

Department for International Development, UK

World Bank Urban Transport Strategy Review

Background Paper

**Experience in Urban Traffic Management and
Demand Management in Developing Countries**

Final Report

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Background Paper

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EXECUTIVE SUMMARY

Introduction

The World Bank is carrying out an “*Urban Transport Sector Strategy Review*” (UTSSR) with the aim of formulating policy guidelines in the urban transport sector. To assist in providing the context for the UTSSR, a number of background papers dealing with specific key aspects of urban transport have been commissioned including the current paper. The preparation of the paper has been funded by the UK Department for International Development and has been co-ordinated by the UK Transport Research Laboratory and the World Bank. The Review is not intended as a “traffic management planning/design handbook” and thus does not contain detailed guidelines on planning procedures. The primary objectives of the Review are:

- ◆ to examine experience in traffic and demand management in developing countries with particular attention to the institutional requirements for sustainability;
- ◆ to determine the issues affecting successful planning and implementation of traffic management and demand management components of Bank projects.

Urban Transport Issues

In cities in developing countries population growth rates of 3%-5% are common. Population growth leads to increased demand for travel and population pressures which in turn leads to spatial expansion of urbanised areas and to increased journey lengths. Parallel growth in city economies and household and personal incomes also lead to further increases in travel demand, car ownership and car use. These factors, together with the inability, for whatever reason, of cities to plan transport systems, to manage travel demand, to relate land use and transport and to provide adequate resources for transport coupled with the high cost of facilities (particularly capital intensive mass transit systems), combine to produce the common transport effects present to varying degrees in most cities (i) increasing traffic congestion; (ii) declining attractiveness of road based public transport; (iii) increasingly high costs of travel; (iv) high levels of (road) accidents; and (v) increasing road traffic related emissions and atmospheric pollution.

Urban Transport Strategy

Although traffic and transport problems are desperate in many cities, the situation is not without remedy. Indeed, improved traffic and transport conditions are essential if urban areas are to thrive. The general directions of a sound traffic and transport policy are likely to include:

- ◆ Management – to make the most productive use of existing roads, traffic systems and public transport by improving operational efficiency and quality (the subject of this Paper);
- ◆ Maintenance – to ensure that existing transport facilities are fully available for use;
- ◆ Demand Management of Road Traffic – to manage demand recognising that new road construction alone cannot meet unconstrained future travel demand by private vehicles;

- ◆ Infrastructure Development – to correct network deficiencies and expand systems, concentrating on public transport, but with new roads where essential;
- ◆ Adoption of Objective and Systematic Evaluation – to evaluate transport investments objectively ensuring economic, financial, operational and environmental feasibility to ensure that investments are prioritised, targeted within realistic budgets and are sustainable;
- ◆ Environmental Management – to reduce vehicle emissions and other adverse impacts and to encourage less damaging modes such as walking and non motorized vehicles;
- ◆ Safety – to reduce the social and economic drain arising from accidents by improving the safety and security of the road based, transport system;
- ◆ Financing – to improve cost recovery in the transport sector including use of innovative policies for private sector participation in the supply and operation of transport services, by application of realistic road user charges and realistic public transport tariffs; and
- ◆ Land Use-Transport Planning and Integration – to improve city planning, in particular the integration between transport and land use and social and economic activities.

Role of traffic management

Traffic management objectives – traffic management is only one element, although an important element, of an integrated transport strategy. The goal of urban traffic management is to make the most productive use of the existing (road based) transport system by adjusting, adapting, managing and improving the system. Specific objectives are:

- ◆ to improve the movement of people and goods and not necessarily vehicles;
- ◆ to improve the quality and safety of the traffic and transport system; and
- ◆ to contribute to the improvement of the traffic related environment.

Traffic management actions divide into two basic categories and a comprehensive traffic strategy for a city cannot separate these two strands:

- ◆ traffic management policies, measures and schemes to improve and manage the supply of transport facilities with the objectives of improving traffic system capacity (in terms of "people" and not necessarily "vehicles") and/or quality and/or safety; and
- ◆ traffic management policies, measures and schemes to manage demand so that journeys are undertaken in the most efficient way for the community as a whole. Ultimately, it is impossible in an urban area to construct enough roads or to create enough capacity by supply side traffic measures to cater for full, unconstrained travel demand by private cars. Most cities will, at some stage, have to adopt some level of traffic demand management as part of an integrated transport strategy.

Balancing conflicting objectives – a traffic management strategy will need to balance the often-conflicting objectives of categories of transport system users – such as "bus user versus car user" or "cars versus pedestrians". The balance can only be achieved by:

- ◆ ensuring that objectives are clearly defined at the outset of planning;
- ◆ selecting “measures of effectiveness” (impacts) which will demonstrate the attainment of the selected objectives; and
- ◆ systematic planning and evaluation to determine the balanced mix of policies and measures to provide optimum impacts.

Limits to supply side traffic management - traffic management has limits in cities where traffic congestion and traffic growth are high. However, it should be borne in mind that

- ◆ even if impacts of traffic management are short term, the benefits are real and worthwhile;
- ◆ traffic management should seek to improve travel conditions for “*people*” not “*vehicles*” and thus even in conditions of high traffic growth and congestion, traffic management measures such as bus priority and road safety have great relevance
- ◆ traffic management should not be a one-time, “one shot” policy but should be a continuous process, adjusted and adapted to meet changing traffic conditions
- ◆ traffic management should seek to apply both supply side measures (concentrating on “people” capacity) and demand management measures.

Other roles for traffic management – in addition to its primary objectives – to improve the movement of people and goods, safety and environment - traffic management has ancillary roles:

- ◆ support to capital intensive transport investments such as major urban roads, mass transit systems etc to ensure efficient and safe access and distribution;
- ◆ alleviation of traffic congestion impacts arising during construction of major infrastructure works affecting the highway; and
- ◆ alleviation of adverse traffic impacts arising from major land use developments.

Scope of traffic management – a distinction must be drawn between “traffic engineering” and “traffic management”. “Traffic engineering” is an integral part of “traffic management” but is largely confined to the application of physical measures to a road network and junctions usually to ensure an increase in traffic (as opposed to “*people*”) capacity and/or to ensure safe operation. “Traffic management” embodies a wider concept and is concerned with the comprehensive management of the road based transport system and deals with policies and measures for the entire urban transport system including at least:

- ◆ traffic circulation
- ◆ public transport (buses and para transit) on-street operations,
- ◆ management and control of parking, servicing and access
- ◆ demand management
- ◆ enforcement of traffic regulations
- ◆ road safety
- ◆ pedestrians
- ◆ bicycles and other non motorised vehicles
- ◆ commercial vehicles management and
- ◆ environmental management (such as traffic calming)

The question was posed to the Review as to "what measures work best" in developing cities. A response in the form of general guideline is not possible. Traffic management measures:

- ◆ are highly city-specific, depending on city size, level of development, level of traffic congestion, traffic characteristics, ability to enforce etc and measures which are successful in one city may not be appropriate or successful in another;

- ◆ are most effective if applied on a comprehensive basis (area wide or corridor) rather than as isolated interventions. Traffic management measures are rarely "stand alone" - bus priority will need parking controls, pedestrian measures and junction improvements - an integrated approach is needed; and
- ◆ will not comprise physical interventions alone. Policy, regulatory and enforcement actions are necessary and success depends on these as much as physical measures.

Traffic Management Institutional Arrangements

Traffic Management Agency - in many developing cities, traffic management suffers from:

- ◆ lack of recognition of the need for a strong, professional traffic management agency with well defined powers and responsibilities;
- ◆ fragmentation of responsibilities between agencies and lack of inter-agency co-ordination;
- ◆ lack of continuity of staff or work programs due to political change;
- ◆ inadequate regulatory powers for effective traffic management;
- ◆ low levels of staffing and lack of professional capacity;
- ◆ lack of operational and implementation resources; and
- ◆ lack of traffic regulation enforcement capabilities.

It is fundamental to the development and implementation of a successful traffic management program that there exists, or is created:

- ◆ a city based traffic management agency with well defined responsibilities and accompanying powers to fulfil the tasks required for effective traffic management;
- ◆ an institutional framework which recognises and legalises, the formal role and responsibilities of the traffic management agency in relation to the traffic police, to the "highways agency" and all other agencies with interests in the transport sector. In some cities, formation of a traffic management agency may require redistribution of responsibilities away from existing agencies; this always presents difficulties but if traffic management is to be effective, this issue has to be faced;
- ◆ a forum ("traffic committee" or equivalent) for policy decisions and to which the traffic management agency reports;
- ◆ a traffic management agency which as far as practicable is de-politicised and thus can avoid changes in technical staff teams and programs when new mayors or political parties take office. Some cities (e.g. in Brazil and Mexico) have successfully used traffic-transport institutes or companies, which may be municipally owned, but which have a high degree of autonomy in everyday action, funding and employment of staff. The agencies have provided stability in the sector and are able to recruit and hold professional personnel; successful agencies become respected and the likelihood of erratic change is much reduced;
- ◆ increased contracting out of specific, or all, traffic management functions . This does not eliminate the need for a professional and competent core traffic agency team which must retain the responsibility to prepare and manage contracts and supervise outputs;
- ◆ appropriate funding procedures. Traffic management is often starved of resources for implementation and operation of schemes. Traffic management has significant potential revenue sources (parking fees, traffic fines, congestion charges, concessions for busways

etc) and other potential funding sources such as urban fuel surcharges and contributions from property/business taxes. If traffic management is to be successful, cities need to capitalise on these revenues and to consider earmarking funds to the traffic system (similar to road maintenance funds);

Traffic Police - traffic police have a vital role to play in the success of traffic management. However, as traffic congestion has worsened, as techniques of traffic planning and operations have become more complex and as traffic management has evolved to make major contributions to transport policy (e.g. through bus priority, structured parking charges, emphasis on pedestrians etc), the scope of traffic management has moved beyond the area of competence, background, skills and training of the traffic police. The aim of many traffic police forces tends to be “keep traffic (notably cars) moving” rather than to achieve a balanced traffic management strategy which places priority on the improvement of mobility of “people not vehicles”. Policy directions for traffic police are likely to be:

- ◆ the traffic police role (aside from vehicle and driver licensing, road worthiness inspection etc) should be confined to traffic regulation enforcement and to accident reporting;
- ◆ while the “traffic management agency” should be responsible for planning, design and operation of all traffic schemes it is an essential part of that process that the traffic police should be consulted and informed at all stages of scheme development;
- ◆ traffic police training and familiarisation with the objectives of traffic management should be improved;

It is regrettable but essential to recognize that in some cities, traffic police corruption in traffic matters such as enforcement of parking and moving traffic offences needs to be addressed. While improved training, reduction of opportunities for direct payment to police through private sector involvement (e.g. parking enforcement) may assist, this is a wider issue than traffic management.

Training and Human Resources

Successful and sustained traffic management requires adequate numbers of (i) trained professional staff in the “traffic management agency” and (ii) trained traffic police for the enforcement of traffic regulations.

Training for traffic management professionals - many Bank projects have included technical assistance to traffic agencies. While this technical assistance has often had some training role, there has not been great focus on training nor has there been any known systematic evaluation of training. The notable and important exceptions were the Mexico Medium Sized Cities and the Venezuela Urban Transport Projects where comprehensive training programs were included and these may serve as models for future projects, subject to evaluation of the successes and issues of the programs. Within Bank (and similar) projects, there is need to (i) take training “more seriously” and promote training within projects, (ii) consider ways of spreading training outside specific project cities and (iii) develop guidelines for assessment of training needs and the preparation of training components for traffic management

Training for traffic police - traffic schemes should be designed to minimise enforcement effort and to “design out” the ability and inclination for drivers to commit traffic offences. Nevertheless, traffic schemes will always require good enforcement for success. Many traffic police forces are neither well trained in current methods of traffic management enforcement nor do they appreciate the role and function of traffic management. Improved and systematic training of traffic police is essential and guidelines are needed for assessment of training needs and preparation of training components for traffic police within projects.

Human Resources - many cities under-estimate and under-provide the staff required for good traffic management as a consequence of (i) general constraints on city finance and staffing, (ii) lack of recognition of the importance of traffic management, (iii) lack of a clearly defined traffic management role for the city and (iv) lack of career structure for traffic management professionals. In the same way that there are no general guidelines for traffic management measures, there are no general rules for levels of staff. The range in developing cities varies greatly (in two mega cities of similar size, the range extends from 250 professionals to the clearly inadequate 5 professionals). To overcome the lack of human resources and it is necessary to provide traffic management with status, career paths and reasonable salaries and the case for "independent traffic companies-institutes", on the model of Sao Paulo and other Brazilian cities is worthy of consideration. There is also a case for increased contracting out specific traffic management functions and contracting out of all traffic management functions within a city may offer potential; some cities are following this latter approach and more documented experience from these cities is needed.

Traffic Management and Road Safety

A high proportion of traffic accidents occur in urban areas. A comprehensive urban road safety policy requires a multi-sectoral approach including programs for driver training and testing, education, publicity aimed at selected groups of road users, vehicle roadworthiness testing, securing funds for road safety, community participation, monitoring and research. Some form of multi-sectoral "Traffic Safety Committee" is required to initiate and co-ordinate safety policies and programs. While a comprehensive safety program is broader than traffic management alone, traffic management actions are an integral and important part and likely to include:

Accident reporting - data from accident sites are collected by the traffic police and, in developing cities, many data bases are incomplete and of poor quality. Accident policies and programs need to be based on sound data and improved data bases are necessary. This requires improved police training, data processing systems and changes in police attitudes to eliminate bias which are often directed against low income road users.

Accident Data Analysis - in many cities, accident analysis is reactive and confined to reported problem sites; there is no systematic, periodic transfer of data from the traffic police to the traffic management agency or systematic evaluation for program planning; improved procedures are necessary.

Accident Prevention - as part of its role in planning traffic strategy and designing schemes, the traffic management agency should:

- ◆ promote safety as an integral part of scheme planning and design and in particular pay attention to "designing into schemes" measures to (i) control speeds (ii) calm traffic, (iii) meet the needs of vulnerable road users including pedestrians (particularly children) and cyclists; and
- ◆ the concept of safety audits (in which all but the simplest of schemes are subject to scrutiny by traffic management designers who were not involved in the original scheme planning and design) is worthy of consideration in developing cities;

Accident Reduction - a well run "traffic management agency" should approach safety on a comprehensive basis and a priority task should be the conduct of a safety review of the city's traffic system and preparation of a comprehensive "traffic management safety program". While accident occurrence cannot be reduced by traffic management measures alone, much can be done to alleviate specific problems.

