

# Urban Rail Development in China: Issues and Options 中国城市轨道交通发展的问题与对策





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# Urban Rail Development in China: Prospects, Issues and Options

Institute of Comprehensive Transport (NDRC), World Bank

*The Institute of Comprehensive Transport (NDRC) and the World Bank jointly carried out a study of urban rail development in China. The joint study team visited several selected cities that have developed or are developing urban rail systems, including Beijing, Chongqing, Wuhan, Changsha, Hangzhou, and Zhengzhou, and held discussions with relevant agencies at the central and local levels. This paper summarizes the key findings. It highlights the positive outlook for urban rail development in China and the strengths of China's circumstances and institutions in responding to that outlook. It also identifies the key areas where strengthening of institutions and processes of urban rail planning would enhance the contribution of urban railways to sustainable urban development and improve value for money from specific urban rail investments. It makes seven recommendations aimed at such strengthening. The study is intended to contribute both to urban rail policy and planning in China's cities and also to help the World Bank target its institutional support in this important sub-sector of China's transport system.*

## 1. Urban Rail Development: An Era Opens

Urban passenger rail service in China is entering a new era of rapid development fueled by a potent mix of demographic trends and policy imperatives. The number and population size of mega-cities and large cities is continuing to increase; more city clusters are emerging and metropolitan areas extending. Personal income growth in cities is creating aspirations for higher quality of urban travel in terms of speed, flexibility, comfort, cleanliness, and safety. At the same time, national policies on land conservation, environment protection, energy saving and CO<sub>2</sub> emission reduction, are guiding cities towards more energy efficient, higher-density, compact land-use development patterns. Transport corridors that have sufficient density of demand for mass rapid transit development will therefore both emerge naturally and through land-use policies. China's cities are increasingly concluding that urban rail systems could help meet these diverse long-term demographic and policy challenges.

In the short term, the 2008 government economic stimulus package to counter the impacts of global economic downturn is speeding the pace of urban rail development as a catalyst for the stabilization and growth of urban economy. While year-to-year investment levels will fluctuate, civic demand for and support of the development of urban rail systems will endure in China for a long time to come.

But urban rail systems are expensive to build, often constituting the biggest single public investment for a city; and international experience shows that they are not always located in the most suitable transport corridors nor delivered in the most effective ways. For those of China's cities wishing to develop a new urban rail system or expand an existing system, critical questions are how to plan such systems to obtain maximum public benefit, and how to deliver and operate them in the most cost-effective way.

## **2. Strengths of the Sector**

The Study observed the many strengths in China's propensity and capacity to develop efficient and effective urban rail systems. Foremost of these is the demographic circumstances referred to above. The combination of rapid urbanization, growing travel demand and increasing ability and willingness to pay for quality in transport service mean that over the next 20-30 years China will probably generate more transport corridors with sufficient density of demand to justify new urban rail lines than any other country, or indeed continent.

Institutionally, China is well organized to respond compared to many countries. Chinese municipal governments usually manage a geographic catchment area much larger than the contiguously built-up city area. This is advantageous for long-term spatial development planning and for the management of the dynamics of land use and transport interactions. Most Chinese cities are therefore already in a position to plan their urban rail systems based on urban master plans that they develop from a wide range of policy objectives. Mathematical transport network modeling tools are also often used in China, though typically used to assess the effect of network changes against assumptions of fixed land-use and travel behavior.

Moreover, the central government has acknowledged both a national social and economic interest in urban public transport and (because of its macroeconomic role) a responsibility for financial oversight of aggregate investment in urban rail projects. It has established a formal screening mechanism for urban rail projects that sets out minimum requirements for cities that intend to develop urban rail projects, including benchmarks for city population, city GDP, city budget income, corridor passenger demand, and city equity investment (to guard against excessive borrowing). It also requires and reviews feasibility studies of specific investment project proposals.

In terms of implementation, China has demonstrated strong capacity to deliver complex major construction projects in a timely and cost-efficient manner. The operation of transport services thereafter is usually carried out with skill and discipline, though less often with strong customer focus.

These strengths in demographics, institutions and implementation capacity can support the successful development of the urban rail sector in China. But they are not by themselves sufficient to ensure that urban rail investments will always flow to the corridors where they will provide most benefit. Nor do they guarantee that urban rail will be fully supported by the wider land-use policies, nor most efficiently operated, nor beneficially integrated into and coordinated with the overall transport system. The Study therefore identified various ways in which China could strengthen this sector to ensure not just that new urban rail lines are successfully planned and built in the physical sense, but that they contribute most effectively to the long-term sustainable development of cities and yield good value for money.

### **3. Recommended Areas for Strengthening**

There are seven main areas in which the Study found scope for improvement leading to the recommendations made below:

#### **3.1 Better Connect Land-use and Transport Strategies**

An integrated land-use transport strategy should clarify the long-term direction of urban land use and transport development, articulate the role of urban rail system in supporting a high-density compact city development concept, and define the supporting institutional framework. Lack of such strategy has led some cities to give inadequate consideration of the supporting policies required to make rail transport the most effective technology and investment choice. In particular, transit-oriented land-use development, which is crucial for the ridership and financing of urban rail projects, is sometimes overlooked or ignored when urban rail plans are adopted. These interactions are both complex and far-reaching. Cities should endeavor to apply the full capability of mathematical models to assess land-use and transport interactions at the strategic level, so that fundamental changes in travel behavior may be analyzed and urban rail routes and urban development corridors be made mutually reinforcing.

#### **3.2 Compare Technologies and Route Alternatives**

The decision to build a new railway line or network is an expensive one. China's cities rightly carry out feasibility studies of such projects. These feasibility studies tend to concentrate on a predetermined solution and rarely include a rigorous analysis of the alternative technology choices (mass rapid transit, light rail, bus rapid transit) or route choices within corridors. Some planned urban rail networks seem unrealistic when compared to existing corridor travel demands (estimated from surveys of existing bus services) or if considered against the availability of finance. Some alignments are selected on the basis of implementation convenience (such as ready availability of right-of-way) instead of on the line of strongest demand. Rigorous 'alternatives analysis' – an exercise to compare and prioritize all feasible solutions to the city's transport problems in economic, financial, social and environmental terms – will lead to more sustainable long-term investment choices and decisions and better value for money. It should also be recognized that many cities in China would be more effectively served by BRT or LRT systems in the medium term, instead of underground rail systems.

#### **3.3 Assess and Mitigate the Project Risks**

As noted, the feasibility studies carried out by many cities tend to be deterministic in nature, based on a particular traffic projection, route, operating scenario and capital cost estimate. Typically such feasibility studies measure the outcome of the project if everything goes right. There is little formal risk assessment, a technique that assesses outcomes if the central assumptions turn out to be wrong. A comprehensive risk assessment will typically examine all the areas of potential vulnerability, such as design risks, construction risks, operating risks, safety risks, demand and revenue risks, financial risks and so on. The purpose of such

tests is not only to gauge how robust the project is in the event of adverse events but to try to take mitigation measures that will minimize each risk.

One important input to risk analysis is the “Stress Test”—an exercise that tests the economic viability of a proposed rail project or system under various assumed pessimistic scenarios. Those cities that have pursued policies of “planning first, financing later” should also consider the benefits of carrying out technical and financial planning simultaneously, including assessing the municipal affordability of any fare subsidy schemes proposed.

### **3.4 Coordinate Transport Plans Across Modes**

Individual modes of transport, including new rail lines, are most often planned in China in isolation, without adequate consideration of how their services could or should be coordinated with those of other urban and inter-urban modes of transport. A ‘co-modal’ approach to urban transport planning would involve the efficient use of different transport modes both on their own and in combination. Such an approach would examine the physical interchanges between modes, the co-ordination of line-haul and feeder routes and timetables, the rationality of co-modal fare structures, and the user-friendliness of intermodal ticketing systems. Integrated planning is especially needed for both urban rail and road network development. There are few cities that have successfully aligned the development of their road and rail networks in a manner that the two reinforce each other’s effects.. Cities also need to consider active policies to discourage the use of private cars to complement policies that promote the use of public transport. The municipal governments should play a key role as a facilitator of implementation of the “co-modal” approach and integrated plans.

While implementing a co-modal approach the service objective of public transport in China should be elevated from providing capacity for those dependent on mass transit to also attracting and retaining those with access to cars. This will require public transport operators to pursue operating excellence throughout the co-modal public transport system. Operators should formulate and implement powerful marketing and customer-care strategies. Significant improvement in the quality of public transport services (i.e. speed, flexibility, comfort, cleanliness, and safety) will be critical to attracting the car-owning households. Only by influencing modal choice will urban public transport in general, including urban rail systems, contribute effectively to congestion alleviation, energy saving and CO2 emission reduction. While road systems in many of China’s rapidly developing city areas also need strengthening, the achievement of modal shift will in increasingly require policies such as travel demand management, public transport priority measures and traffic congestion pricing to effect both modal shift and attain efficient use of road space.

### **3.5 Find Out What the Private Sector Can Add**

At present, almost all new urban rail systems are built with public funds and operated by the public sector. But the financial capacity of municipal governments is always limited. With continued urban growth, moreover, the investment needs will increase in all public service sectors, and the unit costs of providing public services will also increase. Urban rail financing through Public-Private Partnership (PPP), as is being attempted for urban rail in Beijing (Line 4) and Shenzhen, is an option that other cities could usefully assess before committing to 100 percent public finance and operation. The process of structuring and

implementing a PPP is demanding of both management skills and resources to ensure that it provides an outcome fully in the public interest. But well-designed and managed PPP models in the urban rail sector could help deliver the extensive plans that have been developed. This will require that the central government speed up adoption of the relevant policy and regulations for cities to pursue PPP. Meanwhile, cities interested in this approach may consider building institutional capacity for PPP.

### **3.6 Strengthen Central Government Review Process**

The role of central government is to ensure urban rail development in cities is in line with national transport and social objectives and consistent with national financial capacity. The challenge is how to define the appropriate role and procedures in the context of fiscal decentralization. The current review and approval process adopted by the central government focuses on techno-economic feasibility of individually proposed line projects, but these are usually part of a wider network vision. The review process could be strengthened in two ways.

At the strategic level, the cities might be required to demonstrate how a specific project fits into a sustainable long-term land-use transport strategy, taking account of the role of urban rail in land conservation, environment protection, energy saving, and CO<sub>2</sub> emission reduction. This part of the review and approval process could also usefully be made more inclusive, allowing the full participation of relevant agencies (transport, energy, environment, and urban development). The demonstration of urban rail in contributing to the net reduction of CO<sub>2</sub> emission may be methodologically challenging as the urban rail construction requires a large amount of electricity—a main source of CO<sub>2</sub> emissions (from coal fired power plants). However, it is important to recognize that net reduction of CO<sub>2</sub> emissions could be achieved only when the expected role of urban rail in supporting compact land use and inducing a modal shift away from motoring materializes.

At the project level, cities could also reasonably be required to submit both an ‘Alternatives Analysis’ and a ‘Risk Analysis’ as part of the feasibility study. Ultimately, as occurs in other countries, China’s central government could consider using financial assistance grants towards projects as an incentive and inducement to good practices in urban rail planning and development.

### **3.7 Encourage Research and Development in Urban Rail Systems**

China is at the early stages of urban rail development. Learning by doing is a good approach to follow, but there is a need to lay a better scientific foundation and for accumulating knowledge and experience that can be used by others. The central government could consider strengthening financial and policy support to urban rail R&D. Three elements are suggested.

The first is the establishment of a commonly shared database on public transport operating and financial performance for research, comparison, and information exchange. Second is the need for empirical studies on parameters essential for rational urban rail (and other public transport) planning, including land-use and railway interaction, urban rail market characteristics, success factors for urban rail feasibility and development, travel demand modeling, fare affordability, contributing factors to modal choice behavior, perceived value

of time (including in-vehicle time, out-of-vehicle time, and transfer penalties), financial modeling, and financial sustainability including the cost structure of different transport modes (underground rail, elevated rail, bus rapid transit, conventional bus, private car, and taxi). Moreover, relevant international experiences should be analyzed and disseminated more systematically, especially in the aspects of policy and institutional support to sustainable urban transport, land use and transport planning methodologies, PPP, and transit-oriented development. The national research institutes, universities, and cities with strong research capacity should collaborate to undertake the relevant research tasks. The third element of R&D relates to the technologies crucial to support urban rail systems including ticketing and fare collection technologies, passenger information technologies, facilitation of passenger interchange and others. Although China already has R&D skills in railway infrastructure and rollingstock, these ‘service support’ areas are less well-covered.

#### **4. Concluding Remarks**

While the history of urban rail development in China spans four decades starting from Beijing’s Line 1, the accelerated development of modern urban rail systems is a rather recent phenomenon. It is therefore not surprising that the Study should find that there are areas in which policy and process may be strengthened. But these challenges are also strikingly similar to those with which municipal authorities and national governments are struggling in many other high and middle-income countries.

The Study notes that the Chinese cities are growing so fast that it is necessary to look to expeditious procedures to deliver much needed urban transport systems as a whole and urban rail projects in particular and in many of the recommended areas for strengthening it will be desirable to deepen decision-making processes but not at the expense of overly extending them. Moreover, the planning capabilities of most cities are still developing and the recommended areas of strengthening cannot be implemented overnight. Nevertheless a progressive strengthening is essential if urban rail is to make the fullest contribution to China’s transport needs and the sustainable development of its cities. In keeping with China’s pragmatic approach of ‘learning by doing’ the World Bank will seek suitable opportunities to cooperate with national and municipal governments in China in progressing demonstration urban rail projects where some of the recommended strategic, planning and evaluative methodologies recommended can be applied.

# Part 1: Planning for Metro Success in China

Roger Allport

*This paper follows a World Bank Mission to the cities of Beijing, Chang Sha, Hangzhou, Zhengzhou and Wuhan, followed by a Workshop on June 27th 2008 to discuss the issues facing metro development in China. The Mission learned much and was in many respects impressed by current practices of city and transport development. We recognise that China is different in important respects from other countries. This frames our analysis and our recommendations.*

*This paper is addressed to policy makers in China. Its purpose is to provide an overall framework for the subject matter and to identify key planning issues. It is designed to improve the process of metro project development in China, making a success of metro projects by avoiding the mistakes others have made.*

*The key themes running through the report are:*

- *China is at an early stage in metro development. The appropriate approach is 'learning by doing'. This requires a scientific basis of knowledge about metros and their impacts to be established.*
- *Metro development involves weighty decisions about resource allocation that carry large risks for city development and the macroeconomy<sup>1</sup>. Metro risks need to be formally analysed and managed as part of the project development process, starting with the critical planning phase.*
- *Metros are part of a package of measures that contribute to sustainable city development. Tackling traffic congestion is critical to this, and this also requires controls on car use.*

*Just as China is poised to lead the world in metro development, its many advantages could also allow it to lead the world in policy development. Its state government recognises that it needs to make a sustained effort to apply a scientific approach to all aspects of transport policy and metro development, to ensure that its endeavours increasingly deliver success. The international experiences assembled by the World Bank are designed to assist it in doing this.*

## 1. Introduction

### 1.1 China's experience is in some ways different

China's experience is in important ways different from that of other countries. It possesses many of the basic success factors that cities elsewhere do not; demand is buoyant (and therefore less risky); costs are lower (therefore viability easier to justify), and affordability is sometimes not the restraint it is elsewhere. Given an effective enabling environment and development of its project development process China exhibits a favourable environment for metro development.

China's cities are spreading geographically and developing economically faster than anywhere else in the world – a trend that is expected to continue. At the same time its

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<sup>1</sup> Risks are defined to include both opportunities and downside impacts.

centralised planning system is being rapidly decentralised. This poses a huge policy and management challenge and is the most obvious way in which China's experience is different.

But China is better equipped to manage this challenge than almost anywhere else. Its city governments have power over their entire city catchment area, manage all the land and control its use<sup>2</sup>. They control all aspects of the transport system. The state government, city mayors and their technocrats adopt a proactive approach to managing their cities, and a holistic approach to their development. Cities generally have excellent transport assets – with wide boulevards and control over the buses. And the state has adopted localisation policies designed to secure economies of scale and low costs in metro development. The state has accumulated very large financial reserves, and may decide to invest now whilst costs are relatively low, to provide the infrastructure base for tomorrow's cities. For all these reasons China is different and this difference provides opportunities for successful metro development.

## **1.2 China faces urbanisation and transport policy challenges**

China faces unprecedented challenges arising from the rapid pace of its urbanisation and economic development. The state government has set targets for its major cities that are required to develop sustainably. Transport policy is recognised as central to delivering efficient cities, a high quality of life for residents and controlling externalities such as GHGs. Metro development is considered to be a central part of policy for large cities that are not poor.

It is still early days for metro development in China. After 40 years experience it is only recently that a massive increase in metro development has been approved. City mayors are rapidly developing plans and mobilising resources for this programme; and the state government wishes to further develop its policies to ensure that this huge investment is successful. This is the context for the World Bank's assistance in applying international experience to China's in many ways unique situation, is taking place at a pivotal time for its metro development.

## **1.3 Metro objectives need to be defined**

Everyone seems to want a metro (everywhere), and sometimes implementation itself is considered success. But given their huge costs and benefits metros need a much clearer definition of success. Usually this is a combination of: 1] Whether it broadly achieves its policy objectives (reducing congestion, providing good services to all, attracting development and contributing to a clean and green environment); 2] Whether its impacts are broadly as forecast when the project was committed; and 3] whether it is widely supported by its key stakeholders including its users.

When success is defined clearly, the success of implemented projects can be assessed, by means of 'before-and-after' studies. The discipline of rigorously assessing success

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<sup>2</sup> Land is owned by the state but managed by the city government that is thereby able to realise development gain arising from infrastructure investment.

provides insights that allow policy and project development processes to be progressively improved, resulting in continuous upward pressures on performance.

#### **1.4 The conditions for successful metro development**

All cities start by developing Master Plans and Transport Plans that provide the framework for metro development. Then detailed studies are required for major corridors, and comprehensive alternatives analyses are needed to identify whether and where metros should be developed in detail.

Cities should proceed with metros only ‘when the conditions are right’. These ‘minimum conditions’ are met in the largest cities that are not poor, and metros should be considered in the heaviest demand corridors that usually serve the CBD. In other cities and other corridors where metros cannot be justified, other measures are needed to improve public transport. These may include bus operations, bus priorities and busways/ BRT systems, and at-grade rail systems. Over time these may build up demand and pave the way for upgrading to a metro. Where the conditions are right detailed feasibility studies identify and optimise the metro in its city and transport context, and provide the basis for the commitment decision.

This report focuses on the situation facing city governments today who have plans for metro development. We seek to chart a way forwards that will assist in making a success of their projects, transport systems and cities.

#### **1.5 The project development process**

The ‘project development process’ is the sequence of decisions, tasks and events that create and shape a metro from its concept through its planning phase to implementation and mature operations. ‘Planning’ is defined to include all activities from conception through to the commitment decision; ‘implementation’ as all activities from commitment through to opening and hand-over of assets to the owner; and ‘operations’ as all activities from Day 1 of operations onwards.

Planning – the subject of this paper is by far the most influential phase. This is when the critical decisions are taken, that largely determine the metro and its impacts. Planners need to provide sound advice to decision-makers concerning infrastructure/ operational options, integration with land use and the transport system, and forecasts of financial and other impacts.

But this is very difficult in Chinese cities. The pace of change has often threatened to overwhelm the planning and approval process, with long-term forecasts being achieved surprisingly rapidly<sup>3</sup>. City mayors, often judged on the basis of their city’s GDP, have sometimes sought to launch projects ‘immediately’ that designed to achieving early economic development. NDRC has struggled to monitor and manage this process.

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<sup>3</sup> Zhi Liu (2000). ‘Planning and Policy Coordination in China’s Infrastructure Development – Draft Final.’ A Background Paper for the EAP Infrastructure Flagship Study. The World Bank.

## 1.6 Metro costs

Metros are very costly - A 50 km system in China today (typical of a first phase development) would cost between US\$2bn and US\$4bn; with underground alignments particularly costly (double those of elevated construction) whilst technology has relatively little impact on cost. But metro costs in China are currently lower than elsewhere and therefore easier to justify, other things being equal. This cost advantage however will likely reduce as the currency is realigned and local input costs increase.

Local all-in costs in 2008 prices are understood to be as follows<sup>4</sup>. They have been lowered by requiring competitive bidding and a minimum local equipment content; but there have been recent signs of price inflation.

- Elevated RMB 250-300mn/km about US\$37-44mn/km
- Underground RMB 510 -570mn/km about US\$ 76-85mn/km

These costs are 52% (elevated) and 44% (underground) of standard Asian costs - of about US\$ 75mn/ km (elevated) and US\$ 180mn/km (underground)<sup>5</sup>; and recent Japanese experience is broadly similar - elevated costs being about \$75mn/ km and underground \$200mn/km<sup>6</sup>.

## 2. The State of Metro Development in China

We sought to establish the state of metro development in China – the scale of project activity ongoing and planned [2.1], the process by which projects are developed, approved, implemented and operated [2.2] and the key issues currently facing China [2.3].

### 2.1 Projects

China has 40 years experience of metro development, with the earliest projects in Beijing, Tianjin and Harbin being designed as subways to provide air-defence shelters. It was not until the late 1980s/ early 1990s that modern metro development commenced, with the Beijing, Shanghai and Guangzhou systems going ahead and many other cities preparing proposals. In the mid 1990's the state temporarily suspended metro activity while it reviewed its approach to planning and developed a localisation strategy for metro equipment<sup>7</sup>. After a pause in 1998 a renewal of activity recommenced.

In 2003 a first batch of 62 lines in 15 cities totalling 1,733kms was approved by the State Council (SC); these were priority lines in much larger networks that totalled 5350kms

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<sup>4</sup> Based on presentation by Deputy Director Zhu Jun, CIECC; the figures from the cities support these broad ranges.

<sup>5</sup> Halcrow (2000). 'World Bank Urban Transport Strategy Review - Mass Transit in Developing Countries' – Position Paper for The World Bank, 2000.

[http://siteresources.worldbank.org/INTURBANTRANSPORT/Resources/uk\\_mass\\_transit\\_halcrow.pdf](http://siteresources.worldbank.org/INTURBANTRANSPORT/Resources/uk_mass_transit_halcrow.pdf)

<sup>6</sup> Source: Mission member Mr Hashimoto, JARTS.

<sup>7</sup> This followed assistance to the government by the World Bank developing an urban transport strategy for China, reported in the proceedings of the Symposium held in Beijing November 8-10, 1995. Paper 7 in the Proceedings addressed the issue of 'Investment in Mass Rapid Transit'.

(Table1-1). These 15 cities have submitted construction-planning reports for approval by NDRC; and subject to receiving this approval they will proceed with implementation.

A second batch of lines is being appraised and a further set of approvals by the State Council is expected in due course.

**Table 1-1: Approved Metro Plans in China's 15 Cities**

City	Short-term network				Full network	
	Period	Lines	Route kms	Investment Yuan * 10 <sup>9</sup>	Lines	Route kms
Shanghai	2005-2012	10	389	143		815
Beijing	2004-2015	15	447	163		1,114
Guangzhou	2005-2010	7	127	18		726
Shenzhen	2003-2010	5	120	36		365
Nanjing	2004-2015	3	97	36		234
Hangzhou	2004-2010	2	82	33		248
Chongqing	2004-2012	3	82	24		278
Wuhan	2004-2010	3	59	23		354
Chengdu	2004-2013	2	54	19		223
Tianjin	2003-2010	2	51	20		126
Xi'an	2006-2015	2	50	17		215
Suzhou	2006-2012	2	47	16		135
Harbin	2004-2013	2	45	16		143
Shenyang	2004-2012	2	40	17		182
Changchun	2003-2012	2	37	3		179
Total		62	1,733	623		5,350

Source: CIECC 'Urban rail construction planning situation in China in short-term'. Based on approved documents by the State Council/NDRC

Modern metro development is thus a recent development, and there is a massive programme that is being implemented and planned, but as yet there is little experience available. All cities exhibit huge ambition - in their first project, in the basic metro network, and in the full future network. These networks are, for the city size and stage of development, very large by comparison with cities overseas. China's cities will rapidly become No.1 in the world for scale of metro development [Table1-2].For example one medium size city has year 2030 metro plans that exceed in scale today's networks in only three of the world's largest cities – Tokyo, Moscow and New York.

**Table 1-2: Metro Development: China Context of International Experience**

International Experience			China's plans			
City	Population mn	Metro kms existing	City	Population mn	Metro kms existing	
Singapore	4.6	109	Beijing	7.5+	2008	144>200
					2015	560
					2025	1,000
Hong Kong	7.0	175 [+ 36 LRT]	Chang Sha	3.2	2008	0
					2020	170
Seoul	10	287	Hang Zhou	4.1	2008	0
					2020 (2035)	170 (284)
Washington	5 to 8	171	Zhengzhou	4.3	2008	0
Vancouver	2.2	50	Wuhan	9.1	2008	10
Sao Paulo	20	62	Guangzhou	7.6	2008	116
Delhi	17	65	Shanghai	18	2008	228
Tokyo	35	316				

Source: Wikipedia (international) and Mission (China)

## 2.2 Project Development Process

China has a formal evolving process for metro development. In principle the state government sets policies and defines criteria for metro development; its approval is required before metro projects can be implemented; after approval the city governments finance, implement and carry the risks of metro development – and If things go wrong they need to make appropriate provisions. This process is broadly as follows (Table1-3):

**Table 1-3: China's Project Development Process**

Activity		Approval
1	City Master Plan	State Council (SC) and Ministry of Construction (MoCn)
2	City Transport Master Plan (including Public Transport and Metro Plan) – is part of the City Master Plan	SC and MoCn
3	Metro Project Proposal (similar to pre-feasibility/ a few pages)	NDRC based on review by CIECC
4	Metro Feasibility Study [full techno-economic, engineering feasibility study + financing plan]	NDRC based on review by CIECC
<b>After approval of the FS the project is understood to be practically irreversible</b>		
5	Preliminary design	City Panel approve details
6	Detailed design > Construction Plan	NDRC approves Plan
After this stage the City government takes over		
7	Prepare bid documents	City government
8	Procure implementation	
9	Establish operator	

Source: Mission

NDRC has issued two important guidance documents: Decree 81 [2003] on 'Strengthening the Construction and Management of Urban Rapid Rail Transport', and Decree 46[2005] on 'Urban Public Transport Priority Development'.

Decree 81 (2003) defines the approval procedures, construction standards and safety requirements, management systems for construction and operations, and the localisation policy<sup>8</sup>. It defines three generic MRT standards for use in all metro planning [Table 1-4]. This encourages standardisation in technology.

**Table 1-4: General MRT Standards**

<b>Criterion</b>	<b>A Standard metro (high volume)</b>	<b>B Standard metro (large volume)</b>	<b>C 'LRT' (medium volume)</b>
Car dimensions (width* length) metres	3*22	2.8*19	2.6*19/22/29
Train length metres	185	140	100
Operational speed kph	30-40	30-40	20-30/ 30-40
Maximum gradient %	3.5	3.5	6
Line capacity passengers/ hr/direction	50-70,000	30-50,000	10-30,000
City population mns.	>3	>2	>1
Localisation of equipment content	>70%		

The decree critically defines 'minimum criteria' necessary for metro development in China to be considered seriously. These are (Table 1-5):

**Table 1-5: Minimum Criteria For Metro/LRT**

<b>Criterion</b>	<b>Metro</b>	<b>LRT</b>
City population [million]	> 3	> 1.5
City GDP [RMB p.a.]	> 100bn	> 60bn
City budget income [RMB p.a.]	> 10bn	> 6 bn
Passenger demand [passengers/ hour/ direction]	> 30,000	>10,000
City equity investment (this guards against excessive borrowing)	>40%	

Decree 46 (2005) sets out a scientific and comprehensive basis for developing public transport as a major component of transport policy: *“Through compiling comprehensive transport system plan, public transport special plan and rail transport construction plan, the cities should allocate and utilise the transport resource scientifically, establish a public transport-oriented mode of city development and land allocation.”*

It encourages the development of the bus system, and the development of large-volume rapid public bus systems (busways/ BRT systems). It focuses metro development on *“those large-sized cities with better economic conditions but more serious problems of traffic congestion.”* It explicitly recognises that metro projects will not be financially viable without subsidy.

