between large numbers of transit routes and high passenger flows. The figure below shows the existing bus routes in central Guangzhou.

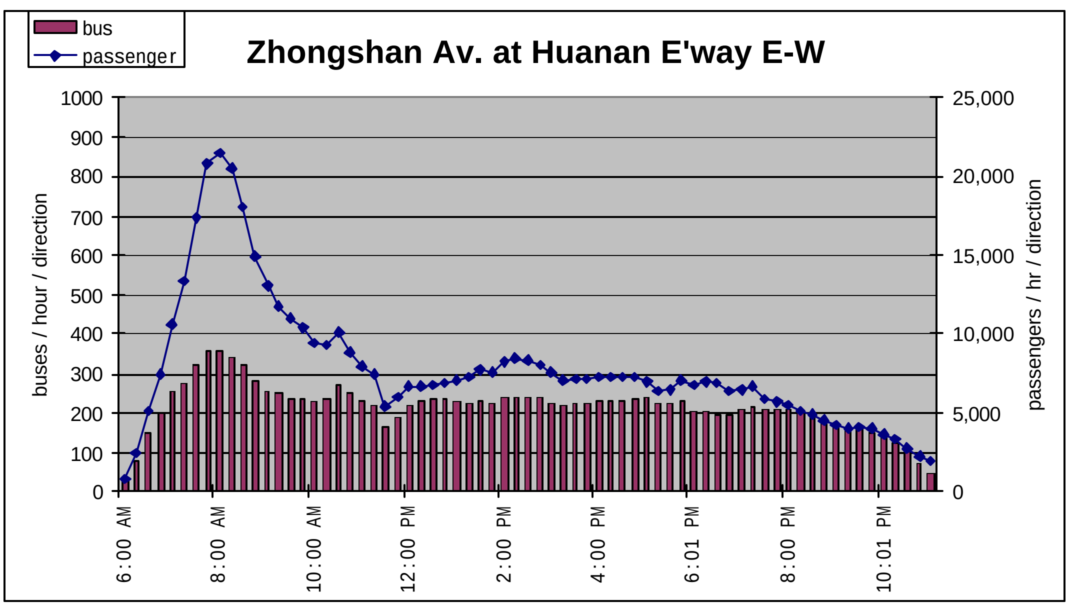


The next step is usually to do traffic counts and bus occupancy surveys in strategic locations. Determining where to do traffic counts is more of an art than a science, but some rules of thumb apply.

The idea at the early stage of planning is to choose enough locations for traffic counts where it is possible to capture most of the trips. If a city has a fairly clearly defined central business district (CBD), and most of the trips end in the CBD, then it is sometimes possible to do traffic counts at the entry points along a 'cordon' around the CBD. Sometimes, travel demand is fairly unidirectional during the morning peak, say from North to South or from East to West. In this case, a 'screen line' count, or several screen line counts will work better than a cordon count, but the principle is the same.

When doing traffic counts, it is useful to count all of the vehicles, not only transit vehicles. In this way, this data will already be available for use in developing a full traffic demand model.

These vehicle counts must be complemented with transit vehicle occupancy surveys. If not counting all the vehicles, sometimes it is enough to only to a transit vehicle count and occupancy survey with just one survey. Occupancy surveys estimate how many people are on each bus by bus type. There may be quite a diversity of buses and paratransit vehicles, and they should be grouped by the number of seats, such as: 40 seat buses, 20 seat buses, 12 seat minibuses, 7 seat shared taxis, etc. Usually surveyors count each transit vehicle type and mark "full", "3/4 full", "1/2 full", "1/4 full" or "empty." With these categories and a few different transit vehicle types, the average bus occupancy can be multiplied by the total buses providing a very rough idea of how many bus passengers are entering the CBD, and on which arterials. Once a count of the total buses at several points along the corridor is available, and this is multiplied by the average occupancy, a graph can be created as below, which will give a rough estimate of the total number of transit passengers passing through a corridor during different points of the day. This will also provide a good idea about the peak in each direction, and the relationship between the peak and the off-peak.



If the itineraries of each transit vehicle can be determined either by numerical route numbers or signage on the transit vehicle, then transit vehicle counts and occupancy surveys can be done on a line-by-line basis. This will already give a rough idea not only of which corridors are carrying a lot of transit passengers, but also of which itineraries are carrying the most passengers.

Because in most cities, trips to the CBD are not the only important arterials, and may not even be the most important arterials for transit passengers, it is usually insufficient to only do traffic counts in a cordon around the CBD, or a screenline, though this is usually a good place to start. Some cities have no clear CBD.

For this reason, normally one would do traffic counts at a larger selection of critical points around the city strategically chosen by local and international experts based on a rough estimate of those locations where most daily trips would pass. This need not be a huge number of counts. In the city of Dar es Salaam, for example, (about 1.5 million) traffic counts in about 30 locations captured a large majority of the trips, and in Jakarta (about 9 million), about 65 counts were enough. If trips are heavily peaked, then one way counts may be sufficient, and if they are not peaked at all, then two directional counts will be necessary.

These traffic counts and transit vehicle occupancy surveys, coupled with detailed transit route itineraries, will later be used to calibrate the traffic model, but for now they will already provide a rough idea of the total transit demand on most major corridors. In Asian cities this process is usually made easier due to the relatively limited number of arterials and a relatively undeveloped secondary street network.

By simply multiplying total transit vehicles at the peak hour times the average total passengers per transit vehicle, one can already get a reasonable estimate of the likely size of total transit demand on most of the main corridors. At this point, one can probably already get a reasonably good guess on which routes a BRT system may be most needed. By rough correlation of the demand with specific transit route itineraries, one can get a crude estimate of which parts of the corridor are likely to be carrying the heaviest volume of transit passenger. What planners are looking for is an estimate of the 'maximum load on the critical link,' usually measured in 'passengers per peak hour per direction (pphpd). The maximum load on the critical link is that section of the potential BRT corridors which is currently carrying the highest volume of existing transit passengers.

