



# World Cities

Achieving Liveability and Vibrancy

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(Continued)

Term	Other terms or abbreviations used	Working definition
Waste audit	Waste assessment, walk-through	A visit to a factory, office or institution for the purpose of inventorying and analysing the ways in which waste is generated, handled, managed and removed.
Waste dealer	Junk shop owner, scrap trader, consolidator, waste buyer	Individual or business purchasing materials for recycling or composting, storing them, upgrading or processing them, and then reselling them, or someone who trades in recyclables and uses a dedicated storage place.
Waste picker	Scavenger, rag picker	Person who salvages recyclable materials from streets, public places or disposal sites.
Weighbridge	Scale, wheel scale, truck balance	A facility for weighing trucks, which produces a written record of the weight on the basis of which an invoice can be sent for the service of dumping.
Wet waste	Organic waste, green waste, organics	Used both for the physically wet part of the waste stream and to describe compostable waste separated at source from dry or recyclable waste.
Willingness to pay	Price elasticity for solid waste service	The level and rate at which users (or their proxies) are willing to pay providers (or their agents).

## Chapter

## 6

## Transportation for Liveable Cities: Problems, Obstacles and Successful Solutions

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The 2008 World Cities Summit Congress in Singapore was an event held at the right time and at the right place. The time was right because the trend of urbanisation and growth of cities around the world requires a broad view and understanding of problems and development of policies and measures to cope with chronic urban problems. Cities' leaders are making increasing efforts to create liveable and sustainable cities. The place was right because Singapore has been one of the world's leading cities in using a systems approach in analysing and developing comprehensive policies to solve social, economic as well as environmental and urban problems. In particular, the focus has been on the relationship between efficient transportation and city's liveability.

This chapter focuses on urban transportation. It is written by the moderator of the session on Land Transportation. He asked the five speakers to report on positive achievements and challenges in their cities or countries. The chapter starts with the moderator's review of developments and trends in urban transportation and a summary of the five reports by participants presented in the session. It is followed by a brief review of the conditions in urban transportation and its impact on cities. Following a review of problems most cities face and mistakes in transportation planning many cities continue to make, this chapter places emphasis on progressive policies and successful

solutions which feasibility has been demonstrated by a number of leading cities.

### URBAN TRANSPORTATION DEVELOPMENTS IN THE 19TH AND 20TH CENTURIES

The process of industrialisation since 1800 led to urbanisation and rapid growth of cities (particularly in the industrialising West). A major problem in that process was that people could travel only as pedestrians, on horse-drawn coaches and, later, on inter-city trains. The cities were, therefore, being developed with high density for easy travel: this period resulted in “*Walking Cities*”, that is, cities that were compact and walkable (Schaffer and Sclar, 1975).

The invention of electric tramways and metro systems in Europe and the US led to extensive building of rail lines and networks to meet the need for greater mobility and better quality of life. Following rail transit lines and networks, the cities grew spatially. Thus, from the 1890s onwards, cities could be described as “*Transit Cities*” for several decades.

Another major transportation development that greatly affected cities was a fast increase in automobile ownership, which occurred in the US during the 1930s, and in Europe, Japan and other industrialised countries during the 1950s and 1960s. Widespread ownership and use of private cars for urban travel caused a serious conflict in cities between personal convenience and transportation system efficiency. This conflict can be explained in very simple terms. For many trips, the private automobile offers the most convenient mode of travel, particularly if its direct out-of-pocket costs are very low. However, when most travel is performed by cars, the resulting chronic traffic congestion makes the transportation system inefficient and the entire city unliveable (Figure 1). Construction of freeways/motorways and parking garages can alleviate this problem, but it results in creation of cities which are not people-friendly (Figures 2 and 3). Moreover, large freeway networks induce longer trips and lead to even greater congestion. This phenomenon is often referred to as the “collision of cities and cars.” Policies of accommodating and maximising automobile travel while sacrificing system efficiency and quality of life have been strongly supported by lobbies of highway builders, automobile manufacturers, oil companies and related industries. Many of these industries not only promote



Fig. 1 Traffic congestion and pollution in cities — negative side effects of unlimited motor vehicle use



Fig. 2 High-capacity freeways in central cities harm their liveability



Fig. 3 Large parking area requirements make cities less people-friendly

the use of cars, but work actively to downgrade transit services to the least attractive mode — buses on streets.