<sup>8</sup> This sought to prevent cities proceeding with projects without finance or permission or when using excessively high standards. It became effective in 1995.

## 2.3 Metro development in practice

We understand that the focus of attention to date has been on keeping costs low because as one expert said “*we are going to do it (build the metro), the question is how.*” In practice this formalised process is often overwhelmed by the pace of change (Zhi Liu, op. cit). We were advised that the network and construction plans were often changed frequently making their review problematic. These observations are supported by CIECC<sup>9</sup>: “... *we still have problems with Document 81: some local governments make requests to construct urban rail transit projects regardless of their financial strength; some urban rail transit projects are initiated blindly without prior review and approval from the Central Government; some areas simply desire transit systems because other areas have them, leading to higher construction standards and wasted investment; some also carry out projects with inadequate capital, resulting in heavy debt and severe losses after operation.*”

We understand that the state government now wishes to strengthen its controls and support, whilst not holding back needed projects or local initiatives.

## 2.4 Issues facing China

The underlying issue facing the state government is how it should support and control metro development strategically. We consider that there is a strong imperative for the state government to undertake this role, by adapting existing practices leading to improved metro development processes and more successful metro projects.

Our assessment is that the key sector issues facing China are:

- Maintaining stability in the macroeconomy. Metros are mega-costly and risky projects. The state government recognises the importance of managing the pace and approach to metro development.
- Developing cities that are environmentally sustainable – this requires the increasing application of clean technology that is energy saving and mitigates GHGs. Metros, developed well and when conditions are right can contribute to these goals.
- Developing metro technology - for industrial policy reasons and to exert downward pressures on costs.
- Ensuring city affordability – in some cities this does not appear to be a current problem and metro development is proceeding unhindered. But in most cities affordability is and will be a problem. The focus needs to be upon prioritising investments and developing new financing modalities.
- Ensuring value for money – even where metros are affordable without difficulty, good projects need to be identified as poor projects become a drain on the economy.
- Providing the basic knowledge for scientific planning – this needs to be created.

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<sup>9</sup> Zhu Jun, CIECC: ‘Current Status of Chinese Urban Rail Transit and Measures’. Paper prepared for the Mission.

### 3. Relevant International Experience

This section summarises relevant international experience, to provide a benchmark for possible application in China. We consider in turn:

- The appropriate role for metros;
- Metros as risky megaprojects – and the consequences;
- The poor success record of metros – and whether this matters;
- The requirements for economically justifying a metro; and
- Metro success factors – 9 factors are identified.
- In each case we comment on China’s existing practice.

#### 3.1 Role for Metros in Sustainable Development

Metros increase the quantity and quality of public transport especially when integrated well with the city/ intercity bus/ rail systems. They enable a thriving city centre to grow and they encourage compact city development. Some also expect metros to solve traffic congestion, and they do ease congestion to some degree, but visits to Seoul, Tokyo, Paris or New York – all cities with large metro systems, reveal they do not alone ‘solve’ congestion. However they do make necessary controls on car use more politically acceptable – and with this congestion can be controlled.

Metros need to be part of a package approach that includes controls on car use, improving NMT and improving buses (operations and busways/ BRT) to serve the metro. Then they can become the catalyst for the sustainable development of large cities that are not poor. Hong Kong and Singapore provide exemplars of this approach.

*China’s practice* – metros appear to be promoted in China as means to increasing city GDP (in the short-term)<sup>10</sup>. They appear to be seen as the obvious way to solve traffic congestion and sometimes to guide city development. It was not always clear that the metro projects identified were the result of assessing problems and appraising all options. Sometimes there appeared to be a leap from perceived problems to the ‘obvious’ metro solution. Cities varied in their understanding of transport policy and the need for a package approach to attain policy objectives. Some plans incorporated metros and extensive improvements to the bus system including BRT, and occasionally controls on car use, but others did not. To date the approach had often ‘crossing the river one step at a time’. First road building had been pursued, then low fares on buses, now metro development.

#### 3.2 Metros as risky megaprojects

Increasingly the management of risk is at the heart of metro development processes. When we understand the risks faced we should be able to manage their impacts - an

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<sup>10</sup> This may be because, unlike many other countries, city mayors are responsible for the performance of the city economy as well as public services; and their success was until very recently measured by one indicator – the rate of annual urban GDP growth.

essential prerequisite to success. Risks result from the nature of metro projects and the environment in which they are developed.

*Metros projects - are quite unlike other projects. They are mega-costly and therefore always political. They require land for depots and they are implemented through the centre of the biggest most congested cities. Their assets are long-lived – many have economic lives of 30 years – so metros are inherently inflexible and today’s decisions have long-lasting consequences. They have no captive passengers - all their passengers need to be attracted. Their justification is based on forecasts 20- 30 years ahead - that are subjective (they deal with an uncertain future and many assumptions), demanding to undertake (transport models have limitations) and are always very uncertain. Until they open no-one knows what ridership will be generated. And their operating finances are difficult – revenues and operating costs are large and their operating surplus/ deficit very uncertain. Then once operational they require major maintenance overhauls and asset replacement that is costly.*

*The environment for metro development - is difficult. Recent research<sup>11</sup> identified ‘show-stopper’ and ‘window-of-opportunity’ events that had impacted severely upon the development of 9 recently developed metros in Asia and the UK. The main ‘show-stoppers’ that caused major setbacks were: the unavailability of depot sites, conflicts with the highways authority, environmental opposition, the abolition of the sponsoring authority, and changes in bus policy (that undermined metro ridership). The main ‘windows-of-opportunity’ provided unexpected opportunities for metro development: new financing opportunities (public sector and private financing), changes in government, and an acceptance of city centre pedestrianisation (that made at-grade trams acceptable).*

**China’s practice** – there appears to be little systematic effort to stress-test plans and metro projects, to make sure they will be robust faced with an uncertain future, and insofar as possible flexible. This lays them open to future strategic risks.

### **3.3 Metros have a Poor Success Record**

There is surprisingly little information available about the success of metro projects<sup>12</sup>. Three sources incorporate all available evidence and provide the basis to judge international experience (outside China):

- Worldwide experience until recently<sup>13</sup>: this revealed a poor record of success across the board – almost all metros were developed and procured as traditional public sector projects. Capital costs were typically +50 to +100% above forecasts at the time projects were committed, implementation times +0 to +50% longer, operating costs probably much higher (by orders of magnitude) and ridership just one-third to two-thirds of that

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<sup>11</sup> Allport RJ (2008). ‘Improving Decision-making for Major Urban Rail Projects.’ PhD Thesis. Imperial College London.

<sup>12</sup> ‘Success’ is as defined earlier

<sup>13</sup> Allport RJ and Anderson R. ‘A Challenging Metro Agenda for Change’ in UITP Public Transport International, September 2005

forecast. All outturns were thus negative, and together they seriously undermined expected economic and financial viability.

- Asian metro private concessions<sup>14</sup>: this evidence of private sector concessioning in developing cities was promising. It evaluated six operational metro concessions in Bangkok, Manila and Kuala Lumpur. Many problems and challenges were revealed, but most projects were judged beneficial, would probably not have happened had they been left to government, and had government implemented them they may not have been as successful. The benefits of this approach appeared to outweigh significantly the higher costs of capital.
- Asian and UK latest evidence<sup>15</sup> - this analysed in detail the development of 9 metro projects including 7 concessions that had recently opened. It concluded that private concessions provided much greater predictability in capital cost and timing – but critically there was little evidence of improvements in the operational forecasts.

Overall the evidence is conclusive, that outside China the record of success is poor although we have seen some improvement recently particularly with private sector concessions. The core problem remaining is that operational forecasts – particularly of ridership - are poor, and this undermines the central purpose of metro development.

#### *Does poor success matter?*

Some argue that all projects overshoot their forecasts, and that we should not be unduly concerned. But this misses the defining feature of metros: that they are megaprojects and mistakes can be mega-serious. Four examples demonstrate this point:

- Singapore's government defined the opportunity cost of its US\$ 3bn North-East Line as either the entire public budget for education and health for one year; or a new terminal at Changi Airport + 2 new hospitals + 1 new Polytechnic + 5 LRT (people-mover) systems + the interim upgrading of 10% of the housing stock. The project was implemented well and the forecasts were almost achieved.
- In Colombia, the national government estimated the cost of Bogotá's first 30-km metro line would require the commitment of 30% of the national investment budget in all sectors for the subsequent decade. This project has yet to get the go-ahead.
- In the Philippines the annual transport budget for all transport sectors – road, rail, maritime and aviation – was about US\$1bn; this was within the forecasting error of two new metro projects. One was implemented well and one poorly – for which government is shouldering a major financial burden.
- Pusan's metro finances were so unexpectedly poor that the city faced bankruptcy.

***China's practice*** – We know little about the success of China's metros – little information appears to be available. City governments carry the full risks of metro development and poor success clearly would matter – it could undermine the city's finances and its city development strategy seriously.

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<sup>14</sup> Halcrow (2004). 'A Tale of Three Cities: Urban Rail Concessions in Bangkok, Kuala Lumpur and Manila', Paper for East Asia and Pacific Infrastructure Review. World Bank, December 2004. [http://lnweb18.worldbank.org/eap/eap.nsf/Attachments/background+13/\\$File/threecities.pdf](http://lnweb18.worldbank.org/eap/eap.nsf/Attachments/background+13/$File/threecities.pdf)

<sup>15</sup> Allport (2008) op. cit.

### 3.4 Requirements for Justifying a Metro

Research into developing city metros outside China defines the minimum conditions for metro economic viability (Halcrow, 2000 op. cit). These were based on extensive data collection and strategic modelling/ appraisal in 21 cities worldwide [Table 1-6]:

**TABLE 1-6: Guidance for Economical Viability of Development City Metros**

Criterion	Requirement	Rationale and specification
Corridor size	High existing bus demand	The viability of metros is concerned with the size and/or characteristics of major city <i>corridors</i> , (not just with city size). The great majority of metro passengers will need to switch from buses. Large <i>existing</i> bus passenger flows (the potential metro market) should therefore exist in any potentially viable metro corridor. Existing flows of about 10-15,000 pass/ hour/ direction required.
City incomes	Incomes that are not low	The costs of a metro do not vary substantially with city income, but the benefits - mostly time savings that increase with income - do. Metro viability is thus correlated with income. At least US\$1800/person/ year.
Growth prospects	Sustained economic growth	Future conditions affect most benefits. Future growth in incomes (particularly) and an underlying growth in the city center are important
City centre growth	An expanding centre	
Low-cost alignment	Elevated alignment where possible	Low costs require an alignment that is elevated rather than underground, and at-grade rather than elevated.
Metro/ bus fares	Encourage ridership/ limit subsidy	Large numbers of riders and high revenues requires station locations in the right places and integration between buses and metros.
City management	Stable and competent institutions	These are a prerequisite for undertaking a megaproject.
Metro management	Strong, autonomous, management with clear objectives	These are requirements for sustaining operational success.

Projects that pass such minimum requirements are then subject to intensive feasibility study that concerns their technical and financial planning. A few countries have firm guidelines for justification but even here political decisions dictate timing; more usually final approval depends upon politics and the state of the public finances, since it is usually central government that provides most of the funding.

**China's practice** – metro approval by the state government (NDRC) is understood to be based on: 1] Satisfying the criteria for metro development (Table 5). The key criterion is that demand is required to exceed 30,000 passengers/hr/direction for metros and 10,000 for LRT<sup>16</sup>, that depends critically upon the credibility of the forecasts (discussed subsequently); 2] Approval of the Metro Plan Feasibility Study, and 3] Approval of the construction plan for the project to be implemented.

<sup>16</sup> This is assumed to apply to the early years after opening.

### 3.5 Metro Success Factors

International experience suggests nine success factors that are important in explaining metro success and in particular planning success.

#### *1) Risks to be formally analysed and managed*

The common theme running through recent experiences of metro development is risk and its management. Metro development has been described as “a massive exercise in the management of complexity” and risk is the other side of the coin to complexity. Risks are so large and often unexpected that the achievement of success needs them to be formally analysed and managed. This brings the discipline of risk management into the main project development process. There are recognised methods for doing this. One such approach is RAMP<sup>17</sup>. The RAMP approach identifies potential risk ‘events’, attach probabilities to them, assess how to respond to them, and understand the scale of residual risk and the impact of this on project viability. This requires a strong commitment of time and resources. The evidence is however that it increases success and predictability of outcomes, and removes the danger of unintended consequences.

*China’s practice* – It appears risk analysis and management processes are not currently applied throughout the metro development process.

#### *2) Control initial cost by focusing on vertical alignment*

Metro viability is most likely when costs are low and ridership/ revenues high. The major cost decision concerns the vertical alignment. Ideally an at-grade alignment would be identified (its cost is less than half that of an elevated alignment) - but this is rarely available. Elevated alignments are then preferred on cost grounds – their cost is no more than half that of an underground alignment and risks are much higher underground. Arguably a larger system will result when it is substantially elevated as sooner or later the money is likely to dry up.

*China’s practice* - during the Mission we became aware that most metro alignments are underground. We asked why more of the system was not elevated. This would much reduce the up-front cost and reduce the construction risks; but we were advised this was not considered appropriate given the city’s environment. We believe this may be unduly burdening the city finances when good design makes elevated development acceptable in other cities that place value upon their environment; Singapore is one such city where the choice of vertical alignment is appraised section by section – and most of its metro system is elevated, constructed to high design standards.

#### *3) A realistic metro network is necessary*

International experience reveals that, as in Chinese cities, metro networks are often large. This is usually a failure of planners to confront financial and economic realities. At first everyone appears happy – as ‘their’ project is included in the metro network. But

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<sup>17</sup> RAMP (2005). Risk Analysis and Management for Projects. Institution of Civil Engineers and the Faculty and Institute of Actuaries. Thomas Telford.

disillusion quickly sets in. First projects unwisely assume future projects that are not implemented – and the specification of the implemented project proves inadequate. Because everyone expects a large network to materialise, other improvements to public transport – such as busways/ BRT systems are not developed. Sometimes projects are implemented because they are in the plan but they are not successful. The conclusion is that effort is needed to devise a realistic metro network, as part of the public transport system.

It is demanding to plan for a rapidly growing city, and necessary to focus attention on the next 15-20 years. The plan needs to develop from an understanding of demand. Who is the metro to be for? In China there appears to be a widespread view that this is ‘to serve the ordinary people’, in other words it is not to be a premium service but part of an integrated bus-metro system with broadly common fares.

Then experience suggests: 1] Public sector affordability should be an input to the metro plan process, and not an assumed output; 2] Metro projects require a compelling purpose that links major traffic attractors and generators; 3] Successful metros are almost always down major radial corridors to thriving city centres; while those designed to attract development (‘green-field’ alignments) are particularly risky; 4] There is merit in implementing bus priorities early, upgrading these and building up demand, with conversion to a metro in the heaviest corridors; and 5] Technology should be an output of planning, depending upon forecast demand and required service level; not an input.

***China’s practice*** – metro networks are often large, much larger than elsewhere. First phases are very large (2-3 times the size of those elsewhere). Financing is assumed to be available, without financial planning that would allow this assumption to be validated. Many projects appear to have a compelling purpose, but some do not and appear to follow ‘easy’ but low demand routes. And some projects follow non-radial alignments or green-field alignments that appear particularly risky. There is some welcome evidence of incremental development starting with BRT, for conversion to metros when demand has built.

Metros are identified when demand is high – but are usually assumed to be underground. At modest demand levels instead of considering partly segregated systems ‘LRT’ is often assumed, yet its essentials differ little from a metro (weight, cost and performance are broadly similar for a given capacity); and it is usually assumed to be elevated.

These observations should raise questions about the scale, structure, technology and phasing of proposed metro networks.

#### ***4) Integration with the transport system and land use to be planned***

A mass ridership requires the metro to become ‘mode of choice’ for many travel markets, and because relatively few trips are made entirely on the metro, it is necessary that the metro is integrated into the city and its transport system as fully as possible.

In many cities the metro needs to serve the major intercity bus and rail terminals. Within the city the buses need to be integrated with the metro, desirably by physical integration and ticketing and fares integration. Large numbers of riders should ideally be within walking distance of metro stations, and this requires integrated planning of individual

buildings and pedestrian accesses with metro stations; sometimes metros follow densely developed corridors but without attention to local integration it attracts few riders from these developments - because walking distances are just too far.

So integration is critical to attracting a mass ridership, and this requires proactive planning to achieve. Critical to transport integration is serving the major bus and rail interchanges/ terminals, tariff integration providing for through ticketing, and land use integration that requires both high density developments along the metro corridor, and planned walk-in catchments to metro stations.

**China's practice** – we found great awareness of these needs, and in the case of transport integration substantive plans to bring them about. Major intercity terminals provide the focus with interchange with intercity bus and rail travel, and these terminals are usually major metro traffic objectives. We found great awareness of land use integration and intentions to achieve this, but sometimes flawed expectations. This is important because China is perhaps uniquely able to develop integrated corridors around metro projects.

Sometimes we observed major development along new metro projects, but its users appeared unlikely to use the metro because walking distances to metro stations were too far. Successful integrated development requires land use and metro stations to be planned together to ensure walk-in catchments are in practice large.

#### **5) Extensive/ substantive Alternatives Analysis to be undertaken**

International evidence demonstrates that 'good' metro projects do not happen by accident. Rather they result from continuous optimisation from early in planning to late when deciding the procurement and financing modalities. 'Alternatives analysis' requires a comprehensive comparison of 'options', quantifying their impacts and presenting important differences in summary form for decision-makers.

The 'options' might concern:

- BRT or metro – early in preparing the Transport Plan
- Horizontal options – between closely competing alignments
- Key station locations – it is critical that metros serve the key traffic objectives.
- Underground and/ or elevated? This may vary by section of route.
- Depot location (linked to first phase development) – comparison of options.
- Integration options with the buses. For example tariff integration.
- Tariffs and their relationship to the buses.

Table 1-7 presents a typical appraisal summary table comparing the vertical alignment decision for a section of route.

**China's practice** – The Mission was made aware of some alternatives analysis; but often decisions appear to be taken without considering alternatives, or made qualitatively without rigorous analysis.

**Table 1-7: Alternatives Analysis for Vertical Alignment of a Section of Route**

<b>Objective</b>	<b>Scope</b>	<b>Option 1: Under-ground Option 2: Elevated</b>
Economic efficiency	How do benefits compare with costs? What are the risks?	Underground 2* cost & much riskier & less accessible. But alignment has more freedom. Overall underground has strongly adverse impact upon economics.
Social	Who wins/ loses? What relocation problems?	Users have better view from elevated route; but more relocation may be necessary.
Land use/ City Plan	To what extent are the City Plan policies supported?	Both options are effective. Elevated routes offer opportunities, and underground more still.
Environment	What are the impacts – positive and negative	Adverse visual impact of elevated route may be critical; but good design can mitigate this. Elevated routes provide ‘visibility’ and helps market the system to customers.
Financial	What public sector funding req’t? What risks are they exposed to?	Underground cost is 2* elevated cost, operating costs are higher & risks are much increased.
Summary		This is an example of a major decision that should be evaluated carefully

Source: author

**6) All forecasts to be ‘reality-checked’**

The international evidence is compelling that metro forecasts are often simply implausible - there are systematic biases towards optimism in virtually all cases – capital costs, operating costs, ridership and revenues. Such optimism should be obvious if even the most cursory checks are undertaken. This matters because forecasts provide a major input to alternatives analyses and to financial planning, and poor forecasts leading to poor decision-making. The lack of independent checks must undermine the due diligence undertaken for NDRC upon which metro approvals depend.

The cause of poor forecasts is understood to be a mix of behavioural biases (that we all demonstrate), a desire to justify projects (that everyone seems to want) and the nature of technical forecasting. The latter is particularly problematic for ridership forecasting. This is a complex procedure that requires good data, the resources to develop validated models, preparation of many input assumptions, and interpretation of outputs. A large number of uncertain inputs inevitably produce very uncertain outputs, and the combination of behavioural biases and wish to justify projects, readily produce what turn out to be optimistic forecasts.

How then to bring ‘reality’ back to forecasting such that outturns bear a strong relationship to forecasts used to make the commitment decision? The answer is that independent checks are needed and their results reconciled with the model forecasts, thereby creating much increased confidence as well as coming to terms with the scale of risk.

Checking ridership forecasts - Internationally we know most riders are ex-bus passengers, so we need to count bus passengers at the peak location on the metro corridor, and estimate 1] how many people would use the metro if it existed today, and 2] what growth in ridership may be expected tomorrow. This provides a very quick ‘back-of-envelope’ idea of the rough magnitude of demand.

An alternative approach is to ‘benchmark’ the proposed metro against comparable metros operating elsewhere for which good information exists. Benchmarking is a recognised approach in many industries, and for metros too - Imperial College London runs two metro benchmarking clubs for 27 of the world’s leading metros and benchmarks all aspects of their performance. The approach involves *e.g. for ridership*:

- Defining an overall Key Performance Indicator (KPI) e.g. passengers/ station/ day
- Identifying the important factors that determining demand
- Accessing data for these factors for relevant comparable projects
- Drawing conclusions about the probable range of forecasts
- Comparing the results with model and other independent forecasts
- Reconciling the results. This process focuses attention on the assumptions used and ultimately reveals the scale of risk.

***China’s practice*** – we understand that metro forecasts are carried out primarily using ‘bottom-upwards’ model-based methods without reality checking. There appears to be confidence that capital costs are under control. It is the operational forecasts – particularly ridership – that appears most in need of reality-checking.

### ***7) Substantive Financial Planning is necessary with Technical Planning***

Technical and financial planning need to proceed together, yet too often technical plans are developed ahead of financial planning, with the danger that financing will not be available when required. Financing is needed for implementation costs and operations including asset replacement. There needs to be confidence that financing will be available to deal with the unexpected during their implementation and operations - that usually occurs. And the operation needs to be established on a firm footing, providing the operator with clear objectives, support as defined, and the capacity to manage the metro business proactively.

The starting point is usually to consider pricing policy in the context of the objectives for the metro, and then determine the operating surplus/ deficit that will strongly influence financing. Experience suggests care when assuming that subsidies will be paid, as financial conditions may change in the future. The remaining financing for implementation and asset replacement then needs to be engineered.

***China’s practice*** – technical planning proceeds far ahead of financial planning, on the assumption that the finance for implementation will be available. Fares usually fund operating costs or an ongoing subsidy is needed that will need to be financed. Little advance financial planning appears to be made for operations, and inadequate attention appears to be given to establishing the operation contractually.

The failure to develop strong financial plans has two impacts: 1] city governments do not face ‘hard decisions’ because technical decisions are taken without understanding their financial consequences; and 2] the future city finances are subsequently put at risk.

We understand that metro financing is today typically 40% equity by the city government (a minimum requirement) with 60% loans from domestic banks (with no operating surplus expected). Banks consider metros less risky than many other investments, particularly where there are good city finances. But there is recognition that new sources of financing are required to handle the scale of metro development being planned, and the state government wishes to diversify financing sources. Beijing points the way with its recent metro concession contracts.

**8) *The entire project development process to focus on Operations***

International evidence is that the metro development process is often dysfunctional and that this is a cause of poor success<sup>18</sup>. It arises because of a lack of continuity between the project development phases and a failure to focus on operations – that provide the compelling purpose for the metro. Table 8 illustrates the problem.

**Table 1-8: A Dysfunctional Metro Project Development Process**

<b>Stage in project development process:</b>	<b>Planning</b>	<b>Implementation</b>	<b>Operations</b>
Led by	Planners	Engineers	Operators
Role	Identify project, secure commitment	Implement to time + cost	Operate commercially
Approach to risk	Risk largely ignored	Strong focus on implementation risk – only	Risk inherited, very large
Influence on operational success	Large	Large	Modest

Source: author

The three phases in project development – planning, implementation and operations, are led respectively by planners, engineers and operators. Each has a clearly defined role but critically they exhibit very different approaches to risk. Planners largely ignore risk. Engineers take it very seriously, but their focus is solely on implementation risk. The operator inherits previous risks. Then when ridership is lower than expected and operating costs higher, it is too late to do much – because these have been progressively committed by prior decisions, usually without the influence of the operator. The requirement is for greater continuity of thinking and skills between the phases, and the early and continuous influence of an operator to focus project development on the operational phase of the project.

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<sup>18</sup> Allport (2008 op. cit.)

Metros operations develop businesses that need to endure through to the long –term. This requires the operator to be established contractually such that he can proactively manage the business; and it requires the operator to be market-facing, developing a strong marketing strategy.

*China's practice* – we have observed that city governments do not appear to have an in-house transport planning capability; yet this is a critical function without which cities cannot control or interpret its outputs, or respond rapidly to leaders' 'what-if' questions. Implementation appears to be effective as such, but to provide inadequate attention to establishing future operations. Operators appear to be efficient but need to become more market-facing and implement marketing strategies.

### **9) Increase Private Sector Participation [PSP]**

Many are interested in PSP to secure up-front financing to build now what would otherwise only be possible tomorrow. Concessioneering can provide such financing - the six Asian metro concessions (Halcrow, 2004 op. cit) raised US\$4.0bn in private finance towards their US\$5.3bn cost.

But PSP can do so much more and it is here that the major benefits of PSP lie:

- Implementation - PSP appears to be decisive in improving success (section 3). It does this by ensuring risks are understood and controlled such that outturns are close to expectations.
- Planning - PSP can improve project specification. It does this by reality-checking project planning, bringing an independent focus to bankability and implementability, areas where planning is often weak. A private 'project development group' may be appointed by the city before the commitment decision to check the business case and proposed procurement approach. This group bids for the concession and is recompensed by the successful bidder if unsuccessful.
- Operations - PSP can improve operations. There is some early evidence that innovative concessioneering focused on operations can improve operational success. There is strong evidence that private operators can be effective in driving efficiencies and marketing the system to its customers.

*China's practice* – the Mission found active interest in PSP in central government and many cities. As yet it is early days for this approach, but two major metro concessions have recently been let – Beijing Line 4 and Shenzhen Line 4, and bus operations are increasingly being concessioneered. We understand government policy supports wide experimentation over the coming years as a basis for setting policy; at present there is no PSP Law but there is a cap on foreign ownership of a concession company of 49%.

## **4. The Basis for Future Policy**

A huge programme of metro development is underway in China's major cities. Much has been achieved in a short time in terms of engineering and technological development,

construction standards are good and costs low by international standards. Our focus has been to build on these achievements.

Metro decisions are necessarily made on the basis of forecasts of what will happen many years ahead. Producing good forecasts is very difficult because:

- The scientific basis for transport planning in China is currently weak;
- Socio-economic and land use changes are rapid;
- Transport policy is evolving, and metro developments are taking place quickly.

The consequence is that whilst metro development certainly impacts upon city economies in the short term, and this may be regarded as one measure of success, doubts must remain about their wider policy success, value-for-money and financial sustainability. Large-scale and rapid metro development, that characterises existing practice, carries strategic risks.

The need for a programme of applied research to improve the scientific basis for metro planning is therefore of paramount importance. The Annex to this report suggests the priorities and scope for this.

***Role for the State Government [NDRC] - The state government provides strategic guidance and controls metro development in the context of China's rapid decentralisation and other policies, but it struggles to do this proactively for understandable reasons. We fully support the commitment to strengthen this role and support cities in the years ahead to help them develop appropriate, good metro systems. This focus for this guidance should be towards:***

- Taking the lead in ensuring the necessary scientific basis is put in place for forecasting to inform policy. This will allow the minimum criteria for economic viability to be refined, perhaps combining existing guidance (Table 5) with international experience (Table 6). Annex A expands upon this;
- Making widely available relevant international experience with guidance on its applicability to China's cities (perhaps on the basis of the Mission's findings). This will include guidance on metro success factors (Table 9);
- Adapting the urban plan process (master plan, transport plan, metro plan) for the conditions facing city planners. Specifically requiring plans to be strategic and stress-tested using scenario and risk analysis.