Traffic Regulation Enforcement - enforcement of traffic regulations by the police is essential to safe traffic operations but in many developing cities, traffic police are ineffective, training and equipment are lacking (see training above).

Safety Experience in World Bank Projects - road safety is often stated as one of the objectives of traffic management components of Bank projects but there has been little, if any, systematic evaluation of the components and thus no impact analysis is possible. There is a need for more rigorous (i) definition of systematic safety programs within projects, (ii) definition of safety targets and (iii) monitoring of targets and indicators

Traffic Management and Poverty

Transport assists in reducing poverty mainly by increasing economic efficiency – by lowering transport costs and prices and thus enhancing employment and social opportunities. Traffic management can contribute to these aims. In most developing cities, travel by the poor is by bus, para-transit, walking and bicycling. Traffic management measures can assist poverty reduction by emphasising the objective to improve travel for “*people*” and not necessarily for “*vehicles*” and “*bus-bicycle-walk*” measures are highly relevant to poverty reduction.

Reallocation of road space to buses - in developed cities, it is accepted that full and unrestrained car use cannot be accommodated and this has led to traffic management strategies which positively promote “*people*” and not “*vehicles*” and thus places buses priority measures at the top of a hierarchy of actions. Reallocation of road space from cars to buses not only promotes efficiency but is entirely consistent with a policy of poverty alleviation as bus systems are used by the poor (although it would be a mistake to regard or plan for bus systems to be used only by the poor). As traffic congestion worsens in developing cities, bus priority will become an essential feature of traffic management strategy. While many Latin American cities are world-leaders in busways and bus priority, the approach has not been widely accepted in developing cities in other regions. This is due to a combination of factors - enforcement, poor standards of existing bus services, lack of understanding at technical and political levels, lack of familiarity with technical possibilities and difficulties of dealing with high volumes of para transit vehicles. Good design of bus priority can address some of these issues but more is needed - better information to decision makers, better enforcement, better image for buses and better dissemination of information on the benefits of bus priority.

Pedestrians - in many developing cities pedestrians face very poor conditions including lack of adequate or of any footways, footways obstructed by street traders and dwellers, inadequate or no reinstatement after utility works and subjugation to vehicles, particularly for safe crossing of roads. A more positive and proactive approach to pedestrian measures is needed and should include:

- ◆ better pedestrian planning and appropriate design guidelines and standards for developing cities for dissemination to potential transport project participants;
- ◆ establishment of guideline procedures for dealing with street traders and street dwellers in an equitable manner;
- ◆ increased dialogue with cities which wish to subjugate pedestrians to vehicles; and
- ◆ powers and institutional mechanisms (such as financial penalties) to ensure that utility companies and others reinstate footways after works.

Bicycles - in many developing cities the issues faced by cyclists include increasing motorization (including motor cycle-ization) and thus safety problems, reduction in street space for bicycles as pressures mount (and are accepted) for road space to be devoted to motorised vehicles, social attitudes to bicycles (“backward”, “second class”), lack of interest by urban traffic planners, poor

physical design of bicycle facilities, security of bicycles against theft and personal security of cyclists. Bicycles should be treated as an integral part of the traffic management system and strategies should be designed to capitalise on their strengths such as usefulness for short trips, affordability, non polluting, affordable, etc. Care must be taken to ensure that bicycle schemes are planned to meet a real (or a realistically assessed) need and are not constructed in locations which are “easy”, an inconvenience to no one (basically cars) but are of little value to users and potential users

Demand management and poverty impact (see below) - demand management, particularly congestion pricing, will have a positive poverty impact. Generally, it is the rich who own and drive cars and (i) the direct costs of congestion charging are not borne by the poor, (ii) public transport improvements should be integral parts of a congestion pricing scheme and will assist the poor and (iii) revenues from congestion pricing can be used to improve quantity and quality of public transport.

General traffic management measures and poverty impact - positive and negative impacts apply:

- ◆ some traffic management measures are directed primarily towards cars (e.g. junction capacity improvements) but will assist buses as part of general traffic; thus, while poverty impacts may be secondary, they will still be positive;
- ◆ in some cities, traffic management has sought to provide more car lanes at the expense of pedestrians or bicycles; not only are poverty effects negative but the measures are not likely to meet the improvement of travel for "*people*" objective of traffic management;
- ◆ Area Traffic Control (computerized control of traffic signals) is now almost a universal feature of traffic management projects but has been criticised as "car orientated" and without positive poverty impact. Benefits are most likely to accrue to all traffic but this will include buses and, in some cases, bicycles and pedestrian crossings may be better integrated. ATC also has benefits in elevating the image of traffic management and is probably essential to any well "traffic-managed" city.

Bank traffic projects and poverty - Traffic components of Bank projects are generally consistent with a "poverty approach" as most include measures for buses, pedestrians and to a lesser extent, bicycles/non motorized transport (NMT). However, in the context of a city, the components are often relatively small in scope. While the measures themselves are very worthwhile and can demonstrate the advantages of good traffic management, the key Bank role in the context of poverty impact, and in traffic management generally, should be to promote the overall case for traffic management and to seek policy agreements on a comprehensive approach in which buses-pedestrians and where appropriate NMT is at the forefront of traffic strategy.

Evaluation - traffic management schemes usually result in high economic rates of return when assessed on a conventional basis. To ensure that schemes are "*people*" and not "*vehicle*" orientated, and that poverty impacts are included as a valid part of the assessment, evaluations should include changes in person time costs. Even then, there are measures which are difficult to assess by conventional economic means - notably bicycle and pedestrian schemes (although many of the latter are often justified on reduction of accidents alone) and a more comprehensive, objective lead evaluation framework approach should be considered and the Review presents suggestions.

Traffic Management in Bank Projects

Experience in developed and well managed developing cities shows that traffic management:

- ◆ is an essential element of any city transport strategy

- ◆ is fundamental to realise the potential of more costly transport infrastructure and system investments; and
- ◆ costs are small and the benefits are exceptionally high.

It is axiomatic that a development agency such as the World Bank or DfID should support traffic management. Nevertheless, there have been problems in implementation. Important issues to be overcome include long implementation periods; lack of ownership; little public involvement; limited project scope; little monitoring and most importantly, lack of sustainability institutional arrangements. It is difficult to recommend generally applicable actions to overcome these issues since traffic management is highly city specific. However, key areas which need to be addressed in Bank projects and to which greater project attention is needed include:

Institutional arrangements - projects should ensure that there is a capable traffic agency in place or being created, an appropriate institutional framework within which the agency can work and adequate funding for the agency to deal with traffic management on a continuous and sustainable basis.

Project scope - traffic management projects should aim not just for implementation of simple measures, but should aim to establish traffic management as a sustainable part of city transport strategy. Despite the difficulties, traffic management projects should deal with institutional arrangements and policies which are wider in scope than the "project" and form the foundation for a sustainable traffic management system;

Implementation period - cases have existed where traffic management components designed during project preparation are outdated before implementation due to protracted periods of project and loan processing. A more programmatic approach to traffic management components should be considered with loan funds allocated to "traffic management programs" and not defined schemes. Not only does this allow schemes to be developed which are responsive to current traffic conditions but it also provides an opportunity for the traffic management agency to become established and credible by designing and implementing schemes. Some traffic projects are moving in this direction. It accepted that more supervision would be needed but the possibility should be investigated to contract this supervision to the private sector as part of the project;

Guidelines – some aspects of traffic management project preparation and implementation are new to many cities and thus cities lack expertise. Project processing could be assisted by the development of guidelines for some aspects such as: (i) institutional arrangements, (ii) public involvement in traffic management, (iii) training, (iv) planning and procurement of ATC, (v) programmatic approach to traffic management components and (vi) monitoring.

Demand Management

All urban areas require a good road network and construction of additional road capacity or to correct deficiencies in the network can alleviate some of the effects of congestion. However, new roads even if they are affordable, generate new traffic, and benefits will be offset by future congestion unless growth in traffic is managed. Inevitably, demand management policies will be needed which will involve balancing increased cost of car use and making public transport more attractive. The underlying rationale for demand management is that vehicle users should pay a realistic price which reflects the full costs of their journeys by a combination of direct charges (such as parking) and indirect charges (such as vehicle taxes on ownership and use). Ideally the costs of journeys should reflect traffic conditions by location (e.g. city centres) and by time (e.g. peak periods) and should seek to manage demand such that facilities are used by vehicles in the most efficient way at all times. Thus the objectives of demand management are to:

- ◆ reduce traffic congestion;
- ◆ reduce adverse traffic related impacts on the city environment.
- ◆ although not strictly an objective of demand management, policies which rely on pricing mechanisms can generate significant revenue which should be used to improve the transport system, particularly public transport, in parallel and integral with restraint measures.

Demand management policies and measures can be categorised in various ways but essentially comprise:

Parking controls and management - parking control is the most universally accepted demand management mechanism and is used to some extent in all cities; however, the main objective is usually to eliminate obstructions to traffic flow by parking prohibitions rather than to manage demand. On-street prohibitions, while clearly necessary, require management of the released road space (e.g. for bus priority) or else increases in "through" traffic can occur. Charged parking should be part of any traffic policy as free parking is a subsidy. Charges are usually aimed at limiting car commuting to reduce peak traffic volumes but parking charges alone are unlikely to achieve the congestion relief effect required and furthermore, a parking policy will not be fully effective as a restraint measure unless the traffic agency controls a large fraction of all on and off street parking. The traffic agency will need to co-ordinate charges for on-street, publicly available off street and private non residential parking within an integrated policy. This is not easy to achieve, particularly controls on private non residential parking where some form of local taxes on parking places (such as "workplace parking levies") are politically difficult and moreover must be passed on to drivers in some way to act as a disincentive to car travel. In developing cities, the institutional aspects of parking - enforcement, corruption relating to collection of charges and fines, levels of fines, tracing offenders and so on - pose practical difficulties for implementation of a parking policy but increased use of private sector contractors has been successful in some cities. A parking policy is essential to good traffic management practice and parking charges can raise revenue for financing transport improvements; despite the practical problems and policy, is likely to be the starting point for demand management in most cities

Regulatory control on use of vehicles - a number of developing cities have sought to alleviate congestion by restrictions on vehicle use on various days defined by vehicle number plates, at its simplest by prohibiting vehicle use on alternate days defined by "odd-even" number plates but other variants have been used (2 days per week, peak hours only, selected roads only etc. Such measures exist or have existed in the past, in Lagos, Mexico City, Bogota, Santiago de Chile, Seoul, Manila and Sao Paulo. The measures cannot be regarded as a long term solution as they are likely to encourage second vehicle ownership, generate increased trips by permitted vehicles and are undermined by concessions and growth in vehicle ownership over time. However, the basic measures are relatively simple to implement, generally well observed and there are short term de-congestion benefits. Provided the period when schemes are effective can be used to develop more comprehensive and sustainable measures, the measures may be worthwhile, particularly when they are aimed at emergencies such as air pollution alleviation (Mexico City, Santiago etc).

Physical control on vehicle use - measures such as pedestrian areas, environmental cells and road space reallocation to buses have been considered as demand management policies. As traffic management measures, bus priority and pedestrian schemes have great merit in increasing urban transport efficiency, promoting public transport and improving the urban environment but as "incentives", do not impose direct restraint on car use and are unlikely to affect car demand greatly. Bus priority and pedestrian measures should be pursued as traffic management measures

in their own right; their role in demand management is likely to be complementary to other measures.)

Pricing - charges on vehicle use and ownership - measures such as general fuel prices or urban fuel price surcharges (to limit use) and vehicle registration and other ownership taxes (to limit car numbers) are often proposed.

Fuel prices - fuel consumption is proportional to distance travelled and thus, to some extent, the price paid for fuel reflects vehicle use and price increases could affect demand. However, (i) there are probably practical limits to which fuel prices can be raised and (ii) fuel consumption is only marginally related to use of vehicles at congested times and in congested locations whereas prices affect all users - urban and non-urban alike. Thus, fuel price is a "blunt instrument" and does not address urban congestion directly. Fuel taxes are (i) important sources of revenue for public investment, including transport, and specific urban fuel surcharges may raise significant revenues for transport improvements (as used in Colombia) and (ii) have some re-distributive effect as car users tend to be most affluent. However, fuel price is not an efficient or targeted instrument to alleviate urban traffic congestion which is often located in specific areas and at specific times.

Ownership taxes - some countries have applied taxes to vehicle registrations designed to affect ownership or finance public transport, e.g. differential taxes by engine size on vehicles in UK to encourage fuel efficient vehicle or metro bonds coupled to car purchase in Korea. However, Singapore is probably the only country which applies registration or licence charges high enough to control growth in the vehicle fleet (the "Vehicle Quota System" in which bids are made for a pre-determined number of registration licenses). It seems unlikely that the locational and institutional circumstances which allow Singapore to operate the system could be replicated in most other countries and the practical levels of ownership taxes are not likely to be solution to urban traffic congestion particularly, as with general fuel prices, vehicle ownership taxes are indiscriminate instruments in dealing with urban congestion

Pricing – demand management through congestion charging - it has long been advocated by transport planners that direct congestion charging ("cordon pricing" or "area pricing") for vehicle use in urban areas is the most efficient demand management policy. There have been, and continue to be, numerous recent proposals for cities as different as London (targeted implementation 2002) and Mumbai. However, implementation world-wide is extremely limited and of the few congestion pricing schemes, perhaps only Singapore has, as its primary aim, the restraint of road traffic. However, schemes like Trondheim, while seeking to raise revenue for transport improvement, do seek at the same time to use the system "traffic regulation tool".

In so far as experience of the limited schemes in the world show, congestion pricing schemes are effective in reducing vehicle demand and are practical to operate. The case for congestion pricing in developing cities appears very strong in that (i) traffic congestion is increasing and congestion pricing can target congested times and congested areas of a city, (ii) the majority of travellers use road based public transport which should benefit greatly from congestion pricing and thus should be natural supporters and (iii) the revenues should enable essential parallel public transport improvements to be made.

The reasons for lack of implementation are complex but include (i) political, and some public, opposition, (ii) failure of transport planners to present convincing arguments, (iii) legal and institutional constraints associated with direct charging for road use, (iv) lack of legal framework for dealing with offenders (e.g. "owner" versus "driver" liability), (v) institutional weakness to plan, design, implement and manage a scheme on a continuous basis, and (vi) a tendency to regard congestion pricing as a stand-alone scheme and thus a failure to recognise and develop integrated policies for improved, quality public transport as an alternative to car use.

