# Urban Traffic and Transport

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*He is a mediocre golfer and an amateur cook.*

## Acknowledgements

During the preparation of this report I came to realize how much I owe to many people in different positions in and outside Sweden. A name list would be far too long and probably defeat its purpose. Instead, I feel that I want to direct my appreciation and thanks to Sida for their initiative to include urban transport as one of the areas for Swedish assistance. Having had the opportunity to participate in the policy work to this extent a couple of years ago, I would particularly like to thank Göran Tannerfeldt, Mikael Söderbäck and the members of the Sida working group. Thanks also go to Hartmut Schmetzer who helped to improve and shorten the text.

## Contents

# 1 Introduction

## Problem

**Urbanization and growth of cities**
When the British left India in 1947, Dhaka was a town with 250,000 inhabitants. Today, Greater Dhaka has a population of about 11 million inhabitants that is likely to increase to 16 million in 2015.

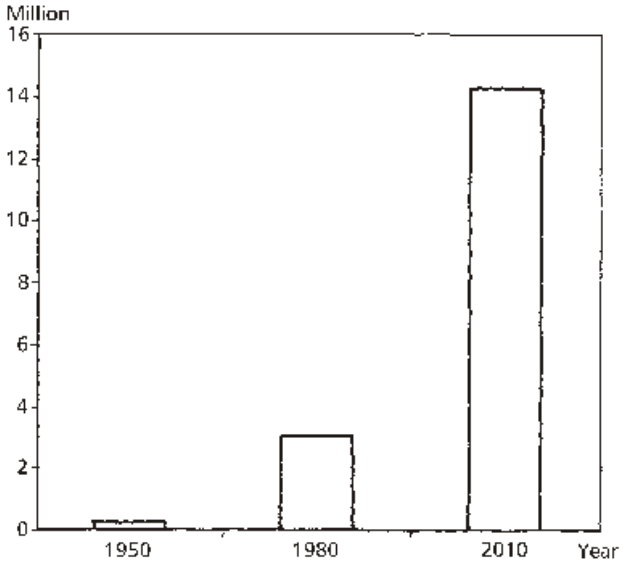


*Fig. 1 Greater Dhaka growth*

The examples of Dhaka and other mushrooming cities such as Jakarta, Mexico City and Cairo illustrate one of the most powerful trends in the developing world-urbanization. In 2020 3.5 billion people in developing countries will live in cities, and Africa and Asia will be predominantly urban, as Latin America already is. A process which took a hundred years in a country like Sweden will be compressed into decades.

Such rapid growth puts high pressure on all city functions, and one of them is transportation.

**Traffic, a problem – transportation, a need**
To many people, transportation planning means the design of roads and pavements and bridges – something to be handled by a few engineers with calculators. The purpose of this activity is often thought to make life easier for the car driver by eliminating congestion, bottlenecks and bad roads. In effect, these are ***traffic*** problems, and those are certainly important to those with access to a private motor vehicle.

But for another part of the population, often the largest part, the problem is not confined to better traffic conditions: the issue is ***transportation*** which is something different than traffic. To them, the matter is how to move between homes and jobs, schools and other activities, in an affordable way, safely, and using as little time as possible. When daily travel requires two, three or more hours each day and consumes a large part of the household income, then the potential becomes reduced for life quality as well as for economic development.

Transportation in itself is not a luxury but a very deep and fundamental ***need*** among people, after food and housing possibly one of the strongest. The transportation system directly affects the economic efficiency of cities and the well-being of their inhabitants. It is especially important for new settlers in the outskirts of growing cities, since it expands the options for work, education, health, and other amenities.

When urban transport is inefficient, it can be a major source of problems for cities and their inhabitants. Traffic congestion reduces the city's productivity and consumes time. Air pollution from traffic is almost always the major environmental problem in a city. Investments in urban transport infrastructure such as roads and streets is often a major drain on the city's economy, and in many cases existing facilities could be more efficiently used. Above all, traffic problems and lack of transportation facilities affect individuals at all levels in the society.

One of the challenges for the future in developing countries and reform economies is to implement policies to make cities sustainable, efficient and equitable. Solving transport problems is one of the chief tasks.

## Method

This study was performed as a desk study including review of literature, studies and reports. In particular, the report is based on background material produced when Sida developed its strategy for urban transport and traffic.

The World Bank recently prepared a revised Urban Transport Sector Strategy Review and it has been possible to follow this process on the Internet. Considering the importance of the World Bank to shape development, the opportunity was taken to use some of this material.

Visits to different countries on earlier occasions play a decisive role in forming impressions and opinions. Much of the comments and opinions expressed in this report derive from personal experience as an international consultant, most recently in countries as diverse as India, South Africa, Russia and Honduras.

The main challenge in trying to describe such a vast sector as urban transportation is to make a meaningful selection of problems and cases. Due to the importance and relevance of public transport and non-motorized transport in developing countries, more effort has been laid on these areas than, for example, on conventional road and street design.

The synthesis of the collected information was done with a view to structure the urban transport sector into sub-sectors so as to provide an overview of the issues at stake. The ambition was not to produce a comprehensive textbook, and more emphasis has been laid on examples than on "universal truths".

## Organization of the report

To present the whole range of problems of urban transportation in what we call "developing countries" would be an impossible ambition. Instead, an attempt has been made to present and discuss a selected few of the more relevant aspects of urban transportation, without going too deep into

technical solutions. The report basically adheres to the standard format of Building Issues with the following main chapters:

- General considerations
- Discussion and recommendations
- Case studies

# 2 General Considerations

## The city's importance for economic development and the role of transportation

Urbanization is a fact in developing countries just as it was in industrialized countries. The importance of urban areas for the economic output of a developing country is now generally recognized. It is estimated that up to 70% of GDP in most developing countries is produced in cities. Even in African countries where urbanization is more recent, the contribution to GDP of urban areas is already 50–60%.

The better the city functions, the more it can contribute to the national economy. Transportation of goods and people plays an important role, as it functions like the circulation system in a living organism. Lack of transport facilities as well as traffic congestion therefore impedes economic development.

> *"Urban congestion is a source of economic inefficiency … it reduces the net economic output of urban areas …"*
>
> World Development Report 1992.

Saving time in urban travel is not only an important social consideration but also has a very real economical impact on the urban and the national economy.

> *"Urban transport projects can generate large time savings by reducing average journey times and their unpredictability, thereby releasing a city's economic potential."*
>
> Asian Development Bank

In an increasingly global economy, the establishment of international companies can be an important source of employment and income. One of the factors routinely analyzed by potential investors in such cases is the quality of the transport system. To be able to offer an efficient urban transport system without congestion was one of the key components in Singapore's long-term development strategy to attract investment.

In this context, however, it must also be recognized that wasteful and ill-planned urban transport projects can have a harmful effect not only on the urban but also on the national economy. They are often financed from the national budget and, for example in the case of subways, may produce considerable deficits without the corresponding benefits.

## Impact of urban transport on some development issues

In addition to its importance for economic development, urban transportation has a very high impact on quality of life issues.

**Environment**

Probably no effect of urban transport attracts more debate than the environmental impact of motorized traffic. In some mega-cities with unfavourable conditions – Santiago, Mexico, Tehran, Dhaka – air pollution is visible as smog and is directly harmful. As motorization gains momentum in the world, an enormous urban population is about to be affected. These effects are not only local (although this is

bad enough) but many experts are warning of the serious potential effects of global warming in a world where motorization multiplies and is driven by bad engines and poor fuel. However, the city most related to the concept of smog, Los Angeles, has largely managed to combat it. Even in Bangkok, ill reputed for its notorious traffic problems and air pollution, a turn to the better has been possible.

In the general ambition to come to grips with the long neglected urban environmental problems e.g. in Eastern Europe, it should be recognized that it may be even more urgent to counter and prevent the future dangers of a dynamic and irreversible traffic development than to improve a polluting, but more static, industrial sector.

**Poverty**

As populations shift from rural areas to urban areas, so does poverty. Studies by the Asian Development Bank indicate that, with few exceptions, the proportion of the population in Asia which is poor is similar in rural and urban areas, but that the quality of life at a given poverty level tends to be lower in urban areas.

There is sometimes a tendency to regard the urban transport issue as a luxury for the rich. This may be based on the misconception that urban transport planning is an activity aiming at building more roads and create more car traffic. In reality, urban transport has a very strong bearing on poverty and is one of the factors with highest impact on the economy of families in low income groups.

New migrants arriving in the cities from the rural areas typically end up in the outskirts where they have to find housing. Transport is essential for them to be able to benefit from the city's supply of employment, schools and other services. But since they travel long distances, cost is an essential factor. Transport can also be dangerous. In a recent survey in selected slums in Delhi the residents noted that commuting to work is the most dangerous aspect of their work.

Studies show that households in developing countries often spend 15–30% of the household income on transportation as compared with some 3% in Britain. Some poor families in Kingston spent almost all of their "disposable income" (after deduction of costs for housing, food and fuel) on transport which again shows that urban transportation is not a luxury but a basic need of poor families. For the poor, almost all trips are work trips with few school trips and almost no social trips. Again, this is in marked contrast to industrialized countries where a majority of trips are for social, shopping and similar purposes.

When private transport is unattainable because of the cost, and public transport is at the margin of a poor family's affordability, walking becomes the only available means of transport. In Nairobi, price elasticity for bus transport is about 1, which means that a 10% increase of bus fares deprives 10% of present riders from the possibility to use the bus. Subsidized public transport can be justified although the construction of subsidy systems is often imperfect. But also projects aiming at improving non-motorized transport, e.g. walking, can have a high impact on the poorer segments of the urban population. ***If*** a bicycle becomes a possibility, then the accessible area for a person can increase up to 25 times – something which revolutionized rural life in Sweden a century ago.

**Gender issues**

Urban transport is essential for both men and women but there are some differences that can be identified, although there are few urban travel studies that have specifically identified women's trip-making.

The access to a private vehicle is even more limited for women than for men, and women therefore tend to depend more on public transport than men. For example in Nairobi, 66% of women's trips are by bus as compared to 56% for men. However, women suffer from poor design of vehicles and the way they are driven. For example, the height of entry steps present problems to women in traditional dress (like saris) and women with shopping and/or young children. In some areas market traders are often women and they have special problems with bulky commodities. The travel needs of women are often outside the peak hours, and then there is often no public transport service.

Cycling is a very common form of transport in some Asian and African societies but women's use is often limited to being a passenger because of local customs and culture. In Vietnam, however, the use of bicycles is equal between the sexes. In some Asian countries, for example India and Indonesia, scooters are an option for women because they can be ridden in traditional dress as there is no frame cross-bar that must be straddled.

Traffic accident risks sometimes have different implications for men and women. Evidence from South America suggests that low-income women from the peripheral areas of cities perceive a high risk of theft and sexual assault, and hence are reluctant to make bus journeys without escort. In Kingston and Nairobi there is a risk element in walking home from the bus stop, particularly at later hours.

Gender aspects have so far not been much recognized in internationally funded transport projects.

> *The limited gender focus in World Bank transport projects can be at least partly attributed to an emphasis on traditional transport planning objectives, which focus on ensuring that investments are economically efficient but typically say little about the distribution of project benefits. This approach raises the question of whether the gender impacts of transport should be treated primarily as efficiency issue or an equity issue*
>
> (World Bank 1999).

**Current trends in international thinking**

The World Bank is currently undertaking a comprehensive review of the urban transport sector including the Bank's own intervention policy. It is remarkable to note that an institution like the Bank – known for strict market-oriented and infrastructure-building approaches – is now emphasizing issues like poverty and inequity related to transportation. Many of the background papers provide in-depth analyses of this issue as do several recent articles and books (for example Vasconcellos 2001). The following excerpt from a World Bank background paper provides an indication of the current thinking.