***Success Factors- We have reviewed the lessons of international experience and assessed the implications for China's future policy as follows (Table 9).***

**Table 1-9: Metro Policy Directions for China**

<b>Issue</b>	<b>Existing practice</b>	<b>Future policy direction</b>
Role for metros	Metros often promoted as means to increasing city GDP, then as the solution traffic congestion and sometimes to guide city development. Cities vary in understanding transport policy. There is a disconnect between policy objectives and what metros will achieve in the absence of a package approach.	Information on international experiences is relevant and should be disseminated.
Metros as risky megaprojects	Risk is largely ignored during planning. There is little systematic effort to stress-test plans and metro projects to ensure their performance is robust.	Metro projects and the project development process should change. Projects need to be developed with strong viability under alternative futures; and that are (as far as possible) adaptable. Decisions should be staged, with commitment after technical + financial planning demonstrates this has been done.
Metros have a poor success record	City governments carry the full risks of metro development. Poor success could undermine the city's finances seriously; and undermine - not be the catalyst for the city's development strategy. We do not appear to know much about the success of China's metros.	It is essential to establish empirical evidence about the success of China's metros to inform future policy and create successful projects.
Requirements for justifying a Metro	Metros require approval by NDRC on the basis of: 1] Defined minimum criteria; 2] The Metro Plan feasibility study and 3] the Construction Plan.	This process needs strengthening, following empirical research into China's metros
<b>Metro success factors</b> 1. Risk to be formally analysed and managed	This approach does not appear to form current practice except probably during implementation.	This is essential throughout the project development process if government is to avoid being open to unintended strategic consequences.
2. Control initial cost by focusing on vertical alignment	Most metro alignments are underground, despite elevated alignments halving the up-front cost and reducing the construction risks. We were advised this was to protect the city's environment.	Vertical alignment options should be formally appraised for each section of route as part of alternatives analysis. Elevation is often implemented overseas in 'green' cities.

Issue	Existing practice	Future policy direction
3. A realistic metro network is necessary	<p>Metro networks are often very large – much larger than in cities elsewhere. First phases are also very large – 2/3 times larger than elsewhere.</p> <p>Financing for these networks is assumed to be available, without financial planning that would allow it to be validated.</p> <p>Many projects appear to have a compelling purpose, but some do not.</p> <p>Some projects are non-radial or green-field alignments and particularly risky.</p> <p>There is some welcome evidence of incremental development starting with BRT for conversion to metros when demand builds up.</p> <p>In China ‘metros’ are identified when demand is high and usually assumed to be underground. For lower demand instead of considering partly-segregated systems ‘LRT’ is often assumed. Yet its essentials differ little from a metro (its weight, cost and performance are broadly similar for a given capacity); and LRT is usually assumed to be elevated.</p>	<p>Plans should be developed from understanding demand. Technology should be an output based on demand and required service level.</p> <p>Our observations raise questions about the scale, structure, and prioritisation of proposed metro networks.</p>
4. Integration with the transport system + land use to be planned	<p>There is strong awareness of the need for transport integration, with plans to bring this about.</p> <p>China is perhaps uniquely able to develop integrated corridors around metro projects; and there is a great awareness of land use integration and intentions to achieve this; but sometimes there are flawed expectations.</p>	<p>Successful integrated development requires land uses and metro stations to be planned together with care to ensure large walk-in catchments.</p>
5. Extensive/substantive Alternatives Analysis to be undertaken	<p>The Mission was made aware of some alternatives analysis; but often important decisions appear to be taken without considering alternatives, or made qualitatively without rigorous analysis.</p>	<p>More and more rigorous alternatives analysis is necessary as part of the process of optimising metro projects.</p>
6. All forecasts to be ‘reality-checked’	<p>Metro forecasts are carried out without formal reality checking. There appears to be confidence that capital costs are under control, but no such confidence exists for operational forecasts.</p>	<p>Reality checking forecasts should be routine. The focus should be operational forecasts, and critically on ridership.</p>
7. Substantive Financial planning is necessary with Technical planning	<p>Technical planning runs far ahead of financial planning, on the assumption that finance will be available. ‘Hard decisions’ are thereby avoided (technical decisions are taken without understanding their financial consequences). Little advance financial planning appears to be made for operations.</p>	<p>Financial planning must be carried out together with technical planning. The commitment decision requires confidence that finance will be available ‘when things go wrong’ and for operations.</p>

<b>Issue</b>	<b>Existing practice</b>	<b>Future policy direction</b>
8. The entire project development process to focus on Operations	<p>City governments do not have an in-house transport planning capability. This hinders understanding and responsiveness during planning.</p> <p>Implementation appears to be effective but to provide inadequate attention to establishing future operations.</p> <p>Operators appear to be efficient but need to become more market-facing and implement marketing strategies.</p>	<p>City governments need to establish an in-house transport planning capacity – to control/ interpret its outputs and respond rapidly to ‘what-if’ questions.</p> <p>Attention is needed to planning for operations and establishing the operator contractually.</p>
9. Increase private sector participation [PSP]	<p>There is active interest in PSP in central government and many cities.</p> <p>It is early days for this approach, but two major metro concessions have recently been let and bus operations are increasingly being concessioned.</p> <p>We understand government policy supports wide experimentation over the coming years as a basis for subsequently setting policy.</p>	<p>We strongly support experimentation to improve project identification, predictability of outcomes and develop market-facing operations.</p>

Source: author

## **5. Annex**

### **DEVELOPING A SCIENTIFIC BASIS FOR METRO PLANNING OUTLINE SCOPE AND APPROACH OF FUTURE RESEARCH**

#### **A1 OBJECTIVES**

The Mission considers it a matter of concern that too little is known about China's metros for the purposes of proper scientific planning<sup>19</sup>. Information about the users, impacts and success of implemented metro projects all appears inadequate<sup>20</sup>. And good comparative data for China's metros and those for comparable metros overseas appears lacking<sup>21</sup>.

This absence of knowledge and information undermines effective metro planning. Project planning needs to start from an understanding of demand. This is fundamental to forecasting impacts and to undertaking due diligence checks.

#### *Purpose of Future Work*

A programme of research is scoped that would enable a continuously more scientific approach to be undertaken for metro planning in China. This would materially reduce the strategic risks that government currently faces and contribute to better policy and more successful metro projects. NDRC could take the lead in making this happen, thereby supporting city governments in planning their metro systems.

#### *Scope and Priorities*

The core priority is to establish an understanding of existing metros – who uses them, and their success. This understanding will then allow forecasts to be reality checked. And it will allow minimum viability criteria for metros in China to be developed.

With this evidence base and supporting guidance far more confidence will exist that metro projects are cost-effectively meeting policy objectives, without exposing government to strategic unintended consequences.

#### **A2 PROPOSED RESEARCH**

The research is divided into 4 components that are designed to inform four questions:

- Who uses metros?
- What is the success of metros?

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<sup>19</sup> This conclusion is based on meetings with Chinese experts and available information. It may be that some of this information is known to some individuals but it is not widely known, and this is what is needed.

<sup>20</sup> There is some anecdotal evidence of metro success that appears mixed.

<sup>21</sup> Shanghai Metro [SMOC] Metro is part of the CoMET metro benchmarking club run by Imperial College London, but its analyses remain confidential.

- How can forecasts be improved?, and
- What are the minimum conditions for metro viability?

Informed by the results of this research, metro development can rapidly improve in effectiveness, better serving China's policy objectives, and providing increasing confidence in the role and success of metro activity in this endeavour.

### ***Component 1: Who uses metros?***

Questions to be asked – these should focus on:

- What is the socio-economic profile of existing passengers?
- How did they previously travel (or are these new trips)?
- What are the characteristics of their metro travel?
- What are their attitudes towards the metro – how satisfied are they?

Form of research – Passenger interviews at stations/ on board trains, on operational metros<sup>22</sup>.

Value of research – This will increase confidence in metro planning and demand forecasts<sup>23</sup>. This should become routine for all metro projects.

### ***Component 2: What is the success of metros?***

Questions to be asked<sup>24</sup> - these should focus on:

- What was the financial basis of the decision to implement the metro project?
- What policy impacts were expected at that time?
- What were the outturn results<sup>25</sup>?
- How satisfied are the main stakeholders with the metro<sup>26</sup>?

Form of research – Research of documentation and interviews with key participants.

Value of research – The research will identify the strengths and weaknesses of existing practice. This will focus attention on how improvement can be most effectively undertaken. This should be undertaken for all metro projects quickly to improve success.

### ***Component 3: How to improve forecasts?***

Most forecasts – of capital and operating costs and of ridership and revenues are prepared by means of 'bottom-upwards' methods, that are detailed. They have a poor record of success internationally and may do in China too. We need to 'reality check' forecasts to

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<sup>22</sup> Desirably this would be on recently opened metros, so that passengers can remember the 'before-metro' situation clearly.

<sup>23</sup> For example if we know that most passengers formerly rode buses (the situation overseas) then bus passenger counts would provide a quick back-of-envelope reality-check on model-based forecasts.

<sup>24</sup> Success is assumed to be as defined in the main report.

<sup>25</sup> This should focus upon capital cost, implementation time, ridership/ revenues and operating costs in these same years.

<sup>26</sup> The main stakeholders will include: passengers, city government, business community, bus operators.

increase confidence in them. This is done by preparing ‘top down’ independent estimates – that are *not* detailed. These in turn need to be reconciled with the main forecasts. When this is done confidence in the resulting forecasts improves hugely, and an understanding of the risk profile of the estimates develops.

Independent forecasts require 1] knowledge about metro characteristics in China, 2] the development of a performance database for China’s metros and its extension to comparable metros overseas; and 3] applying the database to reality-check forecasts.

*Component 3A: Knowledge about metro characteristics in China and Development of a performance database*

Questions to be asked - these should focus on:

- What are the supply (physical and operational) characteristics, and what service level/ quality is provided?
- What are the demand characteristics – passenger characteristics?
- What is the metro financial performance – its revenues, operating costs and the operating surplus/ deficit?
- What are the major inputs (staffing, energy, materials, capital)?
- What are the major outputs (peak trains, train hours and car kilometres)?

Form of research – development of a database using available sources supplemented by questionnaire/ interview. It is important that definitions are concise so that data are truly comparable. The database should comprise all operational projects in China.

Value of research – this database assists an understanding of degrees of success on comparable metros and begins to provide an expectation of what should be expected for a new project.

*Component 3B: Applying the database to reality-check forecasts<sup>27</sup>*

Formal benchmarking can be carried out at different levels. For our purposes the approach is straightforward (see the main text<sup>28</sup>). A *second method* should be applied when there is a better understanding of the source of metro ridership. This provides ‘back-of-envelope’ estimates of demand based on bus counts (assuming ex-bus passengers are the main source of metro ridership). It comprises the following:

- Defining the metro route and its role/ competitive position (e.g. will buses compete? What are the bus/metro fares?)
- Identifying the busiest part of the metro route. Counting the number of bus passengers in the peak and non-peak directions at this location (i.e. number of buses \* average passengers/ bus)

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<sup>27</sup> This approach should be used to reality-check all parameters – costs, revenues and ridership.

<sup>28</sup> The following are relevant: Allport and Anderson (2005 op. cit) and Allport RJ (2001). ‘Benchmarking to Improve Demand Forecasts for Major Urban Rail Projects’. AET Conference, Cambridge UK.

- Estimating the metro ridership at this point were the metro to exist today (not everyone would transfer from the buses, some would transfer from other modes, and there would be new trips too).
- Estimate the daily metro ridership on the whole line (grossing up for the non-surveyed time, and allowing for passenger turnover along the route). The daily revenue is then passengers \*fare/ passenger.
- Looking ahead to future demand. What are the growth drivers (population/ income/ economic activity, traffic congestion...)? What is the scale of future ridership and revenues?

Reality checks provide 2 or in the case of ridership 3 independent forecasts. These must be reconciled so that a judgement can be drawn about the probable scale of ridership. This involves critically reviewing the assumptions in each method until some agreement is possible.

Technocrats tend to trust transport models but the evidence is compelling that alone they should not be trusted. If common-sense checks do not broadly validate such forecasts then the conclusion should be that they are probably wrong. The value of this approach is that it provides confidence in key forecasts that should reassure governments, investors and bankers alike.

#### ***Component 4: What are the minimum conditions for metro viability?***

Table 5 sets out NDRC's existing minimum criteria and Table 6 sets out the economic viability criteria developed for developing city metros outside China. The NDRC criteria explicitly build in city affordability that is of central importance. The developing city approach focuses on economic viability for key corridors<sup>29</sup>. It is probable that a combination of these approaches is appropriate to China's needs.

*Form of research* - most of the developing city criteria are uncontroversial and are expected to apply in China. The key criteria concern today's peak bus passenger demand, income level and the cost of vertical alignment options along key corridors. These criteria were developed from strategic pre-feasibility demand and economic viability modelling<sup>30</sup>.

When there is a better understanding of China's metros and their impacts a similar analysis will be possible that will refine the Table 6 criteria. Then a combined set of criteria can be formulated with some confidence.

*Value of research* - new guidance on *minimum* criteria, when combined with much greater confidence in forecasts, will allow city governments to quickly identify priority projects that, after full feasibility study, are likely to be justified. This will increase the productivity and effectiveness of metro planning activity substantially.

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<sup>29</sup> Corridors are preferred to city-wide figures. Some cities are linear and it is the corridor demand and supply characteristics that are critical to viability.

<sup>30</sup> Halcrow (1992). 'A Pre-Appraisal Model for Rail Transit in Developing Countries', Bamford TJG and Allport RJ, Journal of Advanced Transportation. Vol. 26 No 1, 1992.

## **Part 2: Comparing Urban Rail Transport Issues in Latin America and China's Metropolitan Regions**

**Jorge Rebelo**

### **1. Objectives of this Paper**

This paper will describe the main urban transport sector issues especially the urban rail issues faced by the Bank in the Latin America and Caribbean region and their parallels in China where a growing number of large cities and metropolitan regions have started or are about to start a major metrorail program.

### **2. Background**

The Bank metrorail program in Latin America has been very active since the 1990's. It started in Brazil with the decentralization to local authorities (States and Municipalities) of suburban rail systems which belonged and were operated by the Federal (National) Government around several of the main cities of the country. The 1988 Constitution indicated that the urban transport systems were to be operated by local authorities and therefore the Federal Government had to decentralize them to States and Municipalities.

The States which were to receive those systems indicated that they would accept them provided they would be rehabilitated and modernized. They also indicated that they would like the Bank to act as an honest broker between them and the Federal Government. The Federal Government requested Bank's assistance to finance the rehabilitation and modernization of the São Paulo and Rio de Janeiro systems followed by the Belo Horizonte and Recife systems and later by Salvador and Fortaleza.

- Main systems were located in São Paulo, Rio de Janeiro, Belo Horizonte and Recife.
- Smaller systems in Salvador, Fortaleza, Natal, Maceió, J.Pessoa
- Central Administration



Figure.2-1:-Brazil- Brazilian Urban Rail Company (CBTU) Decentralization Program

Table2-1: World Bank-financed Metrorail Projects in Latin America and Caribbean (LAC) Region

Investments in Metrorail Projects	World Bank (in million US\$)	TOTAL (in million US\$)	Completed/ To be Completed
S. Paulo – CBTU	126	281	1998
Rio – CBTU	128	272	2000
Belo Horiz.- CBTU	99	199	2003
Recife – CBTU	102	204	2003
S. Paulo (CPTM)Estado	45	95	2004
Salvador CBTU/Est/Pre.	150	350	2009
Rio Mass Transit /Estado	253	375	2009
Fortaleza CBTU/Estado	35	35	2009
S. Paulo Metro Line 4/Est.	209	1,400	2010
Buenos Aires (PTUBA)	200	400	2006
São Paulo Trains & Signaling	550	1,550	2011
Rio Mass Transit 2	400	550	2012
S. Paulo Metro Line 4/ Fase2	225	640	2012
Buenos Aires (PTUBA 2)	100	138	2011

The Bank saw in this request an opportunity to help the low-income users to access their jobs, health and education facilities. It also saw an opportunity to better integrate rail with other modes such as bus and also with land use planning and air quality strategies to improve areas of the cities which were decaying due to the lower use of a dilapidated rail system. Before agreeing to participate in these projects which would allow the transformation of these suburban rail systems into actual surface metros, the Bank agreed with the local and federal authorities on a four pillar strategy which are summarized in the next paragraph and discussed in detail at the end of this paper.

The strategy consisted in four pillars:

- Establishment of a regional transport coordination authority in charge of coordinating and planning urban transport in the metropolitan region as a representative of the State and the municipalities of the MR. This authority would evaluate, select and prioritize investments in the MR and also define tariff and subsidy policies;
- Preparation of an Integrated Urban Transport, Land Use and Air quality strategy which would be updated regularly and would map out the investments and policies to be discussed by the metropolitan authority;
- Introduction of financing mechanisms other than government budgets to provide funds for the sustainability of the systems; and
- Progressive participation of the private sector in the operation and investment of the systems with regulatory oversight.

The parties involved accepted these points and the Bank embarked in a lending program which, as mentioned above, started with the financing of the modernization of the commuter railways in 6 cities. Subsequently, in two States (Rio and São Paulo) Bank support continued with loans to the States, guaranteed by the National Government. Those loans included further improvement of their surface metros, concessions of operations to the private sector and in some cases, “greenfield” projects, that is completely new projects, e.g. the São Paulo Metro Line 4 and the Salvador Metro. In addition to Brazil, the Bank financed the rehabilitation of the commuter lines in Buenos Aires Metropolitan Region and the modernization of the signaling systems in one of its lines.

### **3. Urban Transport Sector Issues in Latin America and Parallels in China**

As in most emerging countries, the main sector issues in urban transport revolve around the increased use of the automobile, their impact on congestion and pollution and also on the weak organization and effectiveness of public transport. Fig.2 illustrates the vicious circle of urban transportation which is self-explanatory. The most affected by this vicious circle are the low-income populations which depend on urban transport to get to their jobs, education, health and leisure facilities. They have issues of affordability, accessibility, availability and acceptability of urban transport. Often they cannot afford the tariffs which eat up a good portion of their salaries, they have difficulties in accessing the modes because they are far from their homes, the frequencies of urban transport are most often than not enough to allow for acceptable waiting times and finally they complain that the vehicles are unacceptable because they are not comfortable, feel unsafe due to lack of vehicle maintenance and sometimes due to theft and assaults during operation.

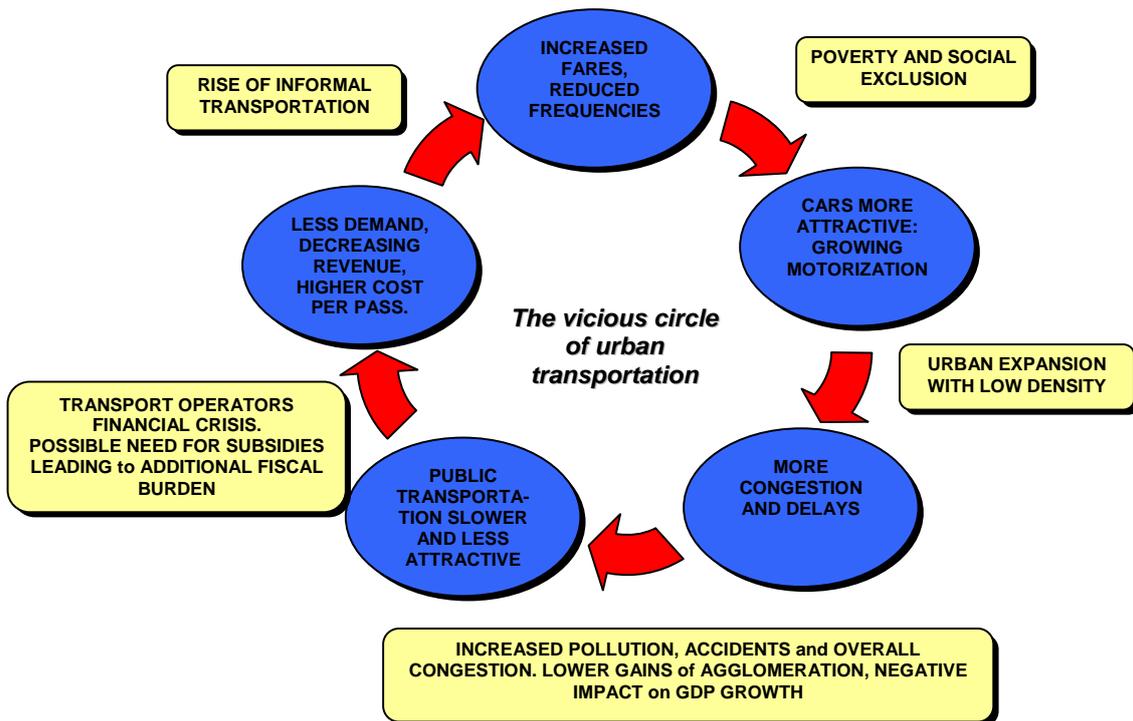
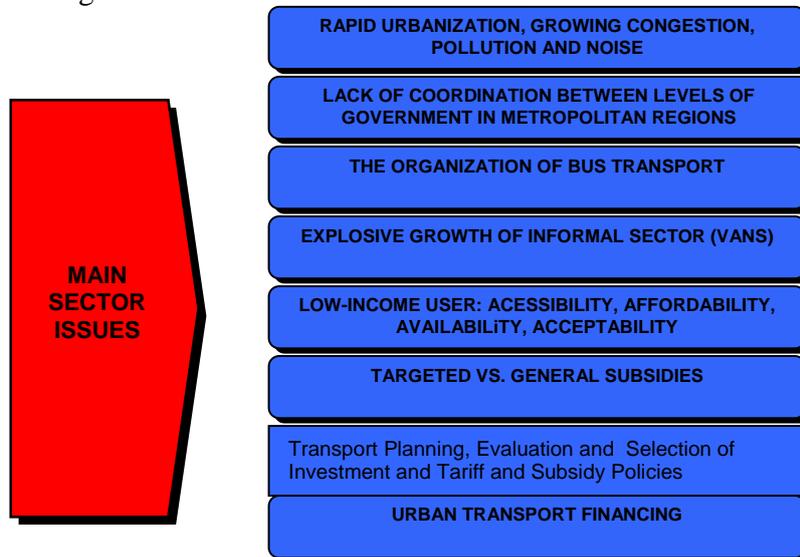


Figure 2-2:-A Simple diagram illustrates the “vicious circle” of urban transportation in Latin America

But the actual sector issues encountered in the urban transport sector of LAC countries are described in fig.3: We examine each of them next



*Inefficiencies within the urban public transport system generate negative social and environmental impacts, and weaken cities as growth engines*

Figure 2-3 Main sector issues in LAC

## 4. Main Sector Issues

### 4.1 Rapid Urbanization, Growing Congestion, Pollution and Noise

With the increase in disposable income and the migration of rural populations to the urban areas or the expansion of urban areas to their surrounding rural space, there is a trend to buy automobiles. Governments create incentives for their local industries to make or assemble vehicles and the availability of easy credit is generating more automobile owners.. This is happening in LAC countries but also in China where automobile ownership is increasing. Motorization is therefore a major trend in emerging economies. Automobile growth is high (+245% in Santiago from 1991 to 2001) ; and induced by poor public transport.

The private automobile is one the main producer of emissions. Trucks and buses are very noisy and they are responsible for a lot of the hearing problems in major metropolitan areas.

Congestion exists in major cities, and is responsible for substantial negative externalities with loss of time, fuel and productivity.

One can easily say that this phenomenon is similar in emerging LAC countries such as Brazil, Chile, Mexico and in China where urban population have grown very fast in the last 10 years and income growth is allowing higher car ownership of the middle-income inhabitants.



**Figure 2-4: Limited road space is taken by private auto with very limited priority for public transit increasing door-to-door travel times. There is an urgent need to give priority to public transport**



**Figure 2-5: Pollution in Santiago mainly due to transport activity**

## **4.2 Lack of Coordination between Levels of Government in Metropolitan Regions**

In LAC's Metropolitan Regions (MRs) there are in general 3 major governments: National government often in charge of urban railways, the State Government often with jurisdiction over intermunicipal buses, subways and ferries and several Municipalities normally in charge of buses, rail within the municipality boundaries and traffic and transit within the municipality. The lack of coordination between these three levels of government create problems in the evaluation and selection of major investments, in the regulation of all modes but particularly buses and in the physical and tariff integration between modes. Unlike Madrid, Paris, Vancouver, Washington DC and other major metropolitan regions the lack of a metropolitan coordination agency leads to petty fights between governors and mayors and cause difficulties in the institution of a common smart card and also in defining subsidy policies if needed. In China, since the Mayor of each Municipality is in principle in charge of all modes, these problems shouldn't exist unless several municipalities start getting closer and the buses from one would serve the other and vice-versa. But we detected that there is lack of coordination between the several municipal authorities in charge of planning, bus company, metro agency, and municipal civil works. This leads to improper planning in intermodal connections which may harm future demand and reduce the comfort of passengers, to the continuation of bus routes parallel to the metro systems, to a lack of an integrated fare between modes. So, our suggestion is that in China the problems of intra-coordination within the several bodies of the municipality be revisited carefully. Since in the future, most likely there will be municipalities close to each other we suggest that Chinese Provincial governments take notice of how difficult it is to coordinate transport in a metropolitan region without an efficient Metropolitan Authority.

BRAZIL	National Govmt	State Govmt	Main Municipality	Other Municipalities
Commuter Trains				
Metros				
Intermunicipal buses				
Municipal Buses				

Figure 2-6: In most cases Municipal buses, intermunicipal buses and rail/metro are not integrated neither physically nor tariff wise

### 4.3 The Organization of Bus Transport

In LAC main MRs, most of the trips are done by bus and therefore with few exceptions bus has 60% or more of the daily trips. If one accounts for the informal vans and small minibuses which since the early 1990's invaded the LAC major cities, the bus mode may take more than 75% of the trips. Some of the most common problems with the organization of the formal bus transport subsector in LAC are:

- It is often a private monopoly without competitive bidding, mainly permissions passed from generation to generation. Some cities like São Paulo Municipality, Santiago and Bogotá have done competitive bidding of routes with good results. But in the majority of other cities it continues to be route permissions passed from generation to generation with very little regulation and enforcement.
- The bus networks are not optimized and therefore there are more often than not multiple routes; oversupply and overlapping. This adds to the congestion. The passenger renewal coefficients were very low due to the oversupply and this is economic wastage.
- To organize the networks there is a need for a network optimization plan followed by competitive bidding of routes. Enforcement of schedules and other level-of-service factors should be done through GPS from a control centre by the government. But the bus operators associations are normally very powerful and they can make or break political candidates. So, there is a need for a strong political champion to break the logjam.
- In the 1990's due to poor level-of-service offered by the buses there was a proliferation of informal vans and minibuses used for transport. They were often unsafe, with untrained drivers, but the public liked them because they would go door-to-door, stop at the request of the users without respecting bus stops and would be more easy to maneuver in traffic congestion. They added to the

congestion, stole about 20% trips from the formal bus sector and start to organize in powerful political lobbies because a lot of policeman, politicians and questionable groups owned these vans. It is big business which does not pay taxes. The informal vans and their transformation into a formal group with adequate regulation is a major issue in the urban transport sector.

- Bus priority schemes: To be able to increase bus speeds at peak-hour, LAC was a pioneer in introducing bus priority schemes (Curitiba, São Paulo, busways, counter-flow bus lanes, Bus Rapid Transit (BRTs in Bogotá, Santiago) and other priority schemes which recaptured part of the ridership.