Once this is done, the highest priority corridor or corridors should be selected. Normally, the most impo rtant criteria for selecting the first BRT corridor or corridors is the highest level of transit demand. Already at this point one should have a rough idea of which corridors should be further studied to be Corridor I and II.

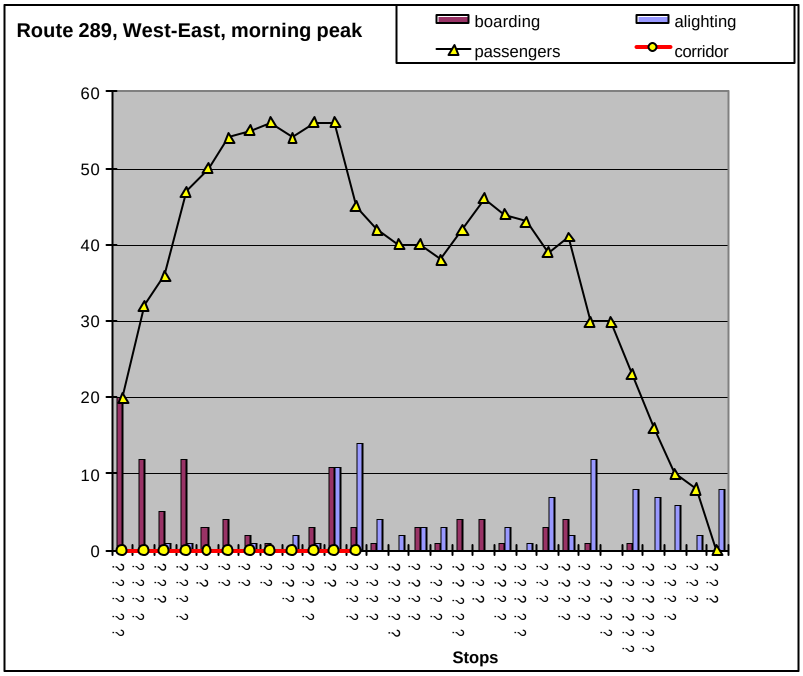
Frequently, however, the highest demand corridors have already been identified by government officials for metro system development. At this point, it is important for the technical team to make it clear to the political decision makers the options available to them for addressing the demand in the corridor at reasonable speeds and to reappraise this decision in light of new information. However, ultimately the decision maker must decide which corridor is to be developed, and system designers must then test the feasibility of this decision.

VI.2. Refining the Demand Estimate for the Pilot Corridor

Once the team has selected a corridor, or if government officials have already pre-selected a corridor, some judgement is needed about whether and what type of BRT makes sense on this corridor. A more careful look at the demand on this corridor should be done. This would start with more transit vehicle counts and occupancy surveys along the first corridor, to get a preliminary sense of differences in demand along the corridor, to make sure the link with the highest level of demand has been determined.

With an estimate of the pphpd at the maximum load on the critical link, planners can already make some preliminary determinations. ***While these initial traffic counts will not reveal how many passengers will use a new BRT system under different scenarios, they will provide some indication of how many transit passengers are currently using the corridor at the peak hour***.

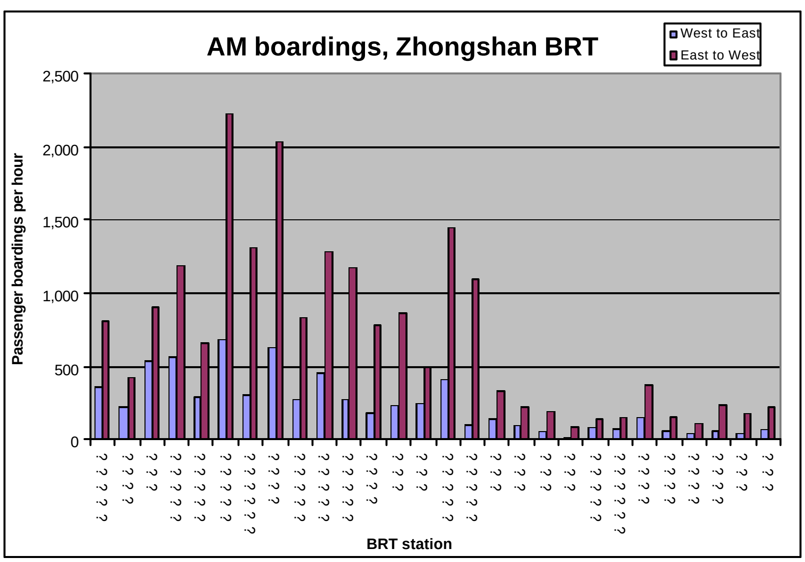
In some cities, where a significant share of transit demand is handled by paratransit vehicles, shared taxis, and other forms of collective transport that do not have fixed itineraries, this methodology will not work. In most Chinese cities, however, the bus sector is better regulated.



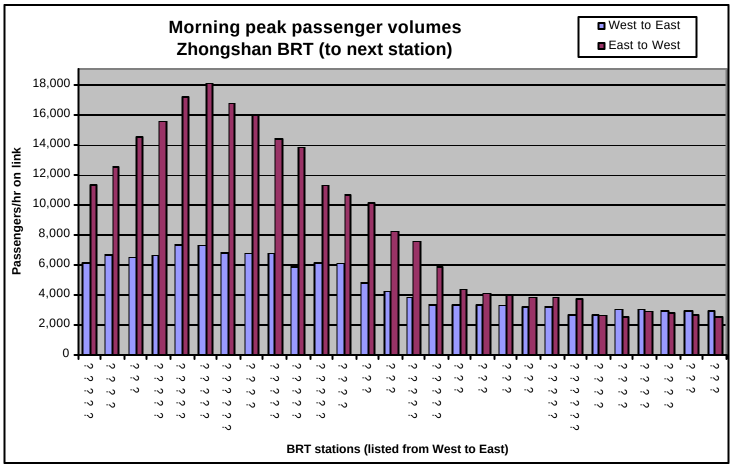
At this point, an additional survey needs to be conducted: a boarding and alighting survey on each transit line. For this type of survey, surveyors should ride the entire length of each major transit line during the rush hour recording how many people are getting on and off the bus at each stop. At the same time, one can generally also record the speed of the bus. If a GIS is carried by the surveyor, the speed can be calculated based on readings downloaded from the GIS device.