*Inability to access jobs and services is an important element of the social exclusion which defines urban poverty …. The role of transport in this complex concept of exclusion may be characterized as follows. The "income poor" make less trips, and more of their trips are undertaken on foot. For most purposes they are restricted to whatever services (usually poor) can be accessed within walking distance, making them "accessibility poor." The journey to work may be relatively long. Even if it is not, it will use slow modes and may be very time consuming, so they are also "time-poor". For the poor, and particularly for women, children and the elderly, trip making is often discouraged by their vulnerability as pedestrians both to traffic accidents and to personal violence, making them "safety poor". Finally there is evidence that long walking distances and times also creates a tiredness and boredom which reduces their productivity by adding an "energy-poverty" dimension to their deprivation. In assessing transport provisions for the poor it is therefore necessary to look at the total package which defines "exclusion," and not just simply at the proportion of income or even of time, spent on transport*

(World Bank 2002).

## Trends and outlooks for the future

Some – but not all – developing countries show positive economic growth. Although distribution of wealth can be uneven, there is often an increasing part of the population that can be categorized as middle or high income. Almost invariably, an improved economy will be translated into more private vehicles, sometimes beginning with motorcycles as in Asian cities, and ultimately cars. Just as it was in Europe 50 years ago, the private car is a symbol for freedom and for success. The income elasticity for car ownership is roughly 2: each % increase in average household income means 2% increase in the number of cars. Few cities – Singapore being the exception that confirms the rule – are willing or able to implement policies that would control the free ownership and use of the private car.

When road and street infrastructure in fast growing cities is unable to cope with additional vehicles, congestion and environmental problems occur.

*Fig. 2 Cars in Bangkok*

According to Hook, 1996, the US has sacrificed some 60% of its urban land to traffic compared with 15% in most East Asian countries, and he estimates that with the same degree of motorization and use of private automobiles, China would have to pave over 40% of its arable land.

## General approach to urban transport development – two scenarios

Two distinctly different approaches to urban transport development can be identified; the demand-following approach and the supply-leading approach.

### The demand-following approach

The following black scenario is a description of the demand-following approach in its extreme:

"Land use is uncontrolled and the development of the city is chopped up into individual exploitation projects without coordination and without consideration to effects on transportation demand or traffic problems. Each new project reduces the number of options for transport, and once made it is forever there.

As the city grows, transport infrastructure decreases in proportional terms. At the same time motorization grows, rooted in strong individual desires and fanned by a strong lobby headed by motor industry and politicians in combination. Politicians see motorization with hidden pride as a sign of national progress, even though they may complain when their own cars get stuck in traffic jams. With too many cars on a too small street network and with too little regulation, problems such as traffic congestion, pollution and accidents multiply rapidly.

Eventually, at irregular intervals, and only as a result of pressure because of unacceptable traffic conditions, a new road link or a stretch of expressway is being built. Costs are now huge because all land has been occupied and is already developed. Often there is no other option but to build elevated highways; sometimes in several layers. The new highway – in the planning stage pictured as the ultimate solution – quickly becomes filled with traffic and the situation sinks back to square one.

Public transport is neglected. Given no priority in the street network it has to compete with other traffic. It therefore constitutes no attractive alternative and only captive riders without other options are using it. The government bus company is plagued by inefficiency and corruption. Privately operated public transport is in practice uncontrolled by authorities. A licensing system is pretended, but in reality licenses are achieved through bribes or simply ignored. Often, the system is under Mafia-like control, and vehicles are unsafe and polluting. The poor, living far away, cannot afford transport anyway and are excluded from city functions.

Only spectacular mass transit projects like a subway or an elevated rail system catch the interest of the city government, and a project is being pushed through with national funding. Costs are huge to the benefit of contractors, suppliers and middle-men. The end result is a situation with one or two lines of ultra-modern subway technology, surrounded by the same sea of miserable transport conditions as before.

Most cities seem to remain in this situation forever. The result is a loss for everyone. Lost time in unending traffic jams that force workers to spend three hours a day in traf-

fic instead of being at home, and make business appointments a lottery. Lost health for thousands and millions of people breathing toxic gases instead of air and with abnormal levels of lead in their system.

Eventually a city may mobilize both the financial resources and the political will to correct the problems. Now, however, the city is irreversibly a car city, and every solution has to be based on that. Fantastic investments are needed in new highways on top of each other, and when it is all over the city is no longer recognizable."

Too many of the features of this rather negative scenario are familiar in too many cities.

**The supply-leading approach**

The contrasting picture, which can be called the supply-leading approach, is described in the following scenario. This may seem to be a bright picture but it is not unrealistic – there is nothing to prevent it from being realized if the right policies are pursued.

"At an early stage, authorities recognize the importance of active involvement in the transportation/land use development process. The city government formulates objectives and policies which are there to be implemented and not only lip-service. It is determined to be the master of transport development and not its slave.

Land use development is controlled, and every project is carefully evaluated from a transportation and traffic point of view. Developers of land are obliged to provide parking space. Land is reserved for future transport use.

Efficient and attractive public transport is provided. The responsibility for its structure and coordination with land use and other transport is recognized as the city governments'. The operating responsibility can be one of several models, with emphasis on the public sector, the private sector or both. When public transport system provides an alternative to private transport, policies can be implemented to control private transport, in the first place by voluntary means, for example by pricing policies. Subsidies to public transport may occur, but if they do, they are budgeted against required performance standards and not allowed to reward inefficiency.

The capacity and the desired function of the road and street network are analyzed and urgent missing links are provided. A long term development plan for the road network is designed and followed. A comprehensive traffic management program is implemented. In sensitive central areas, private traffic is restricted, for example by a zone system preventing through traffic, while public transport is given priority in the form of reserved space. Clear traffic rules are designed and enforced. The mobility in the street network is permanently monitored. Should signs occur of growing congestion because of more private traffic than capacity, actions are taken to reduce traffic to acceptable levels, referring people to public transport.

By carefully monitoring both ownership and use of private vehicles – even with politically costly actions – and by supplying a public transport alternative with sufficient capacity and high standard, it is ensured that the growth of private traffic is adapted to transport capacity. Congestion is prevented and high mobility ensured to the traffic that the system can handle.

The city gradually develops in a planned way, maintaining character, style and good environment with an efficient urban transport system contributing to its productivity and competitiveness."

## Planning and analysis methodology

Investments in new urban transport infrastructure are high and irreversible and should be carefully considered in a comprehensive planning process. Urban transport planning is a complex discipline, and in order to increase the possibilities to analyze and evaluate different scenarios, various computerized planning models have been developed. Today, consultant firms make frequent use of such systems and many cities also have them as permanent tools. Developing countries may need assistance in building up resources for analysis and planning of their traffic infrastructure in order to be able to form their own independent policies and, not least, in order to be able to handle various lobbies and pressure groups.

Properly used, such systems can be very useful for the development of good policies. Being basically mathematical models, they force planners to formulate problems and to interpret effects in a quantified way and this can contribute to an "objective" and transparent planning process. There are, however, some considerations that need attention.

Many of the traffic planning systems originated in the United States with the purpose to facilitate highway design. Totally focused on the flow of passenger cars, they do not always correspond well with a situation where public transport and/or non-motorized traffic dominate as is typically the case in developing countries. Some of the techniques borrowed from a car society can become very misleading, as has happened for example in India and Vietnam, where observed bicycles were "converted" to fictive cars to fit the model, resulting in recommendations to build fly-overs and urban highways where there are many bicycles.

Some of the modern planning systems, developed outside the US, are more useful for developing countries since they recognize public transport – thus making it possible to optimize the transportation of *people*, not vehicles. Also, modern systems are more user-friendly thus reducing the need to engage planners with more expertise in computers than in transportation. Still, the use of sophisticate tools requires good knowledge of the strength and weakness of the model and also an understanding of local conditions and how they should be handled. There is a strong need for local and national research and development which, unfortunately, does not yet exist.

# 3 Discussion and recommendations

## Land use/urban planning

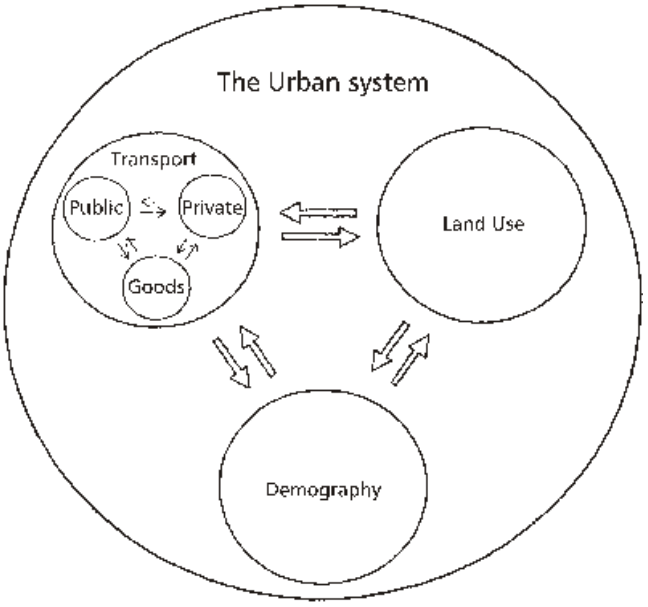


*Fig. 3 The urban system*

In the urban system, there is a constant interrelation between land use, demography, and transportation. The transportation system itself can be seen as a function of sub-systems, such as private transport, public transport and goods transportation. In the process of development, it is of vital importance to consider all these interrelated elements. The generation of traffic can not be understood without studying land use and demography. On the other hand, urban transport has a high impact on land value and can be used as a tool to influence it.

Transportation planning is a complex subject spanning over a number of different disciplines, and indeed constitutes a complete discipline in itself. This fact is often neglected with the result that the whole problem complex is reduced to the aspect of street and intersection design.

The urban transport problem in a market economy is not essentially an engineering problem and can not be solved by engineering approaches solely. A wide range of tools and techniques must be applied, including socio-economical issues, marketing considerations, and legal, political, administrative and management aspects. Only then can consistent and meaningful policies be formulated, and technical solutions be found.

## Urban transport infrastructure

Fundamentally, the urban transport system depends on the road and street system. Even though some cities have invested in urban rail systems of some form, the rail system is only one minor component of the total system. Therefore, the real issue is how to design and organize the finite asset that consists of roads and streets.

The traditional approach to urban transport in the United States was to "build away" the problems by producing more urban roads and highways, and this approach was often transferred to developing countries through for example the World Bank. In contrast, European cities with an ambition to preserve historical city centres were more inclined to find solutions aiming at using existing resources efficiently.

Fast growing cities in developing countries certainly need more transport infrastructure to connect new areas, but it is now more and more realized that infrastructure alone will not solve traffic problems. Transport planners frequently lament the low allocation of space to roads. For example, it is said that Bangkok with 11% of urbanized land under roads, compares poorly with typical western figures of around 20%. But many successful and accessible cities have similar rates. These include Paris (11%), Hong Kong (12%), Singapore (12%), Munich (13%) and Tokyo (13%). Experiences from large cities in China where input to road infrastructure has doubled during the last five years, demonstrate once again that these policies have not improved traffic congestion levels.