**Figure 2-7: Formal articulated buses in Bogotá- Transmilénio**



**Figure 2-8 : Informal transport in Lima**

- But bus priority schemes alone, without a full optimization of the bus network that operates in mixed traffic, is not enough. Most cities are going to the concept of having three types of buses in the network: a) Feeder buses which connect either with Trunk/Express buses or the subway or rail; b) Trunk buses which operate in the main trunk roads stopping in most bus stops; and c) Express buses which skip several bus stops providing faster services between the main origins and destinations. The challenge is how to plan for these routes in a way as to minimize headways and transfer between types of buses and/or modes.

- In China, it seems that there a lot of issues to be tackled insofar as bus organization is concerned: a) It is not clear in most cities which ones are feeder, trunk or express buses; b) there could be much more bus priority schemes particularly in future subway axis while the construction of the subway is underway and areas which are not in the area of influence of the subway mainly because there is road space; c) there is no competitive bidding of routes in most cities, most of the providers are city-owned companies with less than 10% being a private company but it is not clear how the latter obtains its right to operate; d) fortunately it seems that there are not informal van operators; e) passenger renewal coefficients appear to be relatively high

#### 4.4 Explosive Growth of Informal Sector (Vans) and Motorcycles

The explosive growth of the informal sector road-based vehicles namely vans and motorcycles in LAC has been mentioned in the paragraph before. From the 1990's onwards, maybe as a response to a decaying level-of-service offered by the formal bus transport operators, there was an invasion of vans and minibuses in the market which started to grab a significant share of the formal bus subsector trips. This growth of informal van trips continued until now and reached, in cases like Rio de Janeiro, 20% of the public transport motorized trips. The questions are:

- Why are they multiplying? Was it because they offer lower tariffs or are they an alternative to unemployment for people with enough money to buy a van?
- Can they be turned into an ally of the formal bus sector rather than being seen as the enemy?
- How can they be controlled?
- How can they be used to foster competition with the formal bus system and integration with rail?

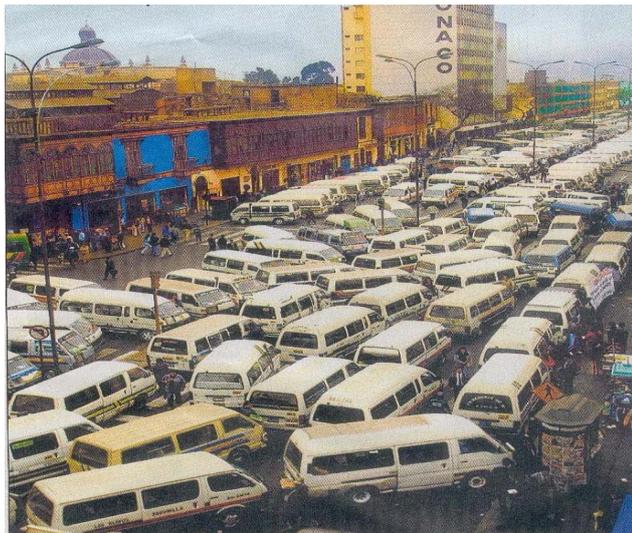


Figure 2-9: Lima, Peru

They add to congestion if they don't work as feeders, are more often than not illegal, are unsafe, stop where they want, don't pay taxes, but people like them because they are door-to-door transport

In most cases the multiplication of vans has been fostered by people who lost their jobs, received compensation and applied the money to buy and operate them themselves or using drivers who are very cheap (Argentina); or by groups (including military police and drug traffic-related groups) who owned and operated several vans; and also politicians who owned them indirectly and lobby strongly for them. But the truth is that the public appears to like them because they almost transport door-to-door and stop when people waive them. Protests from the formal bus sector that they are unsafe, don't pay taxes and are cheaper because they do not comply with safety rules, are probably right in most cases. But it was the poor level-of-service and unwillingness of the formal sector to serve some areas of the cities that led to their appearance.

The fact is that they are unsafe, add significantly to congestion, have now become sometimes a political or at least lobbying force as big as the formal bus sector and need to be dealt with. So, how can they be controlled and turned into allies, e.g., as it was done in São Paulo, Brazil? First, there must be a strategy on how to deal with the vans, not just police enforcement. How many of the total illegal fleet is needed to complement the formal bus sector? What are the minimum standards required to regularize the vans from the safety and operational standpoint? How are you going to bid the routes in which they can operate? How are you going to enforce them? Should they also receive the equipment necessary to validate the "smart card" used in the formal system? These are the questions to be asked when dealing with informal van operators.

Often the lack of a metropolitan agency as indicated above made it even more difficult to tackle the illegal vans because the policy adopted by the State was different from the one adopted by the Mayor as it is the case of Rio de Janeiro. But in other cases such as Recife and Belo Horizonte both levels-of-government appear to have dealt successfully with the issue.

In China, there are no informal vans and this seems to be a non-issue. However, this issue may come up if and when the formal bus sector starts faltering in the delivery of adequate level-of-service. In those cases, the public seeks for alternatives that are faster and authorities must be very attentive to this unwanted explosion of illegal vans.

More recently, several cities of LAC have been experiencing an explosion of motorcycles which weave through the traffic in packs leading to as much as 3 fatal accidents per day. Attempts by the authorities to control this surge in motorcycles is again met by strong lobbies mainly from the owner-operators of these motorcycles who claim that they use them for their jobs and, since they don't have enough money to buy a car and public transport is weak, they see in the motorcycles the best solution for their personal and job-related needs. Attempts by the authorities to have separate lanes for motorcycles have been met with little success mainly because few are the cities that have the width that one sees in Chinese cities.

One way or the other, the explosion of the motorcycle fleet in the urban transport scene of main cities must be avoided. If there is enough road space to separate them the better.

But if there isn't they must be carefully regulated from the safety standpoint because they tend to cause a high number of fatal accidents.

#### **4.5 Low-Income User: Accessibility, Affordability, Availability, Acceptability**

From the standpoint of the user, his/her desire is to receive services which are affordable, accessible, available and acceptable. What does this mean? Affordable services are those that users, particularly those who are low-income can afford, that is can pay. In general if the cost of home-to-work trips for a user exceeds 6% of its gross salary then urban transport starts becoming unaffordable. This may lead to major disruptions in other items of the user's household budget since it may take away from food, energy and other basic components of the household needs. In some Latin America countries, when not subsidized, urban transport costs can reach 12 to 15% of their gross salaries. One of the reasons we see so many trips by foot is the unaffordability of public transport tariffs (35-40% of the daily trips by foot in several cities). In some countries, like in Brazil, the employers must, by decree of the national government, pay the difference between 6% of the gross salary spent in home-to-work trips and the actual cost of those trips. In other words, if the total cost of the home-to-work trips is 12%, the employer pays 6% of the costs and the other 6% are paid by the employee. But this applies only to the formal sector employees. Unfortunately, those in the informal sector, which is growing very fast, are not covered. So, the government should try always to make tariffs affordable either through targeted or blanket subsidies if there is evidence that the companies that are charging those tariffs are cost-efficient. In China, tariffs appear affordable and subsidized through blanket subsidies. The question then is whether this subsidy by the city is sustainable over the long-term and which consequences will have.

Accessibility is basically the need to make the public transport systems accessible to most users by ensuring that there is a bus stop, a rail station or other mode available at a walking distance that is considered reasonable such as 800 meters from a house. It is also important to have the same concept for basic health, education and leisure facilities. They must have easy access for the users. One of the reasons for the explosion of van transport was the poor accessibility of formal transport in low-income neighborhoods.

Availability is basically the need to make urban transport available, that is, more frequent particularly at peak-hours. This is one of the main complaints of most users particularly low-income neighborhood users. Also, at off-peak hours, frequencies must be reasonable to allow non-work trips to take place. Availability is one of the main problems cited in Latin America both at peak and off-peak hours.

Acceptability has to do with whether the transport services offered are acceptable from the standpoint of operational safety and personal safety. In LAC quite often the vehicles used and some of the facilities do not comply with minimum operational safety standards used in industrialized countries quite often putting in jeopardy the safety of the user. Also the number of assaults with thefts in buses and sometimes in rail is high and make the service unacceptable for the user often endangering their lives. For example, in Brazil the number of assaults and thefts in municipal and intermunicipal buses is high. Most rail trains are now equipped with cameras monitored from control centers to respond quickly

to such situations. In China, although personal safety does not seem to be the problem, operational safety of the vehicles will require attention. Also pedestrian safety appears to be a problem because vehicles do not respect the cross-walks, particularly in the access to public transport.

#### **4.6 Targeted vs. General (Blanket) Subsidies**

If possible, transport subsidies must be avoided. However, reality shows that in urban areas where there is a great number of low-income users who earn 2-4 minimum salaries that urban transport tariffs for their daily needs are sometimes a significant portion of their earnings. On the other hand, since in Latin America most bus provision is in the hands of the private sector, the bus owners must also cover their costs and make a profit otherwise they will not be in business and will take their money elsewhere. To make transport affordable, governments can either subsidize the operating companies paying them the difference between what they estimate the tariff to be and the social tariff that government would impose; or they could subsidize the low-income users through some targeted subsidy (the one in Brazil called “vale-transporte” which means transport voucher).

A blanket subsidy which benefits everyone independent of their income is often justified on the basis of positive externalities such as decreasing congestion and pollution as it is the case of Mexico’s city subway fares and several cities bus systems. The problem is to ensure that the operating agencies are cost-efficient and are not passing its inefficiencies to the government by claiming a remuneration cost higher than what would have been if there was no subsidy and they had to fend for themselves. If the government could easily audit the costs through a standard cost accounting system compulsory for all operators, then operating subsidies to cover the differences between social tariffs and the remuneration costs claimed by operators would be easy to monitor. But this requires constant work and supervision and there is a high risk that governments delay the payment of subsidies. This in general causes a downturn of the level-of-service offered by the operators, thereby affecting the users. If a blanket subsidy is provided without careful government oversight, chances are that operating subsidies will grow and become unmanageable and this happened in several LAC cities.

On the other hand, a targeted subsidy to users in the form of a monthly amount which can be deposited in a machine that add value to the smart card is possible if the users are registered. Employers can do the same by providing the money to the smart card agency (in the Bank we receive a US\$30/Month to compensate for not having parking downtown. This subsidy can be collected at smart card machine in any subway station). Therefore, there are ways of delivering the subsidy to users directly and ensure it is used just in urban transport. The problem is that there is a growing informal sector which is more difficult to track down because they are not formally employed.

Overall, the best practice is to minimize subsidies. However, if the affordability becomes an issue, targeted instead of blanket subsidies appear more cost-efficient because operators will have to show efficiency, particularly if there is competitive bidding of routes. Operating subsidies to State-owned companies have the tendency to grow and become unmanageable unless they are run with a commercial orientation and as a private

organization. This is possible as demonstrated by the Santiago, Chile and Medellín, Colombia subways which make a profit and are both State-owned and operated companies.

In China, there appears to have a tendency to have blanket subsidies, that is, for every user irrespective of its income mainly justified on externalities. In this case, China should ensure that operating agencies either bus, metrorail or ferries are in fact cost-efficient. They should try to optimize the bus network by avoiding unnecessary duplication of routes, providing priority schemes where they may help and pressing state-owned companies to be managed with commercial orientation meeting pre-agreed performance and financial targets.

In cases where very low-income people cannot afford the prevailing bus/metro tariffs, targeted subsidies may be justified and that must be done in a way as to minimize the fraud that normally accompanies these type of schemes in LAC cities. The city must also promptly reimburse the operating companies for all the “free riders” imposed by law, e.g., the aged, students, handicapped, police, etc.

#### **4.7 Transport Planning, Evaluation and Selection of Investment and Tariff and Subsidy Policies**

The need to strengthen transportation planning, traffic data base, traffic management, and economic and financial evaluation of new investments could be met if there is a formal coordinating agency for urban transport in the metropolitan region. This agency should be equipped with a battery of sketch planning, demand and supply models which will test different land use, air quality, and urban transport scenarios. Furthermore, an integrated land use, urban transport, and air-quality strategy should be designed and periodically revised. The institutional component of proposed projects must have provisions to finance this type of models and supporting studies. Although most Brazilian main cities which had Bank-financed projects are equipped with good O-D surveys, sometimes it takes longer than the normal 7 years to undertake them because governments during fiscal crisis cut planning budgets. Cities such as Rio de Janeiro and Buenos Aires were without O-D surveys for years. These are tools which are fundamental for transport planning analysis. The other aspect which is often forgotten is a very transparent analysis of alternatives to meet the desired objectives. For example, would a busway be the solution or should it be a light rail or a heavy metro rail? These questions require a very thorough alternative analysis which starts with realistic demand estimates for several scenarios, preliminary engineering costs, operations modeling, economic evaluation of alternatives sometimes complemented with qualitative analysis, environmental and social impact analysis, financial evaluation and risk evaluation and mitigation measures. Finally, an analysis of sources and application of funds for the project is required. For example, will the city finances be able to finance the project and maintain it during its first years of operation? In several cities in LAC, this analysis is often not done and the results are quite often: a) Much lower demand than expected; b) failure to integrate modes particularly when this is assumed rather than formally agreed and enforced by the State; c) higher engineering costs than required due to lack of value engineering analysis; d) higher than expected resettlement costs, to name just a few.

In China, most cities we visited appear to have a Comprehensive Transport Study and recent O-D surveys. The questions that appear relevant in the Chinese context are: a) Is demand analysis being done in a very pragmatic way with “back-of-the envelope” checks such as comparison with the demand presently transported by buses in the area of influence of the subway line ? Have realistic transfer times between modes at transfer points been properly reflected in the demand modeling? It appeared, in most cases, that there is an over-optimistic view about demand by planners because the density in most Chinese cities in terms of inhabitants per square meter is high and there is the wrong presumption that ridership will be necessarily high because of that.

Also it seemed that the decision of only using elevated structures in the accesses to the cities rather than in the middle of existing wide avenues, on the basis of environmental impacts, needs to be reviewed case by case. There are now very slim elevated structures which can blend in easily and adequately in urban areas. Also, present technology allows for much lower noise and vibration impact. And given that in general these structures would cost half the cost of underground lines, these studies are worth doing, particularly if the resettlement and expropriation required is not significant.

From the operational standpoint, it is very important that planners work with operation specialists of existing metros and with bus operators to be able to understand and input in their models the finer operation schemes that can avoid future headaches because the civil works did not take into account operational needs. Length of station platforms is an example, others being evacuation space, tunnel sizes, type of traction (third rail versus fixed catenary), width of the cars, signaling systems. It was felt in our conversations that this joint work with operational specialists could be improved in most cities we visited and, often, they are not part of the design teams.

Economic evaluation of alternatives comparing the alternative at stake with the next best alternative is fundamental to obtain the incremental rate of return. Equally, an economic evaluation of the investment when compared with the do-nothing situation is also part of the evaluation process. We did not obtain good answers when asking about economic evaluation, particularly which inputs were used such as value of time, which is normally a major contributor for benefits. Some guidelines on value of time need to be prepared to ensure some consistency in the economic evaluation of projects.

Financial analysis of the future operation must also be undertaken again in a very pragmatic way to determine the working and operating ratios of the operating agency and assess the size of operating subsidy required.

Finally, the sources and application of funds in the investment must be checked with a thorough analysis of city finances. A huge investment and later on huge operating subsidies may have very negative impacts on the city’s financial health.

Overall, pragmatic transport planning and evaluation of projects is crucial to proper planning of mass transit alternatives and should be a major priority of all cities involved in mass transit investments.

## 4.8 Urban Transport Financing

In LAC, most major mass transport investments are financed either by the State or by the State and National Governments. There are no pre-defined rules for financing like in Japan and Korea where the national government finances 30-40% of the total project cost and the rest is financed by the Municipality and commercial loans; or in France where there is a mechanism named “versement transport” which is a tax on the payroll of every company whose proceeds are then used for urban transport investments. In Brazil for example, the rail decentralization program was financed by the national government. Subsequent mass transit investments in each city were financed by the State with its own budget plus multilateral Bank loans guaranteed by the Federal government and/or by the National Development Bank of Brazil (BNDES). In Argentina, the mass transit systems are financed 100% by the Central Government. In Chile, the subway is financed by the national government (infrastructure) while the rolling stock and systems are financed by the subway company with a guarantee from the national government.

The lack of predictable financing policies and the taxation system in LAC countries has prevented mass transport systems, particularly subways, from being built as needed. This and the high cost of building such structures, particularly civil works, is the main reason for such a small number of kms of subway in LAC. Fortunately, cities such as São Paulo, Rio de Janeiro and Buenos Aires have extensive networks of suburban railways which can be quickly transformed in surface metros. That network when properly connected to the subway network can provide extensive coverage of the metropolitan region.

In China, the Municipality finances the subway through land sales (therefore from its budget), receives sometimes funds from earmarked funds and the rest from commercial loans. There are no direct contributions from the national government. If the municipalities can afford these investments and are strong enough to sustain them in case there are operating subsidies, there is no problem with that. The issues are: What are the other investments that would be crowded out by the huge allocation of budget funds to the subway investments and whether the subway investments “benefit-cost” ratios and economic internal rates of return are higher than the other investments which could not be budgeted. In case the municipality decides that subway investments have the highest economic and social priority, the question will be how to minimize costs through optimal design and later on with cost-efficient operation. This should be the main objective of financial planners at the Municipality level.

Urban transport financing should not rely only on budget funds alone. It should seek wherever possible other sources of financing to ease the burden on government budgets. For example, in LAC cities the use of advertising inside and outside the vehicles and stations, the use of rights-of-way for fiber optic cables for phone companies, the use of station space for shopping are sources of revenue that should be explored very carefully. But the most rewarding type of extra-operational investment will be associated real estate developments around the main stations in the areas expropriated for the systems. In LAC there are some examples of this in São Paulo and Santiago but they are very shy of what we see in countries like Japan, Korea and China (Hong Kong). Although the land-use planning in most Chinese cities we visited is quite impressive, we suggest that at early stages of planning of the mass transit systems, the planners take into account the need for

these associated station development because it not only helps in improving the surrounding area but also helps in generating important revenues which can ease the burden on government budgets.

The other types of financing which have been used in LAC cities are: a) concessioning of the operation of suburban railways and subways with (Buenos Aires) or without operating subsidies (Rio de Janeiro) or Private Public Partnerships (PPPs) like in São Paulo Metro Line 4 where the civil works and electrification infrastructure were financed by the State and the rolling stock and systems were provided by the private sector in exchange for a 30 year concession to operate the Line. In Beijing, we learned of one PPP initiative in the case of Line 4 with the MTR consortium which is similar to the one described in São Paulo, although the Beijing City government is part (51%) of the consortium. This will not be acceptable by most private companies who would like more freedom in their decisions to operate and meet the performance targets imposed in the PPP contracts. There is also ample opportunity for concessions of existing lines to the private sector to decrease the operating subsidies which are partly due to the very low tariff (policy decision) and also due to the inefficient operation which can be improved by the private sector, thereby saving in operating subsidies. This will also provide a benchmarking for state-run operations.

#### **4.9 Pillars for Urban Transport Sector Sustainability**

The main pillars for the long term sustainability of urban transport in LAC cities are described in Fig.10. Next we examine them and establish a parallel with China's urban transport.

##### ***PILLAR 1 – Establishment of a regional transport coordination commission***

We have indicated above how important it is to have planning, evaluation and operational coordination within a MR. This continues to be the main issue in a great number of LAC cities. The main problem, unlike in China, is the constant lack of coordination between State and Municipalities of the MR each one wanting to have the right and power to issue licenses for bus routes. This lack of coordination leads to duplication of investments, poor evaluation of impacts on the territory under the other level of Government and above all inability to coordinate tariff and subsidy policies sometimes because of lack of integration. The main problems are normally between the State and the most important Municipality. For example, in Rio although they meet regularly in thematic commissions, the Municipality and the State are at odds in several aspects of urban transport such as how to control informal transport.

In China, it is very important that the Mayor asserts his authority from the very beginning ensuring that the several municipal authorities, operating agencies, civil works departments work together and under the direction of the official named by the Mayor. The better interaction between planning, bus, construction and finance departments is essentials for success. If and when more Municipalities become involved given the fast urban sprawl, establishment from the very beginning of a metropolitan transport agency is recommended. This agency should have representation from all levels of government, users, operators and other stakeholders.

A metropolitan coordination agency can have several forms. It is recommended that the Madrid (Consortio de Transportes de Madrid), Paris (Syndicat des Transports de Ile-de-France) and London (Greater London Authority) examples be examined. Another which might be very interesting is Vancouver's Translink. One point that is going to be very important is the decision on whether the authority is going to deal just with public transport (Madrid, Paris) or all urban transport, public and private as in London and Vancouver.

In China, an effort to bring together all the existing agencies and make them work together as a single unit will payoff in the long-term.

### ***PILLAR 2 – Integrated urban transport, land use, and air quality strategy***

This pillar seems so obvious that one wonders why so many cities in LAC fail to comply with them. The answer is that when there are fiscal crisis, planning is reduced and when better times come up there is no planning ready to be transformed into projects. All MRs with Bank-financed projects had some type of Integrated Urban Transport, Land Use and Air quality Strategy. The most stable effort which has now lasted more than 18 years is São Paulo with its PITU (Integrated Urban Transport Program) program. This was started as an exercise to propose several scenarios for the development of urban transport in the MR and to ask a group of stakeholders their views. It evolved into a detailed analysis of the main mass transit corridors. Other similar exercises are the PDTU (Urban Transport Development Program) in Rio, the PDTU in Belo Horizonte, the PTUS in Santiago.

An Integrated Urban Transport, Land Use and Air Quality Strategy must include among others: main modal corridors (mixed bus, busways, rail/metro, ferry, road), non-motorized modes (bicycles, walking), intermodal transfer terminals, pedestrian malls; parking areas; pedestrian safety; traffic engineering; it should also include the tariff policy, the subsidy policy; the modal integration policy; the parking policy; the traffic restraint policies such as vehicle rotation, congestion pricing; the vehicle fuel policy and its impact on air quality. It must also include the land use policy with clear indication of areas which might be subject to major urban operations (land use changes) and how that will affect transport.

In the case of China most cities have a Comprehensive Transport Study but we did not have access to them to see how they are organized. We believe that this is a good start, however, this must be a continuous process with periodic updating and must be very comprehensive with periodic O-D surveys to show the trends in mobility patterns and the new areas where demand is growing and require a supply response. It is important that the very good land use plans we could observe be properly intertwined with the transport planning. In most cases we did not see a clear explanation of parking policies as they might play an important role in restraining car use. Demand modeling capability need to be beefed up and it is clear that there is an over reliance on the materialization of very high ridership which might be dangerous if planners are wrong.



**Figure 2-10: The Four Pillars for Urban Transport Sector Development and Sustainability**

***PILLAR 3 – Financial mechanisms to ensure long term sustainability***

Strong financing mechanisms are necessary to fund mass transport investments particularly subways. Funds must be available on a predictable basis so that a clear signal is given to the market that investment in heavy equipment will be depreciated over a number of years making it easier for companies to amortize the cost of the equipment. Stop and go patterns observed in LAC due to unclear financing policy definitions, make local governments dependent upon the central (national) government who must also guarantee loans from multilateral institutions. In China, local governments finance the mass transit investments out of their own budgets, commercial loans and sometimes earmarked funds. Other financing mechanisms such as the development of real estate around the stations and along the right-of-way can be a major contribution for the mass transit investment. It is recommended that the Hong Kong example be followed but also be aware that this requires very thorough planning from the start of the development and specialists in real estate in the planning teams.

Other financing mechanisms could be either Public Private Partnerships where the private sector will for example provide rolling stock and systems in exchange for an operating concession for thirty years based on the tariffs agreed or on a remuneration tariff which can be higher than the tariff imposed by government. The PPP is in fact a mechanism by which Government, for lack of investment budget, contracts with the private sector to advance those investments which are paid by a combination of the revenues obtained from the operation of the system plus an annual subsidy if a social tariff is imposed and the overall remuneration contracted with the private sector is not achieved just with the operation net revenues. Other forms of financing mechanisms for existing systems consist in concessioning out the operation of the system to the private sector at the lowest subsidy. This, if well done, can reduce significantly the operating subsidies paid by the State, freeing thereby the savings for investment.

Advertising in and out of the vehicles, in stations and rights-of-way can be a source of significant revenue. So is the proper use of station space which can be rented for businesses and use of the right-of-way for placing fiber optics and other telecommunications equipment for which phone and cable companies pay a fee and often the installation. Experience has shown that few LAC subway systems are very professional in these areas, the best being Santiago, Medellín, São Paulo and Rio.

***PILLAR 4 – Progressive participation of the private sector in operation and investment under a regulatory authority***

In LAC cities there is an attempt to involve more and more the private sector in the operation and investment of mass transport systems. This is a result of bad management by the public sector with huge operating subsidies as it happened in Rio and Buenos Aires before the operating concessions to the private sector; or the need for Government to complement its limited investment funds with private sector funds as it happened with São Paulo's Metro Line 4 PPP. Involvement of the private sector requires an enabling environment that mitigates risks perceived by private investors. This enabling environment includes a good regulatory framework with a very clear concessions or PPP law; guarantees which provide the private sector with risk mitigation in case government fails to pay its part of the contract obligations; and a recognized regulatory authority which will be overseeing the contracts and ensure that both parties comply with their obligations. The private sector requires also sufficient independence to be able to manage the systems in a cost-efficient way to meet the performance targets agreed in the contract. This was still not possible in China because in the only PPP in Beijing, the city owns more than 50% of the Special Purpose Company created to operate the system. China would benefit by allowing some concessions of the subway systems to the private sector. This might provide a reference for public run systems and a benchmark for operating subsidies and level-of-service provision.

# Part 3: What Role for Public Private Partnerships?

Michael Schabas

## 1. Introduction

Many Chinese cities are now developing Urban Rail systems. For most cities, Urban Rail will be their most complicated and expensive project. Most Urban Rail systems are successful and become valuable and essential elements of the city's infrastructure. But they often take longer to build and cost much more than expected. Some also cost much more to operate, and do not attract the projected traffic. Mistakes in the planning, design, construction, and operation can leave a city Government with an enormous financial burden, as well as inferior or inadequate transport service that will impede development for future decades.

Many Governments are now entering into "Public Private Partnerships" (PPPs) to develop and operate Urban Rail. A PPP is a commercial deal between Government and a Private Sector Company<sup>31</sup> to deliver a public service.

A well-designed PPP can help deliver a better Urban Rail system at lower cost and lower risk. But Urban Rail PPPs can be very complicated. A badly-structured Urban Rail PPP can end up being very expensive if it does not provide necessary flexibility.

This paper briefly considers the reasons for using a PPP, and discusses the main choices in the type of PPP to be used. It includes a basic guide as to how a city Government can go about implementing a PPP for Urban Rail. Some experience of Urban Rail PPPs is described. Finally, specific recommendations are made on the possible application of PPPs to Urban Rail projects in China.

This paper is the result of a three week mission co-sponsored by the World Bank and the Institute of Comprehensive Transportation. While the author has tried to verify all facts, only limited information was available on recent actual Chinese experience with Urban Rail development. There may, therefore, be significant omissions.

## 2. What are the benefits of a PPP?

The principle reason to consider using a PPP is to deliver better services to the public, faster, and at

### *Key benefits of PPP:*

- *Competition and Innovation*
- *Clarify objectives and costs*
- *Risk Transfer*
- *Impose financial discipline*
- *Improve efficiency, quality and accountability*
- *Ability to deliver better services, faster and at lower cost*

<sup>31</sup> The term "Private Sector Company" is used for convenience, but can include "joint ventures" and partially "state owned enterprises" where they behave like private sector companies. Often the Company will actually be a Consortium or Special Purpose Company formed by several Companies to bid for the project.

lower cost. There are several ways that PPP can help to do this.

First, the process of competition by Private Sector Companies for the role of PPP partner can bring innovation in system design, construction, and operations. This can reduce costs and improve the value of a project. Most cities only build a few Urban Rail lines, and have little chance to learn from their mistakes. Also, city planners may lock in too early on an Urban Rail plan, failing to consider a wide range of alternatives.