The boarding and alighting survey will provide a picture of how many passengers are on each bus line at different parts of their journey, some of which will be on the BRT corridor and some off.

The boardings and alightings are needed for designing the bus station. By aggregating the boarding and alighting data as below, one can see which stations will need to be designed to handle large numbers of passengers, as shown left for Guangzhou.



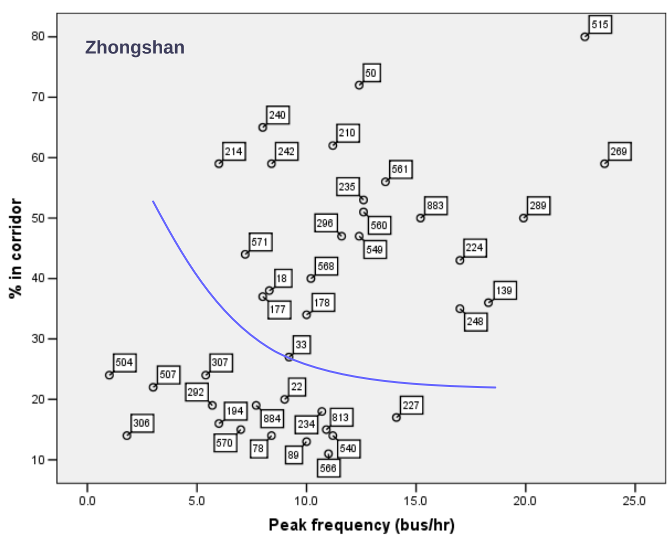
By adding up the ridership on each bus line at each bus stop, one can then get a graph as below which shows how many passengers are on *all* buses at any given point along the chosen BRT corridor.



With ridership data on a bus line by bus line basis, one can already make some preliminary judgement about which bus lines to incorporate into the new BRT system, and which bus lines to keep outside the system.

This is more of an art than a science, but mainly concerns two factors:

- the percentage of the existing bus line in the corridor, and
- the peak hour, peak direction frequency of the buses by line

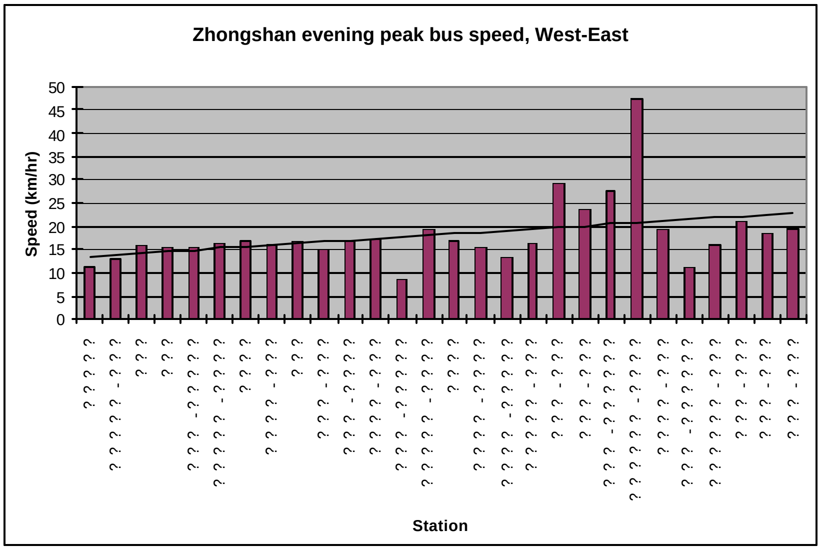


To analyze which bus lines should be included in the system, and which lines should be left alone to operate in the curb lanes (if any), the following graph can be used:

This graph of the bus lines operating on the Zhongshan Av corridor in Guangzhou locates each bus line according to the percentage of the bus line in the corridor, and the peak frequency. All those bus lines with a high frequency that are heavily concentrated on the corridor should be incorporated into the system, or else the BRT system will not capture the bulk of the transit demand in the corridor. The more bus lines that heavily overlap with the full length of the corridor, the easier the corridor will be to design.

After making this determination, one can crudely estimate what percentage of the total existing transit demand in the corridor will be captured by the new BRT system, and what part of that existing demand will remain outside the BRT system. At this point, one can collate the transit demand for only those bus routes that will be brought into the new BRT system, and arrive at a first estimate of the maximum load on each link of the actual proposed BRT system. It will be some fraction of the total maximum load on the critical link in the corridor. With this level of demand analysis, one can already avoid three quarters of the serious design mistakes commonly observed in BRT planning.

Using the same boarding and alighting survey, one can look at the average bus speeds in the corridor and arrange them in a graph as shown.



With the new BRT system, assuming it is properly designed, speeds of 26km/hr can be achieved throughout the corridor. The difference between existing aggregate speeds and this speed provides the projected time savings benefit of the corridor, and multiplied by the number of passengers on each link provides the total passenger time savings for the system.

This level of analysis already provides a good idea of how many of the existing transit system's passengers the new BRT system will capture, assuming that the fare is the same. This is a very good baseline for a minimum demand assumption.