Since investments in urban transport infrastructure constitute a considerable drain on the financial resources of national and city governments, there has been an increased interest in private sector involvement, for example in various forms of arrangements where a private investor is invited to build a facility, operate it for a specified time and then hand it over to the city in question. Many cities have hoped that a desired subway or highway system could be built in this way by foreign capital. However, this approach to urban transportation has largely failed to produce results, because large-scale transport infrastructure projects, although beneficial for society, are seldom commercially viable (Allport 1995).

The two main structures regarding urban street networks can be defined as the spider network structure and the grid structure.

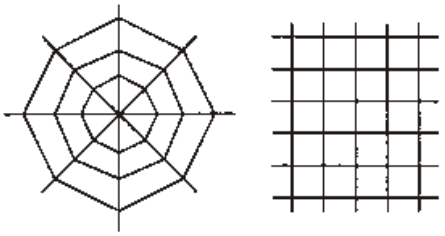

*Fig. 4 Spider net structure Grid structure*

The spider net structure is typical of, for example, older European cities that grew slowly in an "organic" way. The grid network is often found in cities that have grown rapidly in a "planned" way. (Washington DC is typical.)

Few cities have a consistent structure but are more often a mix of the two principles. Often, a historical city centre, e.g. from colonial times, has a spider net structure while later development, when the city grew fast, is characterized by a grid structure influenced by motorized planning (for example Lima, Peru). One interesting case is the city of Rawalpindi, Pakistan, which is an old military garrison and has a typical spider net structure. The adjacent Islamabad, on the other hand is an "artificial" city planned to be the

capital of the country, and the strict grid structure design by Doxiades reflects the thinking of the time.


*Fig. 5 The Islamabad/Rawalpindi road network*

Even though few planners may have the opportunity to design a city structure, it is still important to realize that the impact of (sometimes unconscious) ideas and principles can be high and irreversible. A planning for the car will produce city structures that are feasible only for the part of the population with access to private car – and in many developing countries this will remain a minority for the foreseeable future. The kind of car-adapted structure shown below is an example of a third fundamental road network structure, the "tree structure". In the tree structure, efficient public transport is difficult to obtain, natural and direct contacts are rare and movement patterns are hierarchical. For the car owner, distance in itself does not matter and for him the whole city is accessible. Others, however, become contained in their own neighbourhood and an occasional minibus link into the city centre, particularly in combination with a public transport system of the "individual operation type" with a direct route principle (see fig. 6).

*Fig. 6 Typical tree structure in a medium size Swedish city (Borås)*

*Source: G Lagerqvist Traffic on the City's Conditions. Report in Swedish, 2000.*

## Traffic management

An important part of an urban transport policy should be to reduce, or at least delay, the need for urban transport investments. This can be achieved by traffic management actions in combination with a good supply of public transport.

Traffic management and traffic engineering can be applied for varying reasons, from increasing the capacity of individual streets to diverting traffic away from the city centre for environmental reasons (Singapore, Gothenburg). This can include fees and restrictions parking private cars, one-way streets, roundabouts, lane markings, traffic signals, etc. Considering the fact that the capacity of a street is generally much lower in developing countries, first priority should be to improve the use of existing resources with low cost measures before major investment schemes are undertaken.

The tools and techniques of traffic management solutions taught at universities and applied in the West may require careful adaptation. Sophisticated traffic signal installations with computerized zone control systems must be used with care in an environment where bicycles and pedestrians are the major modes, where traffic rules are seldom followed and where enforcement and control is deficient. There is often a misconception that problems can be solved by engineering alone, leading to an over-emphasis on installation of traffic engineering hardware without adequate appreciation of the need for appropriate organizational change, and the need for full cooperation of the authorities involved.

Traffic management and engineering can give very good results if properly implemented, and projects of this kind should preferably aim at building up local capabilities. Since traffic management indicates a shift of emphasis from "capital" solutions to "management" solutions, there is a need for training local professionals as well as for institutional strengthening. For example in Nairobi, the Transportation Unit responsible for most traffic issues in this fast growing city consists of five or six professionals compared to at least ten times more in much smaller Western cities.

One of the schemes that can be applied with low monetary costs (although the political costs may be high) is the type of traffic zone system introduced in some European cities, for example Gothenburg, Sweden. The concept is based on an inner ringroad around the inner city centre which is divided into traffic zones. Direct traffic between zones is not possible but has to use the ringroad, while traffic within each zone is unrestricted. This makes it possible to introduce public transport corridors between the zones without being crossed by other traffic. Experiences from Gothenburg have been very positive in terms of environment and public transport economy and the scheme has now been in effect for many decades.

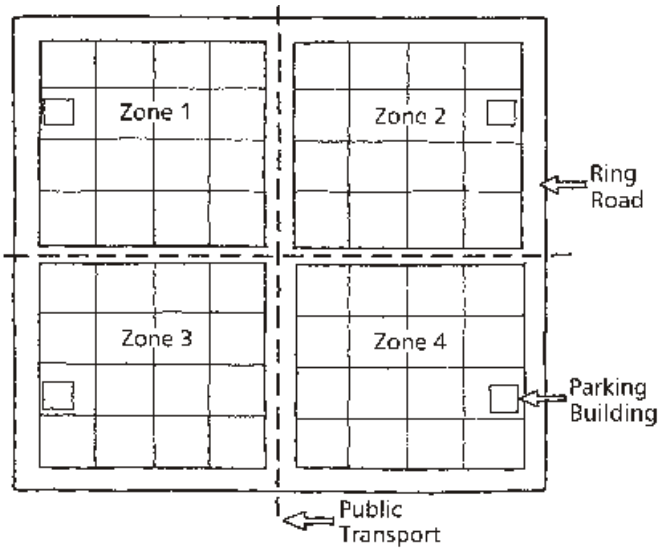


*Fig. 7 Traffic zone system*

## Public transport

### The role of public transport

Public transport is an important component of the urban system. In developing countries, public transportation is crucial for the mobility of the majority of the inhabitants since few have access to a private car or even to a bicycle. For the poor, and in particular for those newly arrived to the outskirts of fast growing cities, public transport is a lifeline, the only way to access jobs, markets and services.

In addition to its obvious social impact, an organized and well planned public transport system can also be a very efficient concept from the point of view of road space use, fuel consumption, environment and accessibility (see fig. below). In some reform economies, the decline of the public transport system and the increase of car ownership have resulted in spiralling congestion problems, leading many to believe that the only remedy is to invest heavily in urban highways and fly-overs. If, instead, more people could travel in fewer vehicles, this would have very positive effects. With car occupancy rates in developing countries approaching Western figures (down to 1.1 persons per car) this will become even more evident.

*Table 1 Transporting 10,000 persons 1 km*

| | Persons | Nos. | Space $m^2$ | Fuel cons. l |
|---|---|---|---|---|
| | 2.5 | 4,000 | 48,000 | 400 |
| | 25 | 400 | 8,800 | 120 |
| | 100 | 100 | 3,400 | 50 |
| | 175 | 57 | 2,850 | 35 |
| | 270 | 37 | 2,370 | 26 |

*Fig. 8 Potential benefit of public transport*
*Source: Volvo Bus Corporation*

### Technical options

Due to the importance of public transport and, perhaps not least due to the political power inherent in this sector, attempts are frequently made to provide optimal solutions. Often, however, the discussions tend to focus on vehicle technology; for example whether buses, metros, tramways, are the "best" solution. In particular, the underground railway is often seen as the ultimate solution to the public transport problem. This, however, is not always the most relevant issue in the context of developing countries.

Of the over 20 000 urban areas in the developing world, only a fraction have any component of public transport with electrical propulsion, and only a handful of these are rail-based systems. Nowhere in the world is there any public transport system that is exclusively, or even predominantly, based on such technologies – even in Western cities that have had fully developed metro systems for many decades, the majority of public transport trips are still by bus. The real mass transit system in the world thus is, and will remain to be, the humble bus or minibus in different shapes and forms and operated under different conditions. Of more importance than technology discussions, therefore, is the issue of the balance between the public sector and the private sector and the related issue of the structure of the public transport service.

### Organizational and operational options

In many cities in developing countries, the public transport system has historically developed along two lines. The conflict between two fundamentally different and all but incompatible concepts is the most important factor to consider when strategic options for future public transport are to be assessed.

The first concept is the "classical European concept" and refers to a situation where medium or high-capacity vehicles are operated in ***fleet operation*** providing an integrated network of services. A group of vehicles, whether they represent bus or rail technology, thus constitutes an entity in terms of passenger service and operating economy. The driver is employed independent of the passenger load of his particular vehicle. Routes of different types complement each other in a planned way and the system requires regulation.

The second concept, predominant in developing countries, represents the contrasting principle of ***individual vehicle*** operation. Here, each vehicle is a profit centre, owned by an investor or, less common, by the driver himself. Often, the fleet owner "leases" the minibus on a daily basis to a driver for a fixed fee and is thus the winner in the business. The driver is dependent on the revenues from his vehicle, and has to work hard to get passengers. Where there is a large pool of unemployed people, however, recruitment is easy. This type of system, well-known from a number of developing countries, is most common in a system of ***deregulation***.

The problem is that these two different forms of public transport do not mix well together. Generally speaking, attempts to combine them in the same urban area can only be successful with serious political commitment and a strong intervention from the part of the municipal government. When studies show that metro projects in developing coun-

tries practically never fulfil their expectations, this clash of different concepts is one of the reasons.

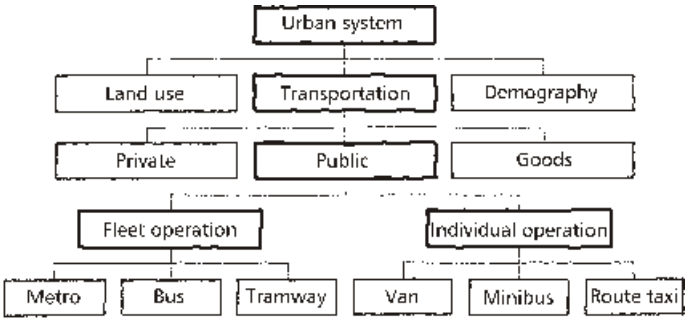


*Fig. 9 Two fundamental concepts of public transport*

**Route network and service options**

**The direct route network**

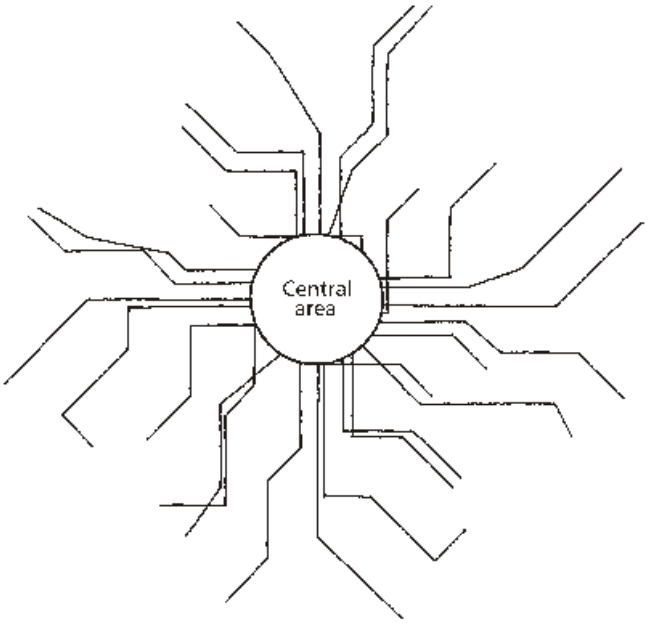


*Fig. 10 "Direct route" principle*

The direct route network – see the figure above – is predominant in developing countries and is an almost unavoidable effect of the concept of individual operations as described above. Some general characteristics are:

- The network includes a large number of routes in order to provide direct trips since transfers require double fares.
- Most routes lead to the central area which is often a dominating trip destination. Normally, routes are radial and provide access to the city centre but not between different city sectors.
- The network does not include circular route elements which means that tangential trips are not catered for.
- The route alignments are not straight and the distances between stops are short which means limited average speed and long trip times.
- The route network is typically operated by a large number of small vehicles which tends to create congestion particularly in the central parts of the city.