Second, the PPP competition process can clarify system objectives. Urban Rail systems are usually proposed to achieve several objectives. But there are often conflicts between these objectives, and trade-offs which need to be made. For example, there are choices as to how many stations to have, where they should be located, whether to use elevated or underground alignments, what provision to make for future traffic growth, etc. Each of these has costs and benefits. Because the costs and benefits occur at different times, to different people, government or companies, and have different levels of uncertainty, it is not simple to determine the best solutions. If these issues are not resolved, the resulting system may cost more to build and operate, and deliver fewer benefits. A well designed PPP process can help expose conflicting and competing objectives, and force decision makers to make explicit decisions as to priorities and values.

Third, a PPP can transfer implementation risks from Government to a Private Sector company with specialist skills and experience. Urban rail systems are costly, and require diverse and skilled staff. Most cities have limited experience building Urban Rail, and will have difficulty establishing an in-house team with the required skills. An experienced Private Sector Company can mobilise the required skills better and thereby reduce the cost and risk of on-time system delivery.

Fourth, contractual separation of Government as “service purchaser” from a Private Sector Company which is responsible for “service delivery” imposes a financial discipline that can improve efficiency, service quality, and accountability. Experience in other countries is that Urban Rail systems, if operated directly by a Government agency, often have lax financial controls and tend to become inefficient and often not maintained properly in the medium to long term.

Fifth, with a PPP structure, Government may be able to use private finance and build a larger Urban Rail system, faster. Urban rail systems are very expensive, typically at least RMB 10 billion for even a fairly short elevated line, and many times more for complex underground networks. Most cities can only afford to build one or two lines, even over a decade or more. PPPs can provide a way to finance Urban Rail without violating Government restrictions on borrowing. But the Private Sector company will demand a

*Main types of Risk:*

- *Construction risk – how much will it cost to build the system?*
- *Integration risk – will the equipment (trains, track, signals, tunnels) work together and carry the required passengers?*
- *Operating risk – how much will it cost to run?*
- *Traffic and revenue risk – how many passengers will use it? Will the profits support the debt?*

*These risks can be transferred in one single contract or several contracts.*

healthy return on its investment, so PPP should only be used where substantial responsibility and risk is being transferred to the private-sector company.

There are other costs to using a PPP. Compared with “conventional” public sector procurement, there will be more contracts to negotiate before work can start, and the Government will need to retain specialist advisors to assist in awarding and managing the PPP. Whether the benefits outweigh the additional costs and complexity depends on local circumstances and the nature of the project, and the skill in which Government attracts, manages and motivates Private Sector Companies to do what they are best at doing.

There is no single “right” way to do an Urban Rail PPP. Government objectives and local conditions will shape the decision as to the type of PPP. Hopefully, understanding the successes and failures of others will help Chinese cities build more and better Urban Rail systems, at lower cost.

### 3. What are the main types of PPP?

Key choices for Urban Rail PPPs are:

- whether a single Private Sector Company is responsible for infrastructure, equipment, and operations, or the responsibilities are split between different companies or retained by Government
- whether the Private Sector Company is taking risk as to actual system revenues and operating costs, and whether these risks are shared or mitigated by Government.

There is endless variety in PPP structures (and even more variety in the names that are used to describe them).<sup>32</sup> In this section we discuss the main issues that arise in the contract models and issues.

#### 3.1 Full “Build Operate Transfer” (BOT)

In concept, Full BOT is the purest form of PPP. A contract (also called a “concession”) is awarded to a Private Sector Company to “Build” and “Operate” a complete Urban Rail system, very much as companies deliver other facilities and services. This “BOT Company recovers its investment from operating profits. Usually the BOT Company is required to “Transfer” a working Urban Rail system meeting specified standards to Government, at some point in the future.

##### *Main types of PPP Contracts*

- *Full Build Operate Transfer (vertically integrated)*
- *Partial Build Operate Transfer (infrastructure only)*
- *Partial Build Operate Transfer (equipment only)*
- *Operating Franchise*
- *Can be with or without traffic risk*

The full BOT model has several important advantages:

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<sup>32</sup> See *Best Practices for Private Sector Investment in Railways*. ADB/World Bank Report July 2006. This is an excellent discussion of PPP experience mostly in mainline railways. See also appendices, available from [www.adb.org](http://www.adb.org)

- The BOT Company usually has previous experience with Urban Rail and can draw on international skills and resources. A dedicated BOT Company with a single purpose is likely to be more efficient at delivering a system than a Government department that has many other responsibilities, which may have no previous experience with building Urban Rail, and which may need to operate within public sector management constraints. Because the BOT Company is accountable to shareholders rather than taxpayers, it will usually have more flexibility to negotiate with suppliers and business partners and to motivate skilled staff. The sheer complexity of Urban Rail projects means that some things will always go wrong. A BOT Company will usually be more able to solve commercial and technical problems than a Government agency.
- The BOT Company will have the clear objective of maximising its own profits within the terms of the BOT contract. Normally, a BOT Company will depend at least partly on passenger revenues to recover its investment, so it should be highly motivated to deliver a system quickly and one that is safe and efficient to operate. In all aspects of system design and operation it will seek to maximise attractiveness of the system to paying passengers while minimising costs.
- The BOT Company will be able to optimise life-cycle costs, making tradeoffs between capital costs, maintenance costs, operating costs, and revenue benefits.
- The BOT Company will be accountable to investors who will usually insist on independent and periodic assurance that the system is being built and operated efficiently, and will attract the expected passenger volumes. This can be an excellent check on system viability – whether the Urban Rail project really is worthwhile.
- Government bears only a pre-defined financial burden, as set out in the BOT contracts. Normally most risks, especially cost overrun risks, will be taken by the BOT Company.

*Why Urban Rail BOTs are difficult*

- *“Natural Monopolies” so fares and service must be regulated to protect public interest*
- *Very expensive, long construction time, smallest increment is large*
- *Integrated into a city – interfaces with thousands of properties, buildings, other services*
- *Traffic depends upon other parts of the network*
- *Usually require subsidy in some form, and there is little potential for real competition - so Government wants control of fares*
- *Substantial operating costs and ongoing equipment renewals*

PPPs are never simple. However there are several factors that make Urban Rail BOTs particularly difficult:

- Urban transport (bus as well as rail) systems are usually “natural monopolies”. Without regulation, the BOT Company will tend to operate fewer services and charge a higher price, compared with the level that would maximise net benefits to society. At a minimum, the BOT agreement should set out rules about how fares are set, and the quality and level of service that is to be provided. For example, Government will probably want to specify whether air conditioning is provided, frequency of evening and weekend services and peak capacity, with

rules as to when capacity must be added to reduce overcrowding. As the Urban Rail system will be a highly visible monopoly service provider in the city, Government will often want controls over other aspects of system design, for example station architecture.

- The term of a BOT is typically 20 to 30 years, to minimize the annual cash burden on Government. This also reflects the long life of a new Urban Rail system. However, Government will want flexibility during that period to make major changes to the system, including perhaps extending the line, adding stations, or building connecting or even competing parallel lines. It may be difficult to make effective provision for this in a BOT contract. Bidders know this, and will try to take advantage of it.
- Competition from cars and buses means few new Urban Rail systems are commercially viable. Government subsidy is usually required. This is usually justified on the basis of transport, environment and social benefits which cannot be captured through fares. The subsidy payment can be in cash or “in kind” (for example, land or property development rights), or an annual payment, or some combination. Normally Government will not want to pay all the subsidy at the beginning, but will want to pay it over time. It will want to retain some ongoing control to ensure that the intended benefits are actually being delivered. But the BOT Company and its investors will want some certainty they will be paid, if they deliver what they are asked to do.
- Traffic demand will depend upon many factors beyond the control of the concession company. These include the pace of surrounding land development, which generates traffic demand, and development of competing and feeder transport modes including buses and expressways. BOT Companies will be reluctant to invest where traffic revenues are dependent, at least in the medium or long term, upon other Government actions.
- Operating costs will depend substantially upon labour and energy costs. While these are not directly within the control of government, they are likely to move generally in relation to the fares that can be charged. It makes sense for revenue and cost risk to be linked, and borne either by an operator or by Government.
- Even where a Private Sector Company is prepared to take all the risks of a BOT, there will still be some risk that the Company will fail. In this case, Government may be left with a half-built Urban Rail system, occupying valuable city space, which must either be removed or completed at significant expense. Government

*The problems with consortia*

- *Different members have different interests*
- *Contractors and equipment suppliers want to get paid up front – don't want to wait 30 years!*
- *Infrastructure and equipment life is 30+ years - needs long term finance*
- *Operators think about tomorrow rush hour, or 10 years at most*
- *Different interests mean consortium members often end up fighting each other*
- *Few companies can do full BOT alone - so consortia will continue to be necessary*

will want protection against these possibilities before allowing a BOT Company to start construction.

- Finally, there are in fact very few companies prepared to take on all the risks inherent in a full BOT concession for an entire Urban Rail line. Normally, bidders will not be single companies but will be consortia including equipment manufacturers, construction contractors, operators, and perhaps banks. Consortia have their own problems, as different members have different objectives. Sometimes consortium members get into legal battles with each other, affecting delivery of the system to Government.

Government will sometimes find that it must provide guarantees of the minimum level of revenue, if it is to get serious bids from Private Sector Companies for a completely new Urban Rail line. This may be because there is real uncertainty, but it could also be because the Government's own forecasts are optimistic, and not credible to bidder. In this case, Government should review its own plans.

Even where a Private Sector Company is prepared to enter into a full BOT contract, Government may find that it still carries substantial risk, for example if it is unable to provide a clear right of way for construction at the time required, or if it fails to provide feeder bus services to stations.

The cost of bidding for an Urban Rail BOT can run to several million dollars. Bidders know that Government will never commit to award a contract until it sees that it has actually received attractive bids. Indeed, Urban Rail projects are often cancelled after bids are received. So bidders will often ask that Government agree to reimburse a share of bid costs, especially if the project does not proceed within a fixed time. If this attracts more, serious bidders it can be worthwhile to pay something towards bid costs.

### **3.2 Partial BOT or “Build Transfer” (BT)**

A key problem with the BOT model is the mismatch between the long period required to pay off the capital investment, and the much shorter period over which Private Sector Companies (or indeed Government) are able to forecast revenues and costs with a reasonable level of confidence. A second problem is the need to include both project managers and operators in the same BOT Company, which is therefore usually a consortium. From experience, the “cultures” of system developers and operators are often very different, and this can lead to disputes.

The Partial BOT or “Build Transfer” (BT) model addresses these problems by splitting train operations from system construction and maintenance.

Essentially, the BT Company designs, builds, and equips an Urban Rail system to meet the required specification, but then provides it to Government. Sometimes, the BT Company is required to operate the system during a startup period and may perhaps even be rewarded with a share of revenues or operating profits. Sometimes the BT Company continues to maintain the system, in return for “availability” payments, but “operations” (as distinct from maintenance) are the responsibility of Government. Sometimes operations then become the responsibility of a third party, with a separate contract with Government (see discussion of Operating Franchises below).

The BT Company generally takes responsibility to design and build a working system, but does not directly bear the long term cost or revenue risks.

As with full BOT, in a BT structure Government gets the benefit of an experienced Private Sector Company, with access to international resources, and able to operate free of the constraints of a government agency.

A disadvantage of BT is that Government will bear the full risk of the long term financial success of the project. The BT Company may bear the risk of delivering the Urban Rail System, but Government will bear the risk that the system can be operated efficiently, and attract the expected traffic and revenues. While it may be possible to use vendor financing, especially for the trains and equipment, Government is ultimately carrying most of the funding risks.

The BT Company will not have any direct interest in maximising passenger use, or in minimising lifetime operating costs. Government will in effect be purchasing a system, and will need to use contractual mechanisms to ensure that the system can be operated safely and efficiently. While most reputable contractors will want to be associated with a successful project, Government will certainly need to retain its own expert advisors to review the system specification and detailed designs and ensure that it meets long term requirements. Buying a Metro is not like buying a car or a suit of clothes. While there are “standard” specifications, there are also hundreds of important choices to be made to finalise the design, many of which have a major impact on the successful operation of the system.

If the private sector company is simply building and handing over a working Urban Rail system, there may be no good case for using Private Finance. Government may be able to borrow the money more cheaply and buy the system outright. This is commonly called a “Turnkey” contract, but not a PPP.

Sometimes, maintenance of the system will be left with the BT contractor, but operations will be the responsibility of Government or a third party. There can then be a case for using private finance. While there is much experience with this, it brings some contractual complexity. The PPP contracts will need to set out clear and workable rules as to the rights and responsibilities of the system maintainer and the system operator.

It may be possible to link the BT contract directly to a contract with another party to operate the system. In some cases, Government has appointed a “shadow operator”, or even awarded an initial contract of say 5 years duration, to operate a new system, at the same time as it awards the BT contract to supply the system. This shadow operator can provide support the Government in ensuring that the BT Company supplies an efficient and effective system.

Although a BT contractor will not actually operate the system, it is still possible to require the BT contractor to guarantee full life maintenance costs subject to agreed levels of usage. For a system with automated driving, it may even be possible for the BT contractor to guarantee a specific level of energy consumption.

Compared with BOT, there may be more competition for a BT contract. Bidding consortia will not need to include an operator, and there will not be long-term exposure to revenue and operating cost risks. Several large engineering companies and equipment

manufacturers have shown willingness to lead BT consortia, together with financial partners, procuring other elements of the system with competitive tenders.

### **3.3 Operating Franchise**

Like BT, an Operating Franchise (OF) has the advantage of matching the skills that are available in industry. There are now several Private Sector Companies that are willing and able to take on the responsibility for operating Urban Rail systems. These companies have limited experience or appetite for building entirely new systems, but can be very skilled at managing large numbers of staff, ensuring reliable daily delivery of train services, and controlling costs. They can also bring useful skills in marketing and pricing, that can increase traffic and revenues.

Urban Rail is a complex business, requiring a wide range of specialist skills and focussed, day to day management. In public ownership, Urban Rail systems often experience deteriorating performance, rising costs, under-investment, and poor customer service and marketing. By awarding an Operating Franchise to a Private Sector Company, Government limits its role to service “purchaser”, alongside paying passengers. Operating Franchise companies can offer:

- Focussed, experienced management
- Innovative proposals for service enhancement and investment
- Responsive to performance monitoring and penalty/incentive regimes
- Staff recruitment, motivation and management
- Efficient purchasing of equipment and consumables, including fuel and electricity

Normally, Government will define the minimum service requirements and the fares regime within which the OF company will operate. It will invite competitive proposals, and award the contract to the best bidder under some combination of best service and lowest subsidy.<sup>33</sup>

### **3.4 Gross Cost versus Net Cost**

A major distinction in PPP contracts that include Operations is whether they are Gross Cost and Net Cost.

In a Net Cost contract, the Private Sector Company retains all passenger revenue and receives defined additional compensation from government (subsidy). Normally there are clear rules as to the fares that the Company is allowed to charge, often including schemes for through-ticketing onto buses and other railways. There will also be rules as to the minimum service level that must be provided. However, Net Cost contracts usually leave the Company with some freedom to offer better services, and to offer special fares in addition to the regulated fares. Sometimes, a Net Cost contract will include additional

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<sup>33</sup> As Urban Rail systems mature, OF Companies may be able to pay “premiums”, or “negative subsidy”, to Government. Many successful Urban Rail lines can generate fare revenue that entirely offsets operating costs as well as capital renewals. However, operating losses are difficult to avoid in early years, and even over many years fares may not pay back all of initial capital costs.

per-passenger subsidy payments, and “compensation payments” for carrying certain types of passengers who are entitled to discounts (students, pensioners, disabled persons).

In a Gross Cost contract, the Private Sector Company is paid to provide a specified service regardless of the number of passengers carried or the revenue collected. Government may be able to vary the specification during the term of the contract, in which case the actual amount of the Gross Cost payment would be adjusted, for example the number of trains operated each day, but otherwise the Company has no direct interest in the commercial success of the business as a whole. The Private Sector Company may be responsible for collecting revenue on behalf of Government, and may have a small incentive to ensure effective collection.

There are various “hybrid” structures.

Sometimes, a BOT or OF Company takes revenue risk within a range, but with a “cap and collar”. If revenue is below the “collar”, then Government guarantees a minimum level of revenue. If revenue climbs above the cap, then revenue above the cap is shared with Government. While these reduce risk to bidders, they also reduce the incentives. A bidder might win a contract with very optimistic traffic forecasts, knowing that it could rely on the collar. Government needs to be convinced that revenue is likely to be in the range between the cap and collar. If in fact either the cap or collar is reached, it may make sense to renegotiate the contract, with the cap or collar shifted, so as to restore incentives to the PPP company.

A Gross Cost structure can give Government much more future flexibility. Because the PPP BOT or OF company is not bearing revenue risk, Government retains more freedom to determine service levels and fares. The Company will not have any interest in whether or not the city provides feeder buses, or whether the city builds connecting or parallel lines. The PPP company will not be concerned about the traffic impacts of future extensions.

Flexibility is more likely to be an issue with BOT or BT contracts which include infrastructure. Because of the large capital investment, these contracts are likely to have terms of 15 or even 25 years. Any BOT or BT contract should include careful provision for possible line extensions. This can be very difficult in a Net Cost contract, although there are solutions that have been used. Even in a Gross Cost contract, extensions to a line would affect reliability or maintenance of the initial line.

If a BOT or BT company is using proprietary equipment (mostly trains, signalling and communications) that cannot be obtained through competitive bidding, consideration should also be given to future supply of additional compatible equipment. This can be a serious problem, even with conventional (non-PPP) Urban Rail projects. Manufacturers will not be prepared to commit to supply specialist equipment at fixed prices, for orders that may be confirmed many years in the future.

### **3.5 Contract length**

The appropriate length of a PPP contract is usually a trade-off between flexibility (for Government) and providing a return on investment (for the Private Sector Company).

Government will generally want to have shorter PPP contracts, retaining flexibility to deal with changing needs. Private Sector Companies will want longer contract terms, long enough to recover their investment, including their investment in preparing their bids.

For example, if an Urban Rail line proves inadequate to meet traffic demand, Government will want the right to build a second line. Private Sector Companies will want a BOT contract to preclude building a parallel line, at least for a defined period.

However Private Sector Companies will not generally want to take very long term risks with respect to revenues and costs, unless these can be passed on or hedged. They will aim to make a profit in the short or medium term, with the ability to walk away if conditions become difficult far in the future.

Generally, contract lengths of 5 to 10 years are appropriate for Operating Franchises. BOT Contracts are usually longer, 20 to 30 years, so Government can minimise annual payments and amortise the capital cost over a longer period. However a shorter BOT term is possible, either with higher annual payments or with an option to “buy out” the BOT at predetermined prices at specific dates. This can provide flexibility where future extensions are contemplated but not committed.

### **3.6 Escalation**

When forecasting costs and revenues, inflation is a major area of uncertainty. Contracts can include mechanisms to adjust payments to reflect underlying inflation, or changes in prices of specific inputs. Since Government’s own income will increase with inflation, it can make sense for Government to take the risk of general inflation and make adjustments to operating subsidies accordingly.

Where a BOT or OF Company is taking passenger revenue risk (Net Cost), normally the PPP contract will allow for fare increases to reflect underlying inflation, or perhaps some more specific index related to incomes or fuel costs. If a BOT Company with a Net Cost contract is allowed to increase fares in line with inflation, or more, and if fares generally cover operating costs, then there may be no need to make adjustments for inflation.

Not all payments need to have inflation-adjustment. For a BOT contract, the capital costs will mostly be incurred in the early years of the contract, but paid off over many years in the future. BOT Companies will normally put long term debt in place at the beginning of the project, so there should be no need to adjust future payments to reflect inflation. Where a BOT contract includes both substantial up-front capital investment and long term operations, Companies can be required to distinguish capital and operating subsidy payments, which would be treated differently in escalation.

The situation for a BOT or OF Company with a Gross Cost contract is somewhat different. It may face increasing costs for example for electric power, without an increase in revenue. But Government’s income will not necessarily increase with these costs. The BOT or OF Company may have other ways to manage its risks, including changing suppliers or even purchasing “futures” on financial markets. Whether or not to offer to include escalation in a contract is a complex issue that needs to be studied in detail for each PPP contract.

### **3.7 Capital at Risk**

Because of the large value and long duration of PPP projects, careful design is required to ensure that the Private Sector Company always has capital “at risk”. This can be a particular problem where the Private Sector Company is a consortium, sometimes led by builders, equipment suppliers, and property developers who may have little long-term interest in successful or efficient operation of the system. Normally a Private Sector Company would not risk bankruptcy but member companies within a Consortium are less concerned if they are able to make money for their parent company first.

Performance Bonds are sometimes used to ensure that the Private Sector Company is always exposed to substantial financial risk. The Performance Bond is usually set at some proportion of annual revenue or profit. It must be posted by the Company, usually in the form of a bank guarantee, at the time of signing a binding contract. The bond is paid out to the Government under specified conditions, including early termination and non-performance by the PPP contractor.

A performance bond is most important in OF contracts. In most BOT and BT contracts, the Private Sector Company is committing substantial capital investment for which it is only earning a return over time. The company therefore has a strong incentive to perform, and will suffer large financial losses if it fails. At least in the early years of a BOT contract, a Performance Bond may not be necessary. However, for OF contracts, there is sometimes little or no capital investment on the part of the Company. There is therefore the risk that a Company will bid recklessly in order to win, either making money (if it is lucky) or abandoning the contract (if it is unlucky). In the latter case, Government will be left with a problem, at a minimum having to rebid the contract again, perhaps also facing a disruption to services or a delay to the project.

In the latter years of a long contract, BOT and BT contracts become similar to OF contracts. Sometimes there is also a bond for restoring or repairing facilities or equipment that are returned to Government at the end of a contract.

## **4. How to do a PPP**

### **4.1 Structuring the Deal**

The first step in developing a PPP is to establish, in principle, what Government is trying to achieve and how it wants to allocate responsibilities between the potential parties. There are literally hundreds of issues which must be decided. For example, does it want private bidders to suggest the route and stations, or simply to implement a scheme that has been devised by city planners? Does government want to be able to decide changes to the train services, year by year in to the future, or is it willing to leave this to market mechanisms?

Any Government considering using a PPP will need to retain specialist advisors with relevant experience. Normally, the following types of advisors will be used:

- Economic and Commercial Advisors
- Lawyers
- Accountants/Auditors
- Specialist Technical Consultants

Economic and Commercial Advisors with knowledge of the Urban Rail industry and experience with PPPs are essential to define the core “proposition”. Essentially this is the fundamental “deal” between government and private “partner”. It will establish

- The split of responsibilities and risks between Government and the Private Sector Company (the BOT, BT or OF company).
- Detailed specification of what the Private Sector Company is required to provide or deliver, how their performance will be recorded or monitored, and how they will be paid for it
- For a BOT or OF, rules for setting and collecting passenger fares, any system for sharing revenues with other operators, and any commitments by Government to integrate bus and rail systems
- Other obligations on Government, for example provision of property, permits, licenses
- Provisions in the event of serious non-performance or default by the private partner
- Provisions for arbitration in the event of a dispute

#### *What type of PPP Contract?*

- *Many ways to write contract – no “standard” but some common types*
- *Government wants to achieve certain objectives (and these may change over time)*
- *Private investor wants certainty and control of factors which will affect profitability*
- *A good contract reaches a balance of risk transfer and control*

The economic and commercial advisory role is usually led by a merchant bank, economics, or management consulting firm. The success of the competition will depend greatly upon whether the details of each issue, and how they are being addressed, has been thought through.

Each PPP is defined by a set of contracts between the parties. These contracts set out the responsibilities of each party. The contracts can be very complex, running to hundreds or even thousands of pages, in an attempt to anticipate every possible situation that may arise. Lawyers will be needed to draft the actual PPP contracts, in a form (law and language) acceptable to both the Government and potential bidders. Generally, Government can expect the best competition if contracts are drafted in English and subject to adjudication under the laws of recognised and neutral jurisdiction.

Accountants may be required to review financial plans, especially where a BOT or OF company will share in passenger revenues from existing bus systems. They may also be required to audit accounts of existing companies or activities that are being transferred with the PPP, or which provide historical information used by bidders to determine the pricing in their bids.

Specialist technical advisors will be required to review specific details of bids, and confirm that the proposals are reasonable and practical. For an Urban Rail system,

Government will usually need advisors with knowledge of civil and railway engineering, railway operations, environmental impacts (including noise and vibration), fire and life safety, and property acquisition. It is not unusual for a bid to be submitted that is in fact not practical, due to ignorance by the bidder of some local condition. Even if this is the most financially attractive bid, it may not be in the Government's interest to accept it as the bidder may subsequently discover its error and seek to escape responsibility. Contracts usually work best when both parties see some potential for benefit.

## **4.2 Competition for the PPP**

The private sector company should always be selected by a competition.

After appointing advisors, the next step is usually "market testing" or some form of consultation with prospective bidders. Usually an advertisement in a leading industry or international business journal will be sufficient to alert potential bidders. Depending upon the scale of the project and the extent of interest, it may be useful to have a "road show".

Government and its advisors will determine the form of competition to select the Private Sector Company. Often, there will be an initial pre-qualification and shortlisting. This gives bidders and opportunity to understand the project and, if necessary, to form consortia. Government needs to recognise that bidder companies also need to get their own internal approvals to participate in a project, and this can take some time.

The objective usually is to short list three or four serious bidders, to ensure competition and value-for-money to the Government. If more than four companies are selected, bidders will likely drop out because the chances of winning will not be good. Generally, it is better for Government to pick the short list, rather than leave it for bidders to select themselves.

If possible, all terms of the proposed contract should be finalised before inviting final binding bids. Bidders can be invited to make non-compliant proposals, but usually they are also required to make a proposal that is entirely compliant.

Although the winning bidder is usually chosen as the one asking for the least amount of money (or paying Government the most), sometimes the choice is also made partly on quality aspects if so, then a structured and objective system should be used to determine which is the "best" bid.

Usually, bidders are required to submit a detailed business plan, including technical description and financial projections. Although the bidder is taking the risk that it can in fact deliver, Government also has an interest in understanding whether or not the bid is realistic.

The entire process of bidding and awarding a PPP for an urban rail system will normally take 6 to 12 months, depending upon the complexity of the project. Some operating franchises have been awarded in as little as 3 months, while complex BOT contracts can take 2 years or more.

A key risk throughout any PPP competition is that the process will for some reason fail, and need to be re-started. This can happen for many reasons, for example:

- No acceptable bids are received (perhaps because the Government's requirements were unreasonable or unrealistic)
- Having narrowed the range of bidders to a shortlist, one or more of the bidders withdraw, leaving Government in a weak position to negotiate terms with the final bidder
- Sometimes issues emerge late in the process that cannot be resolved in a way that is acceptable to Government and bidders. This may result from an oversight, or simply both parties putting off a difficult issue in the hope that the other side will give in.
- Priorities change which mean Government is no longer willing or able to award the PPP contract on the terms under which bids were invited.

Bidders will usually have previous experience with Urban Rail PPPs, while the city government may be doing it for the first time. Bidders will “play games”, holding back difficult issues until there are few competitors, and only drawing attention to problems where they think it will help their competitive advantage. For example, failure to include effective provision for future line extension can be seen as an “escape route” for a BOT or OF contractor. They may be prepared to use optimistic traffic forecasts in the expectation the contract will need to be renegotiated anyway before they get into problems.

#### **4.3 Costs to award a PPP**

Urban rail systems are very expensive. A typical Urban Rail system can cost \$1,000 million to build, and another \$50 million per year. Including equipment maintenance and renewals, a BOT contract for an Urban Rail line can be worth \$3,000 million or more. It makes good sense to spend money making sure that a PPP is well designed, and that details have not been overlooked. Government costs to develop a PPP scheme, including the costs to develop the scheme concept, hold a competition, negotiate and award a contract, can run to 1% or more of the total value of the contract. But this can be very worthwhile if it can save 5% or 25% of the total system cost.