There has been a recent resurgence of interest in the developed world partly due to the potential for electronic charging (stored value cards etc) and automatic enforcement and tracing of offenders. Singapore has shown that such schemes can work effectively and are efficient as charges can be readily geared to traffic conditions to achieve a balance between vehicle use of road space and charges. However, past experience of the original Singapore Area License Scheme also shows that a “paper based”, manually enforced cordon pricing scheme is feasible; simple technology is not a bar to congestion pricing in developing cities. Indeed manual schemes may be the only way forward in the short term in many cities as electronic charging must be underpinned by facilities to enforce and trace offenders. This requires a complete national, up-to-date, accessible vehicle registration data base which can be accessed automatically - not always available in developing cities. Even the Singapore manual scheme required tracing of offenders and this may not be possible in some developing cities. On-the-spot fines for violators may be the only enforcement policy possible and this has serious implications for feasibility of cordon schemes in that (i) road space is required to deal with offenders, (ii) there is the possibility of corruption and (iii) the numbers of offenders and thus congestion induced at control points may be so great that the benefits of the scheme are eroded.

Restraint through land use and transport development – integrated land use and transport is the long term planning goal of most cities. As travel demand is related to land use disposition, it should theoretically be possible to reduce overall demand for travel and to plan efficient transport systems through control of land-use development. Few cities have been successful in administering land use development controls in relation to transport. As with most effective transport policies, the key lies in the institutional arrangements. However, if a long term view is taken, cities such as Curitiba and Singapore show that it can be done and the benefits of less travel, shorter journeys, lower cost journeys etc are great.

Trends in traffic management

Traffic management continues to progress in developed cities and some recent trends will find increasing application in developing cities:

Public involvement - public information, consultation and participation are integral parts of planning and implementation of traffic and transport schemes in developed cities. Many, but by no means all, developing cities have similar process. Public involvement takes time and resources but the effort is off-set by resolving public concerns for traffic schemes with resulting fewer problems with implementation and should be the policy in any project;

Traffic Demand Responsive Area Traffic Control (ATC) – ATC is already well established in developing cities but as real costs of equipment reduce and reliability increases, traffic demand responsive ATC not only provides traffic operational benefits but can assist in improving the status and image of traffic management agencies;

Road space reallocation-bus priority – most developed cities accept that not enough new roads can be constructed to fulfil unconstrained demand for car travel and that most efficient use must be made of scarce road space. Buses are efficient users of road space but to realise that efficiency they must be freed from the effects of traffic congestion. A policy of preferential road space reallocation from cars to buses to provide bus priority, if not already adopted, will be an important part of traffic strategy in any congested developing city.

Packaging of measures - some cities have sought to involve all agencies -- traffic management agency, local councils, bus operators, highways agency -- in integrated programs with each agency contributing both support and finance for their respective areas of responsibility; the trend may find application in developing cities;

Development gains – financial contributions from developers for the improvement of the traffic and transport system to provide and “compensate” for traffic impacts of large scale land use developments are now common; the process find application in developing cities;

Road pricing – there is a resurgence of interest in congestion pricing (although, regrettably, little new implementation) in developed cities. To some extent, the renewed interest has been stimulated by the potential for automatic, electronic charging and enforcement systems and by the growing realisation that significant funds can be raised to improve the transport system. It is only a matter of time before schemes in major developed cities are introduced. Equally, there is a great need in many developing cities for demand management although the feasibility of electronic systems will depend on such factors as the status of vehicle registration systems to allow automated tracing of offenders

Contracting out – there has been an increase in contracting out traffic management functions to the private sector which may have application in developing cities;

Potential for transport telematics – there is increasing use of electronic advanced technology for traffic management measures – enforcement using automatic vehicle recognition, dynamic route signs, electronic pricing for tolls (or potentially for congestion pricing), etc. In more advanced cities in developing countries, such measures should increase efficiency of traffic operations.

Background Paper

Experience in Urban Traffic Management and Demand Management in Developing Countries

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1. INTRODUCTION

1.1 Background

1.1.1. The World Bank is carrying out an “*Urban Transport Sector Strategy Review*” (UTSSR) with the aim of formulating policy guidelines in the urban transport sector. To assist in providing the context for the UTSSR, a number of background papers dealing with specific key aspects of urban transport have been commissioned including the current paper, a “*Review of Traffic Management and Demand Management in Developing Countries*” (the Review)¹. The preparation of the Review has been funded by the UK Department for International Development (DfID) and has been co-ordinated by the UK Transport Research Laboratory (TRL) and the World Bank (the Bank). Terms of Reference (TOR) for the Review are included as Annex A.

1.2 Objectives of the Review

1.2.1. The objectives of the Review are:

- a) To examine experience in traffic and demand management in developing countries with particular attention to the institutional requirements for sustainability;
- b) To determine the issues affecting successful planning and implementation of traffic management and demand management components of Bank projects; and
- c) To suggest traffic management and demand management policies and approaches to be discussed in the UTSSR.

1.3 General Scope of the Review

1.3.1. Audience for the Review – Based on discussions with the Urban Transport Thematic Group in the World Bank and with TRL and DfID, it was concluded that the Review should provide information to Bank staff and to technical staff in cities to enable traffic management and demand management policies, measures and components to be promoted. Thus, the Review should be aimed at a wide technical, but not necessarily traffic planning specialist, audience.

1.3.2. What the Review is not – The Review is not a “traffic management planning/design handbook” and thus does not contain detailed guidelines on planning procedures, standards, norms, or design criteria for traffic management measures. Good traffic management depends on the ability of city traffic planners to develop policies and measures which capitalise on the unique problems and opportunities in their city and on

¹ Other background papers in the present series include “Mass Transit”, “Road Safety”, “Public Transport Competition and Regulation”.

the planners ability to convince stakeholders and politicians of the need for action. Thus “fixed” or “standard” solutions are not possible.

- 1.3.3. City-specific nature of traffic management and demand management – All cities in the world apply traffic management to a greater or lesser extent – it is an essential element of good city governance and no city traffic system can function without some level of traffic management. However, the level and sophistication with which traffic management policies and measures are applied depends widely on individual cities and depends, for example, on:
- a) the “starting point”. The level of development of the transport system, levels of car ownership and use, development of the road network and similar factors determine the severity and nature of traffic problems faced within a city and thus determine the types of traffic policies and measures which are appropriate;
 - b) the size, population and spatial characteristics of a city. Measures and policies which apply in mega cities will not necessarily find application or success in small or medium sized cities and vica-versa. Even with cities of similar size, population and level of development, locational and physical constraints will impose differing traffic policies;
 - c) the level of development and traffic congestion. For example, measures which, say, aim to provide buses with priority or to restrain traffic may be appropriate in mega cities with relatively high car ownership and intense peak period (or longer) traffic congestion (such as Bangkok, Moscow, Cairo, Sao Paulo, Mumbai etc) but such measures may not be appropriate in smaller cities with short periods of traffic congestion or in cities with low car ownership; and
 - d) the degree to which traffic management is given political support and developed institutionally. Policies and measures which may be acceptable in one city could be unacceptable or unable to be implemented in another city of equivalent size and with equivalent traffic problems.
- 1.3.4. Lack of quantitative data – the TOR for the Review poses questions for which quantified responses would be desirable - “*what are the impacts of traffic management*”, “*how many people are employed in traffic management*”, “*what is the level of inter-agency co-operation*” etc. However, there is a general lack of real and representative data to respond to these and similar questions. Thus, the Review is selective and qualitative at least for the following reasons:
- a) regrettably information on the impact of traffic management strategies is limited. World Bank projects include Implementation Completion Reports (ICR) which present component impacts in conventional terms of economic internal rate of return (EIRR). Most such evaluations are extremely general and tell little about the success or problems of individual schemes. Additionally, there are practical difficulties in the assessments themselves (such how to deal with traffic growth over time). Regarding sustainability, there are no known time based reviews or evaluations. The ICR-type evaluations are likely to provide an incomplete basis on which to judge “success” of traffic management policies. A case can be made for more systematic evaluations and this is discussed in subsequent Chapters but, given this limited quantitative data, the current Review is largely qualitative;

- b) to respond to such questions as “*how many people are employed in traffic management*”, “*what is the level of inter-agency co-operation*”, there has been the difficulty within the limited resources available for the Review, of obtaining representative data for a wide ranging sample of cities with similar characteristics. It has not been possible to circulate world-wide questionnaires;
- c) traffic management undertaken for Bank projects is limited in coverage and scope and generally is concerned with a specific corridor or area or problem. Rarely is the complete traffic management strategy for a city addressed in a Bank project and certainly it has never been addressed for large or mega cities. Thus, even though traffic impact data for the Review are limited with respect to Bank projects, there are an even greater limitations on obtaining quantified traffic impact data city-wide.

1.4 Procedures employed in the preparation of the Review

- 1.4.1. The Review was commenced in January 2000. Resources for the Review were constrained and thus neither city visits nor comprehensive city case studies were possible. Thus, the Review has been based on (i) consultations with representatives of international funding agencies (the World Bank, the Inter American Development Bank and to a limited extent, the Asian Development Bank), (ii) published documentation, (iii) internet-based consultations on specific issues with various city and agency representatives and NGO’s, (iv) previous experience of the consultant in the sector. A draft report was submitted to the World Bank and Transport Research Laboratory (technical co-ordinators for DfID) in July 2000 for review and the current "Final Report" incorporates the comments made. As required by the TOR, the Review has been assessed by a practising traffic planner-engineer in a “developing country”, this case, Brazil and incorporates comments arising from that review.

1.5 Form of the Review

- 1.5.1. Traffic management measures may be divided into two basic categories²:
 - a) traffic management policies, measures and schemes which seek to improve and manage the **supply** of transport facilities with the objectives of improving traffic system capacity (in terms of persons and not necessarily vehicles) and/or quality and/or safety; and
 - b) traffic management policies, measures and schemes which seeks to manage the **demand** for transport with the objective of ensuring that journeys are undertaken in the most efficient way for the community as a whole.
- 1.5.2. These two strands of traffic management cannot be separated. Ultimately, it is impossible to construct roads to cater for unconstrained demand by private cars. A well managed city will, ultimately, have to embrace traffic demand management policies as part of an integrated transport strategy. Demand management policies may be achieved through a combination of restraint (such as limitation of movement through parking or

² A similar classification is presented in “Transport and the Global Environment – Global Overlays for the Transportation Sector”, UNEP, Halsnaes, Markandya and Sathaye, Nov 1999 (draft)

through pricing) and incentives (such as good public transport or encouragement to other efficient modes). The Review deals with both the supply side of traffic management and with the demand management side.

2. ROLE OF TRAFFIC MANAGEMENT

2.1 Introduction

2.1.1. In cities in developing countries population growth rates of 3%-5% are common. Population growth leads to increasing travel demand and population pressure which in turn leads to spatial expansion of urban areas and increased journey lengths. Parallel growth in city economies and in household and personal income leads to increased travel demand, increased car ownership and increased car use.

2.1.2. These factors - increased travel demand, increased journey length, increased car ownership and use - together with the inability, for whatever reason, of cities to plan transport systems, to manage demand, to relate land use and transport and to provide adequate resources and the high cost of facilities (particularly capital intensive mass transit systems), combine to produce the common transport effects which are present to varying degrees in most cities:

- a) increasing traffic congestion;
- b) declining attractiveness and use of road based public transport;
- c) increasingly high costs of travel;
- d) increasing (road) accidents;
- e) increasing road traffic related emissions and thus atmospheric pollution; and
- f) urban blight and declining quality of urban life.

2.2 General directions of urban transport policy

2.2.1. Although traffic and transport problems are desperate in many cities, the situation is not without remedy and indeed improved transport is essential if urban areas are to thrive. There are opportunities to deal with transport problems and to alleviate deficiencies. The general directions of a sound traffic and transport policy are likely to include, at least:

- a) Operational Management – make the most productive use of existing systems (roads, public transport etc) by improving efficiency and quality of operations;
- b) Maintenance – ensure that existing transport facilities are fully available for use by improving maintenance;
- c) Demand Management of Road Traffic – recognise that new road construction alone cannot meet future travel demand and develop policies to:
 - ◆ constrain “inessential” road use by inefficient users of road space (low occupancy private vehicles) by ensuring that system users meet their true costs

of travel³ through various forms of vehicle and road user charging mechanisms; in parallel and as part of a realistic user charging system, raise revenue for transport investment;

- ◆ encourage efficient modes by emphasising public transport systems to increase system capacity, attractiveness and financial viability;
- d) Infrastructure – expansion of transport infrastructure is likely to be essential but programs should be developed with clear policy objectives, address priority issues (such as correcting deficiencies and imbalances in the system) and should seek to cater for growth by favouring efficient modes namely, public transport systems;
- e) Objective and Systematic Evaluation – adopt transport planning procedures which ensure that all transport investments are evaluated objectively, prioritised and targeted within realistic budgets such that transport policies and measures are economically, financially, operationally and environmentally sound, are sustainable and form a realistic “implementable” program;
- f) Environmental Management –improve road based vehicle emissions and reduce adverse environmental impacts of transport investments and operations through vehicle testing, fuel improvements etc. Additionally, policies are needed to encourage less environmentally damaging modes (walking, NMT etc);
- g) Safety – improve the safety and security of the transport system, particularly the road based transport system;
- h) Financing – adopt innovative policies for financing transport including involvement of the private sector participation in the supply and operation of transport services, by realistic road user charges (see “demand management” above) and by realistic public transport fares systems; and
- i) Land Use-Transport Planning and Integration – improve general city planning, in particular the integration between transport and land use and social and economic activities.

2.3 Objectives of traffic management

2.3.1. Traffic and demand management is just one element, although an important element, in an integrated transport strategy. In broad terms, the goal of urban traffic management is to make the most productive use of existing (road based) transport system resources. Traffic management seeks to adjust, adapt, manage and improve the existing transport system to meet specified objectives without resorting to substantial new road construction. Thus, the rationale for traffic management may be stated as:

- a) maximise efficiency of existing traffic-transport facilities and systems. This will be achieved by providing for, and improving, the movement of people and goods and not necessarily vehicles and may involve management of road traffic demand;
- b) defer capital expenditure to the time when it is most needed or is inevitable;
- c) make immediate improvements in road and road based public transport travel conditions;

³ It is of course recognised that some travel – say by the urban poor – may be subsidised

- d) provide time to develop longer term policies-measures and to seek appropriate finance;
- e) improve quality of road based public transport system and to at least slow, and preferably reverse, mode shift towards use of private cars;
- f) improve safety of traffic systems; and
- g) contribute to a reduction in the adverse impact of road traffic on the city environment.