However, one still needs to make some assumptions about how many new passengers are likely to be attracted from other modes. ***To get a robust estimate a full traffic demand model is needed***, but an important clue will be the existing bus speed data. If existing bus speeds are already at or above 26kph, it can safely be assumed that new passengers will not be attracted to the new BRT system, even at the same fare, because the system does not provide any significant improvement in travel times or travel costs. The lower the existing bus speeds, the higher the projected modal shift to the new BRT system.

From a financial perspective, it should be standard practice to assume no modal shift from private vehicles in the initial years, and it should be assumed that the entire demand on the new service will come from the existing bus routes that will be replaced by the new service. This is a highly conservative estimate, but a conservative estimate is what is called for in financial projections. For physical design purposes, a higher modal shift should be assumed. It is highly unlikely that the short term modal shift will be more than 25% of the baseline demand from existing transit trips, though to be conservative the system should be designed to accommodate an increase of up to 50% above existing transit demand to be safe.

VI.3. Getting a Demand Estimate Usable for a Business Model

VI.3.1. Selecting a commercial modelling package

At this point, planners still will not have a demand calculation usable for financial analysis. For this, as a minimum a transit model of the specific system being developed needs to be prepared.

This section will describe how to build a bare-bones traffic model that only models the transit system. With this planners will be able to get a much more robust estimate of the demand on the existing system, and also will be able to much more easily test the demand for different alternative scenarios for bus fares and small changes in the routes, as well as optimize bus operations.

In many cities, some sort of traffic model will already exist, but in China it is relatively rare for BRT planners to have access to a transit system already coded into a traffic model. Often if there is a traffic model, it is only usable for motor vehicles and has very limited capacity to model transit systems. If a good traffic model already exists and is available to the BRT planners, it should be possible to simply put the transit system and the proposed BRT scenario into the existing transit model. If not, one should start by modelling the transit system first, which is the most important information for BRT system planning.

The first step in setting up a transit model is to buy traffic modelling software. The development of transportation modelling software has greatly aided the process of transport supply and demand projections. Software models today can greatly ease the modelling process and increase accuracy and precision. However, with an array of software products on the market, the transport planner can be left with an overwhelming set of options. Of course, there is no one software solution that is inherently correct. A range of variables will guide the software selection process. These variables include cost, familiarity of municipal staff and local consultants with a particular product, degree of user friendliness sought, degree of precision sought, and the overall objectives of the modelling task. The table below lists a few of the commonly used software packages that are on the market today.

Modelling software packages

Software name	Vendor	Comments
EMME / 2	INRO Consultants Inc.	Good general purpose
CUBE/Trips	Citilabs	Good general purpose
TransCAD	Caliper Corporation	Good integration with GIS, easy to use
VISUM	Ptv/ITC	Good general purpose
AMSUN2		Microsimulation model useful for animations for intersection design
Paramics	SIAS	Microsimulation package, very useful animations for traffic design
VISSIM	Ptv	Microsimulation package, good animations, good integration with VISUM
QRS II	AJH Associates	Low cost but weaker on PT assignment
TMODEL	TModel Corporation	Low cost but weaker on PT assignment
SATURN	Atkins-ITS	Good for congested vehicle assignment, but no PT assignment

The strongest packages for general purpose planning and design of BRT systems are Emme/2, Cube/Trips and Visum with TransCAD offering close capabilities. Many cities in China have either Emme/2 or TransCAD, and both are adequate.

All of these are rather expensive packages but the most significant costs will be those of training leading to effective use and familiarity with the package. Older and more sophisticated modellers like the flexibility of Emme/2, which allows one to easily write custom sub programs, called ‘macros’, but Emme/2 does not have a windows interface, and its graphics capability is fairly weak. More and more consultants are now using Emme/2 in combination with other programs with better GIS capability. Saturn, TMODEL, QRS II, all either have no transit assignment component or else are fairly weak at modelling transit demand, and are not recommended for BRT.

Amsun2, Paramics, and Vissim simulate trip making at a high level of detail, in particular vehicle-by-vehicle. These are very powerful packages to study priority at junctions and interactions and delays at stops. They should only be used for these purposes and in combination with the macro demand models listed above, as they are not appropriate for BRT route analysis.

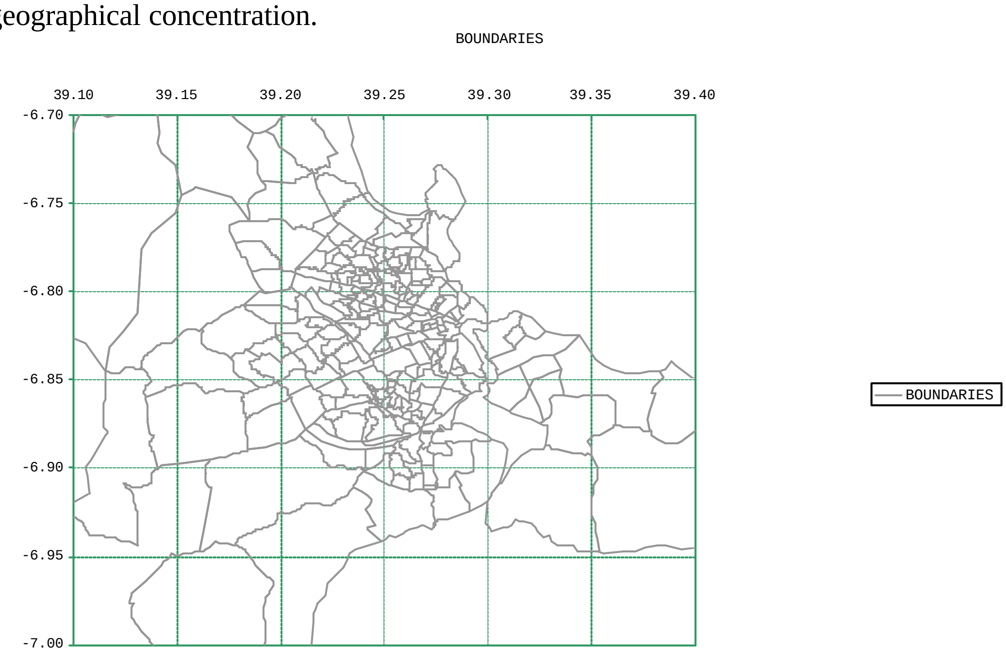
VI.3.2. Defining the Study area and the zoning system.