#### **4.4 Managing the contract**

As suggested by the name, a PPP is a Partnership between Government and a Private company or consortium. The Partnership lasts many years. While most of the burden for delivery is on the Private Sector Company, Government will need a specialised team to design and manage the PPP competition, to award the contract, and to ensure the selected Private Sector Company fulfills its obligations. Most city governments find that it is very difficult to manage an urban rail project within an existing departments, and usually need to set up some sort of special “Urban Rail Procurement Agency” for this purpose.

The URPA needs to have a clear mandate and dedicated budget. It will need a small but highly skilled staff, usually no more than 20 or 30 people for a metro system growing at the rate of 5 to 10km per year. Normally this would include:

- Project Director, able to understand all key issues, and take overall responsibility for project delivery

- Finance Director, experienced in PPP projects, to manage the project finances and to control all expenditure
- Technical managers, ideally with broad experience but covering, between them, rail planning, rail engineering, rail operations and marketing, municipal engineering (streets, sewers, etc), city planning and property development
- Contract Managers for each of the contracts or lines, or sometimes for sections of the lines.
- Public relations and consultation staff, to explain the project to the general public and to communicate with the thousands of homes and businesses that are likely to be directly affected by the project.

The URPA will need to be able to hire staff directly, including specialists who will need to be recruited from other cities and perhaps even internationally. Key staff may be hired on limited-term contracts, typically 2 to 5 years, during key phases of the project. The URPA will also need support from specialist technical consultants, drafting the bid documents, reviewing the bids, and ensuring the system that is delivered meets the specification.

Usually, the URPA answers to a regional authority of some kind. China is fortunate in having strong city governments with broad powers across the city and usually also the surrounding region. Given the scale and importance of Urban Rail, the URPA Project Director should report directly to the Mayor.

## **5. PPP Experience**

“Public Private Partnerships” were widely used in the 19th and early 20th century to implement urban and national rail systems. The French national railways, most of the New York Subway, and light rail systems in many cities were built using what would now be called PPPs, although the term PPP (and also BOT, BT, etc.) have only been used much more recently. From 1930 until around 1980, almost all Urban Rail systems were built by Government using “conventional” public sector procurement. Private companies were used only as contractors for specific elements of construction and equipment supply, and almost all systems were operated directly by Government. For new Urban Rail systems, city Governments sometimes would award dozens or even hundreds of separate contracts to build stations, supply equipment, and provide other services. There were often serious coordination problems, with incompatible or unsuitable equipment being purchased, resulting in cost overruns and delays.

From about 1980, Governments started to experiment with new ways to procure Urban Rail systems. Some cities used single “turnkey” contracts, with a company taking responsibility to supply and install a complete Urban Rail system. Sometimes this was linked with “vendor financing”, with the city only becoming liable to pay when and if the system was completed and operating. Governments also began to experiment with franchising or contracting passenger rail services. Beginning in the 1990s, some Governments have entered into “Build Operate Transfer” (BOT) contracts for entire Urban Rail Systems.

Some of the more prominent examples of Urban Rail PPPs are described here.

## 5.1 Case Study: Vancouver Skytrain

The Government of Province of British Columbia Canada contracted in 1981 with UTDC to design, build, and operate an automated 22km Urban Rail system. This line was one of the first generation of systems supplied under a “turnkey” contract, with a “single” contract to design and build a complete working system.

Perhaps because it was awarded in the days before personal computers, the contract was very simple, less than 200 pages in length, with simple drawings. The contract was fixed price for equipment including trains and signalling, but “cost plus incentive fee” for the stations and tunnels. There was no competitive tender process, in part because UTDC was itself owned by the Government of Ontario, another Canadian province. The system used several unusual technologies, including linear motor propulsion. The “Expo” line opened on time and has worked very successfully, attracting traffic in line with expectations. There were however substantial cost overruns, which were shared between the two governments.

British Columbia subsequently built three substantial extension of the Skytrain, the third effectively a second line. In each case, equipment including trains and signalling were provided by UTDC under negotiated contracts. The BC Government had a weak negotiating position with UTDC, by then a subsidiary of a larger company, Bombardier. Although the initial contract gave the BC Government certain rights to the technology and to seek competitive bids, only UTDC/Bombardier was actually producing the equipment which was also being used on systems in New York and Kuala Lumpur. From a passenger’s perspective, the system is very good, with automated trains running as little as 100 seconds apart during the day and with trains very five minutes or less even late at night.

In 2003, Vancouver Canada decided to build a third Skytrain line. There was no strong case for an operational connection to the existing system (although free interchange will be provided at two stations). So the BC Government was in a stronger position and held an open international competition, seeking a BOT contractor to design, build, and operate the system for 35 years. The bid process was designed to allow innovation by bidders within reasonable parameters. The BC government also agreed to make a contribution to the costs incurred by two final bidders. The bid process actually took 2 years.<sup>34</sup>

In 2005 a BOT contract was awarded to a BOT Company led by a major engineering company. The BOT Company made some very innovative proposals for the tunnel and station design, which substantially reduce costs. The Company does not include construction companies or manufacturers among its shareholders, but has procured stations, tunnels, trains, and all other equipment by competitive tender. Government will pay \$1,331m of the \$2,005m capital cost in stages up to system commissioning. The BOT company will provide the remaining \$720m, and recover its investment mostly

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<sup>34</sup> See *British Columbia Richmond Airport Vancouver Rapid Transit: Canada Line Final Project Report - Competitive Selection Phase April 12 2006* ([www.ravprapidtransit.com/file/uploads/docs/doc495.pdf](http://www.ravprapidtransit.com/file/uploads/docs/doc495.pdf) ). Many additional documents are available at [www.ravprapidtransit.com/siteMap.asp](http://www.ravprapidtransit.com/siteMap.asp) .

from availability payments. The “Canada Line” is expected to open for the 2010 Olympics, and is currently understood to be on budget and on schedule.

Vancouver now has a very extensive and very efficient urban rail system. The system has been built generally efficiently and at acceptable cost to the taxpayer. The initial Turnkey contract delivered a high performance system without serious technical problems, while the later BOT competition has delivered real economies in design.

## **5.2 Case Study: Southeast Asia BOTs**

In the 1990s PPP contracts were awarded for seven Urban Rail lines in southeast Asia, three in Bangkok, three in Kuala Lumpur, and one in Manila.<sup>35</sup>

The six Bangkok and Kuala Lumpur projects were all conceived as BOTs. Five of these were remarkable in that private sector companies took leading roles even in the planning and promotion of the systems, including route alignment and location of stations. Government made it clear from the start that it was not offering to pay any subsidy. In most but not all cases the BOT “concessions” were awarded after some sort of competition.

The Bangkok Elevated Road and Transit system was abandoned after 12% was built. Most of the structures were subsequently demolished. The State Railway has built a new line on part of the route, as a public sector project.

The Bangkok BTS Skytrain was completed and is now making substantial operating profits. However profits are too low for backers to recover their equity.

The Thai government eventually decided to finance and build the tunnels and stations for an underground line as a public sector project, awarding a concession to finish the stations, supply and install trains and equipment, and operate the trains.

The three Kuala Lumpur BOTs were all completed as planned, but all quickly got into financial difficulty and were taken over by the Government. The Government has now introduced integrated ticketing and is marketing them as a single network together with buses.

In Manila, a private company proposed and planned the line, and persuaded Government that it would be a worthwhile addition to Manila’s urban rail system. Government awarded a contract to the Private sector company, which built the line essentially under a Turnkey contract but with annual lease payments rather than a single payment on completion. The project is described as a “Build Lease Transfer” contract. Unlike the Bangkok BOTs, the Private Sector Company took no risk either of operating costs or revenues. The Government did subsequently award a contract, to the same company, to maintain the system, but actual operations and revenues are the responsibility of Government.

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<sup>35</sup> For additional information see [www.Wikipedia.org](http://www.Wikipedia.org) articles on Bangkok, Manila and Kuala Lumpur mass transit. See also *Financing Bangkok’s Mass Transit*, 2006 Transgate/IDC World International Development Consultants [www.idcworld.com/bangkok.htm](http://www.idcworld.com/bangkok.htm)

**Table 3-1: South East Asia BOT Contracts**

	<b>System Size</b>	<b>PPP type</b>	<b>Outcome</b>
Bangkok BTS Skytrain	23km \$1.7 billion elevated Light Rail	Full 30 year BOT; no subsidy	Opened 1999. Start up losses resulted in near-bankruptcy. Daily ridership now 400,000 and additional trains may be purchased. Thai government may purchase system to integrate with other lines
Bangkok Elevated Road and Train Scheme	36 km \$3.2 billion elevated toll road and Light Rail scheme	Full BOT, no subsidy,	Contract terminated 1998 after 12% completed. Most structures now demolished at public expense and replaced with Airport Rail Link built by Thailand State Railways (not a PPP)
Bangkok Metro “Blue Line”	21km underground Metro	Tunnels and stations by Government Equipment and operations 25 year BOT.	Opened 2004. BOT company “Bangkok Metro Company”. Ridership now 180,000 per day. Extensions now proposed.
KL Ampang (formerly Star)	27km elevated Light Rail	Full BOT, no subsidy	Built and operational. Start up losses resulted in bankruptcy. Ridership now 110,000 per day.
KL Kelana Jaya (formerly Putra Line)	29km elevated Light Rail	Full BOT, no subsidy	Opened 1998. Start up losses resulted in state taking over in 2002. Ridership now 190,000 per day; additional cars ordered,
KL Monorail	9km elevated monorail	Full 40 year BOT, no subsidy,	Opened 2003. Start up losses resulted in bankruptcy and state taking over in 2007. Ridership now 45,000 per day.
Manila Metro Rail Transit Line 3	17 km mostly elevated Light Rail	Tunnels and stations by Government Equipment and operations BOT.	Opened 1999, now carrying 400,000 passengers per day.

A World Bank study<sup>36</sup> has concluded that, generally, the lines were well planned and were valuable elements of transport infrastructure. There have been some problems with integration, both between lines owned by different companies and with bus and mainline rail systems. All three cities are now making changes to the lines and also improving bus-rail integration with electronic card ticketing systems. The World Bank study also concluded that, without the PPP, the lines would probably not have been built as quickly, if at all. However, it may be many years before private investors are persuaded again to invest in full BOT schemes. The main problem was overoptimistic revenue forecasts.

<sup>36</sup> See “A Tale of Three Cities:- Urban Rail Concessions in Bangkok, Kuala Lumpur and Manila - Final Report”  
December 2004, Halcrow Group Limited for ADB-JBIC-World Bank

### **5.3 Case Study: UK Urban Rail Systems**

In the late 1980s, several UK cities made proposals to develop light rail systems. All of the schemes are surface tramways, with a mix of street-running, and running on old railway lines.

The UK Government had previously funded Urban Rail systems which had suffered serious cost overruns, and which has not attracted projected traffic. It therefore insisted that new Light Rail schemes could only go ahead the following principles:

- Private BOT concessions, receiving an up-front capital subsidy which must be clearly less than the total initial capital cost
- Remaining costs to be recovered by the BOT company, and at its own risk, from operating profits

#### **Manchester**

The first BOT scheme, approved in 1988, replaced an earlier proposal for an underground system. Manchester Metrolink Stage 1 was completed in 1992 and traffic exceeded expectations apparently by about 5%. Provision was made in the PPP agreement to facilitate extension of the system. Essentially, Government had the power to “buy back” the line, so that it could be “sold” again together with the obligation to build further extensions. This process has now been repeated twice, extending the system to 37 km. Stage 3 is now underway using the same PPP model. The public sector contribution will be funded in part from an area road charging scheme, similar to those implemented in Singapore and London.

Overall, the development of Light Rail in Manchester has been a success for the city and the taxpayer. Successful bidders have also made money.

#### **Sheffield**

A second scheme was built in South Yorkshire (Sheffield). After the success of Manchester, the UK Government allowed the Sheffield system to be built under a turnkey contract using public funds, with the understanding it would be “sold” upon completion to a private operator and operated as a Franchise. The 29km system opened in 1994 and operated in accordance with the specification, although there were problems especially with the fare collection system. It also became apparent that traffic had been grossly over-estimated. The system was eventually “sold” to a private sector bus operator for GBP 1.1 million as a 25 year Operating Franchise. Although full details are not disclosed it now appears to be operating profitably.

#### **Birmingham**

The West Midlands (Birmingham) awarded a BOT contract in 1995 for a 20 km light rail line on a model similar to Manchester. The system opened in 1999 and has operated reliably, however traffic has fallen short of forecasts and currently the system is not even making an operating profit. The PPP company is continuing operations, having made some changes to reduce costs. It does not apparently expect much return on its capital, but does expect the line to begin to operate profitable within a few years. Provision was

made in the BOT contract for extensions, similar to Manchester, however none have as yet been completed.

It may be that the BOT bidder used optimistic revenue forecasts, on the expectation that the contract would be terminated early so the line could be extended. This has not happened.

The route follows an abandoned rail line, which greatly reduced construction costs, but without extensions it does not effectively penetrate the city centre. There is competition from parallel bus routes, which in Britain are essentially unregulated. The buses are more convenient for many passengers.

The net result is that the West Midlands region has got a rail system of limited usefulness, but also at a very limited cost to the taxpayer. Had the scheme been funded directly by Government, it would almost certainly have cost the taxpayer more money, and be continuing to be a drain on tax money.

## **Croydon**

In 1996 a 99 year BOT contract was awarded to a consortium led by a construction company and an equipment manufacturer, to build a 28km surface tram system in the London suburb of Croydon. Estimated capital cost was GBP200 million. GBP125 million was provided by Government. The BOT Company hoped to recover the remainder from operating profits, almost entirely from fares. Many bus and rail routes in London operates profitably without subsidy, receiving fares revenue through London's integrated electronic ticketing system. Passengers transfer freely between bus, tram, and regional rail, paying fares on a zone system with revenues shared among routes based on actual distance travelled on each.

The line was completed in 2000 and traffic has been in line with expectations. By around 2005 Government wanted to make changes to the fare structure and to extend the system. However there was no effective provision for this in the BOT contract. In 2008 the Government bought the BOT company for a negotiate price of GBP98 million.

Croydon Tramlink has been a successful project for Government and passengers, providing a good service at an acceptable price. Manufacturers and contractors appear likely to have got back their investment although the project has probably not paid the return they were hoping for.

## **London Jubilee Line and DLR**

The initial Jubilee Underground Line was built in stages from 1930 to 1979, as a public sector project. Originally called the "River Line", it was to link new development in London's Docks with central London. The project was abandoned in 1979, because it was too costly.

In 1984-1988 a much cheaper elevated "Docklands Light Railway" was built, under a turnkey contract. This attracted large scale redevelopment to Docklands. An extension in tunnel into the "City" was built 1988-1992, and the Jubilee Line was finally completed, although on a somewhat different route, by 1999.

The DLR “City Extension” and the Jubilee Line Extension were both developed by the public sector, although with financial contributions from developers of the Canary Wharf. Both opened late, and both had serious technical problems. In 1993 the UK Government awarded a “Prime” contract to make reliability improvements to the DLR, including major changes to the signalling. DLR is now one of the most reliable railways in Britain. In 1997, Government awarded a 7 year Operating Franchise, with revenue risk (Net Cost) for the DLR system. The operating franchise was re-bid in 2004 but is now on a Gross Cost basis.

A package of upgrading works is now also underway on the Jubilee Line, as part of the London Underground infrastructure PPP. Essentially, the London Underground network is being operated, maintained and upgraded under long term contracts, with payment based on availability. Train and station operations, however, remain in the public sector.

A second extension of the DLR, to Beckton, was originally planned as a BOT, with operating and traffic risk transferred to a private company. The line served essentially vacant land and there was a large risk that traffic would simply not materialise. However Government decided that it was cheaper to build the line itself and judged that there was little traffic risk. In practice, land development was much slower, and lower density, than expected. Traffic was far below expectations. Although the line is not treated as a separate “business”, it seems clearly to be costing Government money indirectly with revenues probably not covering operating costs and certainly not covering capital costs.

Three extensions to the DLR have been built under BOT concessions, to Lewisham, City Airport, and Woolwich Arsenal. Two of these include tunnels under the river Thames. In each case, the BOT contractor financed, built and “operates” the infrastructure and is paid for making it available for use by DLR trains. The BOT contract does not include operation of the trains. The “operate” element of the contract includes cleaning and maintaining the stations, including escalators and lifts, and pumps (the line runs under the river Thames).

The Lewisham concession includes payments in part relating to passenger volumes.

These extensions are understood to all be successful for their investors as well as for Government and passengers.

Overall, the DLR and Jubilee projects have attracted traffic far in excess of expectations, but at somewhat higher cost than anticipated and with delays in implementation that might have been avoided using PPP models.

## **5.4 Australian Airport Railways**

In the early 1990s Sydney planned a new rail link to serve the Airport and also provide additional capacity for commuters from the South Hills. The government sought a private partner to share the costs and risks to develop the line. Eventually, Government decided to build the tunnels, at a cost of about A\$700million. Four new underground stations serving the airport and surrounding area were built by a Private Sector under a BOT contract. The private sector company financed and built the stations, which cost about A\$200 million, and is entitled to keep all revenues from a special “access fee” charged to

passengers using the new stations. The state railway operates trains serving the stations, and keeps all ordinary ticket revenue.

In the late 1990s, a Private Sector Company proposed to build a rail link to Brisbane airport as a BOT, recovering its investment from Airport rail passengers. The new railway would be a new branch from the city's existing rail network. A special high fare would be charged for passengers riding trains through to the airport. The private investment was about AUS \$220 million. The Government obligation was limited to operating trains to the airport once the line was built. The Government railway actually collects fares and only pays money to the Private Company after recovering its operating costs for the line.

In both cities there were doubts about whether the Private Sector traffic forecasts were reasonable, but after detailed study it was decided to allow the projects to proceed. Both cities would benefit from airport rail links Government might not otherwise have been willing to fund. In each case the State Railway would also receive revenues from additional trips over their existing network, from passengers travelling through to the airport.

In both cases, the forecasts did indeed turn out to be very optimistic.

The Brisbane airport railway company went through a financial restructuring, and is now operating profitably. However it is highly unlikely the Private Sector Company will ever recover its investment. The Sydney airport railway company actually went into bankruptcy, and government is continuing negotiations and may eventually take over the stations.

Despite the financial problems, each city has benefited from new airport rail links that would very probably not have been constructed using public funds. Furthermore, the cost to Government has been very limited. In both cases, airport rail services continued without serious interruption despite the financial difficulties of the private sector investors.

**Table3-2: Australian Airport BOT Contracts**

	<b>System Size</b>	<b>PPP type</b>	<b>Outcome</b>
Brisbane Airport	8.5km \$220 million elevated rail	35 year BOT; no subsidy	Opened 2001. Start up losses resulted in near-bankruptcy. Annual ridership now 1.1 million or about 3,000 per day
Sydney Airport	10 km deep tunnel with stations	30 year BOT, Government paid for tunnels	Opened 2000. Low ridership resulted in bankruptcy within a few months. Ridership now 15,000 per day, 30% of forecast.

## **5.5 Melbourne Trams and Trains**

Melbourne Australia has an extensive suburban rail network. There are 16 lines connecting into a city centre loop with four underground stations. The system was built by the State Railway over the past century. In 1998, the State decided to franchise the system, in order to reduce costs and to improve services.

The rail network was organised into two companies which were then offered as 15 year Operating Franchises. Bidders would be required to operate and maintain the system to specified standards. They would also be required to make specified capital improvements, including certain short extensions to the network, and purchase of new air conditioned trains.

The OF Company would retain all revenues, including a share of multi-mode ticket revenues allocated between Melbourne's bus, rail and tram systems based on surveys. They would also be paid an annual subsidy, plus a subsidy for each passenger above a benchmark level. The contracts were awarded to the bidder requiring the lowest level of subsidy.

At the same time Melbourne also franchised its tram (light rail) system, also divided into two companies, and a regional rail line.

Bidding was extremely optimistic, especially about potential growth in revenues. One British Company (National Express Group) won three of the five contracts, and commenced investing \$1 billion in new trains. By 2002, National Express realised that its traffic forecasts were unachievable, and that it would never make money on the contract. Government refused to pay higher subsidies. National Express eventually "walked away" from the contract. The company lost its Performance Bond and other capital invested, totalling approximately US\$200 million<sup>37</sup>. The Government was able to negotiate with the other Tram and Train operators (Veolia and Transdev) to take over the franchises abandoned by National Express. The two train franchises were merged into a single franchise with a term shorted to 10 years. There was no disruption to service and the purchase of new trains has continued.

In terms of passenger service, capital investment, and cost to the Government, the Melbourne franchise process has been very successful. The Government is now offering the franchises again, however it is expected that this time they will be Gross Cost franchises, with Government specifying the service and taking all the revenues.

## **5.6 Copenhagen Metro**

Copenhagen "Metro" purchased its 21 km urban rail system with two separate contracts. One contract was for the design and construction of the stations and tunnels. A second contract was for the installation and provision of a fully automated system including trains, signalling and electrification. Although construction took about two years longer than originally promised, this was due to difficult ground conditions which might have been difficult to foresee. The system works very reliable and offers an excellent level of service. It has subsequently been extended and a second line is under construction.

"Metro" also awarded a five year contract to operate the system. This contract allowed for a single 5 year renewal, which has now been granted.

Overall, the project appears to have been a success for Government, passengers, and the system contractors.

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<sup>37</sup> It is impossible to fix a precise amount, as only limited information was disclosed.

## 5.7 Chinese Experience

There have been many proposals for urban rail PPPs in China, but only a few that have actually been implemented.

Proposals for BOT concessions for new lines in Beijing were announced in the 1990s, but subsequently abandoned. Instead, almost all new lines in Chinese cities have been built as public sector projects.

We understand the Beijing Dongzhimen-Capital Airport Railway is being built under a “Turnkey” contract. Although no details were provided, we understand Bombardier is strongly incentivised to ensure that the system works as planned. The line is also to be operated as a separate “company” although still 100% owned by the city government. We were unable to determine the reasons for doing this.

Beijing Line 4 is being built as a partial BOT, with Government providing the tunnels and stations but MTR Corporation supplying and installing all the equipment and operating the line for 30 years. Although there is apparently also some traffic risk, MTR Corporation seems to have a strong incentive to select equipment to minimise whole life cost.

Shenzhen Line 4 is also being built by MTR Corporation under a BOT contract. This line is mostly elevated and the total cost is expected to be recovered from a combination of fare revenues and land development.

## 5.8 Summary

Overall the experience of Urban Rail PPPs can be described as “mixed success”. There have been a few successful projects where Government, passengers, and private sector companies have all benefited. In many, perhaps most cases, at least one party has not got the return it expected, or could have reasonably expected if the project was structured differently. There are many lessons here as to what to do, and what not to do. But there are no simple answers. Each Urban Rail project is different and the best way to develop each one will depend upon local circumstances.

Figure 1 is an attempt to “map” the different spans of contract type. But it is inevitably a simplification. The initial Vancouver contract was Turnkey, but included operations for the first two years. DLR Lewisham extension includes operations of tunnels and stations, but not trains. It includes an element of revenue risk, but it is very indirect. Melbourne trains is primarily an operating franchise, but includes replacement of some trains and construction of some short extensions.

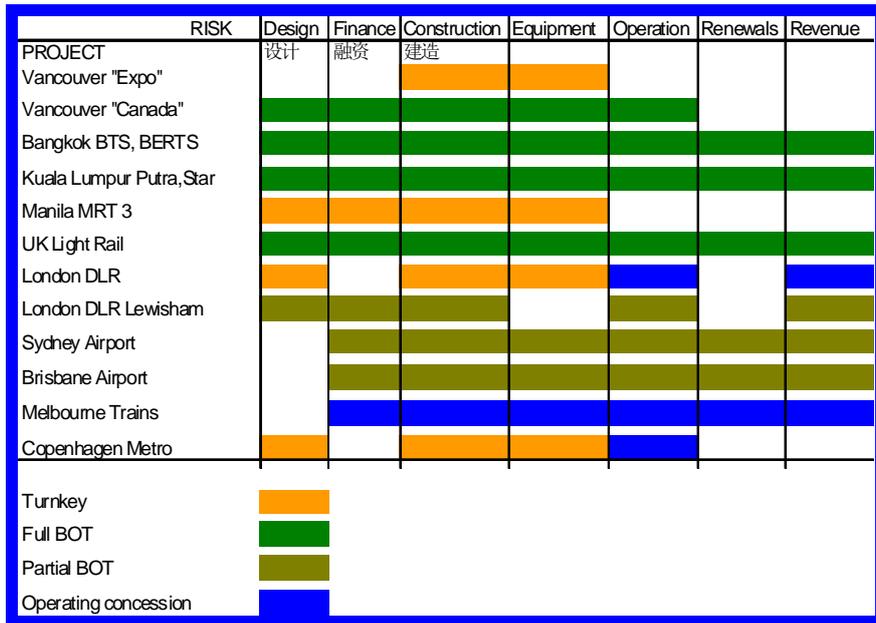


Figure 3-1: Split of responsibilities in Urban Rail PPPs

## 6. Can Urban Rail PPPs help in China?

PPPs have been developed to address specific problems in development and operation of public services. China now has more than 20 years experience with Urban Rail, almost all developed as conventional public sector projects. Before recommending specific types of PPPs to be used developing Urban Rail in China, we examine this experience and see which problems have actually occurred that PPPs might address.

Problems in Urban Rail Development can be categorised into:

- Planning and design mistakes, resulting in low ridership, higher costs and less efficient operation.
- Operational design and equipment integration problems, limiting performance and capacity, and possibly requiring expensive modifications
- Shortage of capital funding.
- Implementation problems, including poor project management and coordination, resulting in cost overruns and construction delays.
- Inefficient operation, resulting in higher costs and inadequate maintenance.
- Poor integration with other transport modes, resulting in lower ridership and revenues.
- Poor pricing and marketing, resulting in lower ridership and lower revenues

All of these have been serious problems in other countries. China has learned many lessons and probably not made the same mistakes. PPPs can help to avoid or reduce some, but not all, of these problems

## 6.1 System planning and design mistakes

### *What is it?*

Most cities only build a few Urban Rail systems, and serious mistakes are often made by architects and engineers especially in design of a city's first line and stations. These result both in higher initial and long term costs and less efficient operation, but also less passenger convenience. Urban Railways may be built along routes with low traffic potential, stations can be poorly located, and too many or too few stations can be provided. Stations and interchanges may be poorly configured, resulting in longer connecting tunnels and longer walks for passengers. Underground lines may be built at great cost even though a less costly elevated alignment would have been possible, with greater passenger convenience, and with acceptable environmental impacts. There are quite detailed decisions with important cost implications, for example whether to provide 2, 3, or 4 escalators at busy stations, and even what type of escalator to use.

### *Is this a problem in China?*

The World Bank/ICT mission visited several cities and was able to examine some station plans. However there was not time to study plans in any detail. System planning and design appears to be reasonably good but could still always be better. For example:

- Interchanges between Beijing Metro Line 2 and Line 3 at Xizhimen and Dongzhimen are particularly inconvenient. This is the result of history; as Line 13 was not conceived until many years after Line 2 was built.
- Wuhan Line 1 was built along an old railway alignment, saving construction costs, but further from existing traffic centres. Traffic volumes are thus relatively low, given the large populations of the cities they serve. However, the line may attract much higher volumes once it is extended and integrated with bus services. This is now in progress.

Neither project is obviously a mistake, although in hindsight things might have been done differently.

Compared with most other countries, China has comprehensive and effective city planning. Generally, roads, urban rail, and other transport facilities are planned together with housing and other development by the City Government, although actual construction is now mostly the responsibility of market-driven companies. Most urban rail lines are planned along corridors with high density development, which can obviously generate high traffic volumes.

Even experts can disagree about whether a rail line has been well designed, and whether a better solution might have been possible at reasonable cost. Most passengers probably never stop to wonder why they must walk so far at an interchange, or whether a different route might have served them better, at lower cost. System planning involves complex tradeoffs between cost and traffic, and assumptions about future development that will generate traffic for a line. It is evident that current plans are, in most cases, the product of lengthy consideration by city planners.