**The trunk line – feeder line network**

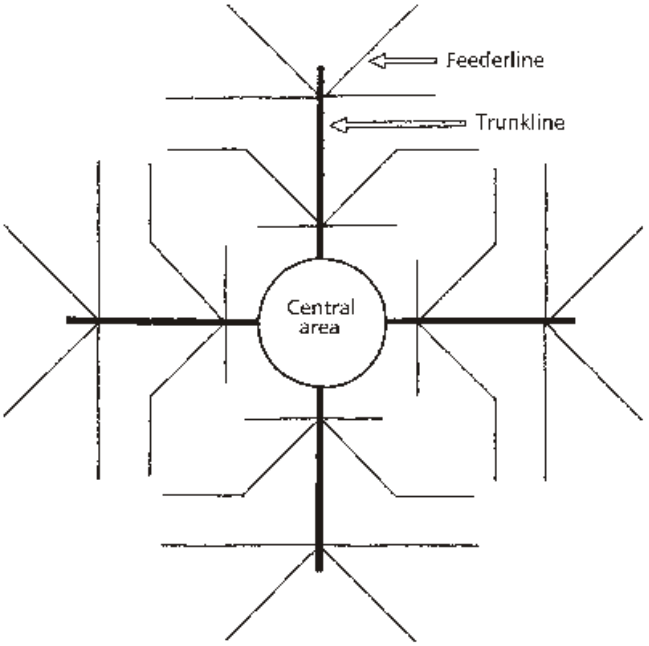


*Fig. 11 "Trunk line – feeder line" principle*

The trunk line-feeder line network is common in larger European cities, especially where different modes exist such as a capacity-strong metro in combination with buses. Some of the characteristics of the principle are:

- A large portion of travelling is concentrated to a small number of corridors which provide high capacity. This gives the possibility to use large (and fewer) vehicles and still provide a good frequency of service.
- Since the number of vehicles is reduced, congestion can be avoided. Economy is good since less vehicle kilometres are needed per passenger kilometre.
- With a limited number of trunk line corridors, these can be given high operational standard resulting in high commercial speed. The transport efficiency of the corridor can thus justify investments like separate right-of-way, grade separation or preferential signal treatment at intersections.
- Transfer terminals need to be well located and designed to allow for comfortable interchanges. Also, the fare system should be designed in such a way that passengers are not punished for making transfers. In this regard, the flat fare system, predominant in e.g. Latin America, is an obstacle.

Since the whole concept is based on cooperation between different routes and different types of vehicles, it requires planning and monitoring. To build a metro line in a deregulated system is not advisable since feeder lines will not emerge by themselves.

**The grid network**

In some cities with a pronounced grid-type road structure, the public transport network can be adapted and form a third principle – a grid route network. This network type, used for instance in the central parts of Chicago, has the main characteristic of one corridor/street – one bus route. The model has the disadvantage that it is difficult to maxi-

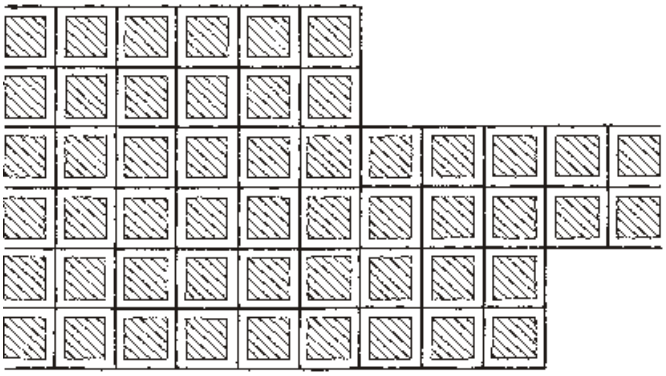

Fig. 12 Grid route network

mize the number of direct trips but on the other hand it is possible to travel between any two points in the city with only one transfer. A possible compromise can be to apply a grid-based route network and implement additional routes for large passenger flows.

**Relation between technical, organizational and network models**

It is important to keep in mind that some combinations of vehicle type, organizational model and network and service structure are feasible while others are not. As an example, the investment in a high capacity metro, light rail or high-capacity bus line makes sense as a component in a trunk line-feeder line system because the new investment then becomes available for most people. But if the new line is just an add-on in a direct trip route network, then it has to compete with other direct lines and will only serve those who happen to live close to it.

Sometimes the aim is to invest in a new line with big vehicles to function as a backbone while it is expected that smaller vehicles will start working as feeder lines. In reality, however, they are not likely to do so without strong incentives. A familiar situation is that small vehicles transport the bulk of passengers along the heavy routes while government buses provide a subsidized (and ungrateful) social service in the outskirts.

**Public transport reform – de-regulation or re-regulation**

For a number of years, the conventional wisdom has been that urban public transport systems need to be reformed in the sense that they need to be deregulated and privatised. The background for this was the failure of many government or municipal public transport companies to function efficiently. It was assumed that the private sector would be more efficient and function without subsidies – which is in most cases true. It was also assumed, however, that market forces and competition without public sector intervention would eventually produce better public transport services to the benefit of passengers and the city alike – which has not proven to be the case.

Today, more and more cities in developing countries wish to introduce regulated systems while at the same time maintaining the concept of private operators. Attempts in this direction are going on e.g. in Jamaica and South Africa while the city of Kuala Lumpur, once a pioneer in the introduction of deregulated minibuses has now abandoned that concept. There is a need for a new formula in which ***both*** the public and the private sector play their roles, and this is now increasingly seen as the most constructive concept both for developing and industrialized countries (see figure 13). Incidentally, this is the concept applied by some of the most successful cities in the developing world as far as urban transport is concerned (Curitiba, Singapore).

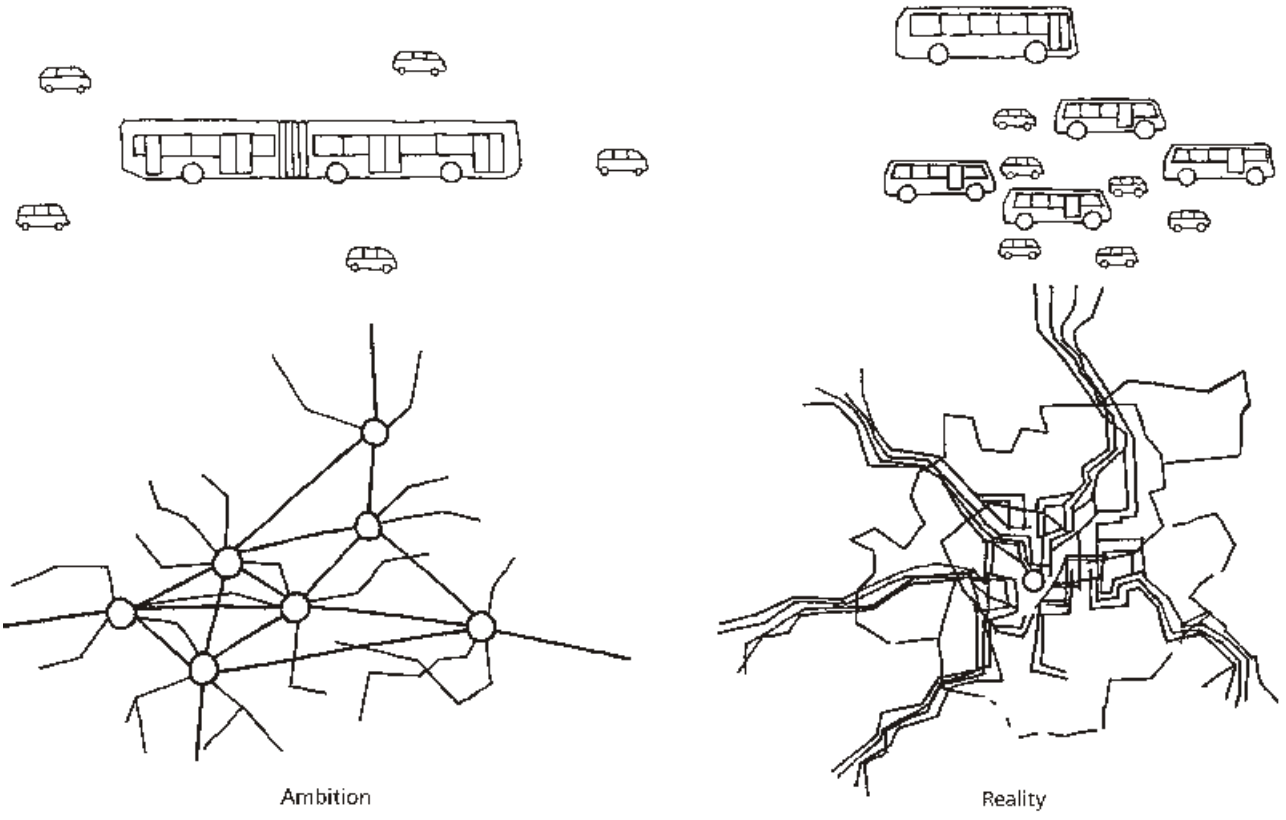


Fig. 13 Failed coordination between different public transport concepts

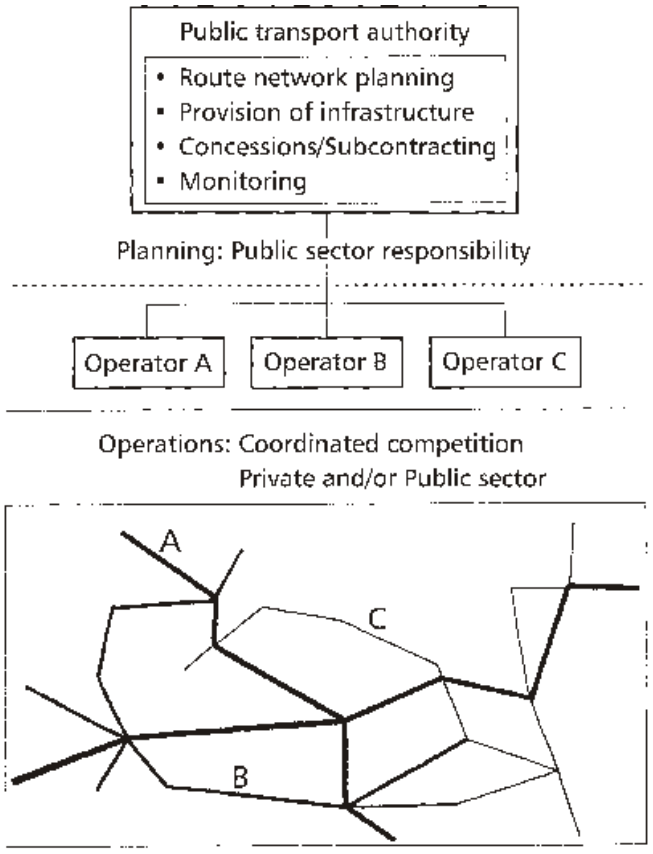


*Fig. 14 Regulation: relation between public and private sector*

One of the interesting questions today is the direction of the development in countries like China, India and Russia, with a tradition of well organized public transport systems but now under the influence of a general deregulation and privatization move in their societies. Such countries would be well advised to consider the options carefully before they dismantle a structure which may prove very difficult to get back.