2.3.2. Traffic management objectives are a summarised a re-statement of the rationale:

Traffic management aims to provide for the short range traffic and transport needs of an urban area by:

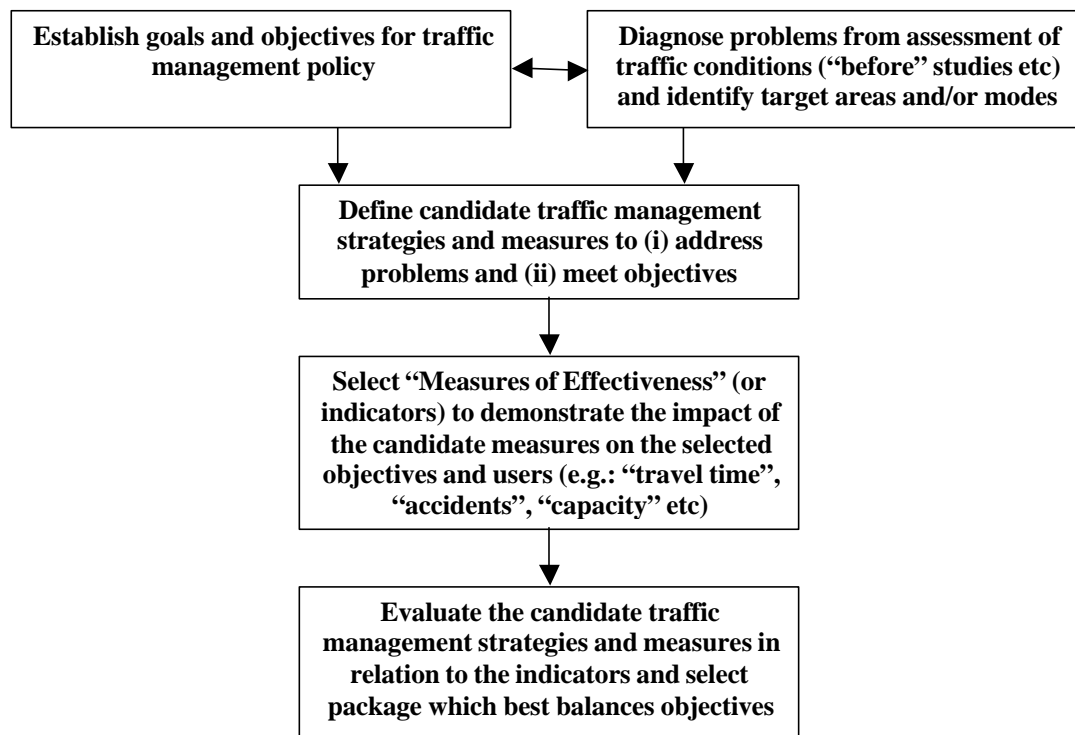
making most efficient use of traffic-transport facilities and systems by improving the movement of people and goods and not necessarily vehicles and by managing demand for road based travel;
improving the quality and safety of the traffic and transport system;
contributing to the improvement of the traffic related environment.

2.4 Conflicts between measures

2.4.1. In developing traffic management policies or measures, it is most unlikely that all objectives can be fully met for all users of the transport system; there are likely to be conflicts between measures. For example, the extent of priority given to pedestrians may conflict with increases in capacity for vehicles⁴ or pedestrian crossings introduced for safety may conflict with traffic flow efficiency or pedestrian streets may adversely affect bus operations or bus priority may adversely affect truck circulation or the extent to which road space is reallocated away from cars to buses for bus priority may impose restraint on private vehicles. An integrated traffic management scheme will require a balance to be struck and compromises made between the competing objectives of the various user of the road and traffic system.

2.4.2. The balance will vary from city-to-city and will be dependent on the policy objectives of the city, the traffic and transport problems and opportunities for improvement. An integrated and balanced scheme or policy will be developed by application of standard planning procedures. It is not the function of this Review to define procedures in detail but a systematic process is a necessary and integral part of the planning and design of schemes, namely, by (i) ensuring that objectives of the strategy are clearly defined at the outset, (ii) selecting “measures of effectiveness” (impacts) which will demonstrate the attainment of the objectives and (iii) systematic planning and evaluation of alternatives to determine the optimum mix of policies and measures to meet provide the optimum impacts; the procedures are summarised as follows:

⁴ e.g. how much time is given to pedestrians to cross the road at traffic signal and the related reduction in vehicle capacity.



2.5 Other roles for traffic management

- 2.5.1. While the primary and underlying objective of traffic management is to “get the best” from existing systems by improving capacity (in term of people and not vehicles) and quality of the traffic system and alleviating traffic related environmental impacts, traffic management also plays other roles in a well managed city including:
- 2.5.2. Support to new road and transport infrastructure development - traffic management can greatly assist in ensuring the efficiency of capital intensive transport infrastructure. For example, in the public transport sector, metro or LRT systems require good access and interchange with feeder modes and traffic management is needed to provide access facilities for buses, for para-transit, for taxis and for pedestrians – all intending passengers. In the road sector, traffic management is needed to ensure safe and efficient traffic distribution between urban freeways and the surrounding road network. These types of traffic management aspects of major projects are often neglected.
- 2.5.3. Alleviation of traffic congestion caused by major works – major projects (metros, roads, major utilities etc) are most often located within rights of way of existing main roads. Traffic congestion caused by such works can be both severe and prolonged (for example, the construction of a cut and cover metro may last many years) Good traffic management can do much to alleviate the worst effects of traffic congestion causes by major works. The temporary traffic management needed when major projects are constructed is often neglected in developing cities and while it may be a requirement of the major works contractor to devise such measures, they are usually given little attention;

- 2.5.4. Alleviation of traffic impact of major new developments – rapidly growing cities often have to deal with large scale developments which have a significant traffic impact (shopping centres, office complexes etc). Traffic management is needed to ensure efficient access and distribution and to alleviate adverse traffic impacts on the surrounding system. It should be noted that the necessary traffic management works in developed countries are often financed by the developer; capturing this “development gain” should be a policy followed by developing cities (see Chapter 10).

2.6 Traffic engineering and traffic management

- 2.6.1. A distinction must be drawn between “traffic engineering” and “traffic management” and this distinction is made throughout this Review.
- 2.6.2. “Traffic engineering” is an integral part of “traffic management” but is largely confined to the application of physical measures to the road network and its junctions, usually to ensure an increase in traffic (as opposed to “person”) capacity or to ensure safe operation. “Traffic management” embodies a wider concept and is concerned with all aspects of the management of the road based transport system – traffic (cars and commercial vehicles), buses, para-transit, pedestrians and non motorised vehicles. Furthermore, in addition to physical measures to improve the efficiency of the road based transport system, traffic management includes regulatory actions (such as control of parking or enforcement of traffic laws) and policy measures (such as the balance of road space allocation between private and public transport vehicles). Thus, traffic engineering deals mainly with circulation plans, traffic signals systems and junction improvements but traffic management strategy should deal with the road based transport system as a whole and may include policies and measures for any, or all, of the following:
- ◆ Traffic circulation;
 - ◆ Public transport (buses) on-street operations;
 - ◆ Management and control of parking and servicing access;
 - ◆ Enforcement of traffic regulations;
 - ◆ Road safety;
 - ◆ Pedestrians;
 - ◆ Cyclists and other NMT’s;
 - ◆ Commercial vehicles;
 - ◆ Environmental management (such as traffic calming); and
 - ◆ Transport system user information; and
 - ◆ Demand management.
- 2.6.3. It is this wider definition of traffic management that is used in this Review.

2.7 Limits to supply side traffic management

- 2.7.1. While traffic management should be an integral part of the transport policy of any well managed city, there are clearly limitations to its role in increasing “capacity”. In particular, in developing cities, travel demand is likely to be increasing rapidly and

traffic management measures aimed at increasing capacity will not alone resolve the congestion problems caused by such rapid growth. Indeed, this is a common reason given by cities for not embracing traffic management with more resolution. However, this is not the complete picture and a number of inter-related factors should be taken into consideration in planning a traffic management strategy and to increase its relevance to cities where traffic and traffic congestion is increasing:

- a) although the impacts of traffic management measures may be over-taken in a short period unless other measures are taken (such as demand management - as discussed below), the benefits are still “real”, worthwhile and will have been obtained in a very cost-effective way;
- b) provided the policy of improving travel conditions for “people and not vehicles” is accepted and appropriate measures are designed to achieve that objective (such as traffic management measures to provide bus priority), then traffic management has great relevance in cities where traffic congestion is growing;
- c) even at a basic level, traffic management measures which “keep things moving” provides time for more capital intensive measures to be planned and for resources to be obtained;
- d) traffic management should not be a one-time, “one-shot” policy; traffic management should be a continuous process; measures and policies should be adapted as traffic conditions change;
- e) most importantly, traffic management should deal with “demand” as well as “supply” sides of policy. Traffic management should seek to balance travel demand to a level which promotes maximum system efficiency. In reality, this means some level of demand management is required in combination with more “supply” side measures (measures which increase capacity). Demand management is the subject of Chapter 9 of the Review but may be achieved through combinations of measures to reallocate road space to public transport and/or to implement well-understood policies such as parking control and/or to implement innovative measures such as restraint on vehicle ownership and use.

2.8 Conclusion

2.8.1. The conclusions of the Chapter may be summarised as:

Conclusions from Chapter 2 – Role of Traffic Management

Traffic management should be an integral part of a balanced transport strategy in any well run city. The general rationale for traffic management is to make the most efficient use of traffic and transport facilities.

The specific objectives are to:

- make the most efficient use of traffic and transport facilities by improving the movement of people and goods and not necessarily vehicles;
- improve quality and safety of the traffic system and
- contribute to the improvement of the traffic related environment.

In addition to the role as part of general transport strategy, traffic management has ancillary roles:

- to support capital intensive transport investments such as freeways, mass transit systems etc to ensure efficient access and distribution
- to alleviate traffic congestion impacts arising during construction of major works and
- to alleviate adverse traffic impacts arising from major land use developments.

Traffic management will often need to balance conflicting objectives of various system users to achieve the objectives and this balance can only be achieved by (i) define objectives clearly at the outset of scheme development, (ii) defining what impacts or “measures of effectiveness” demonstrate the attainment of those objectives and (iii) carrying out a systematic evaluation of alternatives to determine the optimum mix of policies and measures to meet those objectives.

Traffic management has limits in cities where traffic growth is high but it should be borne in mind that

- even if impacts are short term, benefits are real and worthwhile
- traffic management should seek to improve travel conditions for “people” not “vehicles” and thus even in conditions of high traffic growth and congestion, measures such as bus priority have great relevance
- traffic management should not be a one-time, “one shot” policy but should be a continuous process, adjusted and adapted to meet changing traffic conditions
- in conditions of high traffic growth, traffic management should seek to apply both supply side measures (increases in capacity) and demand management measures (parking and other more direct measures – see Chapter 9).

3. TRAFFIC MANAGEMENT TECHNIQUES

3.1 Introduction

3.1.1. The Terms of Reference require the Review to consider the experience of the Bank, and as far as possible, of other international funding agencies, in traffic management components with a view to assessing the “lessons learned” in terms of design problems, impacts and sustainability. The Terms of Reference identify traffic management components in terms of junction channelisation, bus priority, marking, signing and similar. Drawing general “lessons” from interventions poses difficulties for the following reasons:

- a) Specific nature of traffic management – as explained in Chapter 1, traffic management is highly city-specific and depends on level of city size, development, levels of traffic congestion, traffic characteristics and thus measures which are successful in one city may not be appropriate or successful in another;
- b) “Area wide” application - traffic management can be applied at a specific site; for example, improvements may be necessary at a key junction to ensure consistent traffic capacity along a route or improvements may be made at a junction to resolve a severe accident problem. However, traffic management is most effective if applied over an area (say, a corridor or a local area or a town centre or the whole city) to develop a consistent traffic management regime to ensure that:
 - ◆ the objectives of an overall traffic strategy are realised;
 - ◆ traffic problems are not simply transferred to new conflict points;
 - ◆ there is synergy between the various interventions; and
 - ◆ users are presented with the same “messages” thereby improving the likelihood of observance of traffic regulations
- c) “Stand alone” measures – generally, traffic management interventions should not be regarded as “stand alone” measures. Traffic management should seek to balance often conflicting objectives and thus needs to combine individual interventions (in traffic, public transport, pedestrian schemes and NMT) to form effective, “comprehensive packages”; for example,
 - ◆ the introduction of a new traffic signals system is most likely to require junction modifications to ensure that the full potential of the new signals is realised; or
 - ◆ a bus lane scheme will require simultaneous improvements to junctions, traffic regulation enforcement, parking controls; or
 - ◆ junction improvements to increase traffic flows and speeds must include measures for pedestrians and/or NMT.
- d) Regulatory measures - traffic management will not usually comprise physical interventions alone; physical works must generally be supported by regulatory actions (such as enforcement or traffic laws) to ensure that the measures function as planned; and

- e) Policy measures – physical interventions are only the means of achieving a defined traffic management policy; “lessons learned” from individual interventions cannot be separated from the policy they support. A policy is required which enables "measures of effectiveness" sought from each intervention to be defined.
 - f) Road hierarchy context - the starting point for the development of traffic management measures is the definition of a traffic policy which sets the objectives for meeting the differing needs of road users (traffic, public transport, pedestrians, cyclists, other non motorised vehicles, commercial vehicles, etc) and differing transport functions (through travel, business access, residential access, servicing, parking, etc). The road network should be categorised so that mutually incompatible functions are, as far as practicable, separated onto different roads and thus a "functional road hierarchy" is defined. The development of traffic management measures themselves must then be planned in the context of the road hierarchy; for example, while intensive bus priority is likely on major arteries, it may not be appropriate on local access roads even though they may be used by buses.
- 3.1.2. Thus care must be exercised in drawing general conclusion from a review of isolated, supply side traffic management interventions. Traffic management measures should be set within a defined traffic and regulatory policy and are most likely to be combined into comprehensive packages which will vary in type and extent in accordance with the function of the relevant road in the hierarchy. .. However, there are issues that arise in the planning, design and implementation of traffic management measures and these are considered in this Chapter.
- 3.1.3. Traffic management interventions may be classified in various ways but the following categories, similar to the Terms of Reference for the Review, have been used in discussion of experience and lessons learned:
- a) On street parking management and control
 - b) Bus priority
 - c) Traffic signals both area wide and at isolated junctions
 - d) Traffic Management for commercial vehicles/trucks
 - e) Pedestrians and “public space management”;
 - f) Non motorized transport (NMT) – bicycles;
 - g) Road signs and markings;
 - h) Traffic capacity at junctions;
 - i) Enforcement of traffic regulations;
 - j) Environmental components of traffic management – traffic calming; and
 - k) Institutional development (dealt with as a separate matter in Chapter 4).
- 3.1.4. Annex B summarises the objectives, characteristics of each type of measure, of measure, general position in Bank projects, issues and general conclusions for each of the above-noted techniques; the conclusions for each of the components are summarised in the following paragraphs.