Normally, the study area when designing a BRT system will be the areas currently served by bus and paratransit services. If a corridor has already been pre-selected as the first BRT corridor, then the catchment area for this corridor will be the study area.

To analyze travel in the study area, the entire area, as well as some areas outside the study area, need to be divided into a number of zones. As all origin-destination data will be collected and coded to this zoning system, establishing these zones is an important first step. Usually the zones are based on census tracts or political subdivisions that have been used as the basis of any existing census information or previous Origin and Destination studies. Using census and other administrative zones that already exist in the city will increase the chance of compatibility with the overlaying of different data types.

The information needed for traffic modelling, however, is not exactly the same as information needed by the census bureau, so some census zones are usually consolidated into big zones, and others are broken up into smaller zones. Traffic modellers are generally less concerned about information outside the study area. As a result, they tend to consolidate zones outside the study area into fewer, larger zones. This is a simple matter of adding up the data associated with that zone.

Typically, modellers need more detailed information in the city center and/or along their BRT corridor. So typically, the modellers will break up census zones into smaller zones, using more detailed census data if available, or just using their judgement based on aerial photographs. Sometimes, households and employment will be concentrated into some parts of a large zone and not others, and it is important to break up the zone to capture this geographical concentration.



Zoning system for Dar es Salaam BRT Feasibility Study

Selecting the size of the zones and the number of zones is a trade-off between accuracy, time, and cost. The size and number of zones will also depend in part on how the data was collected and how it will be used. For BRT systems, for a large city like Jakarta, roughly 500 zones were used to analyze the main relevant BRT corridors. In a smaller city like Dar es Salaam, only 300 zones were necessary for the main BRT corridor analysis, though for detailed traffic impact analysis the city center was later broken into additional zones.

The table below lists the number of zones developed for various cities. Note that cities such as London have multiple levels of zones that permit both coarse- and fine-level analyses.

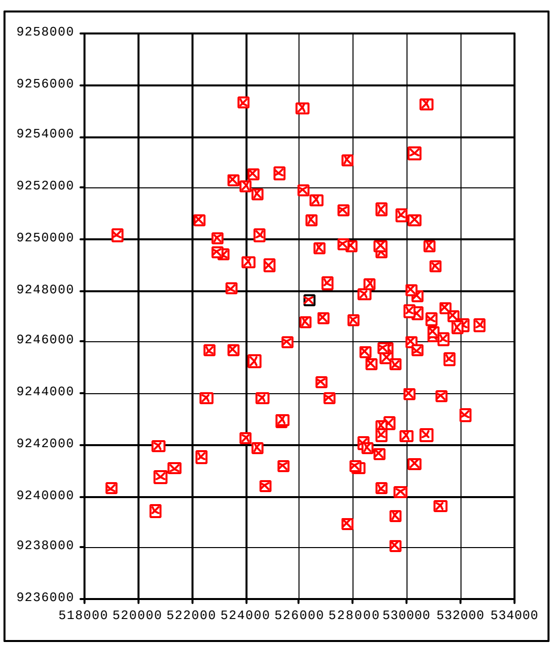
Typical zone numbers for BRT studies

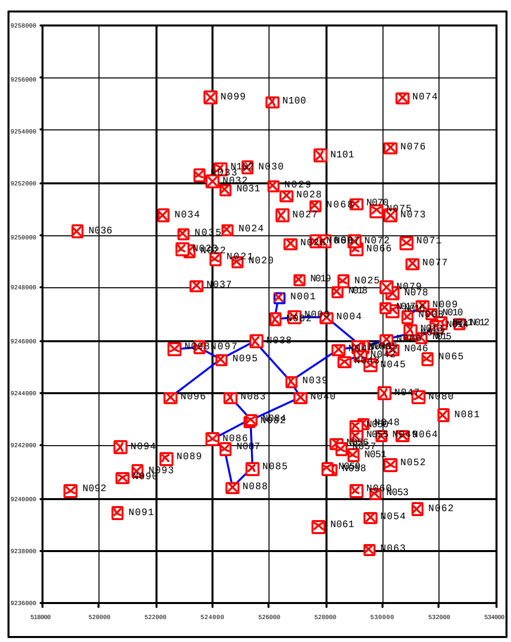
Location	Population	Number of zones
Bogota (2000)	6.1 million	800
Jakarta (2002)	9 million	500
Dar es Salaam (2004)	2.5 million	300
Cali	2 million	203

These zones, and the road network, need to be coded into the traffic model if it has not already been done. This process will not be described here in any detail, as it is a standard function of all traffic modeling, and is thoroughly described in the documentation of any commercially available traffic demand model. But the basic points are covered here for those who do not have any background in modeling.

Data is usually entered into a traffic model either as a point, usually called a **'node'** which has a specific x and y coordinate, or as a **'link'**, which is a line connecting two nodes. Normally, each intersection and each major bend in a road is assigned a separate node. Nodes are usually numbered. Ideally, the x and y coordinates of each node should correspond to actual latitude and longitude. Making sure these nodes correspond to actual latitude and longitude is called '**geocoding.**' This will ensure that data from different sources is consistent.

Normally roads are broken up into different links. Links are usually named from their origin node and their destination node.





If no GIS map exists, then staff will have to use a Geographic Positioning System and take the coordinates of each of these points. Nodes representing most of the important intersections in the city will be enumerated as in the table below.