We were, however, disappointed not to see more evidence of systematic, quantitative alternatives analysis.

There also seem to be many sections of line being built underground, beneath wide roads, where an elevated alignment might well be possible.

Some cities have Urban Rail plans that seem over-ambitious, or seem not to be sensitive to the types of trips that are best served by rail as compared with bus, car, or bicycle. Many cities are developing employment centres as well as housing on the urban periphery, and along the ring roads. While rail can be very attractive for radial work trips into a city centre, it is more difficult for rail to compete with other modes for non-radial trips, and for other types of trips. It is not clear that this is understood.

There also seems to be unrealised potential to make more use of station spaces for retail or other activities, and integrate urban rail stations, both elevated and underground, into buildings.

Finally, there seemed to be some potential for improved urban design. We saw many plans for Urban Rail systems under or over wide streets, with passenger access by long tunnels or bridges. More passengers will use urban rail if stations are carefully integrated into the city, with safe, sheltered and most of all interesting pedestrian routes and convenient access to shops and other amenities..

### ***Is PPP a possible solution?***

The PPP process can help cities to avoid serious planning mistakes. If a BOT company is asked to rely, even in part, on passenger revenues, it will question traffic forecasts and perhaps make suggestions to increase traffic. The experience of UK Light Rail BOT concessions is relevant. If traffic estimates are unrealistic, BOT bidders will usually realise this. In some cases, BOT bidders have suggested alternate routes that can attract more traffic, and cost less to build. But the experience in Bangkok, Kuala Lumpur, and Birmingham shows that even private companies can deceive themselves. At least then it is their money, and not the taxpayers, that is lost.

It is always difficult to prove that a design solution is not the best possible one. PPP competitions sometimes turn up solutions that city planners had missed. Vancouver's recent experience with the Canada Line is relevant. The City government had been trying to find a solution for 20 years that balanced cost and environmental acceptability. A PPP bidder came up with an innovative solution that saved more than \$100 million while also reducing environmental impacts. Chinese cities can benefit from the same process.

In Shenzhen, MTR Corporation would seem to be highly motivated to ensure that Line 4 is successful, and that adjacent land development generates rail passengers.

PPP can be a useful test of whether a scheme is very bad, but cannot be expected to deliver the best solution. The responsibility for improving the planning and design of Urban Rail systems must rest with planners, architects, developers and traffic engineers.

## **6.2 Operational design and equipment integration problems**

### ***What is it?***

Some specific problems can be made in development of Urban Rail systems which affect operational performance and costs, especially in the medium and long term. For example, there may be unnecessarily sharp curves that require trains to slow down, or insufficient (or too many) crossovers for operating flexibility. Or specific technology choices (signalling, power supply, train length) may limit future capacity increases.

In some cases, trains and signalling have been purchased that are incompatible, or require expensive modification to deliver the required performance.

System design features, for example weight of car shells, type of traction equipment, and provision of automatic driving, can make an enormous difference to energy consumption.

### ***Is this a problem in China?***

We were not provided with detailed information about technical performance. However several new Urban Rail lines have opened in the past few years, often with impressively short implementation times, and they seem to be operating reliably. For example, the Tianjin Binhai Mass Transit (Light Rail) line apparently was operating 1,000 days after start of construction. Beijing Line 5 opened in 2007 and operates with headways of less than 4 minutes.

China has now effectively standardised Urban Rail with three types of system for “light rail” and “subway” operation. New systems generally are built for 60m, 80m, or 100m train lengths, with moving block (also called Communications-based) train control allowing 30 or even 40 trains per hour. All of this seems a sensible way to avoid operational and technical problems.

There may be specific cases where non-standard technology offers particular benefits. For example the high speed link to Shanghai Pudong Airport offers a journey time that could not be matched with conventional technology.

Chongqing has used straddle monorail technology on its first line. Although we were not able to visit the city, there must be some doubt as to the suitability of this technology, with relatively low capacity and speed capabilities, for a long, line, haul route.

We are not aware of any other schemes to use non-standard technology.

### ***Is PPP a possible solution?***

A Private Sector BOT or BT company has a very strong motivation to ensure that the system is capable of operating as planned. Otherwise it will suffer loss of revenue. The City will also have a strong interest, and will normally have rights to review and comment on all major technical decisions made by the BOT or BT contractor. This should help to prevent major mistakes.

### **6.3 Capital funding shortages**

#### *What is it?*

In many countries, municipal finances are limited and mostly committed to subsidising operating services. Where capital funding is available, it is usually spent on projects offering a faster “payback”. Urban rail is not attractive to many policymakers because of the high initial cost and relatively long implementation time. In some countries, capital projects such as roads are funded mostly from dedicated tax sources which are not allowed to be used for Urban Rail.

#### *Is this a Problem in China?*

Chinese cities do seem to have strong support from Government in development of urban rail, and the pace of urban rail development is impressive. Although Chinese cities are only allowed to borrow money with permission of central Government, several Urban Rail schemes have already been approved and many more projects are being evaluated.

#### *Is PPP a possible solution?*

The use of a well-designed PPP structure can reduce the amount of funding that is required to develop Urban Rail. It can also provide Government with confidence that a scheme has been carefully planned, will be executed competently, and provide valuable benefits when completed. While many schemes have been approved, there are many more schemes that seem worthy of consideration. Given the pace of Urban Rail development in China, the use of PPP for some schemes seems to be sensible .

### **6.4 Implementation Problems**

#### *What is it?*

Urban Rail systems are among the most complex projects in the world. In many other countries, Urban Rail systems have a reputation for taking longer to build, costing more, and not working properly when they open.

#### *Is this a problem in China?*

We were not provided with any detailed information but, as noted above, recent experience is that China is completed many new Urban Rail systems within impressively short time periods. The total out-turn costs quoted to us were, generally, as low as anywhere in the world. Precise comparisons are not meaningful because they depend in part on currency exchange rates, and labour and land costs which vary from city to city and country to country. Nevertheless it seems that China does have a good capability to implement Urban Rail projects.

One advantage seems to be the fairly steady stream Urban Rail construction, which means that managers and technical experts learn from each project. Many smaller countries have built Urban Rail systems intermittently, so there is no build up of know-

how or experience. Although the USA has built many systems, generally each city has tried to build its own team, often using its own specific technology.

A second advantage is that Chinese urban rail projects attract top-level interest by local government officials and especially the city Mayor. In contrast, responsibility for Urban Rail in other countries is sometimes divided between several levels of Government and even between adjacent municipalities. Everyone will claim credit if the project is successful but nobody will take responsibility if it goes badly.

There may more problems if and when Urban Rail systems to extend across city boundaries.

### ***Is PPP a possible solution?***

Experience with BOT and BT structures is that they reduce, although do not eliminate the likelihood of cost overruns and delays. A carefully structured BOT or BT contract will clearly allocated responsibilities between a Private Sector company and a single, public sector (Government) agency or department.

## **6.5 Inefficient operation and inadequate maintenance**

### ***What is it?***

Experience in many countries is that Urban Rail systems, once built, are allowed to deteriorate. Inefficient operating practices persist and spread, while maintenance is deferred or neglected. This is a common problem in all Public Sector monopolies.

### ***Is this a problem in China?***

Urban Rail is still very new in China, with only a few lines more than 10 years old. The older lines, for example in Beijing, Tianjin, and Changchun, are mostly being re-equipped to newer standards, so deferred maintenance is probably not an issue.

However it is evident that operating efficiency, or at least station staff productivity, of Chinese Urban Rail, is relatively low. There are high levels of staffing visible at stations. No information has been obtained about productivity of drivers and maintenance staff. It was not clear to us that operating costs are even monitored in any systematic way.

Clearly, staff productivity will become an increasing problem as incomes rise in cities. Chinese urban rail operators may face serious problems if they allow labour-intensive working practices to become embedded within their organisations.

New underground stations (for example Beijing Line 5) have platform screen doors. These have a significant operating cost. It is not known whether the decision to include these was made after any cost benefit analysis.

Linear Motor propulsion is being used on the Beijing Donzhimen-Airport railway, although the technical reasons for this are not clear. While Linear Motors are more reliable on steep gradients and in wet or icy conditions, they are much less energy efficient. It is not known whether any cost benefit analysis was done to consider whether

the Linear Motors are the best way of serving the route. At least the Turnkey contract method should ensure that the line works as promised.

### ***Is PPP a possible solution?***

Experience in other countries is that large operational cost savings can be achieved by BOT and OF operators. Being one step further from political control, they have fewer constraints in applying techniques to increase staff productivity and efficiency. A BOT or OF operator will be accountable to its investors, who will want confidence that operating profits can be delivered in the longer term.

The Beijing Airport line is to be operated as a separate “company” although still 100% owned by the city government. This may provide a degree of accountability as to operating costs and revenues. We understand a premium cash fare will be charged to use this line.

## **6.6 Poor pricing and marketing**

### ***What is it?***

There are two persistent mis-conceptions about urban public transport.

The first misconception is that fares should be kept to the lowest possible level to attract riders, and thereby reduce traffic congestion. There are a few good reasons for subsidising public transport and many bad ones. Ultimately, though, the problem is that Government funds to subsidise public transport are always limited. The Government funds should be used to attract the most ridership onto public transport.

The total funding available for public transport is the sum of the money from Government, and the money collected from passengers. Low fares, or free transit, attract more riders but usually reduce the total amount of money that is available to build, operate and maintain the system. Over time, this tends to result in a decline in the quality of public transport service. Extensive research has shown that many potential passengers, especially potential passengers who would otherwise travel by private car, are usually more concerned about quality of service than price. While a 10% increase in fares will, initially, result in 3% to 5% drop in passenger numbers, if the money generated by extra fares is used to improve services it may in the medium term result in a net increase in passenger numbers. Thus a low-fares policy can actually lead to worse road traffic congestion, in the medium and long term, than a high-fares policy. A high fares policy is more likely to attract people out of their cars.

The second is that public transport is simply a “public service”, and that “marketing” should be limited to simply providing information about service times and fares. While there are “mass” markets for “mass transit”, as incomes rise more and more people have choices about where they live, where they work, and how they travel between them. People have more leisure time, including time for shopping and entertainment. They also have more complex journey requirements. The Urban Rail system will attract the most users if it is actively marketed to current and prospective customers, not just with information and advertising, and through ticketing with other modes, but also with additional service features, joint promotions with leisure activities (e.g. cinema tickets), and other features.

### **Conclusions**

- Public-Private-Partnerships can help to deliver better public services, faster
- But:
- PPPs are complicated and need to be designed carefully to suit specific requirements and objectives
- Lessons can be learned from more than 100 Urban Rail PPPs.
- It is very difficult to make a full BOT work for Urban Rail, mostly because it is difficult to transfer long term revenue risk
- More success has been achieved with separate Build- Transfer (BT) and Operating Franchise (OF) contracts
- PPP can be a useful way for Chinese cities to build more and better urban rail systems. But they cannot solve all problems
- Responsibility remains mostly with Government planners, transport engineers, architects , developers, and operators to build cities and urban rail systems that people will want to use

### ***Is this a problem in China?***

Chinese urban rail systems, do not, generally, seem to be very actively promoted or marketed. While there is adequate information about where and how to use Urban Rail, there is little evidence of any proactive effort get more people to use the system and to use it more often. Even signage to station entrances is very discrete. In Beijing, it is easier to find somewhere to buy coffee or a hamburger than a Subway station.

### ***Is PPP a possible solution?***

A Private Sector Company can be expected to be highly motivated to promote use of Urban Rail, if it is on a Net Cost contract or a contract with some other usage related incentive.

Hong Kong MTR Corporation, although still partly state owned, behaves as a Private Sector Company and actively promotes rail travel.

## **7. Sources of information**

This report was prepared after meetings and discussions with officials responsible for Urban Rail development in the cities of Wuhan, Hangzhou, and Changsha.

In addition, informal discussions were also held with

- Beijing MTR Corporation (a subsidiary of Hong Kong MRT Corporation)
- Bombardier Transport
- Veolia Transport China Limited
- Beijing Municipal Development and Reform Commission
- Beijing Urban Engineering Design & Research Institute Co. Ltd
- Beijing Infrastructure Investment Company Ltd
- China International Engineering Consulting Corporation
- Tianjin Binhai /Mass Transit Development Co. Ltd

# Part 4: Urban Rail Planning and Design-A Brief Summary of Lessons from the Japanese Experience

Tsuneo Hashimoto

## 1. Transportation Planning

### Transport mode selection

There are many mass transport modes. They have different character, so it is important to select the mode to match the local conditions. The expense for maintenance, operation and renewal in future should be considered at the time of initial mode selection.

### Land use plan and transport plan

Land use plan and transportation plan are related each other tightly. According to the land use plan, transportation plan should be made. And after the transport plan is made, the land use plan should be modified according to the transport plan, especially the location plan of the railway station.

Densely populated area with high buildings should be located near the railway station.

Parks, sports facilities, schools, low story buildings should be located with some distance from stations.

Image of Suburban Town

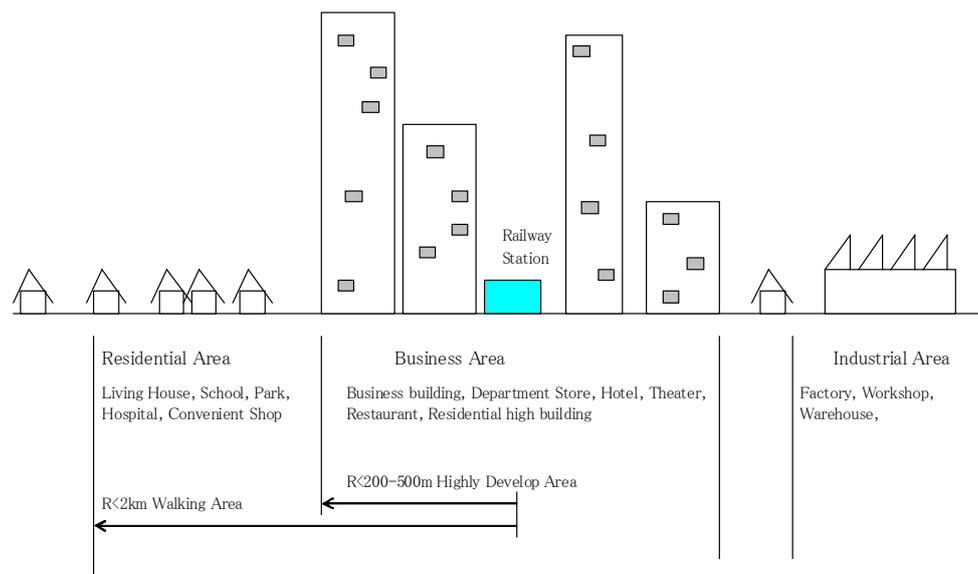


Figure 4-1: Imagine of Suburban Town

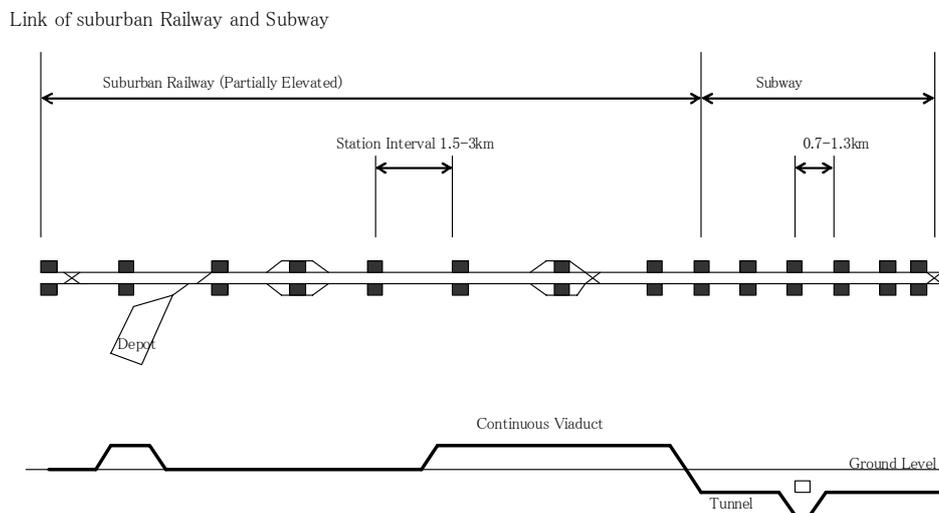
## 2. Improvement of Public Transport Convenience

Urban public transport mode is required following characters.

- Frequent operation
- On schedule operation
- Not expensive
- Not too crowded
- Easy ride on/off and transfer the modes

The distance between neighboring stations at city center area should be about 1km. Almost people can reach 400m distance within 5 minutes walking. The distance between neighboring stations at suburban area should be about 1.5km. Almost people can reach 800m distance within 10 minutes walking. People can reach to the station faster than using bus transport within 10 minutes. Bus transport requires walking to bus stop, waiting bus and riding bus. It needs more than 10 minutes. The strategy of reaching to the station on foot is important for urban transport.

Transport mode is required cheaper construction cost and faster approach to city center from suburban area. The track will locate underground at city center area where land price is very expensive. The track may locate on the ground at out of city center. The construction cost of the transport mode should be considered at the time of planning of land use and transport route selection.



**Figure 4-2: Link of Suburban Railway and Subway**

### **3. For Efficient Urban Railway Transport**

Following themes should be considered for efficient urban railway transport.

#### **How to reduce door to door travel time**

The time value of persons is getting higher accompanied with increasing the personal income. The time value of the people who uses Metro is the same as the hourly cost of the companies for hiring personnel. Commuting time has almost same value with one's hourly salary for commuters. The travel time of commuting gets important matter for urban management. The travel time from door to door should be reduced as far as possible.

#### **Train operation facilities for efficient transport**

Efficient station structure to transfer to other lines should be designed at the time of the first line construction.

- Siding line construction for express train operation is expected to reach the destination quicker.
- Turning track equipment construction for shuttle train service is effective to shorten train interval.

#### **Traffic demand management**

Effective land use plan and suitable demand control is required for urban management.

Transport demand should be guided to use public transport mode. Especially, effective railway transport requires enough transport volume. Railway transport is not effective with small passenger volume. After the railway line plan decided, city planner should make the land use plan and public transport plan to use full capacity of the railway.

### **4. How to Reduce Door to Door Travel Time**

To reduce the travel time, faster operation speed is required.

To speed up operation speed, following items are necessary.

- Faster maximum speed
- High ability of accelerating and breaking
- Decreasing the speed restriction spots
- Decreasing the stopping stations
- Decreasing the stopping time at the stations

The commuting time of door to door includes following items.

- Walking time from home to station
- Waiting time of train coming

- Riding time on the train
- Transfer time to other line/ mode
- Walking time from station to office

To minimize the transfer time in the station, consideration of station design at the initial stage is important.

The sum of those items is the traveling time of commuting. The manager of urban development is required to reduce the total time of transport. The distance between residence/ office and station, distance between platform for transfer line/ mode, operation interval of train, operation speed of train are the factor of composing the travel time.

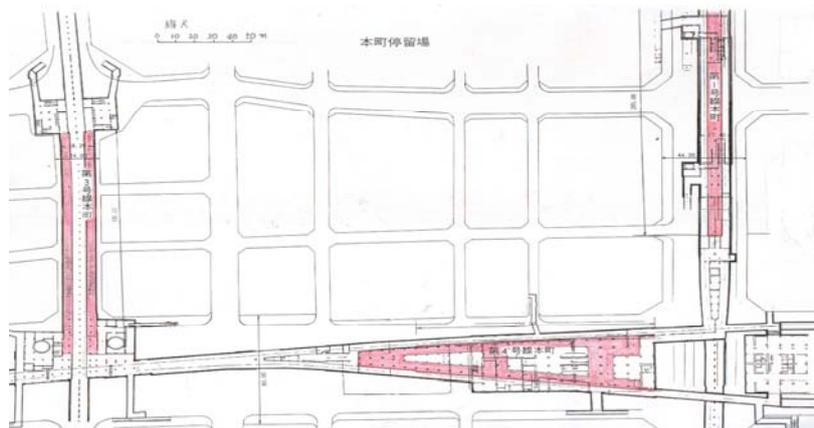
To reduce the door to door travel time in China following matters are expected.

- Station structure to transfer to other line
- Express train operation at suburban area
- High population density land use plan of walking area of railway stations to reduce the time to come to the station

## 5. Efficient Station Structure to Transfer to Other Line

How to connect the platform to transfer other line is the important matter of metro station design. Passengers can not walk fast in the congested path. The distance between platforms of transfer line is shorter the better. It is necessary to consider the design and construction at the time of initial line facilities construction. After the commencement of the train operation, the construction work is difficult to execute at near the operating line.

Bad example of Japanese metro station where platforms are scattered each in their own ways is shown at following figure. At such stations, passengers are forced long way walking.

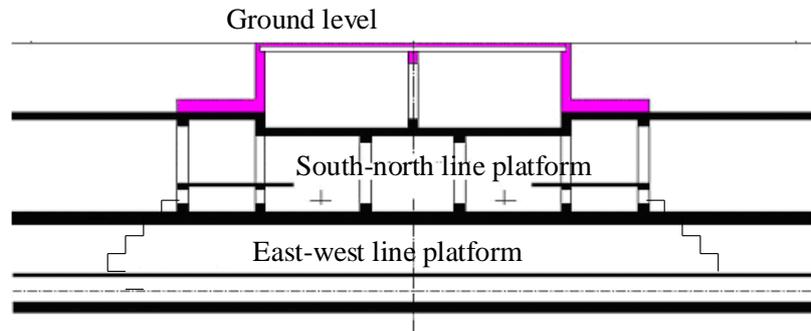


**Figure 4-3: Example of Japanese Metro Station**

The best way to transfer to other line is that trains come from two different ways stop at the both side of the same island platform. The next way is that two different floors

platforms at where trains stop coming from two different ways are connected with the stairs.

The transfer facilities should be constructed as one package at the time of initial line construction.



**Figure 4-4: Best Transfer Station**

## **6. Train Operation Facilities for Efficient Transport**

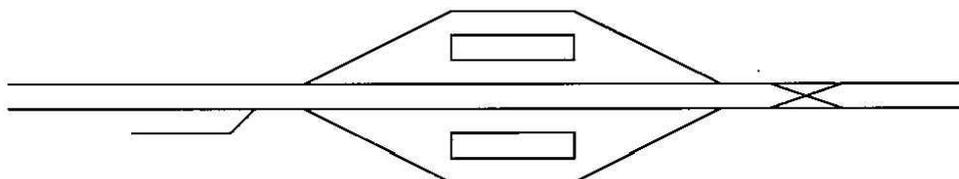
### **Express train operation at suburban area.**

From the suburban area to city center, the travel time depends on the operation speed of the train. Express train operation that stops only few stations at suburban area is the effective means to shorten the travel time. Express train shall catch up the forward train with high speed run. Then the siding line where stopping train gives the line to pass the express train is necessary at the middle point of suburban line.

Maximum train speed at suburban area is expected more than 120km/h and operation speed of express train is about 60km/h. For the operation of express train, the combination operation of express train and stopping train is convenient. The operation speed of stopping trains shall be 35 km/h or so.

### **Shuttle service**

The shuttle train operation that some of trains return back at midway of the line is effective to increase the train operation frequency at city center area. The returning facilities are necessary for shuttle train service.



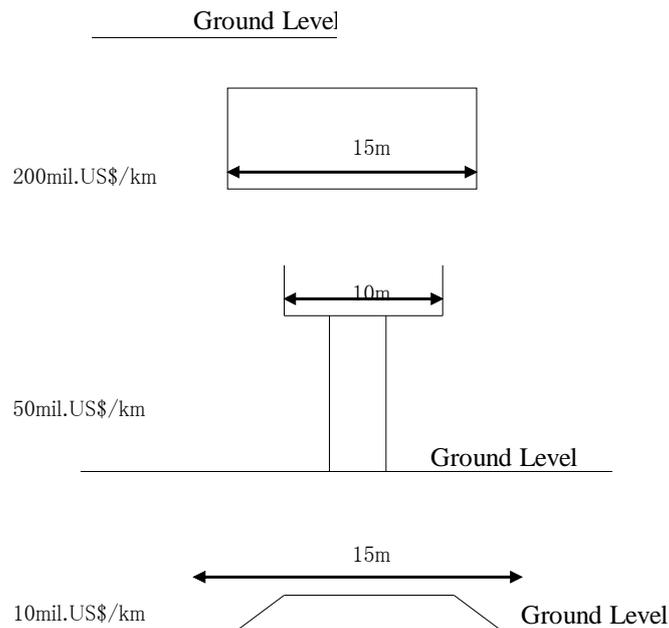
**Figure 4-5: Track for Shuttle Service and Express Train Operation**

## 7. How to Reduce Construction Cost

### Position of the track

The construction cost of railway differs depend on its track position. Underground metro is most expensive. Track on the ground surface is the cheapest. Viaduct railway costs midway of them.

Following figures are the examples of Japanese infrastructure costs.



**Figure 4-6: Examples of Japanese Infrastructure Costs**

The planning of platform level of the railway station requires careful consideration. Either underground or viaduct, the construction cost gets expensive according to the platform level separated from ground level. Furthermore passengers are urged to walk up or down to the platform from the ground long way. For cost saving and for passengers convenient, the depth or height of the railway line should be examined with the greatest care.

## 8. How to Reduce Noise & Vibration

### Light vehicle

The adoption of lighter vehicle is effective for reducing energy consumption, conserving the environment along lines and helping reduce wear and tear of the track and the infrastructure.

The axle load of the trains should be reduced as far as possible.

The noise and vibration are generated by the shock of passing vehicle. If the weight of the vehicle is light, the shock becomes lighter. Noise is generated from vibration of source materials. Small vibration energy causes small noise.

### Cut off the vibration

The vibration can be cut at midway of its transmission. The vibration from rail and wheel is transmitted to the girder of the bridge. To reduce the noise of the girder, cutting the transmission of the vibration from the rail is effective.

The elastic direct fastening track is useful for environmental protection and maintenance free. The Japanese example of the elastic direct fastening track that the sleeper is covered with elastic material of resin is shown in following figure.

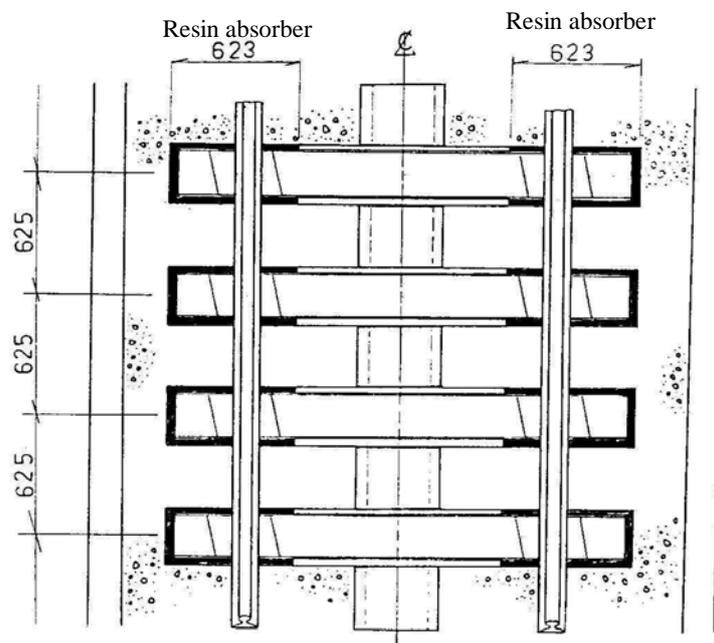


Figure 4-7: Sleeper Covered with Elastic Material of Resin

### Noise barrier wall

Noise barrier wall is also useful to prevent the traffic noise. The tall wall or full cover shelter are necessary at high building area. There are some low type noise barrier walls using the sound wave interference.

# Part 5: Operating Excellence in Urban Rail Services

Reindert Westra

## 1. Introduction

The planning, acquisition and commissioning of rail assets are all intended to achieve high quality rail operations, and those are intended to achieve high quality transportation services for passengers.