**Public transport priority – the potential of busways**

The most efficient concept for urban public transport is the use of designated infrastructure in the form of roads, lanes or tracks exclusively for the use of public transport vehicles. Without disturbances from other traffic and designed with fairly long distances between stops, average commercial speed for public transport can be consistently high and this is one of the key parameters for the profitability of public transport operations. An increase in commercial speed from 15 to 20 km/h can improve the economical result of a bus by 70–80% as shown in the example below. Since the average speed of a bus in Bangkok, for example, is 9 km/hour, there is a large potential for cost savings and increase of standard.

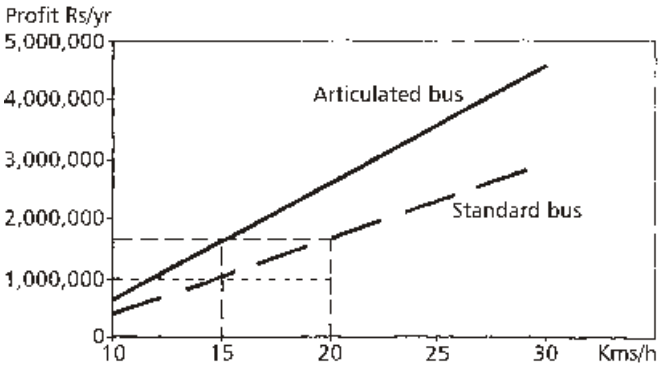


*Fig. 15 Relationship commercial speed/profitability in urban bus operation*

*Source: Bangalore MetroBus Pre-Study*

In addition to providing good transport economy, the concept also offers superior service levels because of short travel times and high punctuality and regularity.

While this concept is conceived as natural for an underground railway, the real potential for developing countries is in urban bus operations. The investments required for such solutions can be only a fraction of that of a full-fledged metro system.

*Table 2 Examples of capital costs and capacity of mass transit solutions*

| *Public transport option* | *Capital cost M USD/km* | *Capacity pass/hour* |
|---|---|---|
| Underground metro | 50 – 100 | 70,000 |
| Light rail | 20 | 30,000 |
| The Curitiba Metrobus system (incl. busways, terminals & buses) | 5 | 15 – 20,000 |
| Bus lane with physical separation (excl. buses) | 0.05 – 0.5 | 5 – 15,000 |

*Source: Sida*

A major review of mass transit systems in developing countries has been undertaken on behalf of the World Bank. Here, the conclusion was that busways have a practical capacity of 10 – 20,000 pass/hour or more while there were no examples of a light rail system carrying more than 10,000 (Halcrow Fox 2000:1–5).

The busway concept has its best known applications in Brazil, especially Curitiba, and is now in the process of being implemented in other cities in South America such as Quito and Bogotá. It is however little known and understood in other parts of the developing world, although it is considered by many planners and economists to have a great potential for example in large Asian cities. At the moment, however, interest appears to be growing and pilot projects are being planned for example in Bangalore, India (with Swedish support) and in Surabaya, Indonesia.

> *There is little doubt that busways could be equally successful in Asia's megacities, producing massive benefits. Yet so far they have been ignored. The problems … institutional rather than technical. They have no natural promoters, perhaps because of their lack of image…*
>
> (Allport 1995)

Few cities will be able to repeat the Curitiba concept because they lack the time, the land and the political leadership that made it possible there. Instead, the recommended strategy must be for each city to carefully review its unique resources and possibilities and to produce an overall urban transport plan which combines infrastructure development, traffic management and efficient public transport route network design.

**Bus stops and stations**

In a bus system based on reserved space, there is an opportunity to provide high comfort and passenger standard, for

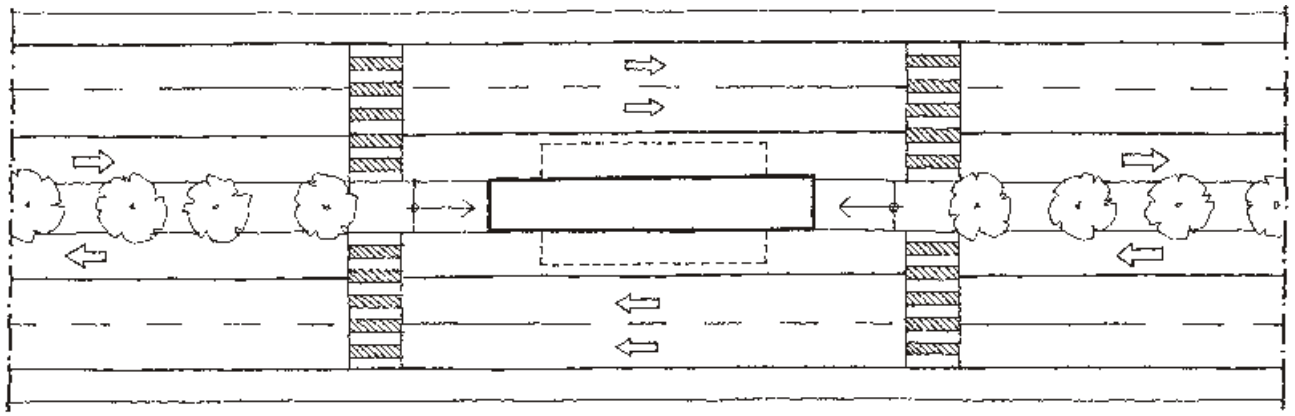

*Fig. 16 Mid-road bus lanes*
*Source: Bangalore MetroBus Feasibility Study*

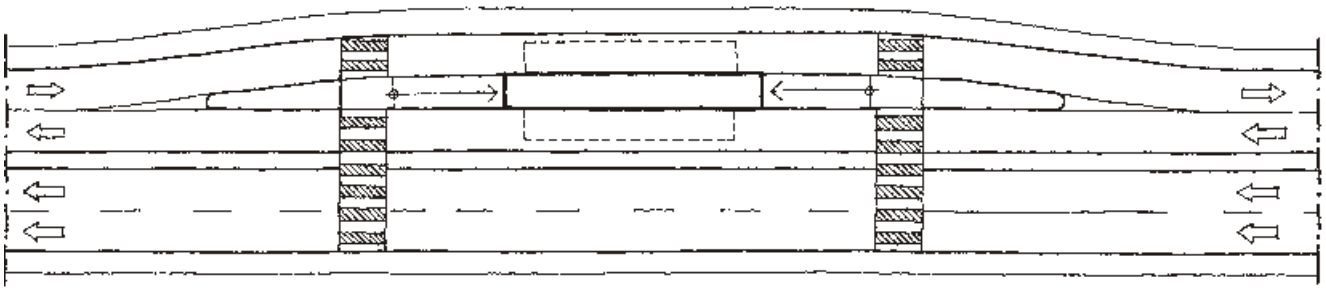

*Fig. 17 Two-way bus lane at the side of the road*
*Source: Bangalore MetroBus Feasibility Study*

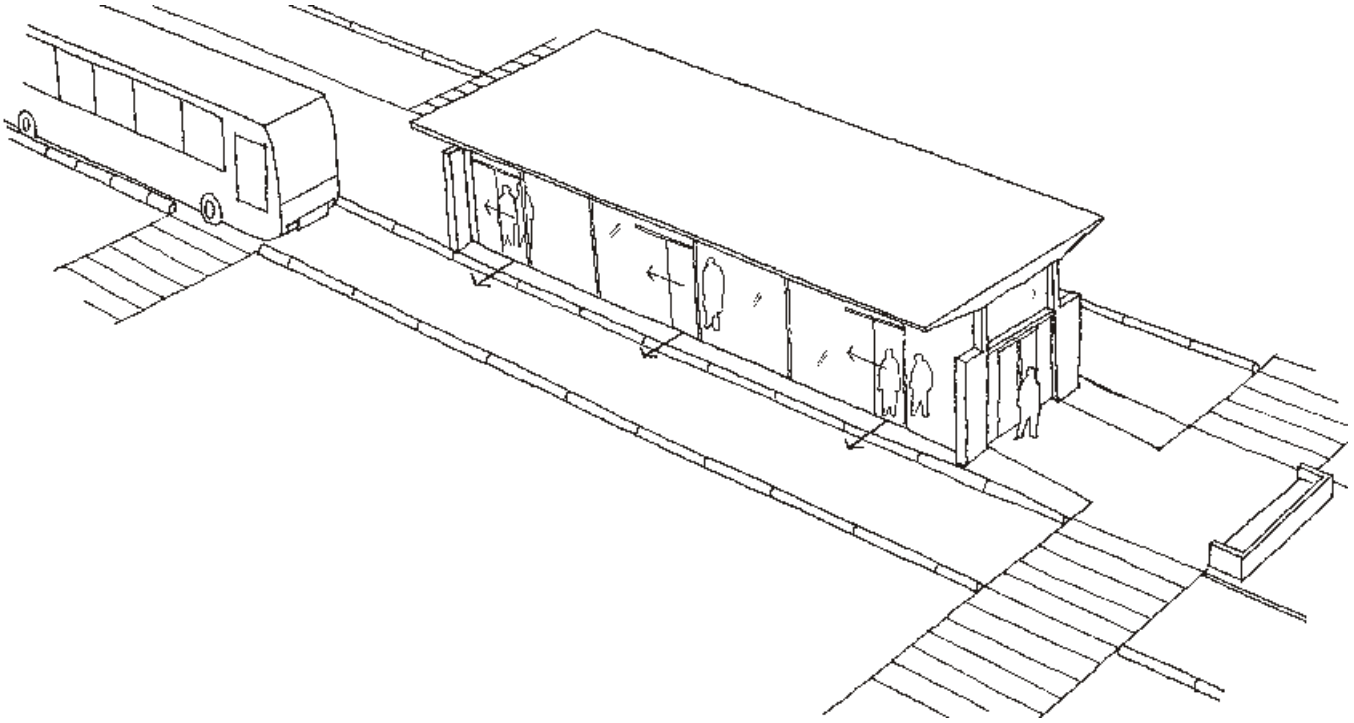

*Fig. 18 MetroBus station*
*Source: St Petersburg MetroBus Feasibility Study*

example with protected bus stations with ticketing. Such visions may seem unobtainable for a developing country, but then it should be recognized that many cities, in particular the capitals, have advanced plans for and are prepared to spend public money on high-investment rail systems. In this comparison, even a very advanced bus system is likely to be more realistic.

**Who should use the busways?**

*Bus services based on large capacity vehicles are by far the most efficient way to provide public transport in Dhaka and also to address the special needs of women and low income groups.*

Greater Dhaka Metropolitan Area Integrated Transport Study (DITS) 1994.

When parts of the road and street network in a city are assigned for public transport, the right to use these facilities should be limited to high or medium capacity buses with an organized operational structure and with defined and planned bus stops. If, as some economists argue, bus lanes are provided for all kinds of public transport, then they will in many cities quickly become saturated and defeat the very purpose of their creation.

*Fig. 19 Public transport in Medan, Indonesia, 1982*

## Non-motorized transport

### Importance of NMT

Although public transport is the only way for many to undertake a motorized trip, there are many others for whom the bus or minibus fare is beyond the limit of affordability. In several large cities in Africa walking accounts for at least half of all trips. In Addis Ababa 79% of daily trips of the poorest income group were made on foot.