Node_ID	X_Coordinate	Y Coordinate
13	16430	26375
14	16835	26370
17	17212	26440
23	16433	26090
24	16835	26090
27	17339	26185
28	17580	26300
33	16435	25810
34	16835	26805
127	17110	26060
128	17540	25930
134	17285	25675

By connecting these nodes, a series of links that represented different roads is defined. Link data is also then entered into the traffic model from an excel spreadsheet that should look something like the table below.

Link	Node_A	Node_B	Two ways?
1	13	14	Y
2	14	17	Y
3	13	23	Y
4	14	24	Y
5	17	27	Y
6	23	24	Y
7	24	127	N
8	127	27	N
9	27	28	N
10	23	33	Y
11	24	34	Y
12	33	34	Y
13	28	128	N
14	128	134	N
15	134	34	N

These links are generally further defined, based on the number of lanes, etc, but for transit planning this is not really necessary to further define at this point.

Zones are generally entered into a traffic model based on the nodes of all points that are needed to define the boundary. In an excel spread sheet each zone will just look like a series of nodes defined by their x and y coordinates.

Once the data is entered into a model, the zone is actually represented by a special type of node called a **"zone centroid"**. This zone centroid is a node that is used to signify the average characteristics of the particular zone. Trips are generated and attracted to these centroids and it is therefore important how they are connected to the real network, in particular to stations in a new BRT design. Normally these zone centroids are in the middle of the zone, but if all the population is concentrated in one smaller part of a zone, it might be better to move the zone centroid closer to the population concentration.

VI.3.3. Conducting an On-Board Origin Destination Survey and Building the Transit OD Matrix

The most important survey for BRT planning is sometimes called an 'on-board origin destination survey. This is one of a family of surveys called 'intercept surveys', where individuals are interviewed about their origin and destination (where they began their trip and where they will end the trip) during their trips.

All the origin and destination information collected will be coded as between the zone centroids of two of these zones, and aggregated based on these zones. A trip between two zones is called an 'origin-destination pair', or **OD pair**. The table of all the trips between each OD pair by any given mode, in this case transit, is called the **OD matrix**.

In the case of a transit model, public transport users are interviewed either on-board a bus or paratransit vehicle, (and in that case it is not an interception point but a section of a road between two intersections) or at stops and interchanges. Sometimes, with the cooperation of the police, paratransit passengers can be interviewed very efficiently by having the van driver pull over and allow the passengers to be interviewed. Other data besides their origin and destination can also be collected. Also useful are the fares paid and the services used, but questions should be kept as simple as possible. Although it is tempting to ask about waiting times, these are seldom accurately reported by individuals and are best estimated by another method.

On-board OD surveys of bus passengers is usually trying to capture the Origin and Destination flows during the morning peak period. Of course, it is impossible to collect data only one peak hour, so normally data is collected for around four hours around the morning peak, and averages are taken or weighted.

The survey locations should correspond to the locations where the traffic counts were conducted earlier, if these points were chosen wisely. In the case of Dar es Salaam, the points where the origin destination surveys were conducted were the same 34 points where the original traffic counts were taken. This was possible because of the help of the police to pull over the vehicles. In Jakarta, the surveys were conducted on board the buses, so surveys were conducted along key links that corresponded as closely as possible to the points where previous traffic counts were available.

The sample size for intercept surveys depends on the accuracy required and the population of interest. The error for an intercept OD survey is a function of the number of possible zones that a passenger might travel to when passing through a particular point. As a simple rule, Ortúzar and Willumsen (2001) suggest the following table for a 95% confidence in an error of 10% for given passenger flows:

Expected passenger flow (passengers/period)	Sample size (%)
900 +	10.0 %
700-899	12.5 %
500-699	16.6 %
300-499	25.0 %
200-299	33.0 %
1-199	50.0 %

Usually, on BRT corridors, the flows are much greater than 900, so 10% of the total passenger flow at any given survey point is a reasonable rule of thumb. In the case of Dar es Salaam, the average traffic flow at the peak hour was around 10,000, so 1000 passengers were surveyed at each point, or some 34,000 surveys. It would have been better to weight these numbers to the flows.

Origins and Destinations should be recorded as accurately as possible, for example as the nearest intersection or other key identifier. These locations then have to be attributed to the zone in which they are located, so the origin and destination can be coded to the zone centroids of these zones.

The data collection process is thus prone to two types of errors: **measurement errors** and **sampling errors**. Measurement errors arise from misunderstandings and misperceptions between the questions asked and the responses of the sampled subjects. Misinterpretation by the interviewer can result in the incorrect listing of a response. Frequently, during an OD survey, for instance, a person will identify the origin and destination of their trip, but neither the interviewee nor the surveyor are able to locate this location within any of the zones on a map. Sometimes surveyors will also not do the work responsibly and will make up answers. There may also be a degree of bias in which respondents answer questions in a manner that represents a desired state rather than reality.

Avoiding measurement errors is a complex process that requires a lot of local knowledge, and should start at the survey stage. One method is to ask the interviewee the best local landmark, and have the local staff identify as precisely as possible its location on a map. Another method is to have the interviewees pick their origin and destination from a pre-selected list of areas and sub-areas, and specific popular destinations. The later method will probably avoid a lot of trouble and confusion, but will lose some subtlety regarding walking distances. In countries where street names and neighbourhoods are far from standardized, the later method will probably save a lot of headaches.

Sampling errors occur due to the cost and feasibility of surveying very large sample sizes. Sampling errors are approximately inversely proportional to the square root of the number of observations (i.e. to halve them it is necessary to quadruple the sample size) (Ortúzar and Willumsen, 2001).