Policies intended to create “Auto-Based Cities” led to the following activities and results (Newman and Kenworthy, 1989):

- Extensive construction of freeways and parking garages that facilitate and encourage faster and longer trips by car;
- Transit services are inadequate, serving only captive riders;
- Resulting automobile dependency leads to increased driving and increased traffic congestion; 30–40 per cent of people who do not drive become second-class citizens;
- Pedestrians are neglected, limiting cities’ liveability;
- Retail and many other activities relocated from central cities to suburban malls.

Another group of countries and cities, led by Germany and several other European countries and Singapore, gave greater attention to defining the goal in urban transportation planning: achieve liveable cities through

coordinated policies towards economic development, transportation, housing and other elements. By defining the types of services and impacts transportation should have, these countries clearly stated that they did not want to create automobile-based cities. To achieve greater efficiency and enhance urban liveability, they decided that the transportation system should consist of a number of complementary modes, including private and public transportation and also encouraging walking, bicycles and other modes. This led to the definition of “*Intermodally Balanced Cities*”.

To achieve this goal, it became clear that a number of measures had to be implemented that will shift a considerable volume of trips from private cars to transit, walking and other more efficient modes from the systems point of view. Examples of these measures, divided into two categories, are presented here.

#### Incentives for Use of Transit, Paratransit, Bicycles and Walking

- Building metro, light rail or other medium-capacity modes with separate rights of way
- Coordinating transit modes and integrating their information and fare collection
- Creating attractive pedestrian streets and areas, often served directly by transit
- Coordinating land use with transit lines and stations
- Providing bicycle ways and other bicycle facilities

#### Disincentives for Use of Private Cars

- Eliminate subsidised and “free” parking in central cities
- Use parking charges to discourage commuting by car which requires eight hours of parking
- Use petrol taxes for financing all transportation facilities, including transit, pedestrian zones, etc., instead of roads only
- Use road pricing (for example, Singapore’s Electronic Road Pricing — ERP) to reduce traffic congestion; it is an effective way of charging automobile users for social and environmental costs which they are not paying

- Provide park-and-ride and kiss-and-ride facilities at rail stations in major cities
- Review and reduce requirements for provision of parking space for residences and businesses in central cities

The following sections present highlights of the five presentations at the World Cities Summit.

### **KEY ROLE OF PUBLIC TRANSPORT IN INCREASING LIVEABILITY AND SUSTAINABILITY: GLOBAL EXAMPLES OF BEST PRACTICES**

Mr Hans Rat, the Secretary General of the International Association of Public Transport — UITP, described the activities of his organisation. With over 200 transit companies as members in more than 90 countries, UITP serves and assists the transit industry with extensive data, reports on technical and organisational topics, from rail and bus vehicle specifications to enquiries on fare levels and collection methods, sources of transit financing and organisational aspects of transit operators.

In addition to this guidance and services for the industry, UITP very actively participates in international discussions about liveability and sustainability of cities as well as the role of public transit in achieving these goals. It publishes a journal and brochures on different topics, reporting on best practices in providing transit lines — the key element in creating pedestrian zones around metro stations or light rail lines in pedestrian malls.

Mr Rat reviewed several world trends that affect urban transportation and, particularly, transit. The wave of globalisation is reflected in the growth of multinational transit companies which operate transit under contracts with cities or umbrella transportation authorities. In Europe, about 40 per cent of public transit systems are now operated by multinational or other companies, which are not owned by the cities they serve. He mentioned that in some countries, there are also anti-globalisation movements. This situation is complicated by the unstable conditions in international monetary

relations and volatile stock market conditions. The weakening role of the US dollar as the international basic currency, and the rapidly increasing price of oil on the world market also create financial uncertainties.

The increasing price of oil, which is affecting most countries' economies and international trade relations, can be expected to have a particularly strong interaction with different modes of urban transportation. With continuous growth in purchasing power of populations of large industrialising countries such as China, India, Russia and Brazil, automobile ownership will increase. This will add to the demand for oil and cause further increases in the price of oil, as well as in traffic congestion in cities.