3.2 On-street parking (off street parking is discussed in the context of Demand Management, Chapter 9)

- 3.2.1. In Bank projects there have been few parking components and parking control and management has received little attention. However, parking pressures will increase as vehicle ownership and use grows and at a minimum, an on-street parking policy is an essential element in a well-managed traffic system. On street parking, at least in central and congested areas, should be charged since (i) charged parking can assist in managing demand (see Chapter 9), (ii) car drivers should pay the full costs of their journey (iii) parking is a part of any journey made by car and free parking would be a subsidy to car users. Few developing cities appear to have, or are developing, well managed on street parking policies. Some form of “parking agency” is required to plan, operate and manage a parking policy and this is rare in developing cities where (i) parking is not treated in a comprehensive way and (ii) responsibilities are often divided between police and the traffic agency. Changes in traffic laws will often be necessary to ensure (i) clear responsibilities and (ii) realistic charges and (iii) realistic sanctions against offenders. Charged parking policies require little investment for implementation and should be self financing; many developing cities are not capitalising on the revenue potential. There will be very limited investment role for the Bank but it is necessary that Bank traffic management projects encourage cities to include a parking management and control policy within their traffic strategy

3.3 Bus priority (see also Chapter 7- Traffic Management and Poverty)

- 3.3.1. Bus priority may comprise bus lanes, busways, bus priority at traffic signals, bus streets, and exemption of buses from general traffic prohibitions (such as banned turns). In developing cities, where bus priority has been considered, most effort has concentrated on busways and bus lanes as the more management related measures (such as selective bus detection at signals and traffic metering-queue relocation-bus lanes schemes) are complex to design and manage. Furthermore, in cities where the bus system is deregulated, it is impossible to organize (for examples to equip all buses with the necessary hardware) more complex systems.
- 3.3.2. As with all traffic management, specific city conditions influence heavily bus priority policy. In cities where traffic congestion exists and where buses play a major role, there is strong case for bus priority. In developed cities, the acceptance that full and unrestrained car use cannot be accommodated has lead to traffic management strategies which accept “*people*” and not “*vehicles*” and thus positively promote bus priority and place measures for buses at the top of the hierarchy of traffic actions. Developing cities are likely to have to adopt the same policy as traffic congestion worsens. However, in developing cities, bus priority can be difficult to implement for both technical and political reasons including (i) where small para-transit vehicles predominate bus lanes are unlikely to be successful, (ii) where bus flows are exceptionally high and bus congestion is a problem, bus priority may have to be combined with bus system reorganisation (iii) where bus systems are only just developing and buses are regarded as a second class mode, reallocation of road space to buses is unlikely, (iv) where there is political and local opposition to road space reallocation. Bus priority is one of the most effective traffic management techniques to improve efficiency and to assist demand management (by providing an alternative to car use). These impacts coupled with a high poverty impact should ensure that bus priority is a fundamental element of

any traffic strategy. Improvement in the acceptance of bus priority would be assisted by:

- ◆ promotion to decision makers/politicians to convince them of the advantages of bus priority;
- ◆ public consultation (see Chapter 10) to explain schemes and to enable designs to respond to local concerns
- ◆ dissemination of bus priority planning and design guidelines to cities with little experience in the area; and
- ◆ commitment to enforcement of traffic management bus priority

3.4 Traffic signals - isolated junctions

3.4.1. Traffic signals are the primary tool of traffic management. Traffic signals are used to control traffic movements at conflict points (usually junctions but also at pedestrian crossings or vehicle merges) in order to maximise road capacity and to ensure safe operation. Additionally, traffic signals can be used to assist the realisation of a traffic management strategy by giving priority to buses, by assisting pedestrians and cyclists and by regulating traffic demand through managing traffic queuing. Traffic signals can be linked together to co-ordinate the operation of signals over a route, a corridor or an area. In developed cities, area wide co-ordination has been proved to provide significant benefits in terms of journey times, number of times traffic stops and so on. Area wide co-ordination under the control of a central computer is termed "Area Traffic Control (ATC)" and is discussed in the next paragraph. However, the impacts of simpler schemes should not be underestimated. In many developing cities much can be done to optimise the operation of existing signals. Traffic signals cannot be installed and forgotten; management is needed. Traffic signals should be optimised to deal with traffic flows as they change over time. It should be the first task of a traffic management agency, to adjust signal timings to match traffic demand and even with out-dated and limited traffic signal control equipment, benefits can still be captured at little costs and with little effort.

3.5 Traffic signals - Area Traffic Control (computerised area controlled traffic signals systems)

3.5.1. In dense road networks with significant traffic flows, junctions interact with each other and simple control of traffic signals at isolated junctions is not enough. Control systems are needed which enable (i) the traffic interactions between junctions to be recognized and/or (ii) priority to be given to one category of system users (usually buses but also pedestrians). Thus, traffic signals need to be co-ordinated on an network wide basis; this is achieved through the use of some form of central computer control of traffic signals at junctions throughout the road network - termed "Area Traffic Control (ATC)". ATC is now a key feature of most Bank traffic management projects- components even in lower income countries. Various control systems exist (see Annex) but there is a clear trend towards traffic responsive⁵ systems since real costs are reducing, reliability is increasing and, although the operational benefits of demand response systems may be marginal over simpler systems since (i) the benefits are

⁵ A system for the control of traffic signals which, in various ways, allows the signals to respond on a dynamic or real time basis to the level of traffic demand

significant, (ii) responsive ATC costs are many orders of magnitude less than new roads and the returns are high, and (ii) demand responsive ATC raise the image and confidence of the traffic management agency. In the past, there have been design, specification, procurement, responsibility and maintenance issues for ATC and there are examples of schemes which have failed at the design and bidding stages. Procurement has been a special problem due to the desire of cities to (i) retain suppliers (of an existing ATC system or of existing signals) or (ii) specify proprietary systems or (iii) use of supplier credit for at least part of a system and these arrangements make compliance with ICB guidelines difficult. Probably the only solution within a Bank project is for the ATC system to be regarded as a counterpart loan contribution (provided the specified system is regarded as technically satisfactory). Many cities do not have the necessary background or expertise to deal with the issues and (i) there is a need for model documents and procedures for the planning and procurement of ATC systems and (ii) although consultants can be employed, training of local staff is vital to ensure sustainability. The institutional arrangements for the system need to be clearly defined if the best is to be obtained; in general, ATC systems should be the responsibility of the traffic agency and not the traffic police.

3.6 Traffic management for trucks-commercial vehicles

- 3.6.1. Efficient urban road freight distribution is essential but must be carried out with minimum traffic and environmental impacts. An urban traffic management truck policy is part of traffic strategy and is likely to involve measures such as truck routes, designated loading areas, break bulk terminals (where appropriate) and “no go” areas for environmental protection. Specific measures to assist trucks, and to protect the environment and other road users are almost entirely absent from Bank projects. It is noted that (i) the road freight industry is a private sector operations and care is needed to avoid imposing truck restrictions-facilities which restrict operations to the extent that they are not commercially viable (such as truck terminals which are implemented by cities without recognition of commercial reality) and (ii) truck policy must extend well beyond traffic management to deal with truck loading limits, fuel for trucks, potential for transfer to other modes etc.

3.7 Pedestrian facilities (see also Chapter 7 – Traffic Management and Poverty)

- 3.7.1. Pedestrians have not been very well served by many developing cities. There is a wide range of issues (i) lack of recognition of pedestrian needs, (ii) even when pedestrian measures are provided, they are focussed on the control of pedestrians in order to assist motor vehicle flow rather than to serve pedestrian needs (iii) poor footway maintenance and reinstatement after works rendering them unusable, (iv) footways encumbered by street traders, frontage occupiers and street dwellers (v) provision of token pedestrian facilities which are neither in the right place nor can be used safely (vi) lack of institutional capacity to deal with pedestrian issues. There is need for much greater recognition of the needs of pedestrians and the need to assist, and not to subjugate, them by (i) convincing city governments that pedestrians are an important element of the transport system and (ii) ensuring that the traffic agency (see Chapter 4 – Institutions) has adequate powers and expertise to deal with the issues of good pedestrian facility planning, implementation, control of encroachment and maintenance

3.8 Non motorised transport (NMT) - Bicycles

- 3.8.1. Bicycles are an efficient mode, suitable for various urban journeys bicycles and available to at least some of the poorer sections of the community. Bicycles should be treated as an integral part of the traffic management system and strategies should be designed to capitalise on their strengths (see Chapter 7). However, as motorization increases, bicycle use becomes more hazardous. Contrary to Bank advocacy of bicycles, some countries do not regard bicycles as a viable, long term transport mode and there is pressure to release road space occupied by bicycles for use by motor vehicle or to divert bicycles onto long and inconvenient routes. Planning must determine that bicycle schemes fulfil a real (or a realistically assessed) need and are not constructed in locations which are “easy”, which inconvenience no one (basically cars) and thus are of little value to users and potential users

3.9 Road signs and markings

- 3.9.1. Many traffic systems suffer from inadequate signing, poor siting of signs, lack of visibility of signs (especially at night), inadequate signing standards, poor materials and lack of budgets for continuous signing and marking upgrading and maintenance programs. Regulatory and warning signing and road marking are essential elements of any traffic regime. It is indisputable that good, city-wide signing and road marking can assist development and maintenance of driver discipline, safety and can support enforcement. Improvements in general marking and signing are closely linked to the existence of an effective traffic management agency. In the past, signing and marking was usually carried out by direct-labour or force-account procedures. The trend is towards contracting out manufacture and installation; nevertheless, even if all works are contracted, the planning and supervision of signing and marking measures should be an important function of the city traffic agency (see Chapter 4 – Institutions).

3.10 Enforcement of traffic regulations (see also Chapter 5 – Training and Human Resources)

- 3.10.1. Traffic schemes should be designed to minimise enforcement effort and to “design out” the ability and inclination for drivers to commit traffic offences. Nevertheless, this cannot be fully achieved and traffic schemes will always require traffic police enforcement of regulation for success. Many traffic police forces in developing cities are under-equipped, not well trained in traffic management enforcement and nor do they appreciate the role and function of traffic management. While projects can provide equipment for the traffic police, the most important advances would be obtained through (i) improved and systematic training of traffic police and (ii) review of, and changes if necessary in, working practices to respond to actual traffic conditions. Chapter 4 – Institutional Arrangements – states that responsibility for traffic management planning, design etc should rest with the “traffic agency” but traffic police views on practicality and enforcement should be sought and recognised at all stages of scheme planning and design

3.11 Environment- emissions

- 3.11.1. Traffic management promotes smooth traffic flow and thus can make a contribution to improvements in the traffic emissions. However, unless demand management actions are taken (see Chapter 9), increases in traffic capacity may be taken up rapidly by vehicle growth and by suppressed demand and thus the measures may make little overall difference to emissions.

3.12 Environment - traffic calming

- 3.12.1. Unregulated and inappropriate vehicle speed is a significant contributory factor to traffic accidents and to the reduction of quality of life, particularly in residential areas. Traffic calming is applied in developed cities and may find increasing application in developing cities particularly as measures which control vehicle speeds through physical or operational means (such as traffic signal timings) can eliminate some of the usual traffic police enforcement problem of speed limits. The scope of measures is discussed in Chapter 6. Traffic Management and Road Safety but it is noted that traffic calming on main roads must be treated differently from traffic calming on lesser roads. On main roads, it would add to accident hazards to introduce some of the more extreme physical traffic calming measures which are used to reduce traffic speeds on lesser roads and thus major roads measures can include:

- ◆ positive signs and road markings emphasising speed limits;
- ◆ “rumble devices” which involve surfacing the carriageway in materials which create noise or vibration when crossed by vehicles and thus warn drivers of approaching hazards;
- ◆ “bar markings” which comprise lateral road markings (lines at right angles to the road) on high speed approaches to urban junctions; the lines are increasingly closely spaced as the junction is approached and create a visual effect such that drivers slow;
- ◆ road texture and colour on the approaches to critical locations (junctions, pedestrian crossings etc); and
- ◆ linking of traffic signal timings at successive junctions to control and maintain a desired safe speed of traffic progression.

- 3.12.2. On lesser roads, a wide range of physical traffic calming measures for speed control include:

- ◆ pedestrian refuges which narrow the effective road width, control vehicle overtaking and do not permit vehicles to reach high speeds
- ◆ road-speed control humps which reduce vehicle speed;
- ◆ road narrowing such that some classes of vehicle cannot use the road (such as trucks)
- ◆ road narrowing such that only one direction of vehicles can pass at one time – thus opposing vehicles must give way
- ◆ chicanes such that vehicles have to following a tortuous route through a short section of road and thus must reduce speed

- ◆ raised junctions comprising a plateau or flat topped road hump built across an entire junction
- ◆ planting which can be used to change the perceived width of a road to cause traffic to slow

3.12.3. Care must be taken

- ◆ not to introduce new hazards such as may be caused by poorly designed and/or inappropriately located and/or inconspicuous (especially at night) speed control humps
- ◆ not to introduce measures which adversely affect bicycles or, particularly bus operations – bus and speed control humps are generally incompatible and other designs such as speed tables and speed cushions have better operational characteristics for buses;
- ◆ do not increase the tendency to stop-accelerate and increase emissions.

3.13 Conclusions

3.13.1. The conclusions of the Chapter may be summarised as:

Conclusions on Traffic Management Techniques

- Most traffic management techniques which have found application in developed cities are equally worthwhile in developing cities but general lessons and "recommendations for technical success" for specific traffic management measures are difficult to define as measures:
 - are highly site specific
 - are most effective if applied on a comprehensive basis ("area-wide" or "corridor") rather than as isolated interventions
 - are rarely "stand alone" - bus priority will need parking controls, pedestrian measures, junction improvements etc
 - will not usually comprise physical interventions alone; regulatory supporting actions (changes to traffic laws, enforcement etc) are necessary;
 - must be set within a traffic policy and thus enables "measures of effectiveness" to be defined and the extent of each intervention to be planned
 - must be placed in the context of a "functional road hierarchy" which separates, as far as is practicable, mutually incompatible functions onto different roads (arterial, primary, local etc) . the "road hierarchy" will govern the types of traffic management measures which are appropriate for each road
- Annex B summarises the objectives, characteristics of common types of traffic management measure, issues, the general experience and conclusions in developing cities and Bank projects.