Once each OD pair is coded to specific zone centroids, planners will create a separate OD matrix for each survey point. For each survey point and each direction, this requires simply adding up the trips between each OD pair for the peak hour. This raw survey data will provide a preliminary OD matrix for each direction at each survey point that will look something like the table below:

A general form for a two-dimensional trip matrix

	Destinations					
Origins	1	2	3	…j	…z	$?_j T_{ij}$
1	T_{11}	T_{12}	T_{13}	…T_{1j}	…T_{1z}	O_1
2	T_{21}	T_{22}	T_{23}	T_{2j}	T_{2z}	O_2
3	T_{ij}	T_{ij}	T_{ij}	T_{ij}	T_{ij}	O_3
I	T_{i1}	T_{i2}	T_{i3}	T_{ij}	T_{iz}	O_i
Z	T_{z1}	T_{z2}	T_{z3}	T_{zj}	T_{zz}	O_z
$?_i T_{ij}$	D_1	D_2	D_3	…D_j	…D_z	$?_{ij} T_{ij} = T$

Source: Ortúzar and Willumsen, 2001

T11 shows how many trips are within zone 1. Tij indicates the total surveyed trips between zone i and zone j. O1 is the total origins in Zone 1, and D1 is the total destinations in Zone 1.

This is still not a full OD matrix for the whole city's transit trips during the peak hour. To get to that, one needs first to relate the number of people surveyed to the total number of transit passengers per direction per hour at each survey point. The total number of transit passengers at the peak hour is taken from the data that was collected earlier at each of the same points using the transit vehicle occupancy surveys. This is called **expanding the matrix**. For example, in Dar es Salaam, on some corridors 1000 out of 10000 hourly transit passengers per direction were collected on some corridors, which yields an expansion factor of 10. On this matrix, one needs to multiply the observed OD trips by 10 to get the total transit trips at the peak hour. On other corridors, for example where 1000 interviews were taken for only 6000 passenger flows, the expansion factor would be 6, so one would need to multiply only by six. Each separate matrix needs to be expanded by its appropriate expansion factor.

Because the point of each OD survey was chosen to pick up a discrete set of OD pairs, each individual OD matrix will largely cover a different part of the city. So the individual matrices will have some OD pairs with information, and some OD pairs with zero trips. The tables below show an example of two resulting matices from Dar es Salaam.

OD Matrix #1 East Bound Morogoro Road and United Nations Intersection

	Destinations					
Origins	1	2	3	4	5	? $_{j}T_{ij}$
1	4	10	6	0	0	O_1
2	12	4	2	0	0	O_2
3	16	5	12	0	0	O_3
4	3	2	0	0	0	O_i
5	0	0	0	0	0	O_z
total	D_1	D_2	D_3	D4	D5	Total

OD Matrix #2 South Bound Old Bagamoyo Road and United Nations Intersection

	Destinations					
Origins	1	2	3	4	5	? $_{j}T_{ij}$
1	0	0	0	12	15	O_1
2	0	0	3	15	20	O_2
3	5	2	15	8	10	O_3
4	0	0	0	6	11	O_i
5	0	0	5	12	10	O_z
Total	D_1	D_2	D_3	D4	D5	

To develop the full OD matrix for transit trips, a simple estimate would be to simply take the maximum value for any OD Pair in any observed survey. Below, we assume there were only two points surveyed, for illustration purposes. Others believe taking the average of the observed trips is better.

OD Matrix Dar es Salaam

	Destinations					
Origins	1	2	3	4	5	? $_{j}T_{ij}$
1	4	10	6	12	15	O_1
2	12	4	3	15	20	O_2
3	16	5	15	8	10	O_3
4	3	2	0	6	11	O_i
5	0	0	5	12	10	O_z
total	D_1	D_2	D_3	D4	D5	Total

This methodology is used to avoid double (or triple) counting of some trips. This may happen because some journeys may have been intercepted by more than one survey station, either potentially or in the sample. In this case, steps must be taken to avoid exaggerating their importance in the matrix by weighting those cells appropriately, for example taking the average value of duplicated cell entries. For more details consult Ortúzar and Willumsen (2001). On the other hand, sometimes people will go in very different directions to reach the same endpoint, so using this method will undercount the total demand.

Due to these distortions, along with measurement and sampling errors, as the data is collected and compiled for the OD matrix, it is usually necessary to undertake corrective actions. A validation process is typically undertaken at the conclusion of the data collection process in order to provide a degree of quality control.

This is usually done by looking at OD pairs route by route, and doing an informal trip assignment, assigning the OD trips to specific transit routes, and comparing the aggregate total trips to the aggregate trip counts developed from the occupancy surveys and transit vehicle counts.

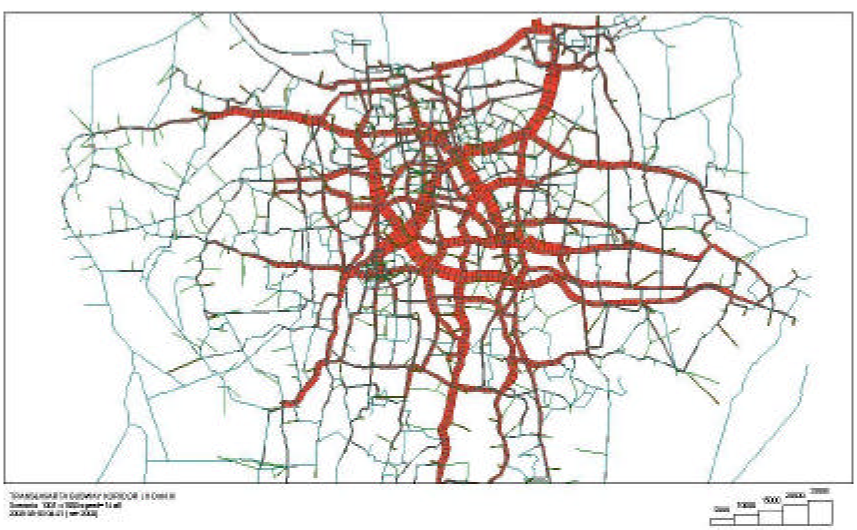
Once the OD matrix has been cleaned up and calibrated, one is ready to input the OD matrix into the traffic model and begin testing different scenarios.