While the increase in the price of oil and hence, operating costs of public transit agencies, affect private car users much more, this might result in significant shifts of travel from cars to other modes, particularly public transit. This has been demonstrated by significant increases in transit ridership in most industrialised countries, including the US. The attitudes toward public transit and demand for its improvements, particularly among the younger generations of citizens, have grown significantly. The support for policies that increase the role of public transit in urban transportation in industrialised countries is now much greater than it was in recent decades. However, in countries which are experiencing growth in automobile ownership now, the costly mistakes of favouring automobiles while neglecting transit made in industrialised countries several decades ago, are in many cases being repeated.

Countries and cities leading in transportation planning support the trend of increasing transit ridership as a development to meet the need for greater mobility without increasing congestion. This is reinforced by the increasing social consciousness for inclusion of different population groups, by income, age and travel patterns, as well as for the revitalisation of central areas in many cities.

In conclusion, the increasing requirements for population mobility in growing cities call for more effective control of traffic congestion and for massive investments in transit modes with high capacity, comfort, performance and permanence, i.e. public transit modes on mostly or fully protected rights of way. These modes with separate infrastructure strongly support urban forms with greater liveability and sustainability.

## TRANSFORMING URBAN TRANSPORT TO ACHIEVE LIVEABLE URBAN ENVIRONMENT — EXPERIENCE FROM BOGOTA

Mr Enrique Penalosa, former mayor of Bogota, Columbia, described major changes he introduced in transportation in Bogota as its mayor from 1998 to 2001. His most important innovation was to define the type of city and its quality of life, and then determine the roles which different transportation modes should have. He emphasised the fact that a transportation system should be adjusted to the specific conditions, needs and possibilities of implementation of selected policies. Hence, Mr Penalosa emphasised that "If we want to have a city similar to Amsterdam, we should not use the transportation policies used in Houston".

Referring to the experiences from Bogota, Mr Penalosa said that in a typical developing city with several million people and a large low-income population, transport is a very peculiar problem: it gets worse as society gets richer. Demand for construction of large highways and parking to accommodate private cars can directly conflict with the needs for better health, education, housing and other basic social needs.

Mr Penalosa asked how a democratic developing city should distribute road space among pedestrians, bicyclists, public transport and cars. To make the city friendly to people, a lot more space should be given to pedestrians and bicycles than had been the case in Bogota.

In developing countries, bicycles were accessible to large numbers of low-income people who do not own cars. Thus, building of bicycle ways represented an economical way of increasing the mobility of certain segments of the population, such as teenagers, students and in some cases even most age groups. This need not be considered only as an improvement for low-income groups, because in Germany, Netherlands, Denmark and many other European countries, bicycles were used extensively by all income and age groups.

In Bogota, a proposal for the construction of a 45-kilometre long urban highway submitted by Japanese consultants was rejected because it would intensify car use rather than decrease congestion and increase

mobility. Mr Penalosa pointed out that if there were more space for cars in New York or London, there would be more cars, but not more mobility. Unfortunately, some cities did not understand this. Mexico for example, had just built a large number of huge elevated motorways which were environmentally disastrous for the city, its character and sustainability.

Bogota built a network of about 400 kilometres of bicycle ways that were being used by up to 350,000 cyclists. This was paralleled by restrictions on car parking and improvements of public transit. Great effort and many innovations had been used in building the Transmilenio Bus Rapid Transit (BRT) system which had four lanes, stations in the median lines, accessible in many cases by elevated pedestrian walkways. With its high capacity and frequent services, Transmilenio had attracted many people away from using their cars so that 20.7 per cent of its riders have cars but choose to use transit.

The Transmilenio BRT (Figure 4) had drawn international attention by its high capacity and design of bus stops with high-level platforms and simultaneous boarding at several doors. Mr Penalosa claimed that the investment cost for the Transmilenio was much lower than for rail systems and then made a strong generalisation that buses were the only feasible solution for high-performance transit in developing countries because the BRT was able to provide the same performance at much lower cost than rail. This statement was challenged as contrary to worldwide experience that for very high passenger volumes, rail transit provided much higher capacities at lower operating costs. Actually, in corridors with heavy travel volumes, rail transit was the only physically feasible solution because in many cities, particularly in developing countries, reserved busways could not be maintained. Even many newly built busways could not be defended from pressures to allow other vehicles in the same lanes, which practically eliminated the entire BRT.