4. INSTITUTIONAL ARRANGEMENTS FOR TRAFFIC MANAGEMENT

4.1 Introduction

- 4.1.1. Planning, implementation, operation, maintenance and regulation of city transport is a highly complex process encompassing numerous modes, users, agencies and the framework within which the system functions. Above all, urban transport is a highly political and visible activity. Failure to deliver an acceptable transport system is immediately evident to transport system users – passenger queues, traffic congestion, slow journey times, accidents, poor traffic related environment and so on are immediately evident. Concerns by users of poor quality transport systems are usually high on the list of complaints against a city administration.
- 4.1.2. Achieving a balance between competing transport modes and interests relies on competent transport institutions working within a clearly defined framework of responsibilities. While, there is no single, ideal or model institutional framework for traffic and transport administration, in broad terms, a city must have an organisational framework which deals with the basic functions of:
- a) Strategic Transport Planning –, development of transport strategies within the urban development context leading to realistic policies, short and long term investment programs and so on;
 - b) Infrastructure for Transport - planning, design, financing, construction and maintenance of road, public transport and other transport infrastructure;
 - c) Public Transport - development of the public transport system including planning, design, management, regulation, licensing, franchising and, in rare cases, operation (there are still some public sector operations – both effective and non-effective);
 - d) Traffic Operations and Management - management of roads and road use for all vehicular and non-vehicular modes-users including planning, design, implementation, operation, maintenance etc; and
 - e) Regulations - enforcement of traffic regulations, driver and vehicle licensing, vehicle testing etc.
- 4.1.3. Cities organise in many ways to address these functions. The institutional structure for any city is determined by its particular political and cultural context and by city size and capacity and there are no universally applicable arrangements. The potential for change or improvement depends very much on current institutional arrangements or “starting point” within a city. The range of organisational arrangements is almost infinite - government ministries, government departments, metropolitan transport authorities, public transit authorities, independent commissions, institutes, municipal departments, local/district agencies, task forces and many other agencies are used. Agencies need

not, and most do not, carry out all functions themselves – many functions are out-sourced while remaining under the supervision of the responsible agency.

4.2 Traffic Management Organization

- 4.2.1. Efficient traffic management and operations requires a competent, professional agency working within a well-defined institutional structure. Institutional arrangement for traffic management is the key element of a successful traffic management system. In many developing cities (for the reasons discussed in this Chapter), institutional arrangements for traffic management are weak and often city governments do not recognize the importance. However, even in cities where traffic management responsibilities are clearly defined and a "traffic agency" has the requisite powers, unless that agency has adequate professional capabilities and capacity then again, traffic schemes and policies cannot be implemented. Thus, capacity building for traffic management must embrace both "Institutional Arrangements" and "Training and Human Resources for Traffic Management" (Chapter 5). Unless a traffic management agency has both the necessary (i) status, powers and funding and (ii) technical capability (or can contract that capability), traffic management schemes and policies cannot succeed.
- 4.2.2. The TOR for the Review pose a number of questions aimed at identifying world-wide experience and at defining the “best” organisation for traffic management. It is of course impossible to review traffic management institutions in cities world wide in specific terms and thus the Review has sought to demonstrate some of the issues affecting traffic management institutional arrangements.
- 4.2.3. In 1983, the World Bank suggested institutional development guidelines for traffic management in a Working Paper, “Institution Building for Traffic Management”⁶. The Paper drew a distinction between:
- a) local or city traffic management agencies with responsibilities for all aspects of city traffic management; and
 - b) national traffic management agencies with responsibilities for aspects of traffic management independent of city application such as design standards, traffic laws, administration of national-federal finance-grants-loans, fundamental traffic research and national statistics and dissemination of information.
- 4.2.4. In general terms, the Working Paper suggested that a specialist group under the "city engineer's department" should carry out the local or city level traffic management functions unless the city was totally inexperienced in the sector. In this case, the functions would be carried out by a national traffic management agency (within say, the "ministry of transport") and this should, over time, be transformed into a local or city agency. However, the reality of the situation is that it is cities in developing countries which are faced with the most pressing traffic and transport issues. Furthermore, responsiveness to local issues is a key part of traffic management and generally, this is best provided by a city-based agency. Thus, the present Chapter concentrates on city based traffic management institutions.

⁶ Institution Building for Traffic Management, R Barrett, Technical Paper No 7/8, World Bank, ISBN 0-82 13-0 136-5, 193

4.3 Institutional issues and comments on their resolution

- 4.3.1. Issue 1 – Lack of recognition of the need for a strong, professional traffic management - in some cities, traffic management is not seen as a distinct function or discipline. Among politicians, and some technicians, the views prevail that (i) traffic problem can only be “solved” by massive capital investment in either metros, possibly light rail, or road building and that traffic functions are of considerably lesser importance and (ii) traffic management should be undertaken as a “by-product” of the work of various other agencies such as the roads department or the traffic police or by low level, inadequately funded and trained local councils.

Comment on resolution of Issue 1

- There is no doubt that cities require a high quality road network; however, politicians often favour road building not only as a “solution” to traffic problems but as a way of raising their profile to demonstrate action to resolve those problems
- However, experience shows that new roads alone will not be a long term solution (see Chapter 9 - demand management) and that even with new roads, there is a need to cater for efficient, road based public transport, to address safety and to ensure that the road network is used effectively
- Traffic management is essential to meet these needs – the problem is to persuading city decisions makers to create, or strengthen, an agency to fulfil the traffic management role
- Conceptually, the solution is obvious – the need for innovative and responsive traffic management policies is essential and a specialist agency with city-wide powers, responsibilities, staffing and funding will be needed to plan and implement the policies
- There is of course no easy way to realise the solution and the only way is to create the necessary climate of opinion in developing cities through dissemination of information and persuading city decision makers of the effectiveness of traffic management:
 - The Bank urban transport strategy paper will assist
 - The experience of developed cities where traffic management points is the rule rather than the exception should be demonstrated
 - Examples of good institutions should be publicised (see for example, Sao Paulo – below).

- 4.3.2. Issue 2 – Fragmentation of responsibilities and inter-agency co-ordination - managing and co-ordinating the traffic system is a complex task. In some cities, there is “*no agency that is specifically responsible for traffic management planning and design*” and “*the meaning of the term traffic management is undefined and its status is low*”⁷.

- 4.3.3. Where traffic management agencies exist, they are often under resourced and lack adequate powers to initiate policy implement comprehensive schemes and these aspects are discussed in following “issues”. However, even if a traffic management agency does exist its remit is often compromised by the large number of other agencies with some involvement in traffic matters, typically,

- a) the city highways agency with responsibility for roads;
- b) the traffic police with responsibility for enforcement of traffic regulations and in many cases for “basic” traffic engineering (signs, markings, street parking, circulation etc);

⁷ Traffic Management and Road Safety in World Bank Projects in Chinese Cities, A Review, G Frame, 2nd Draft 12 July 1999

- c) state or national highway agencies if national or federal roads are involved;
- d) bus and para-transit operators;
- e) the public transport regulatory agency;
- f) private transport operators and associations (trucks, taxis, para-transit etc);
- g) the strategic transport - land use planning and development control agencies;
- h) many non-governmental organisations; and
- i) special agencies - for example, in Bogota, the telephone company is responsible for traffic signals.

4.3.4. In many cities, the boundaries of these responsibilities are neither clearly defined nor are there mechanisms for co-ordination between the agencies and this can lead to:

- a) protracted periods for scheme implementation as agencies try to reach consensus;
- b) abandonment of schemes due to failure to reconcile the views of different agencies;
- c) fundamental differences of view on traffic policy (in particular, this can arise between “traffic planners” and “traffic police”) and thus failure to develop policies to deal with traffic issues
- d) unilateral action by one agency (typically a road building agency with its propensity for road expansion at any price) which can undermine the objectives of a traffic management agency attempting to balance demand and supply and to favour most efficient modes.

4.3.5. There are also jurisdictional responsibility and legal issues for roads and traffic. Typical problems include:

- a) in some large cities, traffic is the responsibility of a number of constituent local or municipal governments. With increasing trends towards local accountability, local municipalities are being allocated more responsibility and in a large city, co-ordination of traffic policy and agreements between local councils can be difficult;
- b) urban development overwhelms previously workable arrangements; for example, two previously separate cities become more-or-less contiguous but transport planning remains separated (e.g. Lima and Callao in Peru and, although there have been recent changes, between the Government of the Federal District of Mexico City and the surrounding State of Mexico); and
- c) national government retains responsibility and funding arrangements for the most important roads in a city but may have a lesser interest in road based public transport and lack of concern for local transport issues;
- d) lack of clarity between "state" and "municipal" governments over their respective levels of responsibility for traffic matters.

Comment on resolution of Issue 2

- Traffic management should be the responsibility of a single agency. The "traffic management agency" must be provided with well defined responsibilities and accompanying powers to fulfil all the tasks required for effective traffic management; these are described in subsequent sections
- An institutional framework is needed which recognises and legalises, the formal role and responsibilities of the "traffic management agency" in relation to the traffic police, to the "highways agencies" and all other agencies with interests in the transport sector.
- The city decision making process must enable the "traffic management agency" to seek approvals to broad policies. The existence of a "traffic and transport committee" constituted at a very high level (as in Moscow) has much to recommend it;
 - The "traffic committee" (or equivalent) would determine broad policies, budgets etc and the "traffic management agency" would report to the "committee" and would act a technical secretariat
 - The "traffic committee" would provide an inter-agency co-ordination mechanism. As agencies other than the "traffic management agency" are likely to retain some transport related roles (national highway agency, state agencies, local municipalities etc), the "committee" would make policy decisions on important schemes;
 - the "traffic management agency" would be empowered to review and approve, by reference to the "traffic committee" (or equivalent), schemes and developments with traffic impacts, proposed by other agencies, to ensure that good design standards are followed and that there is consistency with agreed policy-strategy
- The location and structure of the traffic management agency will vary by city size, culture, and the current "starting point" of the city structure but conventionally, a traffic management agency is likely to be a division within the city administrative structure. In very large cities, it may be necessary to develop a metropolitan traffic and transport agency with at least co-ordination powers over local governments.
- The "traffic management agency" requires competent and professional staffing. Some of the issues inherent in city-employment (low salaries, lack of career path, lack of job continuity etc) may be overcome by innovative institutional arrangements; for example the system used in Sao Paulo (and in some other Brazilian cities) in which a semi-independent traffic management company has been formed (see subsequent description)
- ;

4.3.6. Issue 3 – no continuity or stability in the traffic management agency due to political change – in many cities, professional staff are subject to change as political power changes in the city. Often, all traffic management senior staff are changed when a new mayor or political party take office and thus their duration in post may be only 3 or less years. Under these conditions, there is little prospect of a continuous program of traffic system development.

Comment on resolution of Issue 3

- It is desirable to isolate traffic management as much as possible from political change. Some cities, particularly in Latin America, have created competent professional agencies outside the city structure to try to isolate technical functions from the political cycle. Of course, overall policy has to be approved by the city political leaders but if the professional agency is successful and respected, the likelihood of erratic change is much reduced. For example:
 - In Mexico in some of the cities participating in the Medium Sized Cities Bank Project, independent transport institutes have been created. These (i) have some form of secured financing (e.g. the institute in Ciudad Juarez receives 1.75% of all city revenues under statute), (ii) have contract terms for senior staff which do not coincide with the political cycle, and (iii) there are procedures independent of the mayor for appointment of the institute's president
 - In Curitiba, although it does not deal with traffic management implementation, the Urban Planning Institute is separated from the city structure and even when there have been political changes in the city, the professionalism of the institute has safeguarded it from fundamental change and its role maintained;
 - In Sao Paulo, a separate traffic management company was created with clearly defined responsibilities in the traffic area; although politicians appoint the president, the professionalism of the institute has been respected and for example, the first president was in post for 8 years.

4.3.7. Issue 4 - Lack of traffic regulation enforcement capabilities – most traffic management measures require enforcement of traffic regulations. Clearly, schemes should be made as “self-enforcing” as practicable through physical means but there will always be a need for the enforcement of the regulations by the traffic police. Many traffic police forces are under-trained, under-equipped and have little understanding of the aims and objectives of traffic management – particularly where measures which restrain private vehicles are concerned (such as parking schemes, bus priority measures etc). There is also the issue of corruption. Generally, for traffic offences, traffic police either issue on-the-spot fines or issue "tickets" for later payment. In both cases, it is known that bribes, lesser than the statutory fines, are paid to some traffic police. In developed cities, there is increasing use of automatic enforcement procedures for traffic offences such as cameras capable of number plate recognition. However, these mechanisms require up-to-date, accessible and nation-wide data bases of car registrations and is costly to implement; such conditions are only likely to apply in a minority of developing cities (e.g. cities like Moscow or Sao Paulo). Possible policies to assist overcome corruption are discussed in para onwards.

Comment on resolution of Issue 4

- The improvement of traffic regulation enforcement will be achieved by:
 - ensuring that there are adequate numbers of traffic police engaged in traffic duties;
 - ensuring that modern police methods for traffic law enforcement are adopted as standard practice
 - strengthening of the traffic police through training programs (see Chapter 5)
 - eliminating corruption in the enforcement of traffic offences
 - ensuring that the traffic police are in agreement with the traffic strategy and schemes developed by the traffic management unit”. Although the traffic police should not be responsible for scheme planning and design, it is necessary that they are consulted at all stages and are involved in the co-ordination mechanism (the “traffic committee”)

- 4.3.8. Issue 5 - inadequate regulatory powers for effective traffic management - traffic management cannot be implemented, enforced or play its full role in transport strategy without the necessary supporting legal structure. Issues include (i) lack of adequate traffic regulations and powers to enable effective schemes to be implemented and enforced, (ii) lack of powers to apply adequate charges (say for parking), (iii) lack of adequate sanctions for violation of traffic regulations – the levels of fines for contravention of traffic regulations in many developing cities is derisory and act as no deterrent to drivers who contravene regulations etc.

Comment on resolution of Issue 5

- If traffic management is to be successful, any traffic management program must consider the legal framework within which it has to operate. In many cities, there is an understandable reluctance to seek amendments to laws as this is a time consuming process and the political dimension often means the outcome of seeking change is uncertain. However, if there is need for changed levels of traffic fines or parking charges or regulations for effective traffic schemes to be implemented then the issue must be faced, for example,
 - in Mumbai the municipality by virtue of its existing constitution had no legal right to introduce traffic schemes and thus traffic management has been slow to take hold;
 - in some cities, the levels of fines for traffic offenders are so low that they are meaningless but current law prevents realistic charges;
 - new types of measures will require new laws – for example congestion charging is almost certain to be illegal in some countries.