> *WHAT ROLE DOES NMT PLAY IN DEVELOPING COUNTRIES?*
> *Walking accounts for two thirds of total trips in large African cities such as Kinshasa and Dar es Salaam. In Karachi walking and cycling account for 60 percent of total trips, and for 40 percent of work-related trips. In Madras, one third of the vehicles entering the central business district are bicycles, as are 25 percent of the vehicles passing a cordon-line 10 miles from the centre. In Kenya, more than 90 percent of rural trips are on foot, 4 percent by bicycle, 2 percent by paratransit and only 0.5 percent by bus. In most Chinese cities 50-90 percent of vehicular passenger movements are by bicycle, with most of the remainder by bus. NMT has been adapted as a cost-effective solution for such diverse purposes as trash disposal, ambulance services, agriculture produce transport and wholesale delivery*
>
> (Paul Guitink, Susanne Holste, Jerry Lebo http://www.worldbank.org/html/fpd/transport/publicat/td-ut4.htm)

Non-motorized transport has in recent years been recognized as an important means of transport, particularly for the poorer segments of the urban population. In many of the developing countries, however, the thinking in solving urban transportation problems still focuses on motorized transport – sometimes because decision-makers are car users themselves, sometimes because the few people with some transportation training come from the same class and have received their training overseas in Western, car-influenced societies.

While walking is predominant in African cities, other non-motorized modes such as bicycles, rickshaws and carts are highly used in many Asian cities, particularly in the most populous countries. In a recent Indian study, the following modes were defined:

*Table 3 Non-motorized urban transport modes in India*

| *Human powered modes* | *Animal powered modes* |
|---|---|
| Walk (pedestrians | Pack animals |
| Bicycles | Animal carts |
| Human drawn rickshaws | Tongas/ekkas |
| Cycle rickshaws (passengers) | |
| Cycle rickshaws (goods) | |
| Handcarts | |
| Boats | |

*Source: Asian Institute of Transport Development*

### Rickshaws

The system of human drawn rickshaws, originally *jinrikisha* (from Japanese jin=man + riki=power + sha=vehicle), was invented by a Western missionary in 1870 and replaced the then predominant Asian system of carrying well-to-do people in a sedan chair. Once extensively present all over Asia, it is now all but extinct. Most post-independence governments have banned them because of their perceived colonial character and lack of human dignity.

The successor of the system, the cycle rickshaw or pedicab, is still important in some cities, almost exclusively in Asia. The number of cycle rickshaws in the world was estimated to 3.3 million in 1988, and four Asian countries, India, Bangladesh, China and Indonesia, accounted for over 90% of those (Replogle 1992).

### Bicycle

The bicycle is a successful and important non-motorized mode in Asia, both in low-income and high-income countries (India, Japan), and in many cities they are the predominant private vehicle. For decades, 50 – 80% of urban vehicle trips in China were by bicycle and the rest by public transport, and government policy actively promoted bicycles. By the late 1980s there were 300 million bicycles in China and 45 million in India. (It is worth noting, however, that the number of bicycles per capita is still higher in Western industrialized countries – even in the US – than in any developing country).

If the bicycle is essential in Asian cities, it is of insignificant importance in urban Africa. There can be many reasons for this; the cost of buying a bicycle is conceived by many as prohibitive, and the risk of having it stolen could be real. For many, the bicycle is simply conceived as unattractive.

> *A NEW BICYCLE FOR AFRICA*
> *The most widely available bicycle in Africa, the "Black Roadster" has decades of proven use, but is being shunned by a new generation of urban Africans. Based on a 60-year old design, it is synony-*

*mous with the elderly, rural, and poor. Africa's young consumers, like their American and European counterparts want colourful mountain bikes but these have so far been expensive. The bicycle industry has been focused on developing bicycles for competition and recreation, not for utilitarian purposes. However, leading suppliers like Bianchi, VooDoo, and Kona are now looking at this market and are rolling out affordable single-speed bicycles.*

(SUSTRAN 2001).

It can be worth trying to introduce the bicycle, but an innovative approach is needed. As one example, the "bike-and-ride" principle applied in some Asian cities could be a possibility. This concept is based on guarded bicycle parking in conjunction with railway and bus stations and means that people can access organized public transport without need for feeder services. If bicycles could be introduced on a larger scale, it would among other things mean the potential for low-end job creation. In Vietnam, for example, there are many small scale bicycle repair and pumping shops.

**Walking**

The only other important form of private transport is walking. This is the indigenous form of transportation in Africa, and large pedestrian movements are a characteristic feature of many African cities. Often such movements take place between fringe areas with informal settlements surrounding a growing metropolis. In South Africa, with its special historic heritage, townships are frequently situated away from the original urban areas which means that there is a limit to the possibility of walking. A recent survey in King Williams Town found that walking distances can be considerable, often 10 km and sometimes as much as 20 km.

Sometimes actions are taken to improve facilities for pedestrians. However, often these are undertaken to reduce conflict with motorized traffic which means that they are mainly in the interest of car owners. A typical example is pedestrian crossings over highways that are often so inaccessible that people just do not use them. To improve safety is important but should not be the only priority. Walking needs to be recognized as an important traffic component in its own right, and facilities should be made to improve conditions in a broader sense. In many areas, networks of pedestrian paths could be introduced. Sometimes climate protection could be offered; for example shady trees and simple shelters to wait out a short rain. Sidewalks often need to be widened to provide good walking conditions.

**Infrastructure for NMT**

Special infrastructure arrangements for non-motorized transport, e.g. bicycle lanes, are not very common in developing countries. As a measure to reduce traffic accidents in urban areas, however, infrastructure facilities and traffic regulation aimed at non-motorized traffic can be important, since traffic accidents take their heaviest toll on pedestrians and NMV users.

Separation of bicycles from motorized traffic can be obtained at low-cost but rather efficient measures as shown in the example from Honduras. In Delhi, segregated facilities reduce injury accidents by 40% and fatalities by 50%.

*Fig. 20 Bicycle and pedestrian separation in La Ceiba, Honduras*

*"Studies also indicate that reducing the costs of motorized transport and international transport are highly indirect measures for alleviating poverty, or at best the effects are highly indirect. Far more important to poverty alleviation are targeted interventions which facilitate direct ownership of low cost forms of mobility, such as bicycles, wheelbarrows, animal carts, etc, and reduce the cost and improve the quality of paratransit or buses. Investments into road infrastructure frequently do little to alleviate poverty in a context where the poor lack access to the vehicles to operate on them."*

NGO Steering Committee to the United Nations Commission on Sustainable Development. March 2001.

As a part of the World Bank Sub-Saharan Africa Transport Program (SSATP) a comprehensive analysis and design work has been undertaken to provide guidelines for pedestrian and bicycle facilities in African cities. Such designs could serve as guidelines for transport planning authorities in many cities (see fig. 21).

## Environment

Overall, motor vehicles produce more air pollution than any other single human activity, and motor vehicles contribute 14–16% of fossil fuel carbon dioxide and 25–30% of nitrogen oxides. The transport sector in the United States alone contributes 31% of all carbon dioxide emissions. In city centres, particularly on high congested streets, traffic can be responsible for as much as 80–95% of carbon monoxide, nitrogen oxides, hydrocarbons and particles. An estimated 80–90% of lead in ambient air is derived from gasoline. In many developing countries it can be suspected that the handling of fuel and oil itself is an indirect source of water pollution.

In the following table, some of the main pollutants are categorized according to their effect:

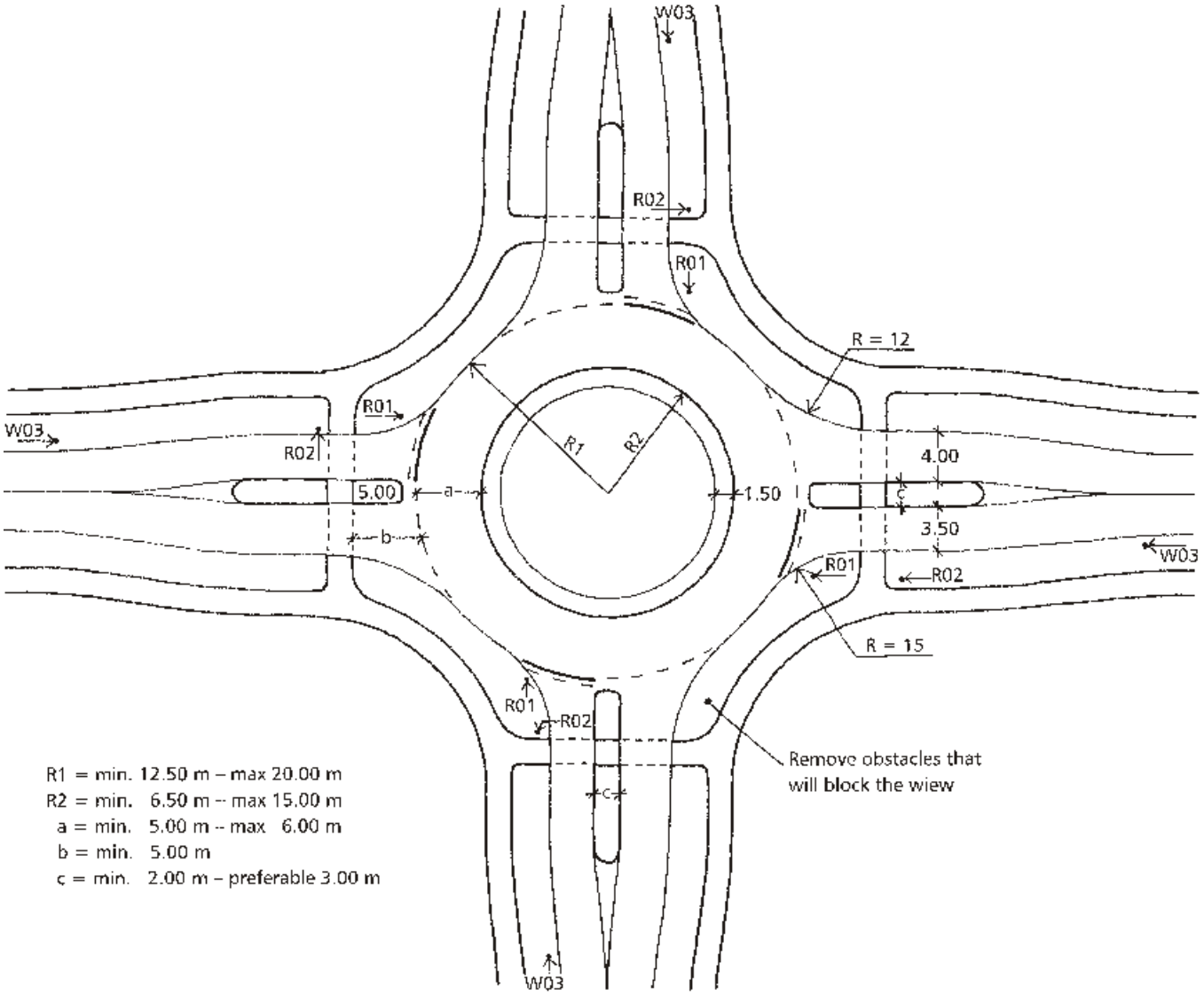


*Fig. 21 Example of a roundabout with provision for bicycles*
*Source: De Langen and Tembele 2001*

*Table 4 Environmental impact from different pollutants*

| | *CO* | *HC* | *NOx* | *PM* | *Ozone* | *$CO_2$* |
|---|---|---|---|---|---|---|
| Local, toxic (human health) | x | X | X | X | X | – |
| Regional, acid (vegetation) | – | x | X | x | – | – |
| Global, greenhouse (climate) | x | x | x | – | – | XX |

(– = virtually no effect, x = some, X = much, XX = strong effect)

*Source: Bangalore MetroBus Feasibility Study*

In the cities of the industrialized world, the car is the main polluter. In developing countries, this is true in cities such as Mexico City, Bangkok and Lagos, and in many other cities motorization is growing fast. In Asia, for example, the growth in the sheer number of vehicles is 10% per year and much of the increase is in urban areas. Pollution levels in the major cities of China are already unacceptably high, especially for CO and HC. The potential effect on global warming from traffic in third world megacities is considered by many as one of the main environmental threats.