Mr Penalosa's emphasis on the need for every city to define the goals for its transportation system was valid for any city. His strong support for better treatment of pedestrians also has general validity. Incentives for greater use of bicycles were also valid for many cities, but would depend on local conditions. He did not discuss in depth the difficult problem of implementing measures to create disincentives for automobile use with the exception of the elimination of curb parking in some city streets.





Fig. 4 Transmilenio BRT in Bogota attracted attention by providing high capacity on a four-lane roadway, but it created a barrier to pedestrians.

### URBAN TRANSPORT CHALLENGES IN RAPIDLY URBANISING COUNTRIES: POLICIES AND INFRASTRUCTURE DEVELOPMENTS IN INDIA

Mr Sanjeev Kumar Lohia, Director of Urban Transportation in the Ministry of Development of India, reported that his country was experiencing rapid urban growth, resulting in 35 cities with population

exceeding one million and seven cities exceeding four million. With automobile ownership growing even faster than its population, most cities suffered from chronic congestion of streets with pedestrians mixing among many types of vehicles, from bicycles and *rikshas* to buses and trucks.

Despite this trend of increasing urban congestion, transit development and financing were seriously neglected. In most cities, transit consisted of buses on streets. However, the rapidly deteriorating traffic conditions in so many cities led to an intensive national discussion about urban transportation and by the end of 2006 most cities began to change attitudes toward transportation policies and measures. Instead of focusing efforts on construction of roads and flyovers to accommodate increasing volumes of cars, it was recognised that mitigating problems of congestion, air pollution and traffic safety required policies that favour public transit as well as non-motorised modes over private cars (Agarwal and Zimmerman, 2008).

Improvements of public transit through operational measures were needed, but not sufficient for large cities. High-capacity rail systems had therefore been planned and built in several cities. Cities with extensive railway networks, such as Mumbai, Kolkata and Chennai, had extensive suburban (regional) rail networks. Mumbai had one of the world's largest suburban (regional) rail systems, carrying about six million passengers per day. Indian Railways reported that the country's suburban railway systems ridership increased from 23 trillion passenger-km in 1970 to 106 trillion in 2005.

The first metro rail system was opened in Kolkata in 1984, followed by Chennai and Delhi. Mumbai, Hyderabad and Bangalore were also building or planning new metro rail systems. The Delhi Metro is particularly recognised as an efficiently planned and built system.

In recent years a lot of attention had been given to BRT. Its promoters had been very critical of the high investment costs of rail systems and claimed that BRT would require much lower investment costs and easier implementation than metro systems. This claim had proven to be too simplistic. While upgrading of bus services can bring significant results in most cities, the claims that BRT can be effective in most Indian cities had proven to be unrealistic. In theory, BRT can operate efficiently on reserved rights of way, but in practice obtaining reserved lanes cannot be implemented in highly congested streets. Thus, the introduction of BRT

in New Delhi and Mumbai led to serious problems which BRT promoters usually overlook: the ability to keep bus ways for buses only faced strong opposition in most cities. BRT was practically unfeasible in cities without strict police enforcement. Mumbai bought BRT buses, but could not organise the infrastructure for their operation.

Interestingly, light rail transit (LRT) which requires substantially lower investment than the Metro, but more effective than buses in its separation from general traffic had yet to obtain much attention in India. Considerable potential for upgrading old fashioned tramways in Kolkata into modern LRT had yet to be utilised.

The discussions about implementation of urban transportation policies that favour transit and pedestrians over cars in urban areas continued in India. The national government was considering a programme that would contribute 30 per cent of infrastructure investments for transit projects but the formulation of coordinated intermodal policies and their implementation were yet to be fully established.