- 4.3.9. Issue 6 – Low levels of staffing and professional capacity - development and implementation of traffic management measures requires specialised staff skills and intensive professional staff input and many cities lack these necessary staffing levels and staffing skills. The lack of status and recognition of the importance of traffic management by cities means that there is often no career structure for staff in traffic management and this is compounded by the likelihood of changes in staffing due to political changes (see Issue 3).

Comment on resolution of Issue 6

- In developed cities, to overcome staffing issues there is a need to improve staff, or potential staff, training (see Chapter 5). Furthermore, traffic management staff must be provided with reasonable salaries, working conditions and, most importantly, career paths. The de-politicisation of traffic management functions and thus creating career paths is important (see Issue 3). Additionally, the difficulties in many countries of recruiting and maintaining staff at the low municipal salaries are well known and low salaries have been one of the main reasons for the creation in some Latin American countries (see Issue 2 above) of independent traffic agencies outside the municipal structure
- Traffic management can generate revenue from (i) parking charges, (ii) fines on traffic regulation offenders and (iii) in the future, probably from congestion charges. However, most cities would find it difficult to devote these latter revenues to the staff salaries of a traffic management unit for obvious reasons such as equity with other staff in city employment, public acceptability - it is hard to imagine public acceptance of congestion charges going towards salaries. Thus, if the traffic management agency is retained within the city structure (rather than as some form of independent institute) reasonable payments for traffic management staff must be considered as part of the wider problem of providing reasonable incentives for any municipal staff.

4.3.10. Issue 7 – Lack of operational and implementation resources - as with most other functions in developing cities, inadequate resources are allocated to traffic management agencies for scheme planning, design, implementation and recurrent costs of operations, monitoring etc. Traffic management is both dynamic (measures should respond to changing traffic conditions) and staff intensive for preparation, planning, design and operation. The lack of recognition by cities that traffic management agencies need continuous financing has resulted in failures of agencies (i) to maintain, monitor, modify and optimise schemes once implemented and (ii) to recruit and retain adequate qualified staff to carry out their activities. Traffic management offers opportunities for "self financing". Revenues are derived from parking charges, illegal parking fines and other traffic offences and in the future, from congestion charges. In the past, cities have been reluctant to earmark such revenues to traffic matters and in some cases, there was no legal basis (as in Brazil until recently). However, some changes are detected; no doubt there are many demonstrations world-wide but typical examples include

- ◆ some revenue from parking is allocated to the traffic agency in Sao Paulo, Brazil (see subsequent discussion on CET);
- ◆ new legislation in Brazil allows municipalities to establish funds for traffic interventions using fines from traffic offences;
- ◆ in Colombia, an urban transport development surcharge is applied to fuel (similar to maintenance-orientated road funds);
- ◆ revenues from the Trondheim, Norway cordon charging must be allocated to transport and
- ◆ London, UK local councils can retain parking fines and if, as is planned, congestion charging is introduced, then the revenue is retained by local councils but must be allocated to the "improvement" of the traffic and transport system.

Comment on resolution of Issue 7

- Adequate financing of the “traffic management agency” is essential to its success.
- Traffic management agencies often do have potential revenue sources. At specific city level, traffic management and other transport measures can generate revenue directly e.g.:
 - parking charges
 - fines on traffic offenders
 - surcharges on public transport operations (as used in Leon, Mexico to improve public transport facilities)
 - capturing development gain from major private sector developers (see Chapter X);
 - in the future, congestion charges
 - other opportunities may exist to increase effective traffic management resources such as the use of concessions for busways⁸ and bus priority or even if segregated busways are provided by the traffic management unit, then direct user charges to bus operators should be possible;
- At a broader level, other sources of finance are potentially available e.g. (i) surcharges on fuel⁹ used for urban transport (Colombia) (ii) property or business taxes used in part for traffic and transport investment; until recently, this was the case in Moscow although most of the resources were devoted to road building and traffic management was not a primary beneficiary (iii) "metro bonds" on consumer durable purchases were used in Korea. While these mechanisms have wide implications which should be carefully assessed, they demonstrate that financing sources can be found.
- most traffic management agencies have been unable to capitalise on potential revenue possibilities as a result of existing legislation and/or as the city administration has viewed that earmarking of traffic revenues is undesirable and/or cities do not view traffic management as important. However, the use of traffic revenues offers opportunities to improve financing and there are now increasing examples of parking, traffic fines etc revenues earmarked to the traffic system;
- there is some trend that as cities recognize the importance of a well managed traffic systems, they are prepared to commit resources permanently under local statute to meet traffic management costs (Moscow) or are prepared to devote a fixed percentage of all city revenues to traffic and transport matters (Ciudad Juarez, Mexico) or are prepared to levy surcharges on fuel to invest in urban transport (Colombia)

4.4 Functions of a traffic management agency

- 4.4.1. While the foregoing issues may vary from city-to-city and with the city size and complexity of the traffic problems, they will be basically similar. Resolution of the issues will require numerous actions to be taken but the key will be the creation and/or strengthening of a traffic management agency. Table 4.1 gives a broad definition of the functions and responsibilities of a traffic management agency and if traffic management is to be successful, there is a need for an agency with the powers to fulfil these functions and for an institutional framework that allows it to exercise the necessary powers.

⁸ Concessions of Busways to the Private Sector, - the Sao Paulo Metropolitan Region Experience, J Rebelo, World Bank, Policy Research Working paper, 1546, Nov 1995.

⁹ This applies in Colombian cities where 20% tax is used to generate funds for urban traffic and transport; while there may be problems both of "leakage" at the boundary and of equitable and efficient distribution of funds, the concept is worthy of consideration

Table 4.1 –Functions and Responsibilities of a Traffic Management Agency

Division	Functions-Responsibilities
Traffic Management Policy	<ul style="list-style-type: none"> ▪ Formulate and implement city wide “Traffic Management Policy” to comply with objectives defined by the “city council” which would include, at least such areas as determination of (i) a functional road hierarchy (ii) the appropriate balance between transport system users (private transport-public transport-NMT-pedestrians) (iii) priority programs for action and (iv) a “5 year” investment plans”
Traffic Research	<ul style="list-style-type: none"> ▪ Assemble-survey, monitor, analyse and evaluate all traffic and accident data to enable trends to be identified, problems quantified and traffic management plans and improvements to be prepared
Traffic Management Plans and Improvements	<ul style="list-style-type: none"> ▪ Plan, design, implement, monitor, evaluate, fine-tune and continuously up-date traffic schemes and policies to realise the agreed Traffic Management Policy. The program would cover all motorised road based modes (cars, public transport, trucks, etc) and all non motorised modes (pedestrians, cycles). Plans and improvements would range from simple junction improvements or marking and signing programs through to far reaching city wide strategies such as extensive bus priority or pricing. Safety considerations are part of any scheme planning and design process but specific safety programs and accident countermeasures would be a responsibility.
Traffic Control Devices	<ul style="list-style-type: none"> ▪ Plan, design, install, operate, and maintain all traffic control devices including (i) traffic signal systems including computer controlled (ii) signals systems; (iii) road markings (iv) road signs and (v) enforcement devices (cameras etc)
Traffic Regulations	<ul style="list-style-type: none"> ▪ Formulate traffic regulations to realise the proposed Traffic Management Plans and Improvements, for enactment by city government and for enforcement by the traffic police
Parking Management	<ul style="list-style-type: none"> ▪ Prepare off and on street parking policies and programs including approval for the location of and access to parking areas proposed by others. Parking enforcement and administration (for example, where paid parking applies) would be carried out by a separate “parking authority” or equivalent
Approvals and Co-ordination	<ul style="list-style-type: none"> ▪ Evaluate and advise city government on all schemes (e.g. new roads) and developments (developed both by public and private sector agencies and including major new land or building developments) which have a significant traffic impact to ensure that they are consistent with agreed traffic policy - in effect carry out traffic impact studies for all major development proposals
Consultation	<ul style="list-style-type: none"> ▪ Consultation with the public and stakeholders on traffic policy and on the impacts of specific schemes and measures
Budget	<ul style="list-style-type: none"> ▪ Preparation of an annual budget for submission to city government for (i) implementation of Traffic Plans and Improvement schemes, (ii) traffic operations and maintenance of control devices; and (iii) the continuous work of the traffic management agency itself.

Notes:

- not all functions would necessarily be carried out by the “traffic management agency” itself. For example, maintenance of traffic control devices and signals would most commonly be contracted out; in this case, the agency would assume the functional responsibility of supervision;
- the potential for contracting out significant elements of the functions to consultants-contractors is discussed in subsequent sections
- traffic regulation enforcement is not included as this is regarded as a traffic police function; however, there are cases where some enforcement, such as kerbside parking, could be a traffic agency function and a "Parking Division" would be needed

4.5 Innovative forms of traffic management agency

- 4.5.1. Independent Institutes or Companies - it has been noted above that traffic management agencies may not always be part of the city administrative structure. Semi-autonomous transport institutes exist in a number of cities in Brazil including Rio de Janeiro (CET/RIO), Belo Horizonte (BHTRANS), Campinas (EMDEC), Santos (SET/SANTOS), Sao Paulo (CET) and others. CET in Sao Paulo provides an interesting example of innovative arrangements:

CET- Companhia de Engenharia de Trafego de São Paulo, Brasil

- CET was founded in 1976 as a “private company” [Sociedade Anonima] with the municipal government as the majority shareholder
- CET works within overall policies determined by SMT
- The purpose of CET is to manage traffic of the city; a huge task as Sao Paulo has a 10 million inhabitants, 4.7 million vehicles (88% of which are cars) and 11000 buses.
- The responsibilities of CET are to plan, design, implement, operate and maintain all traffic facilities but not road construction, paving or maintenance. CET does not have powers to approve major road schemes, but mechanisms are in place for CET to participate in their definition and in the functional design
- Traffic enforcement is mainly done by the State Police (2500 policemen), working in co-ordination with CET staff
- A major reason for creating CET as a Sociedade Anonima ("company") was the need to recruit and sustain a team of professionals and technicians not linked to the unrealistically low wage policies of direct municipal administration. Today staff salaries are still competitive with the private sector.
- CET has over 3500 employees and a budget of US\$ 170 million per year. The income sources are 82% from municipal funds, through a contract with the Secretary of Transportation (SMT). The other 18% comes from the exploitation of curb parking spaces in a manual pay and display type of operation.
- The budget is expended in (i) traffic operation (55%), (ii) installation and maintenance of signs and signals (17%), (iii) planning and designs of traffic measures (18%), (iv) road safety education and staff training (5%) and (vi) internal company costs (9%).
- Directors of CET are elected by the Administrative Council of the company, chaired by the main shareholder (the Mayor of São Paulo). While CET is not isolated from political change, with few exceptions, the President of CET and its Technical Directors came from their internal staff and because of their high credibility changes in technical personnel as a result of political change are few

- 4.5.2. Contracting out traffic management – some traffic management functions can be contracted out to the private sector. The contracting may be a conventional arrangement to perform a well-defined service such as for the maintenance of traffic

signals or the administration of parking both on and off street. These types of functions are already frequently contracted out in developing cities although there are issues which require the "traffic management agency" to frame and supervise the contracts with care. For example:

- ◆ it is necessary to ensure that contracts enable the "traffic management agency" to maintain adequate control over policy, e.g.: the "traffic management agency" may wish to use parking charges to discourage certain types of trips by increasing parking charges and parking contracts to the private sector should not allow the policy to be undermined;
- ◆ traffic signals maintenance contracts are commonly undertaken by signals suppliers or suppliers agents. There have been cases where the involvement has been initiated with a "free" study of a city's traffic signals needs and subsequent "locking in" of cities into contracts which are not necessarily cost-effective and very difficult to cancel. There are various ways in which this might be avoided (such as qualification of a number of type-approved suppliers, cost validation procedures against a comparative index etc) but, as noted in Chapter 3, there is need for guidelines for city's to develop signals contracts in general, and ATC contracts in particular, to safeguard against issues.

4.5.3. Contracting out of traffic management may be possible on a wider basis. A term consultancy contract may be devised for conduct of significant elements of the traffic management process – for example, to manage a large element of the traffic management work of a city although “*the executive must remain, and be seen to remain, responsible and accountable for those functions...*”¹⁰ This process may reduce the need for a large trained staff at the city level although this does not remove the need for a trained core of staff determine traffic management policy and to manage the consultants and in particular, issues arise over the extent of the consultants-contractors responsibility for letting implementation contracts and thus responsibility for “public funds”. However, such an arrangement may assist cities in developing countries as it may be easier for a city to obtain finance for term consultants than for the staff levels required in-house.

Contracting out of traffic management functions - Vila Velha (Espírito Santo, Brazil)

It is reported that there are cases in Brazil of municipal governments contracting out virtually all traffic management functions. The municipality of Vila Velha (Espírito Santo, Brazil) signed a 5 year contract with a consortium of firms to:

- develop traffic management systems (planning, project design, day-to-day operations);
- implement and maintain signs, signals and markings;
- provide and operate radar systems for speed limit controls and traffic signal offences
- process traffic fines;
- operate kerbside parking;

The contract is supervised by the Secretary of Transport which retains powers to impose fines for traffic offences

¹⁰ Guidelines on “Deregulation and Contracting Out”, DETR, UK HMSO 1994

4.6 Role of traffic police

4.6.1. The role of the traffic police is important. Historically, traffic management was concerned only with direction of traffic, with accidents and with on-street parking and these functions were mostly carried out by the traffic police. This still remains the case in some developing cities where traffic management is not well advanced or organized. There are significant differences of approach traffic management between the traffic police and traffic planners;

- a) The main objective traffic police is to “*keep traffic(particularly cars) moving*” on main routes. However, as traffic congestion has worsened, as techniques of traffic planning and operations have become more complex, and as traffic management techniques have evolved to make major contributions to transport policy (e.g. through public transport- bus priority), the scope of traffic management has moved beyond the area of competence of the traffic police and beyond their background, skills and training. Traffic police are not skilled in achieving a balanced approach to traffic movement. The extreme examples have been demonstrated in cities like Bangkok and Manila where traffic police manage traffic signals manually and although they achieve high traffic volume throughputs, they cause immense delays. Changing this culture has proved difficult particularly where innovative schemes (for the traffic police) are involved; for example, sustained enforcement-success of with-flow bus lanes, standard in developed cities, has proved difficult in many developing cities. Enforcement failure reduces the number of valuable options available to traffic planners;
- b) .the independence of traffic police from the city traffic administration and their powers and ability to act in a uni-lateral manner. In some cities, traffic police have powers to introduce traffic measures without reference to other agencies and as such can undermine traffic strategy. On the other hand, it must be said that in some cities, the traffic police is the only agency ready to take action to resolve serious traffic issues (such as the installation of median strips in Colombo to prevent crossing traffic-accidents);
- c) the desire of the traffic police to maintain control over what they perceive as “their functions” . This applies particularly to traffic signals systems. The integration of traffic police and city traffic authorities can prove difficult; and
- d) the resistance of traffic police to any outside interference in their organisation, command structures, working practices etc by civil traffic organisation.