VI.3.4. Estimating Demand for Specific BRT Scenarios using a Transit Model

Once the road system has been input into the traffic model, and the transit OD matrix, one is ready to start developing different scenarios for the BRT system.

The first step in generating specific demand estimates is generally to take a look at the existing transit demand on all major corridors throughout the city at the peak hour. This should provide a much more accurate estimate of total existing transit demand on these corridors, and should be a very valuable tool for prioritizing which corridors should be included in the BRT system. Methodologies for prioritizing corridors are discussed at length in ITDP's forthcoming BRT Planning Guide.

Below is a picture of the total existing transit demand on all of the major corridors in Jakarta.



Desire Lines, Jakarta BRT Study, ITDP

While these total demand estimates indicate how many transit passengers are on each major corridor, it still does not show very much about how many transit passengers will use a specific BRT system.

When first coding the existing transit system into the traffic model, one needs to have included the following information:

- o the vehicle capacity (total standing capacity is all that is used)
- o the transit route (this will be a series of links. Each direction needs to be coded separately because sometimes bus routes do not go and come on the same roads)
- o the specific location of the bus stops (for most of the network, one will just assume the bus stops are at the intersections, but for the BRT corridor it is better to add nodes specifically at the bus stop, and break the links into separate links.
- o the speed on each link (this will be from the bus speed and boarding and alighting survey)
- o the bus fare (usually the models allow fare * distance and if there is a flat fare one leaves the distance blank)
- o the bus frequency (headways)
- o a value of time. There are better and worse ways of doing this, but in practice we have simply used either discussions with bus passengers or 50% of the hourly wage rate for the typical bus passenger.

At this point one needs to define the scenario to be tested. As with the TransJakarta Busway, for example, this might include predetermined:

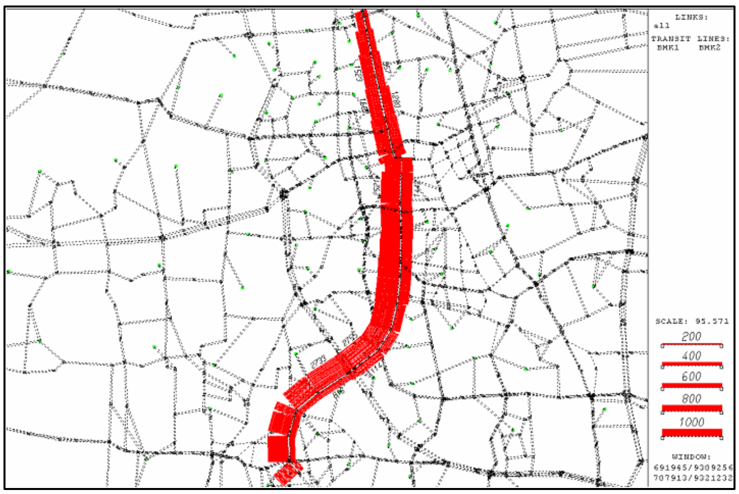
- o routing
- o number and location of stops
- o fares
- o feeder bus availability or otherwise
- o number of buses to be procured
- o number of existing lines to be modified
- o other aspects.

When coding this BRT scenario to the transit model, there is a small difference between coding a new BRT link and coding just any other bus line. The main difference is that normally, in order to test some unique elements of the BRT system, **one will code a new link with special BRT characteristics, rather than assuming that the bus line is operating on an existing road link** that is open to transit vehicles and other vehicles. This new BRT link in the model will only be coded for use by a specific BRT bus that may be a new vehicle category that does not already exist. One also needs to code the BRT line as a new link so that it can be given special fare characteristics, such as the possibility of free transfers between lines when the system expands to more than one line. Other than this, coding a new BRT line is just like for any transit line, except:

- o The bus speed will be higher than for lines on the mixed traffic links. The BRT bus speed must be calculated based on the system's design.
- o New bus stop locations will be created. This will affect walking times.
- o Bus frequencies will be specific to the number of buses and the bus speed

- If a lane of traffic is being taken away from the existing road, planners will need to change also the road's characteristics, but this will only matter when running the full traffic model.
- One needs to adjust downward the bus speeds for all the bus lines that are running in the mixed traffic lanes in the BRT corridor. If one just has a transit model, this will need to be estimated. If one has a full transportation demand model, the model will help calculate this impact.

After defining the new BRT links and assigning to it a new BRT route with the characteristics reflecting the political decisions that have already been made, one is ready to test the specific demand for this BRT scenario.



In the case of Jakarta, ITDP tested the projected demand on Corridor I, as illustrated above. This demand estimate assumed that the new BRT system will only get the trips from existing transit trips. It does not assume that any trips will be attracted from other modes, as the transit model alone does not have the capacity to provide much of an answer to this question. **This is a very good conservative first estimate of the likely demand.**

It is generally a simple matter to convert peak hour demand projections to full day revenue projections. If full day surveys have been done, the relationship between the peak hour demand and the full day demand should be known. If not, the daily demand should be roughly ten times the peak hour demand, with as much as 13 times the peak hour demand if demand is not heavily concentrated in the peak, and as little as 8 times the peak if demand is very heavily concentrated in the peak period. If data is available from bus companies about annual passengers relative to daily, this ratio can be used. In most countries local experts will know what this ratio is, though it varies from country to country. It should range from multiplying daily demand by somewhere between 250 and 300, depending on the number of holidays and weekends.

Once projected annual revenues are calculated, it should be a reasonably simple matter to estimate the projected costs of operating the system. Further details on how this is done is available in the *BRT Planning Guide* (forthcoming, ITDP, 2006).