### **PROMOTING PUBLIC TRANSPORT AS AN ATTRACTIVE MODE OF CHOICE — SUCCESS IN ADELAIDE**

Ms Heather Webster, the Executive Director of the Public Transport Division in South Australia, described a comprehensive effort in promoting transit use in Adelaide by focusing on present and potential transit users. The city of Adelaide, with a population of 1.1 million, low population density, high automobile ownership and cheap gasoline — elements that create automobile dependence which transit must overcome to become competitive.

Facing these difficulties, coupled with the trends of increasing gasoline price and environmental concerns, the government of South Australia made a concerted effort to increase the role of public transit. Extensive surveys were undertaken to establish the features affecting transit use, such as service frequency, moderate fares, reliable services offered during evenings and weekends, as well as improving the image of transit by system symbols, vehicle colours and extensive, easily obtainable information. Explanation about potential savings acquired from switching from car to transit travel had

further contributed to the success of the campaign of increasing the share of transit travel and strengthening its role in the city's pedestrian orientation and liveability, as well as improving economic efficiency of transit services.

### **BUILDING A PEOPLE-CENTRED INTERMODAL LAND TRANSPORT SYSTEM — SINGAPORE**

Mr Yam Ah Mee, Chief Executive of the Land Transport Authority (LTA) in Singapore, described the development of a remarkably comprehensive and successful intermodal transport system in Singapore (Yam, 2008). Development of transportation in Singapore during the last three decades clearly showed that the establishment of LTA was key to the present efficient integrated transport system and liveable city. LTA was an agency that formulated and implemented transportation goals and policies in coordination with land use planning. The emphasis on public transport actually predated the establishment of LTA. The Urban Redevelopment Authority (URA) performed this latter function in close coordination with LTA, and that cooperation had been crucial to the success of land transport planning in Singapore.

Faced with the problems of a growing population and increasing automobile ownership, as well as the goal of achieving a sustainable city, LTA focused its efforts on changing modal split in favour of public transit by implementing three sets of measures:

- i. *Make Transit a Choice Mode* — public transit-use incentives consisting of improvements to its network of Mass Rapid Transit (MRT), automated mass rapid guided transit as feeders to the MRT, and an extensive bus network. The current plan projected a doubling of the MRT to 278 kilometres in length and improvement of its intermodal transfers, improving service quality and its information system.
- ii. *Manage Road Usage* — automobile travel disincentives consisted of expanding its Electronic Road Pricing (ERP) scheme to an extensive system across the island, coupled with disincentives to automobile ownership.
- iii. *Meet diverse needs of people* — analyse and improve travel opportunities by adjusting to the needs of different groups of travellers and population



categories by income, travel purposes and physical characteristics among others.

Singapore's example clearly showed a number of innovations that it had introduced over the last four decades, placing it in the forefront of comprehensive transportation and city planning that contributed to increasing liveability in spite of its population growth.

### PRESENT CONDITIONS IN URBAN TRANSPORTATION

The preceding reports showed that while urban transportation has been a serious problem in most countries, significant progress with innovative policies and implementation methods has also been achieved in a number of cities. Selected aspects of the present transportation conditions and problems typical for many cities are described in the following paragraphs. Successful solutions are reviewed in the closing section.

- The complexity of urban transportation is yet to be fully understood in many cities, as such, the necessary transportation policies are missing in many cases. Actually, many cities do not have organisations that are in charge of developing and implementing coordinated intermodal policies and projects. This problem is particularly serious but not limited to developing countries (World Bank, 1996). Many cities in industrialised countries have not achieved adequate development of transportation policies and their coordinated implementation (Vuchic, 1999).
- In the absence of clear transportation goals, policies and implementation procedures, many cities appear resigned to chronic traffic congestion as an inescapable phenomenon of large cities — or even a sign of their economic vitality!
- When automobile ownership grows, cities and regions must adjust streets to handle higher traffic volumes; a freeway network serving major corridors is also needed. However, attempts to “meet the demand for travel” when automobile travel is underpriced by constructing more freeways into central cities and building multi-storey garages generally

result in increased automobile dependency and permanent decrease of cities' liveability.