Pollution associated with transportation is not only from growth in the number of vehicles, but also from urban sprawl, dirty fuels, poor traffic management, and a high proportion of smoke-belching vehicles such as old and ill maintained minibuses and 2-stroke motorcycles which contribute especially high amounts of air pollution. Better fuels may be one of the most effective ways to deal with the problem.

Many attempts to improve urban air quality have been directed at public transport; in particular introduction of alternative propulsion systems for buses or electrical rail systems. In industrial countries, a strong argument for public transport is to reduce the number of cars. In most developing countries, however, redistribution within the public transport system itself offers a more realistic and important potential. A significant reduction in the number of engines, emissions per passenger-km will be achieved if passenger trips can be transferred from small minibuses to modern buses with higher capacity. This, however, requires public sector intervention.

In the figure below, a comparison has been made between estimated emissions from a modern diesel bus with the capacity of 100 passengers, a minibus in Dakar, Sene-

gal (Car Rapid) with 30 passengers and a motorized petrol-driven rickshaw in Bangalore, India (autorickshaw) with 2 passengers. Since the comparison is not made between ***vehicles*** but between their ***performances*** in terms of emissions per passenger-km, the effect of the autorickshaw's low capacity in combination with its operating characteristics (driving around looking for passengers) is visible.

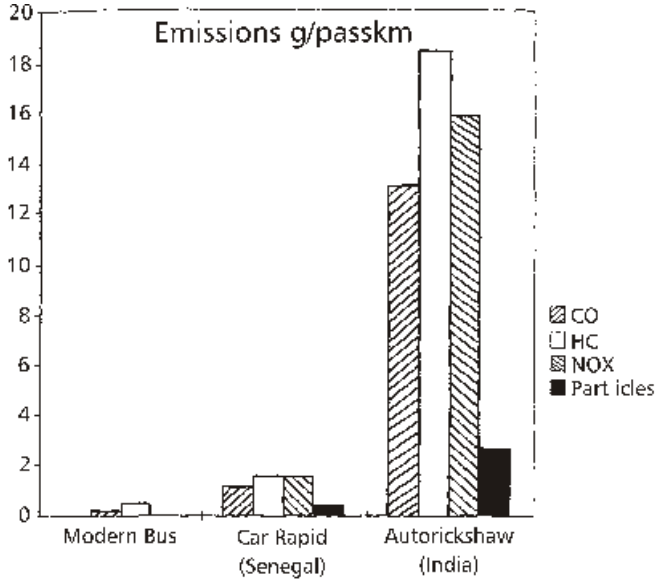


*Fig. 22 Estimated emission levels for bus, minibus and motorized rickshaw*

*Source: CONTRANS*

## Traffic safety

Estimates of the annual number of people killed in traffic accidents world-wide vary from 500,000 to 885,000. The majority of fatal accidents, 67%, occurred in developing countries with Asia and the Middle East accounting for 45% and other developing countries for 22%. In its 1998 World Disasters Report, the Red Cross/Red Crescent recognizes traffic accidents as one of the major threats to human lives and health in an increasingly urban future. It projects that by 2020 traffic accidents will be the third most important cause of death and disability and thus become a more deadly threat than e.g. HIV.

In developing countries, motorization tends to be highest in the cities, where there are also high concentrations of pedestrians and other unprotected road users. In general, urban traffic and pedestrian accidents form a higher proportion of accidents in developing countries than in developed countries. In India, one-third of reported accidents in 1981 occurred in 12 metropolitan areas; in Pakistan, urban areas accounted for 62% of reported accidents (Replogle 1992). For developing countries "personal unsafety" (fatalities per person) is higher for cities than for the national average.

The promotion of traffic safety is a long-term task and much of it has to be done on a national level, for example through legislation. There are options for action on the city level, however, and these would seem to be mostly available in areas like traffic management – in particular the design of schemes to separate motorized and non-motorized traffic and the provision of more infrastructure facilities for pedestrians. In a collision between a car and a pedestrian, the probability of a fatal accident increases dramatically with speed.

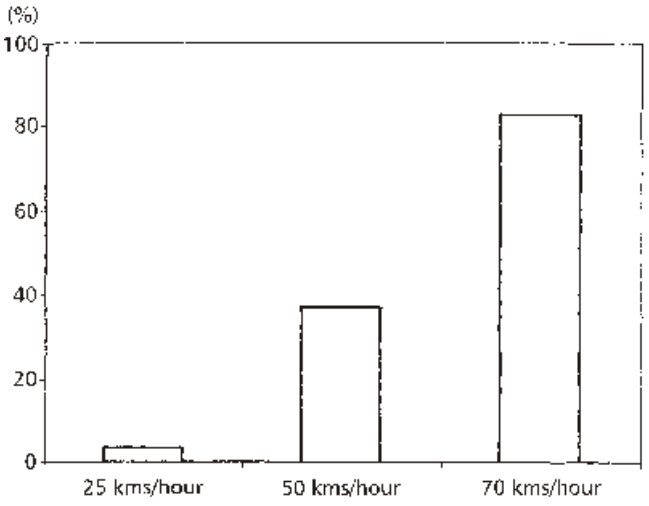


*Fig. 23 Probability of fatal injury*

# 4 Case studies

## Curitiba in South America: The public transport city

The Brazilian city of Curitiba is one of the few truly successful cities in the developing world. Named the City of the Year by the World Bank in 1994, it is frequently referred to by development agencies and financing institutions. Although the city has implemented a variety of schemes to improve the urban environment and quality of life, it is probably best known for its innovative public transport system which is also the fundamental basis for other areas of the city's development.

Curitiba is the capital of the Paraná state in south-eastern Brazil. Still one of the fastest growing cities in Brazil, the metropolitan area mushroomed from a population of 300,000 in 1950 to 2.1 million in 1990. Normally, this would have brought about policies to meet the demands of the private automobile, and had Curitiba adopted the conventional demand-following approach of many other cities it would surely have been a car city today.

But during the 1960s and 70s – a period of rapid urbanization in Brazil – Curitiba started to implement an urban development process based on public transport. Under the dynamic and visionary mayor, Jaime Lerner, a plan was adopted under which future expansion was to take place along linear axes with public transport lines in the centre. Being a medium-sized city, Curitiba opted for a practical and affordable system based on buses on exclusive busways, a concept that has been developed ever since and which today offers capacity, travel speed and comfort comparable to a rail transit system but at a fraction of the cost.

A fully integrated route network was designed and is constantly upgraded in which buses of different types fulfil different tasks. The entire system is colour-coded: red for express buses, yellow for the suburban feeder buses, and green for the inter-district buses that link the concentric suburbs. For major trunk lines, bi-articulated buses have been introduced with a capacity of 270 each. Heavy routes are complemented by express routes and feeder routes, providing good access and area coverage, direct trips and comfortable transfers.

Boarding and ticketing to trunk line buses takes place before entering the bus in the trademark "tube stations" developed in Curitiba – a low cost concept that makes it possible to use high platforms and speeds up boarding (see fig. 24).

Bus terminals are well developed and serve as community and commercial centres. The "Citizen Streets" project aims at rebuilding the area around large terminals and provides more services there, and this further promotes the use of public transport. On the other hand, since these areas are accessible to many people, they become commercially viable and provide an income which goes back to the public transport system.

The city has formed a quasi-public transit corporation which establishes routes, sets fares, maintains terminals, and monitors performance. The 10 private operators contracted by this corporation own, operate, and maintain the buses running on the system, and are paid per bus-kilometre produced. The competition is thus for the market, not in the market. The network as well as the fare system are fully integrated, and provide transfers to all parts of the system. Because of the busways the commercial speed is high and operating costs are therefore minimized. The system operates without any direct subsidy from the city government.

The public transport system is used by more than 1.3 million passengers a day and attracts nearly two-thirds of the population. Curitiba's buses carry 50 times more passengers than they did 20 years ago. Despite the second highest per capita car ownership rate in Brazil (one car for every three people), Curitiba's gasoline use per capita is 30 percent below that of eight comparable Brazilian cities. The public transport system has contributed to give the city one of the lowest rates of air pollution in Brazil, little congestion, and a pleasant living environment.

## Singapore in Asia: The city that controls the private car

Another outstanding example of a city coming to grips with and controlling its urban transport system is Singapore, the city-state island off the southern tip of the Malacca peninsula. With a population of 3 million it may be small for a country but as a city it is not irrelevant.

In the 1950s, the island was often characterized as an "Asian slum." Soon after becoming an independent republic in 1965, the government under the dynamic Prime Minister Lee Kuan Yew realized the importance of urban transportation and began to elaborate and implement a set of policies. Today, after 35 years of these policies, Singapore is an efficient and affluent city with clean air, green areas and a smooth transport system not dominated by multi-level road and highway constructions.

Singapore has, like Curitiba, found its own ways and methods to create a good urban transport system, and the strategies have been partly different. In particular, Singapore has devoted more efforts to private transport demand control; introducing restrictions to both the ownership and the use of private cars. Very briefly summarized, the Singapore urban transport development policy was based on the following elements.

**An attractive and efficient public transport system**
Contrary to many other cities, Singapore developed its public transport system step by step. Starting in the mid-1960s with a number of small, competing bus companies, considerable investments and a comprehensive management development programme led to the establishment of a modern bus system organized as one and later two companies which are private but under government control in a regulated system. Great efforts were made to design the system for maximum service levels, economic efficiency and profitability. Buses were given separate lanes and signal priority.

Only when the bus system was under control and worked, did Singapore start thinking about extending the system to other modes. (Many cities suffer from the mistaken illusion that they should invest in a metro first and