The achievement of high quality transportation services for passengers requires many things to work together in an organization focused on the customer. Because of the complexity of the rail system itself and the further complexity of integrating rail services with other modes such as bus, commuter rail, long distances bus services, a comprehensive approach is required, involving many other agencies and companies in the sector. That means that a comprehensive management approach is required.

The company delivering rail services in itself must function properly first as a basis for providing good service and as a basis for proper integration with other services. Hence, long before any assets are acquired and delivered, operating plans have to be put in place. ***A full business plan in fact has to be developed covering all aspects of the operations to be started up.***

If rail operations are to be integrated into an *existing* bus oriented public transport company, at least there will be an existing organization in place on which to build the new service. In case of a new system in a new company, the business plans and the organization to operate the service must be in place well before system delivery and commissioning.

While the business plans must be comprehensive, we emphasize in particular the importance of two key areas, the supply chain development and the marketing focus.

Once a rail asset has been designed, procured and commissioned, the challenge is handed over to the operator to keep it in good safe and reliable operating condition for the life time of the asset, some 30 years. This is in itself an incredibly challenging and critical task of huge complexity and with huge implications for the operating cost and hence the budget of the operator.

As such it is very important task indeed and therefore it can also be, unfortunately, a huge distraction from the mission of the operator, to service the customer.

Rail operators tend to be oriented around the engineering and operating aspects of the service. To operate the train is not the same as serving the customer. In any public transport business the key mission has to be to serve the customer. This customer, marketing focus is critical to achieve when setting up the service. Public transportation is a consumer product and has to be marketed and the market orientation is indeed the

critical input into the whole design of the alignment, the rolling stock, the stations, the ticketing and the organization itself.

In discussing these it is useful to draw upon the experience of operators and operations elsewhere, and in this case we draw a number of lessons from the operation of public transport services in a number of countries, including Malaysia. We refer in this respect to the WB Document “A tale of Three Cities” which provides some background to the development of rail services in the Region, as well as further background details provided in appendix X to this document.

## **2. Operating Plans**

Setting up a public transport system is not about purchasing an asset. Serving the customer, not the asset is the focus and the purpose of the investment. At the same time the asset itself may well have critical market value, but that will not be achieved or realized if not supported in the organization with the key market oriented functions such as network development, product development and the rest of the marketing functions.

### **2.1 New Assets**

While the asset in itself may not be purpose of the exercise, acquiring and deploying a new asset in itself may indeed be of immense market value and sometimes a new asset is crucial to break the old paradigms.

In Malaysia, as in many countries, public transportation has a very bad name and reputation. The consumer image of public transport as a “dirty old bus” had to be broken.

In Malaysia when RapidKL was established as the new government owned operator, the market was dominated by old busses. Within RapidKL the assets taken over by the Government were very old and unreliable.

The newest bus was seven years old and oldest bus was 12 years old; of the oldest busses, at least 50% were always down with repairs and the percentage of busses that returned to depot for repairs during the course of the day was very high indeed.

The Government of Malaysia responded to this situation by acquiring new busses. In the years 2005-2008 hundreds of new busses were deployed and these were commissioned with a great deal of publicity so as to reposition public transport as a whole. With these new assets the Company could advertise the service as proving key attributes:

- Comfort, with air conditioning inside, air suspension etc.
- Cleanliness, with new seats, new coats of paint etc.
- Safety, being reliable in operation, and not prone to catching fire etc.

The same holds, of course, in the deployment of new rail assets, to an even higher degree, as the Company can boast more space, faster operations, nice new stations that would be well lit and safe, and convenient new access to (new) locations that would take much longer to reach by bus because of distance and/or access difficulty.

Hence the asset itself and its basic attributes can be of huge importance in positioning or re-positioning public transport as a whole, and that can be critical in reaching the target consumers who may have stayed away or left public transport as a daily mode of transport.

..sometimes a new asset is crucial..

- The consumer image of public transport as a “dirty old bus” sometimes has to be broken
- New assets can advertise key qualities:
  - Comfort
  - Clean
  - Safe



**Figure 5-1: Public Transportation Asset Character**

## 2.2 Business Plans

While the new asset in itself can be a major catalyst in bringing the consumer (back) to public transport, it is in itself also not enough. Acquiring the asset is a starting point to making the change in the market place, but many other aspects have to be considered and developed before the asset can deliver a service that the consumer will be interested in trying, once, then will trust to use regularly, and will stay loyal to in the face of competition from other operators and other modal choices such as a private motor vehicle.

The aspects that must be considered in the full deployment of a consumer service in the public transport market place are many, and they are complex in their interrelationships.

### The Assets

As discussed, the asset itself is the most physical direct interaction with the customer at time of boarding and can have immense market value. There are many aspects to the asset that are significant to its operations but the customer will care about some of the aspects already discussed but also other aspects need to be considered, in a full list, including:

- Comfort
- Safety
- Cleanliness

But also:

- Speed
- Reliability
- Ease of entry

## **Network**

The asset doesn't know where to go, it needs a network in which it operates. In the case of rail assets, of course the alignment of the track is the network and is usually part of the same investment cycle as the rolling stock, at least initially.

The network design is the essence of the structure of the service to be delivered, and largely determined the effectiveness of the asset deployment.

In the case of rail assets the network is a permanent fixture and cannot be easily changed; it can be extended, but the alignment options at any time will be limited and hence the choice of alignment is critical.

The bus asset is much more flexible and can be deployed on normal roads and/or on special bus lanes. The choice of corridor and routes for busses can on normal roads be adapted to market demands and can respond to new real estate development, and to levels of demand. Busses can be made most effective in high volume corridors when their operations are protected from other traffic in dedicated bus lanes so as to achieve Bus Rapid Transit status.

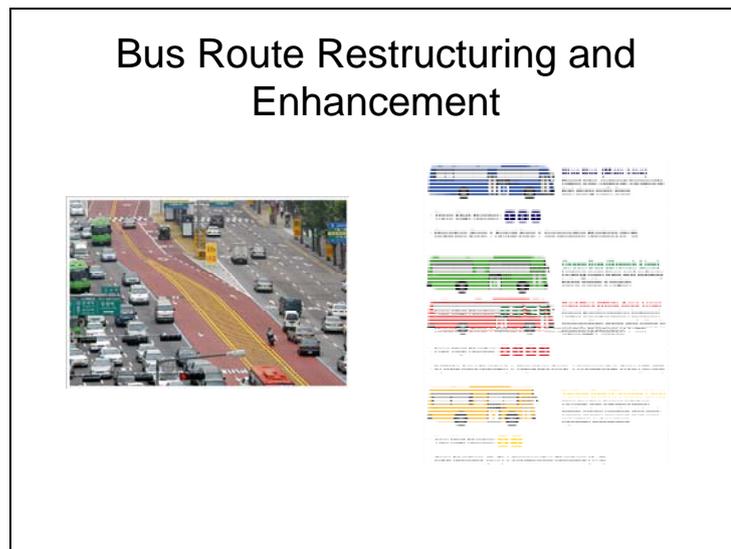
For successful service delivery it will be necessary to properly integrate bus and rail services to provide a seamless door to door capability with the least amount of travel time and interchanges for the customer.

The network design topic is a major chapter in itself, but the experience from Malaysia as well as from places such as Seoul Korea and Vancouver have a few themes in common:

- Prior to restructuring, the development over time of long, winding bus routes that have low profitability, high degrees of vulnerability to breakdowns and traffic disruptions, and usually long waiting times.
- A restructuring strategy that makes a trade-off between more change-overs and more robust service for each element in the network.
  - Major back bones from the suburbs to the edge of the city itself, made up of rail, suburban rail and bus – often BRT - trunk lines
  - Local pick up services to feed the trunk lines in the outlying neighborhoods, linking to rail or bus trunk lines at hubs and sub-hubs where the interchange takes place
  - City shuttles and dense rail service patterns in the city and cbd areas, linked with the trunk lines around one or more major hubs at the edge of the city

- Express busses and trains that go directly from outlying areas to close in points at the city edge or even into the city, avoiding change-overs and stops for extra effective journey speed.

Often the busses are color coded to indicate the type of routes served and to be able to recognize these better at crowded hubs.



**Figure 5-2: Color coded Busses in Korea**

### Infrastructure

The network must be supported by infrastructure to provide bus stops, bigger bus stops and shelters at hubs and sub-hubs, and sometimes space for commercial activities either by the operator, such as selling monthly passes, or by third party vendors of books and newspapers or other convenience goods.

#### TRANSIT HUBS NEED TO BE ESTABLISHED



In the effort to provide efficient and effective public transport, we have also taken the effort in maintaining an overall pleasant and enjoyable traveling experience for all commuters.

**Figure 5-3: Network Infrastructure support**

A major city can have easily up to 10,000 bus stops and some 20-30 hubs and interchanges, so the investment can be significant.

It is also critical to integrate bus and rail operations so that feeder buses are as much as possible fully integrated into the rail operation and vice versa. Often the rail infrastructure has or can be made to have shelters for passengers waiting for the busses at grade level. Then it is also critical to reserve enough space to accommodate the bus traffic, with sufficient bays, and to discipline the drivers to not hover about too long and create obstacles.



**Figure 5-4: Malaysia KL Station**

### **Front Line Staff**

The customer interacts with the Operator in many different ways, but one of most critical customer interactions is with the front line staff: ticket clerks, bus drivers, station masters, telephone operators. To align these into one coherent and cohesive customer support platform is one of the biggest challenges managerially to achieve.

Typically and traditionally each of these groups belong to a different hierarchical line of operations: ticket clerks in rail report to rail ops, bus drivers report to bus ops and Marketing will have a difficult time in most organizations being able to reach them and indoctrinate them unless the company leadership intervenes and gives marketing the authority to do so. An effective means to do so is to create a matrix line of responsibility from Marketing to Operations as to customer service interactions. This will enable marketing to make it mandatory for bus drivers and ticket clerks to be cross-trained as to product knowledge and routes so as to be able to give customers advice on routes to travel and which tickets to buy.

### **Product Portfolio**

When providing more than one service, it is important to the customer what products to purchase, as there is potentially much confusion between bus and rail options and their relative pricing.

Typical ticket pricing types are:

- Flat fee
- Zonal/distance based
- Time based/day passes

On top of that, typically there are monthly passes, for bus only, for rail only or for all modes, providing limitless travel for the whole period, or on specific lines and routes only. When combining modalities, it is important to provide an integrated product, for bus and rail combined.

### Malaysian Integrated Monthly Travel Card – strongly discounted



**Figure 5-5: Malaysian Integrated Monthly Travel Card**

The use of electronic payment systems allows for more dynamic even personalized products to be deployed. The smart card for instance can calculate at every trip the relationship to the previous trip and re-calculate the fare. A traveler in Kuala Lumpur would pay RM 1 for a local bus to bring him to the trunk line which costs RM 2 and this would bring him to the city busses or LRT line: whatever the next journey set, the traveler in KL never pays more than RM 4 if only busses are used, or never more than RM 7 if bus and rail modes are used in a single calendar day.

The electronic medium also allows for personalized products and hence the development of a personalized brand such as My-Rapid. For instance the user wishes to purchase a monthly travel pass, the date no longer has to be the first of the month for the product to become valid, it can be any day he chooses to enable the card, and the product will then be valid for 31 days from that day onward. This is the practice in Malaysia and in Hanoi, Vietnam.

#### **Information**

Perhaps the most critical ingredient after the physical asset purchase to be delivered is information about the service, the products, the routes and the timing of the service.

Time tables are the basis for the execution of the service. Route maps are the basis for informing the public how to obtain a travel solution using the available connections to the desired destinations. Electronic web-based journey planners are widely available and the technology is stable, so it is becoming increasingly possible to deploy those as well.

Nevertheless, in most countries it is not easy to obtain simple to read route maps, as bus and metro routes combined are often extremely complex, and for large cities, multiple operators have overlapping services. Hence it is advisable to employ professional designers and map makers to communicate complex route information to the public.

..and have good information



Figure 5-6: Good Information

..requiring new skills



Figure 5-7: New Skills

## Control Systems

While rail assets as procured as a matter of course come with their own control systems, for bus operations these control systems usually have to be assembled in various pieces by the operator (on-board ticket machine, linked to card reader, linked to depot server, linked to HQ server and linked to route analysis software, linked to GPS data on bus performance, and to bus control centres). These systems are not trivial and their deployment takes generally more time than anticipated.

Further more both bus and rail systems have to be linked to financial software to track and control revenues, operating and maintenance costs per unit, and linked to maintenance management software that triggers required maintenance and tracks inventory levels and parts usage.

Furthermore operational systems need to be linked to route planning and staff scheduling systems to generate daily shifts and control the number of hours worked per driver and other staff to comply with contracts and legal limits.

The integration of these systems is absolutely critical and requires a great deal of attention to ensure a proper operational and financial integrity is achieved.

## Human Resource Management

Public transport service is indeed all about service, not about procuring assets. The operator should not care about the asset at all except as to its capacity, reliability, cost and passenger comfort and convenience.

What is much more critical and typically gets very little attention is the human resource factor: do we have the right type of people driving the bus, the right type of people driving the train, the right type of people to create a product portfolio etc., where technical competence is combined with an in-born desire to serve the public?

The right kind of hiring should combine with the right kind of training to produce the right kind of customer service skills. Older staff should undergo re-training periodically and for each functional change, training should be considered.

..but all aspects of providing a consumer product must be developed



Figure 5-8: Consumer Product Providing

The Operator should integrate all aspects of delivering the consumer service, using all the theories and methodologies of commercial business to organize and execute the delivery of the service.

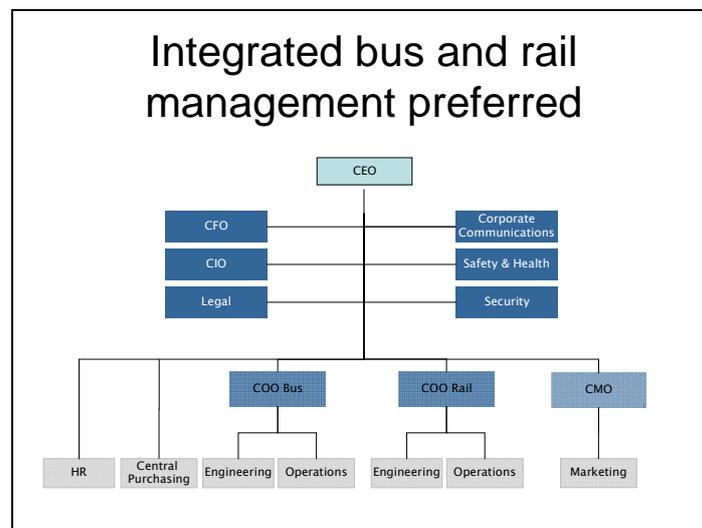
## 2.3 Organization

To achieve the mission in an integrated manner, bus and rail services must be managed in an integrated manner.

The core functions must be bus operations, rail operations and marketing as three equal core functions, to be supported by all the other functions in the organization.

It may be that bus and rail operations are structured into different companies, but on the street, for the customer, that should not make any difference. Operating in different companies has advantages and disadvantages:

- In separate companies, each entity will have clear responsibilities for cost and profitability of their service, but the danger is that the two companies will actually start to compete
- Operating as a single entity has the advantage of being able to integrate policies, share resources, share revenues more directly in providing integrated products, priced competitively; the danger is one of complexity and diffused bottom line responsibility.



**Figure 5-8: Integrated Bus and Rail Management Preferred**

An integrated approach does allow for integrated strategic planning, and easier integration of bus and rail operations. But there are many layers of strategic management to consider in directing the operations.

- As indicated, bus and rail systems need to be integrated as to tickets and products as well as networks.

- Each unit must be managed as to its own profitability, both as to revenue and cost structure.
- The company must be integrated as to policies and ancillary services such as security, and overall HR, financial and safety policies in particular must be aligned.

Here again in some cases it is easier to have separate companies, as train drivers and bus drivers do not necessarily have the same education, training, and therefore salaries.

- Overhead costs, while providing synergies to both bus and rail in an integrated manner, can grow out of control if not properly focused on clear tasks, and must be constantly streamlined.
- Strategic growth can only occur on the basis of sound operating practices as outlined, and has to take into account how to grow demand, options for both bus and rail asset deployment, and alignment with other third party networks.



**Figure 5-9: Strategic Goals management**

### 3. Supply Chain and Maintenance

When procuring bus and rail assets, one is also procuring the obligation to maintain the assets, for decades. A bus should have a 15 year life cycle when maintained properly, and a train car can be used for up to 40 years.

Maintenance depends on the proper planning of the maintenance and then on the availability of spare parts. Typically, the Engineering department does the planning of the maintenance and the central purchasing department procures the parts.

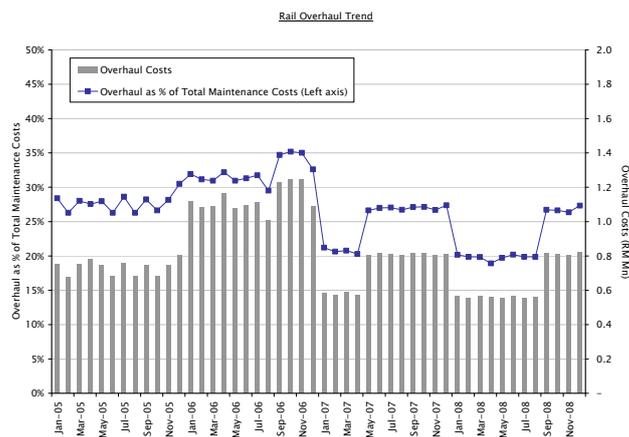
Because it is critical, the supply chain activities that are necessary to achieve well maintained assets can be a major distraction from serving customers.

This is because the costs are high – it eats up a large portion of revenues – and because the process is complex:

- There are bus and rail both a large number of parts to be procured
- The commodities to be procured are very diverse
- The maintenance takes place in many different depots, and hence local availability becomes crucial as a factor, and can easily drive up costs

Particularly in rail assets, there are strong peaks in activities as each system will have its own cycle of major overhauls, and sometimes these peaks coincide. The monthly costs of parts consumed can easily vary up to 100% between ‘normal’ and ‘peak’, and must be budgeted many years out. Some systems have a 3 year major overhaul cycle, others have a 7 year cycle, and these must be made visible long before a budget year is affected by them.

## Staggered maintenance by system leads to peaks in costs



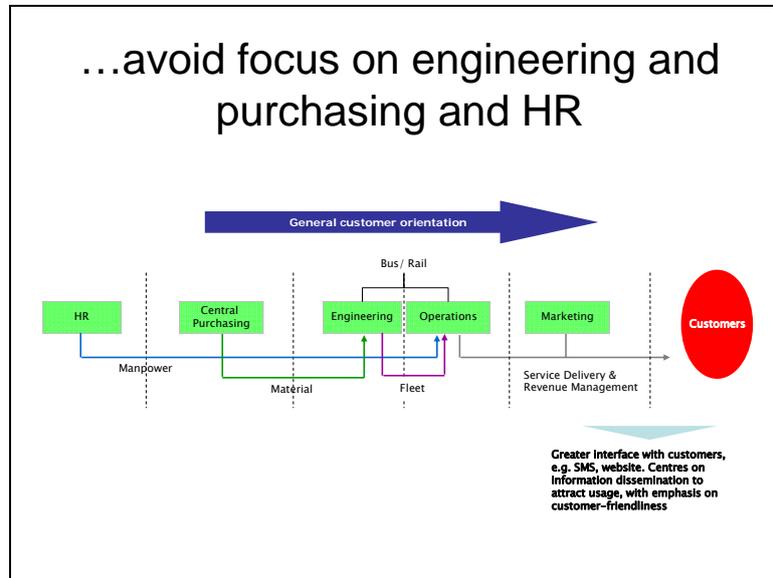
**Figure 5-10: Cost**

So every effort must be made to schedule and budget for the required maintenance, and thus minimize the issues around the peaks in costs and the availability of parts.

The general focus must be maintained on service delivery, and on Revenue Management – the customer. Besides engineering and purchasing, also HR can be a source of distraction. Particularly when setting up a new service, many HR issues will surface, as to pay, pay grades, benefits, evaluation schemes, inflation correction, unions, recruiting, team dynamics etc., all of which are critical, just like maintenance, but have little to do with the customer who is wondering why the bus is late or the ticket machine does not function.

In the long term, precisely HR and Procurement have everything to do with why the bus may be late or why the ticket machine does not work, if you hire the wrong people and do

not have the parts on time for the machine... These aspects have to be fixed structurally or they will eat up the attention of the organization. If not, then the customer will complain about these things, and the customer will be seen as the problem rather than the improper procurement and the improper training that led to the complaint.



**Figure 5-11: Customer Orientation**

## 4. Marketing as a Core Competence

By contrast, marketing is a key function in the business system that should take most of the organization's attention.

Public transport is a consumer product and one must use all the skills and tools of consumer marketing as a means of attracting your customers, and as a means of deciding even what to do: which segments to serve, where to send the bus, where to build the railway alignment, what price to charge and what message to send.

### 4.1 Marketing functions

There are a number of key things marketing must do.

#### Develop the product, in the broadest sense

- Network
- Ticket types
- Customer experience
- Information
- Asset specification

## **Distribution Management**

- Where to sell the product
  - In busses
  - In stations
  - In service centers
  - Through third parties
  - Post office
  - Convenience stores
  - Mobile phone company – value top up of smart cards
- Direct sales to corporations
- How to get the cash back to base

Each sales channel will have to be tightly controlled as to Revenue Control procedures, ensuring the cash generated represents the number of tickets sold, and guarantees have to be organized to cover the risks of tickets or cash lost.

## **Pricing Strategy**

A proper pricing strategy can increase revenues up to 10% without increasing any ridership, not just by raising the price, but through rebalancing daily ticket price with monthly tickets and integrated bus and rail tickets.

Pricing strategies encompass the core positioning of the integrated service and determine also the cost to the City of providing the service and how much subsidy will be required.

Core pricing strategies include the following aspects and options:

- Zonal pricing
- Distance based pricing
- Time based pricing, such as
  - Day passes
  - Two – three hour transfer time
  - Weekly and Monthly passes
  - Off-peak travel passes
- Demographic segmentation
  - Children's fare
  - Students
  - Elderly
  - Disabled discounts

- Transfer prices between operators
  - Free transfers
  - Reduced cost transfers
  - Limited time free transfers
  - Discount sharing

In setting the price, a number of considerations have to be taken into account. Again, basic company and Government strategies have to be made explicit to arrive at proper pricing.

### **Product Cost Price**

One key consideration is that the passenger revenues should as much as possible cover the cost of delivering the service. The picture is of course dynamic as a service will require fixed and variable costs, and the dilemma revolves around the expected number of passengers at any given price. Lower price should generate more passengers, but will also generate more costs as to number of trips to be made, network coverage required to attract those passengers.

At low levels of ridership, more riders will not generate more costs – and then it is critical to create differential pricing strategies to increase ridership volume, or to increase product attractiveness with the least possible additional cost.

In rail services the fixed costs are huge in terms of the investment made, and every effort should be made to make the investment be as productive as possible. For instance, significant ridership improvement in rail can be obtained with proper feeder bus services, as these are relatively low cost investments to make.

### **Competitive Cost**

The price of the service must compete with the cost of alternative travel choices:

- Service from other competitors
- Service from other modes

Depending on the competitive situation, prices may need to be adjusted to meet the levels of prices offered by the competition.

Assuming no direct on-street competition, the price of other modes becomes critical, particularly that of the private car. This actually leaves quite a lot of room for high fares as public transport will at any price be much cheaper than the cost of owning and operating a private motor vehicle.

### **Affordable Cost**

Above all, the price must remain affordable for the people using the system.

- Charge too low and you cannot pay the costs

- Charge too much and you lose passengers, either to competition and to other modes:
  - Back to cheaper modes because they cannot afford the public transport service
  - Back to cars, because the cost difference is too small to pay for the “inconvenience” of travel by public transport



### **Obtaining Feedback**

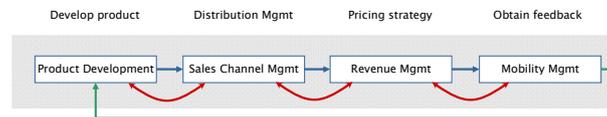
Getting feedback from the customer is a key learning aspect in any commercial service delivery system.

Feed back can be obtained in many channels:

- SMS numbers
- Email
- Call centre
- Feedback forms
- Through press
- Official channels
- Mobility management – field teams

All of these are important ways to inform the customer of ways to travel, ways to avoid complications and to show that corrections are being carried out to address service shortcomings.

# Marketing has its own disciplines



A consumer-centric process to establish feedback loop for continuous improvement

1. **Product Development** develops and manufactures products
2. **Revenue Management** determines the price of the product
3. **Sales Channel Management** distributes the product
4. **Mobility Management** analyzes the response of consumers to the products through obtaining feedback

**Figure 5-12: Market Disciplines**

## 4.2 Segmentation

Perhaps the most difficult question to answer is which segments of the public to serve and then the actual question becomes: “What is the problem we are trying to solve, and how?”

Many large cities in Asia are struggling with similar issues:

### **Strong population growth and hence**

- longer distances to travel, that can no longer be covered well by non-motorized modes such as walking or bicycling
- overly full busses and bus corridors; we have observed some corridors with 100 busses per hour, clogging up even the dedicated service roads they travel on, indicating a limit to the capacity busses can provide

### **Strong economic growth and hence increasing volumes of motorized vehicles on the roads, causing:**

- Congestion of the roads and hence reduced mobility and economic losses, and reduced growth into the future
- Pollution of the environment and hence a degrading of the quality of life of the population at large, and higher health care costs later on

Each of these aspects may require different responses, depending on the size of the problem and the choice by the Government as to which strategy to pursue.

- If the problem is how to cover long distances for low income population groups having migrated to the city and living in low cost development houses far away from the city jobs, a low cost, affordable mode must be found to help them cross

that distance in an acceptable amount of time

- If the problem is congestion and pollution cause by cars, the priority might be to get the car driver to switch to public transport, and the service needs to be attractive, convenient, and at least cheaper than using a car in variable out of pocket costs

Having made such a decision has huge consequences for the public transport system you must develop to achieve the goal.

- Network coverage will be very targeted to upper income neighborhoods if you want to “Get the car off the road”, but if you need to serve the broad public to improve their mobility, for instance by putting rail service in overly crowded corridors, perhaps the coverage is for different corridors and probably for much broader coverage with feeder networks
- The volume of people driving cars is now perhaps much lower than the overall need to get the general public to work, but the number of car owners is growing very rapidly, and perhaps one strategy is to follow the development of affluent neighborhoods with convenient rail service, paid for with relatively high fares, whereas the population at large today is already very large and will require low prices to be affordable.
- Overall the value proposition is very different in serving different segments:
  - The car driver must be convinced to leave his new car at home, and get to work in something fast, convenient, that must also be substantially cheaper than the car (we note in some cities it is more expensive to use the metro than to use the car)
  - The public at large must be served with a system that provide safe, affordable and reliable public transport that gets the worker to his job on time.

## Targeted segments and pricing

Target Segment	Rail Network Coverage	Volume	Price	Value Proposition
Car driver: "Get the cars off the road"	Focused on middle income neighborhoods	Low at first, grows as income grows	high	<ul style="list-style-type: none"> <li>• Fast</li> <li>• Convenient</li> <li>• Cheaper than car</li> </ul>
Total population: "Provide public service"	Broad coverage	High volume	low	<ul style="list-style-type: none"> <li>• safe</li> <li>• affordable</li> <li>• gets you there</li> </ul>

**Figure 5-13: Target Segments and Pricing**

## 5. Conclusions

We have attempted in this Chapter to illustrate that the procurement of public transport assets, or the building of a rail system, is not the same – yet – as providing public transport service.

Public transport is a social service, but it is also a consumer product and must be conceived of as such, in the planning, design, production and marketing thereof.

The management of the Operator is a complex task, and many dynamics must be coordinated and synchronized without losing sight of the goal: *servicing the customer*.