- The relationship between private and public transit is mostly based on the short-term decisions of individual travellers rather than on efficiency of transportation as a system. As automobile travelers do not pay either social costs they incur (congestion, environmental deterioration, stress and accidents), or long term damage to cities' liveability, automobile travel becomes more attractive for many trips than use of transit. This condition results in chronic congestion with all its short- and long-term negative impacts on cities.
- In addition to the issue of excessive trip making, the low direct cost of driving gives the automobile competitive advantage over public transit and forces many cities to subsidise public transit fares. On the other hand, cities which have road user charges, high parking rates and other levies on car use, can have higher fares and lower operating subsidies for public transit (Vuchic, 1999; Shoup, 2004).
- Due to inadequate understanding of the complexity of urban transportation and absence of rational intermodal transportation policies, many cities do not provide adequate funding for public transit, particularly for construction of high-performance systems (rail and other systems independent of traffic congestion), which are competitive with private cars.
- These problems are aggravated in cities and countries where many special interest groups oppose innovations and improvements to present conditions and trends. Pursuing their own interests, these groups are often in conflict with transportation efficiency and city's quality of life. They include, for example, many automobile manufacturers, oil companies, public transit labour unions, jitney and taxi organisations (particularly, in developing countries), parking garage builders and owners, and many others.
- Rail transit, the highest quality of public transit mode, is often the subject of distorted criticism because it decreases use of cars and oil consumption. Pedestrians and walking as a mode — a basic element in any liveable city — are often not protected or promoted in agencies that are planning and operating transportation systems.

- Unfortunately, many cities, particularly those with growing automobile ownership, are repeating obvious mistakes made by the cities in the United States, Canada and Western Europe, where that phenomenon occurred several decades ago. Several examples follow.

Large and rapidly growing cities in developing countries suffer from increasing and uncontrollable congestion. Their public transit systems are so overloaded and often dangerous, that whoever can buy a car does that in order to avoid the slow, unattractive transit. Ironically, the addition of more cars leads to a decrease in mobility by all other modes of travel. Instead of investing in high-capacity metro rail, light rail and bus systems with separate roadways, these cities invest mostly in widening of roads and building of freeways.

- Many cities in China, India, Russia, other former Soviet republics and Eastern Europe are also repeating some of USA's and Western Europe's mistakes made a few decades ago as they now respond to the rapid automobile ownership growth:
  - Bicycle use is discouraged by converting bicycle lanes into motor vehicle lanes, resulting in increased vehicle congestion and parking demand;
  - Trolley buses are in some cases replaced by diesel buses, increasing environmental damage;
  - Tramway tracks are paved to "increase street capacity;" where in reality, person-carrying street capacity is decreased;
  - Tramways are replaced by buses, resulting in passenger losses, while their upgrading into light rail would make transit much more competitive and pedestrian-friendly;
  - Construction of metro and light rail systems is given less attention than construction of freeways;
  - Land use/transportation aspects in urban design are not given adequate attention. In some cities this leads to construction of large office and residential buildings without adequate transit services, street capacities for accessibility, or necessary off-street parking facilities and pedestrian ways.

These policies and activities have been used in many industrialised countries several decades ago, but the negative experience has led to their

reversal. So today, bicycle use is encouraged, transit is separated rather than mixed with general traffic, electric traction modes are favoured over diesel-powered ones and transit improvements are promoted as an important element in reaching sustainability.

### EMERGING SOLUTIONS LEAD TO LIVEABLE CITIES

There are now a number of cities which have used experiences from recent decades to develop policies, organisations and procedures that have made them distinctly successful in achieving efficient transportation and city's liveability. Among the most progressive leaders are core cities like Berlin, Cologne, Copenhagen, Curitiba, Munich, Portland, Prague, San Francisco, Singapore, Tokyo, Toronto, Vancouver, Vienna and Zurich. Selected features which these cities have introduced with success are described in the following paragraph.

Cooperation between competent civic leadership, transportation and city planning experts enabled these cities to develop policies which define the goals for the city where development of efficient transportation system is a component for achieving a liveable and sustainable city. The roles of different transportation modes in achieving the cities' goals are also extensively and publicly discussed, so that innovative measures, including those restrictive in the short run, have been well received by the population. This public awareness is extremely high, for example, in Copenhagen, Munich, San Francisco and Singapore.