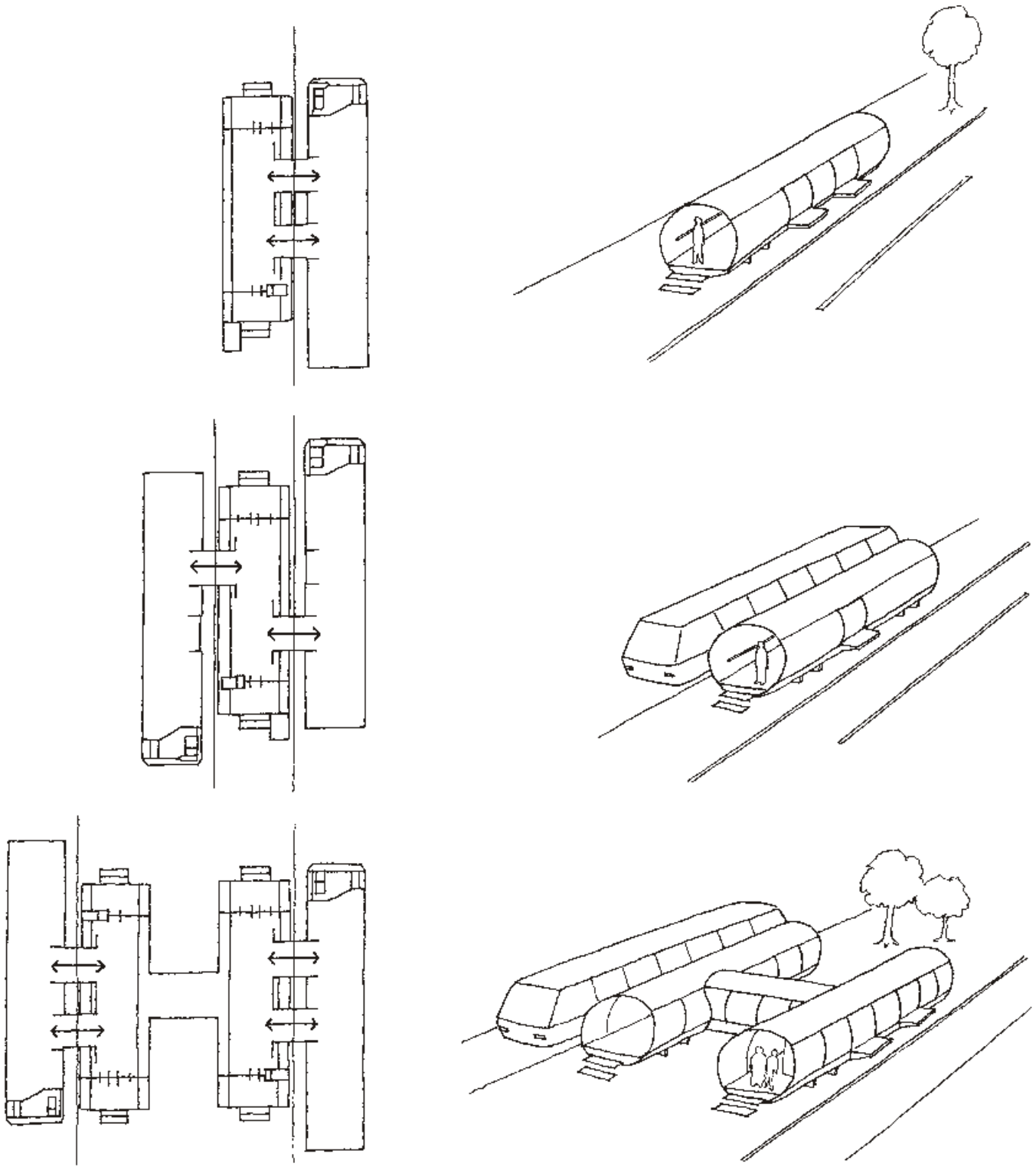

*Fig. 24 "Tube stations" in Curitiba*

then the rest will follow automatically). Today, the bus system is complemented by a modern subway system (MRT), and a small Light Rail system. Today, 3 million trips are made each day by bus and 0.7 million by MRT. There is also an efficient and affordable taxi system.

**A modest road building program**

Based on experiences elsewhere, the conclusion was that a demand approach, trying to "build away" traffic problems, would not work. More roads will, as a rule, give only temporary relief since they tend to attract more traffic, and will irreversibly alter the shape and form of the city. Singapore's objective was to carry out the development of its road network in a planned and careful way – not to be forced ahead because of traffic congestion. Government expenditures on the road network (construction, maintenance and management) have never been more than a fraction of revenues from road users and seldom exceeded 0.75% of GDP. Roads now account for 12% of Singapore's land area which the government considers the maximum desirable.


*Fig. 25 Area licensing scheme in Singapore*

**Restrictions of car ownership**

In Singapore the private car is not regarded as a fundamental and sacred privilege. To actively restrict the number of cars has been a consistent Government policy over many years. Since the only effective method is considered to be pricing policies, a number of taxes and fees have been used, e.g. import duties, road tax, registration fees and scrap fees. For environmental and efficiency reasons, use of cars older than 10 years is discouraged by very high fees. Generally, luxury cars are taxed much more than smaller cars, thus introducing some egalitarian element in the system.

As the first city anywhere, Singapore introduced a car quota system in 1990, under which the registration of new cars is restricted to a certain number each month. The rights to register a car are offered to the public in a monthly bidding process so that the market – not the Government – decides the cost of having access to a private car. Again, luxury cars are restricted since there are different quotas for different classes of cars. Prices fluctuate with the general economic situation and demand, but are often high – sometimes tens of thousands of US dollars.

These strict policies have worked. When hardly any other city in the world has managed to control motorization, Singapore, even in a period of economic growth, has kept the number of cars within limits.

**Regulations on the use of cars**

Singapore policies have not only been aimed to control the ***number*** of cars but also the ***use*** of them. In addition to traditional traffic management measures like traffic signals, one-way streets, parking fees, etc., Singapore in the 1970s introduced an innovative and remarkably efficient system for restriction of traffic to the sensitive city centre area. The area licensing scheme (ALS) meant that any car driver entering the city area during peak hour had to pay a fee which was adjusted so that no more traffic entered the city than the system could swallow. In all its simplicity, the scheme remained almost unique in the world during its more than 20 years of operation. A few cities tried to copy it but most gave up; either for lack of political courage or, as in the case of Kuala Lumpur, because they were not ready to provide the public transport system necessary to make the scheme possible.

Again being the first in the world, Singapore in 1998 introduced the Electronic Road Pricing system (ERP). A car is equipped with an In-vehicle Unit (IU) which contains a value stored card that can be charged for using the road system according to how much it contributes to congestion and/or environmental problems. In this way, traffic can be monitored in a far more efficient and precise way than e.g. taxing fuel. (So far, however, Singapore has not made full use of this technological development and the ERP system is still basically a more advanced successor to the ALS system).

In both the area licensing scheme and the road pricing system, Singapore's main philosophy is to create an instrument to control and monitor traffic. This contrasts favourably with many other countries where the sole objective in the minds of some politicians appears to be to collect more tax revenues so that more roads can be built.

**Selling it to the public**

Some people regard Singapore as an autocratic society and this may be so. It would be a serious mistake, however, to conclude that the Singapore government could succeed in implementing these policies by force. In reality, Singapore has constantly put great effort in the public display of policies and ideas, often through televised debates and campaigns, before they are implemented. In this way the public has been well prepared in advance for the changes in the urban transport policy.

## Buffalo City in Africa: What is ahead?

Curitiba and Singapore are two examples of cities that have found their own way and developed a successful approach to the urban transport issue. Today, they can be said, with some justification, to serve as sources of inspiration for their respective continents; South America and Asia. The third case in this report will be dedicated to a very different place – the newly formed Buffalo City in South Africa.

Buffalo City was recently formed as part of the restructuring process of the new South Africa. Situated between Cape Town and Durban in the Eastern Cape Province, it covers an area of over 2,500 $m^2$, and it incorporates the East London, Mdantsane and King William's Town urban areas as well as more than 350 – 400 rural villages. The total population is some 750,000 people. Within this large area there are very different conditions as far as transportation and traffic are concerned.

Much of East London and also parts of King William's Town is a traditional urban area with an organized street network suitable for car traffic. Here, a North American or Australian traffic planner could feel at home designing street crossings, traffic lights, roundabouts, parking facilities and so on for an affluent, still mainly white, society.

In the outskirts of East London is Duncan Village – a low-income area with some 120,000 inhabitants that can best be described as a shanty-town. Here, main mode of transport is walking but this has hardly been considered in transportation planning and few facilities have been provided to facilitate this type of transport.

The township of Mdantsane (South Africa's second largest after Soweto) has a population comparable with East London (some 200,000). Here, the main transportation need is directed to and from East London, mostly provided

with minibus taxis. Finally, there is a rural hinterland with 350–400 villages and a population of some 200,000 people. Most of them are connected with low-standard roads, and travel is directed towards King William's Town either by minibus taxi or by walking.

**Role of the transport system – tool for social and political development**

The land use/transportation structure within the new municipality is rather representative for South Africa, and illustrates how the transportation system was designed to maintain the former apartheid system by dividing people instead of bringing them together. Little attention was paid to the transport needs of the black majority and urban transport planning was seen as an activity aimed at improving conditions for urban car owners.

Due to historical development, the problems and role of the urban transport sector in Buffalo City differs in many respects from many other cities. The road and street infrastructure is not an urgent problem. The area is reasonably well covered with roads, and generally speaking they are of acceptable standard. (In fact, road standard is exaggerated for corridors between former white areas). Contrary to most cities, congestion is also not a major issue. In core urban areas where car ownership is high (in particular East London) street capacity is sufficient. Also contrary to many cities, environmental problem in form of air pollution is not conceived as a serious threat. However, traffic safety, particularly in urban areas, appears to be a serious problem.

The main transportation issue in Buffalo City is the lack of ***accessibility and mobility*** for the majority of people with no access to a private car. The choice is between walking and public transport, but mostly distances are so long that the only choice is the minibus taxi. This situation exists in many countries but it is particularly pronounced in South Africa because of the segregated settlement structure implemented in the past.

The most important role of the transportation system in Buffalo City is to function as a tool for social and political development towards de-segregation and increased equality. Since access to private transport is rare (bicycles are not used) the key to transportation for the masses is public transportation but this sector is now largely out of government's control.

**Public transport reform**

A minibus operating in the type of private passenger transport system – known as "taxis" in South Africa, "micros" in Peru and "jeepneys" in the Philippines – is a typical example of the "individual operation" concept and dominates completely the market in Buffalo City. The way of operation is the typical "fill-and-run" principle. A driver queues up in the morning and waits for his turn, and when fully loaded he takes off to his destination. Fares are collected by the driver or an assistant.

In South Africa, it is evident that passenger transport is undertaken on the industry's conditions, not the passengers'. The passenger transport market – of crucial importance to so many citizens – was taken by the private sector with no strings attached. The taxi industry is organized in associations, closely knit societies with a fierce sense of competition. Much due to previous unclear rules for route concessions, armed fighting for routes and taxi ranks (terminals and pick-up sites) have become a trade mark for South Africa and the so called "taxi wars" show no sign of stopping.

Due to the increasing anarchy in the system and its failure to fulfil social objectives, the national government now is clearly committed to reform and restructure the industry. Instructions have been submitted to lay down the procedure for this, and work is now being implemented: notably the preparation for a public transport plan. This is a very determined and well designed process which, if successful, will be of great interest for many other cities in developing countries.

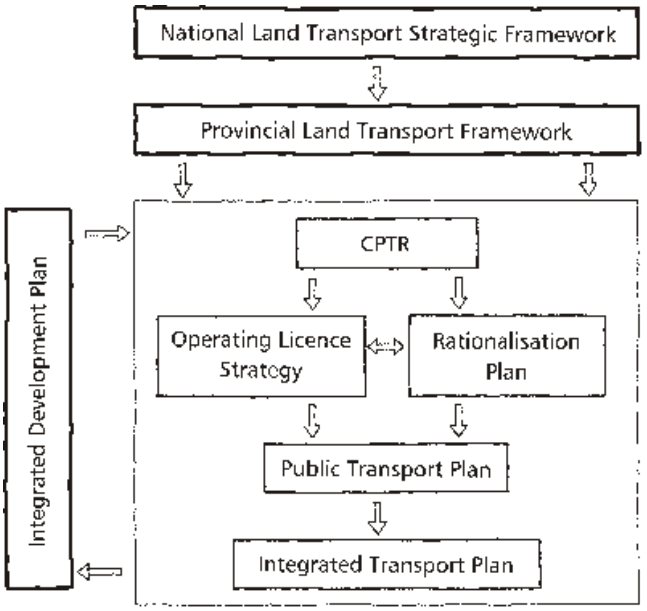


*Fig. 26 Planning framework*

**Swedish assistance**

In accordance with its recently developed policy to assist developing countries in the urban transport sector, the Swedish International Development Cooperation Agency (Sida) provides a package of technical assistance to Buffalo City. Defined as an overall urban development effort, transportation is one of the core elements. Due to the importance of public transport, the assistance focuses on this sector and will include traditional planning issues as well as more institutional aspects.

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