The basic problem in allocating roles to different transportation modes is achieving the optimal balance between individual or private and public transport, automobiles and public transit. In this respect, simply building more roads, parking and using more buses had proved to be inadequate, sometimes even counterproductive. In 1974 Singapore was the first city that introduced road use charges as an efficient means to prevent wasteful traffic congestion (Figure 5). Although this measure was obviously successful, it took more than 20 years before other cities began to use this method. Oslo, Stockholm, Trondheim and London followed suit so that road pricing is now a viable proposition for many cities.

A desirable balance between cars and transit is usually achieved by two sets of coordinated policies: incentives for public transit and disincentives



**Fig. 5** Smooth flow of traffic on attractively designed streets, ensured by the Electronic Road Pricing (ERP) system, contributes to sustainability in Singapore

for automobile use. The key to providing transit incentives is to introduce high-performance public transit systems. In medium and large cities, public transit systems which are competitive with automobiles are those which operate on partially or fully separated rights of way. The number of cities with rail rapid transit or metro systems has increased from 20 in 1955 to about 110 today.

The metro rail system (Figures 6, 7 and 8) is a logical solution for basic transportation networks in large cities because it is by far, the highest performance (capacity, reliability, safety) transit mode that has positive impacts on urban development and liveability. However, their investment costs are very high, so that many medium-sized cities have found Light Rail Transit (LRT) to be fully adequate for medium-capacity lines with very pedestrian-friendly characteristics (Figures 9 and 10). LRT can provide high-speed services similar to those of metros on fully controlled sections, but they can also penetrate into city centres and pedestrian zones in central cities (Girnau *et al.*, 2000; Vuchic, 2007). Their investment costs are therefore substantially lower.



**Fig. 6** Munich U-Bahn — one of the new metro systems built in recent decades in over 100 world cities



**Fig. 7** Bay Area Rapid Transit — BART, a regional metro serving San Francisco and its region



**Fig. 8** Regional rail systems in many cities are introducing double-decker cars to increase capacity and comfort



**Fig. 9** Light Rail Transit (LRT) serves pedestrian zone in the centre of Karlsruhe, Germany



**Fig. 10** Montpellier, France, introduced LRT as part of rebuilding the central city for increased liveability

Considerable progress has been made in recent years in bus technology. Many types of hybrid buses have lower energy consumption and produce much less air pollution than traditional diesel buses. Hundreds of hybrid diesel/electric buses have shown good results in New York City, while Rome and Naples have introduced trolley buses which obtain electric power from overhead wires or from powerful batteries. These vehicles (Figure 11) produce virtually no noise and no air pollution on urban streets.

The BRT (Figure 12) has been aggressively promoted in many countries, including India and China. BRT is usually built at a lower cost and in shorter time than LRT, and its successful operations in Sao Paulo, Curitiba and Bogota have been widely recognised. Caution is however needed because the advantages of BRT over LRT are offset by serious disadvantages. BRT described in theory often cannot be implemented in real world conditions. A number of bus ways and BRT systems in the United States were built during the 1970s, but they were later degraded into high-occupancy vehicle lanes or discontinued completely.



**Fig. 11** New trolley bus capable of using power from overhead wires or battery, introduced in Rome to avoid air pollution



**Fig. 12** The Bus Rapid Transit (BRT) in Mexico, a low-cost improvement attracted many passengers from cars and mini buses

Many conceptual and numerical facts quoted widely about BRT systems are grossly distorted and divorced from real world facts. For example, the Institute for Transportation and Development Policy (ITDP), which has done excellent work on encouraging development of pedestrian, bicycle and transit systems, particularly in developing countries, in the case of mode comparison presents many inaccurate statements in the case of mode comparison — promoting only BRT systems and negatively distorting facts about rail systems. ITDP claims, for example, without any documentation, that BRT requires 10 times lower investments than LRT. This claim ignores, for example, the fact that the BRT Silver Line in Boston had required about five to 10 times greater investment on its core section than average investments for LRT systems in many US cities.

Hensher (2008, p. 30), also a strong promoter of BRT and opponent of rail, quotes that in Bogota, peak ridership of 35,000 passengers per hour is achieved, “with recent claims of up to 45,000 passengers with maximum peak headways of three minutes” and articulated buses with capacity of 160 spaces. Simple computation shows that headways of three minutes, i.e. a frequency of 20 buses per hour, offers a capacity of mere 3,200 spaces per hour, i.e., only 9 per cent of the claimed actual provided capacity and 7 per cent of the “recent claims of 45,000 passengers capacity.” In addition to incorrect computations, the concepts of offered and utilised capacities are mixed here.

These examples show that many claims about BRT capacity and performance are highly inaccurate and based on unrealistic theoretical assumptions about operating conditions in the real world. This kind of misinformation has been very damaging when many cities have been led to believe that BRT is very easy to introduce and that it can provide better performance than rail. Such misguidance has set back transit improvements in a number of cities.

The success of BRT systems depends greatly on the efficiency of police enforcement on streets and intersections. It also depends on the culture and public behaviour. Several BRT or bus way systems were terminated by courts after legal challenges or by local governments under pressure from highway lobbies. Thus, the implementation of BRT in many cities, including New Delhi, Mumbai and Jakarta, has been very different from the systems which their promoters proposed without analysis of local conditions.



Most bus, trolley bus and tram way services around the world can be significantly improved, but that can be achieved only if there is careful planning and cooperation between public transit agencies and the city's traffic departments in giving transit priorities. Such priorities are easily justified by the greater efficiency of transit compared to private automobiles, but that principle must be politically adopted and supported.

Leading cities also demonstrate the importance of giving attention to different categories of travellers (see the above cases of Singapore and Adelaide). Public transit use greatly depends on the attraction and convenience of transit stops and stations, easy transfers, ample information and urban design that provides for human environment. So public transit and pedestrians, when planned to be mutually supporting, create the basic element of urban liveability; they also decrease the need for use of vehicles and provision of freeways and parking which tend to have negative impacts in central areas of cities and major activity centres throughout urban regions.

Recent developments show that the challenges of introducing coordinated intermodal transportation policies and improving liveability of cities have been successfully met in some cities, mostly in industrialised countries. Cities in developing countries face similar challenges and even greater obstacles. They face more rapid urban growth, but must meet greater social needs with much smaller financial resources.

Learning from the past decisions of industrialised countries, including many serious mistakes, developing countries should greatly increase investments and planning efforts in high-capacity transit systems, which provide high transporting capacity that can decrease the chronic congestion of streets. Provision of public transit ways that are separated from general traffic is the most important step in that process. Simple and durable rail systems should be secured for all large and rapidly growing cities. BRT systems can be very effective if their rights of way can be permanently protected. The least costly, but organisationally most difficult and often least durable measure is to control street traffic by giving preferential treatments for buses on streets.

All leading cities in transportation innovations have paid increasing attention to pedestrians. Movement of pedestrians should be planned and promoted not only by providing greater safety, but by making walking attractive. Cities can be liveable only if they provide for a good and attractive environment for pedestrians (Figures 13 and 14).



**Fig. 13** Large pedestrian area in the centre of Munich gives the city a reputation for liveability



**Fig. 14** San Francisco Market Street is a pedestrian haven and it is served by cars, taxis and five transit modes

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## Chapter

## 7

## Biodiversity in Sustainable Cities

LOKE MING CHOU

## INTRODUCTION

Environmental sustainability is a fundamental concern for the survival of human society on Earth where limited resources are expended at an increasingly alarming pace. A city's high demand for resources imposes enormous strains on the environment. Is there a role for biodiversity in a city's quest for sustainability? This and other questions concerning the impact of biodiversity on the quality of life for city residents, city planning and governance were discussed during the "Biodiversity in Sustainable Cities" session of the World Cities Summit 2008 held in Singapore, and highlighted in this chapter.

This chapter examines what biodiversity is and what it means, and how it can be utilised to raise sustainability levels in cities. There are strong but not insurmountable challenges for biodiversity to perform such a role in cities. Required is the willingness to try clever ideas and test creative approaches that may go against some of the basic principles and wisdom of conventional ecology, architecture and urban planning. The challenge of society's acceptance of biodiversity at the doorstep is also addressed, particularly when it comes to dealing with pests and dangerous species. Cities that are ready to accept these challenges will progress faster in becoming model 'eco-cities'.