4.6.2. Clearly, traffic management measures should be made as “self enforcing” as practicable. There are obvious traffic measures which require little enforcement (such as one way streets although not even these are free from abuse) but compliance with other regulations depends largely on drivers’ perception of risk and the implications of being subject to enforcement action. Road signing and marking should direct drivers clearly and where possible schemes should be as close to “self enforcing” as practicable. Schemes should “design out” the ability and inclination for drivers to commit traffic offences and example might include:

- ◆ strong direction of traffic through physical measures (channelisation, physical dividers between bus and traffic streams for bus priority measures, etc) to prevent prohibited movements;
- ◆ guard-rails-barriers to discourage illegal parking at kerbsides;

- ◆ traffic calming on local roads to limit speeds;
- 4.6.3. Nevertheless, if traffic management is to be successful and is to become increasingly sophisticated (for example the use of time based schemes such as peak hour bus lanes or selective vehicle prohibitions such as routes prohibited to goods vehicles have much to offer in developing cities if they can be made to work) then the traffic police must be involved, although not responsible for, traffic management development to ensure schemes are potentially "enforceable. For this participation to be effective, police must be better able to understand traffic matters and this involves improved training and better promotion of traffic management by city authorities to traffic police and the approach to training is discussed in Chapter 5.
- 4.6.4. . Traffic management has become a discipline in its own right and requires an organisational structure to ensure that the best can be obtained from that discipline; a professional "traffic management agency" is needed to develop traffic strategy, initiate, plan and design schemes and policies and so on. It is vital that traffic police are involved in this process since the police will be responsible for the enforcement of traffic regulations on which most schemes depend. Nevertheless, the traffic police responsibilities, as opposed to involvement, in traffic management should be confined to traffic regulation enforcement¹¹ and accident reporting (see Chapter 6).
- 4.6.5. The Bank's "Institution Building for Traffic Management" paper suggested that a "middle path" should be followed where responsibilities in over-lapping areas should be shared. In general terms, there is a need for good co-operation between police and traffic management agency but there should be few over-lapping areas. . The one area where conflicts have occurred in many cities is the ownership and operation of computer controlled traffic signals system (Area Traffic Control - ATC). In some cities, total responsibility rests with the traffic police or has been assumed since there are no traffic management agencies to take on the role (e.g. Mumbai). ATC is part of the traffic management system and prime responsibility for ownership, design and operation should rest with the traffic authority; the traffic police should play an "advice and assistance" role and be able to intervene in emergency situations..
- 4.6.6. Traffic police corruption is an issue in many developing cities. Traffic police often receive low salaries and this, coupled with their powers to fine for moving traffic offences, parking offences or vehicle roadworthiness testing, has resulted in bribes, lesser than the statutory fines, being paid to some traffic police. The resolution of the issue is complex since traffic police corruption is likely to be only one symptom of larger scale corruption in a city. Measures such as improved training, reduction of opportunities for direct payments to on-street police (removal of spot fines) may assist but the issue is wider than traffic management. There are reported success in some cities (for example Bogota) in which the poorly trained local traffic police were disbanded and a performance contract entered into with the national police with the collection of traffic fines privatised. Such policies have merit and are worthy of consideration although there are likely to be local complex issues to overcome. It is unlikely that privatised police forces can enforce moving traffic offences and in some

¹¹ Leaving aside such functions as driver licensing, vehicles registration, vehicle roadworthiness testing etc which may be police functions.

cities, even if the private sector levies or collects traffic fines, the traffic police must still be involved to as a legal offence has been committed¹².

- 4.6.7. To summarise, the organisation of traffic police, traffic police operating procedures and traffic police training present intractable issues but they must be faced. The general directions of police institutional policy for traffic management should be:
- a) Traffic police functions in traffic management should be confined to enforcement and accident reporting; traffic management planning and design should be the function of a professional traffic management agency;
 - b) Traffic police should be consulted and participate in scheme development but should not be responsible for that development;
 - c) Traffic police training and familiarisation with the role and objectives of traffic management should be improved (see Chapter 5);
 - d) The use of private sector agencies to enforce some aspects of traffic regulations (such as parking) should be considered provided the application of the contracts is open to scrutiny; and
 - e) Resolving corruption in the traffic police is a wider issue than traffic management and requires attitudinal changes in some traffic police culture. Some improvements may be achieved by improved training, the reduction of opportunities for direct payments to on-street police (removal of spot fines) and use of the private sector with accountable contracts for procedures such as on-street parking enforcement.

4.7 Institutional development for traffic management in Bank projects

- 4.7.1. In 1986, the World Bank Policy Study “Urban Transport”¹³ stated that “*there is a pressing need to strengthen institutions. The institutions responsible for urban transport generally lack the executive, and technical skills to cope with existing situations let alone emerging problems.*” While there are cities with competent institutions in traffic management (like Sao Paulo, Curitiba, Belo Horizonte, etc), this is still true of many cities.
- 4.7.2. In the past most Bank projects with traffic management components have included some “institutional strengthening” but there are number of apparent problems:
- a) institutional strengthening has dealt with broader transport issues – strategic transport planning, public transport regulation rather than traffic management. Lack of traffic management experience has contributed to cancellation of traffic management components (e.g. Mexico UTP I and various projects in China);
 - b) most traffic management components were relatively minor in a city context and thus it may not always be easy to obtain sufficient city interest or leverage to influence city-wide traffic management changes

¹² This happens in as diverse cities as London (where traffic police as well as traffic wardens musy view the outputs of some bus lane enforcement cameras) and in Mumbai and Moscow (where traffic police must be called to on-street illegally parked vehicles to issue the necessary ticket which cannot be issued by the parking attendants).

¹³ World Bank Policy Study “Urban Transport”, 1986 page 42, and 43 ISBN 0 8213 0755 X

c) it is difficult to identify a fully functioning traffic management agency within a past Bank project city although there are reports that institutional changes for “traffic system management” have had some success¹⁴. However, most traffic management agencies assisted under Bank projects have not been sustained – technical assistance has been provided but the traffic management agency has gradually declined when the technical assistance has been completed (e.g. Mumbai (then Bombay) UTP I, Manila UTP).

4.7.3. Until recently, it appears that few projects have sought to address the fundamental issues faced in traffic management. Issues 1-7 demonstrate that sustainable, successful traffic management in a city is impossible without (i) a competent traffic management agency with adequate powers and financial resources and (ii) a sound institutional framework within which it can operate and projects should move in this direction. Some current Bank projects appear to making significant moves to address traffic management institutional issues directly and example are shown in the following table.

4.7.4. While these programs appear to be a more systematic attempt to assist institutional development for traffic management, the issue of sustainability is vital. The key to sustainability of a traffic management agency is considered to be the access to resources. Continued traffic management requires the provision of adequate on-going budgets for planning, design, implementation and monitoring of measures. The key comments in respect of Issue 7 above are summarised:

- ◆ traffic management agencies do have potential revenue sources:
- ◆ traffic management measures can generate revenue from (i) parking charges (ii) fines on traffic offenders (iii) capturing development gain from major private sector developers (iv) congestion charges (v) and other opportunities may exist e.g.. the use of private sector concessions for busways
- ◆ traffic management agencies may be unable to capitalise on these revenue possibilities as a result of existing legislation; and
- ◆ city administration may view earmarking of traffic revenues as undesirable.

¹⁴ “Practices and Lessons 11: Urban Transport”, OED Report Jan 2000 re Korea.

Examples of Current Bank Project Actions in Building Traffic Management Institutions

Key institutional strengthening action	Moscow Urban Transport Project	Mumbai Urban Transport Project	Mexico Medium Sized Cities Project	Dhaka Urban Transport Project
Traffic law-city ordinances changed to establish a “traffic management agency” with city-wide jurisdiction and powers to plan, design, implement, operate and manage traffic systems city-wide.	Proposed	Proposed	A number of cities have established new transport institutional frameworks including “independent” transport institutes with comprehensive planning powers	To be added
Modification of the existing responsibilities of the traffic police to emphasise traffic regulation enforcement rather than traffic management scheme planning and operation	Proposed	Only overlap was traffic signals design-operation and shift to city agreed	Included in the new structure	To be added
Funding of traffic management	Short term: Provision of “unallocated” project loan funds which are not directed at specific components or schemes, but may be used by the traffic management agency for measures in accordance with agreed objectives and thereby assist in establishing the credibility of the agency Long term: city agreement to take over full funding on a progressive basis	Short term: Provision of “unallocated” project loan funds which are not directed at specific components or schemes, but may be used by the traffic management agency for measures in accordance with agreed objectives and thereby assist in establishing the credibility of the agency	Short Term: Project funds allocated in semi-programmatic manner Long term: Some “institutes” are financed by city revenue guaranteed by decree and some receive funds from public transport surcharge to assist planning and improvement of public transport	To be added
Provision of long term technical assistance within the new traffic management agency to	Proposed	Proposed		To be added

4.8 Conclusions

4.8.1. The conclusions are summarised as follows:

Conclusions on Institutional Arrangements for Traffic Management

Issues

Institutional issues vary in scale from city-to-city - with the city size, “starting point” organisation and complexity of traffic problems - but the issues are basically similar and wide ranging and include:

- lack of recognition of the need for a strong, professional traffic management agency with well defined powers
- fragmentation of responsibilities and lack of inter-agency co-ordination
- no continuity of staff or work program in the traffic management agency due to political change
- inadequate regulatory powers for effective traffic management
- low levels of staffing and professional capacity
- lack of operational and implementation resources
- lack of traffic regulation enforcement capabilities

Institutional requirements for an effective traffic management agency

The issues require a range of actions for resolution but key will be the creation and/or strengthening of

- a city based traffic management agency with well defined responsibilities and accompanying powers to fulfil the tasks required for effective traffic management;
- an institutional framework which recognises and legalises, the formal role and responsibilities of the “traffic management agency” in relation to the traffic police, to the "highways agencies" and all other agencies with interests in the transport sector. In some cities formation of a traffic management agency may require redistribution of responsibilities away from existing agencies. This always presents difficulties but if traffic management is to be effective, this issue has to be faced
- a forum ("traffic committee" or equivalent) for policy decisions and to which the "traffic management agency" reports;
- As far as practicable, the traffic management agency should be de-politicised to avoid technical staff and program changes when new mayors or political parties take office. In seeking to overcome this problem, some cities have successfully used traffic-transport institutes or companies, which may be municipally owned, but which have a high degree of autonomy in everyday action and employment of staff and thus are able to provide career paths and realistic salaries for traffic management professionals, if the professional agency is successful and respected, the likelihood of erratic change is much reduced
- Increased contracting out of traffic management functions may be possible but this does not eliminate the need for a professional and competent core traffic agency team to prepare and manage contracts
- Traffic management is often starved of resources for implementation and operation of schemes. Traffic management has significant potential revenues (parking, traffic fines, congestion charges, concessions for busways etc). and other potential funding sources for traffic investment might be available such as urban fuel surcharges and contributions from property/business taxes. If traffic management is to be successful, cities need to capitalise on these revenues and consider earmarking funds to the traffic system (similar to road maintenance funds);

Institutional role of traffic police

In the past, traffic management was concerned only with direction of traffic, accidents and on-street parking and often these functions were carried out by the traffic police; this is still the case in some developing cities. Traffic police tend to concentrate on “keeping traffic moving” and in particular “keeping cars moving”. As traffic congestion has worsened, as techniques of traffic planning and operations have become more complex and have evolved to make major contributions to transport policy (e.g. through bus priority), the scope of traffic management has moved beyond the area of competence, background, skills and training of the traffic police. Policy directions for traffic police are likely to be:

- the role of the traffic police in traffic management (leaving aside vehicle and driver licensing, road worthiness inspection etc) should be confined to traffic regulation enforcement and to accident reporting.
- while the “traffic management agency” should be responsible for planning, design and operation of

all traffic schemes it is an essential part of that process that the traffic police should be consulted and informed at all stages of scheme development

- traffic police training and familiarisation with the role and objectives of traffic management should be improved (see Chapter 5);
- in some cities, police corruption over the enforcement of parking and moving traffic offences needs to be addressed; while improved training, reduction of opportunities for direct payment to police and private sector involvement (e.g. parking enforcement) may assist, this is a wider issue than traffic management

Institutional arrangements in Bank Projects

Previous Bank projects with traffic management components have usually included some “institutional strengthening” through technical assistance but it is difficult to identify a fully functioning traffic management agency within a past Bank project city. Contributory reasons may be:

- while there have been exceptions, most projects concentrate on project related institutional actions rather than seeking to address the fundamental issues faced in traffic management. Sustained traffic management is impossible without (i) a competent traffic management agency with adequate powers and financial resources and (ii) a sound institutional framework within which it can operate;
- sustainability is a vital issue; the disappearance of agencies after the completion of projects has occurred, particularly as their role has been largely project orientated. The provision of “unallocated” project funds to a traffic management agency for development and implementation of programs is a positive move since it enables the agency to establish a real and credible presence in a city as a result of its own work but for real sustainability, cities should provide adequate resources to the agency to enable a continuous program to be undertaken.
- traffic management agencies have not capitalised on their potential to raise revenue. A traffic management agency could generate revenue from parking charges, fines on traffic offenders, capturing development gain from major private sector developers, congestion charges and other opportunities e.g. the use of private sector concessions for busways. Institutional reform is usually needed to enable traffic management agencies to capitalise on these revenue possibilities but Bank projects could be vital catalysts to achieve this change.

5. TRAINING AND HUMAN RESOURCES FOR TRAFFIC MANAGEMENT

5.1 Training

- 5.1.1. Distinction is drawn in this Review between training for traffic management professional engineers and planners and training for traffic police. Successful and sustained traffic management requires (i) trained professional staff for planning, design, implementation and monitoring of schemes and policies and (ii) trained traffic police for enforcement of traffic regulations.

5.2 Training for traffic management professionals

- 5.2.1. Although traffic management schemes are of relatively low cost, they require a high staff input and the resolution of many detailed and inter related planning, design and procurement issues. Success depends on staff capabilities and thus on staff training. As with all aspects of this Review, generalised views the adequacy or inadequacy of staff training are difficult to make as conditions are country and city specific. Countries such as Brazil and Chile have a well established traffic management capabilities following from staff training. However, in many countries, in say Asia and Africa, traffic management is not always recognised as a distinct discipline and thus staff capabilities and training procedures are deficient. It is towards these latter countries that this Chapter is directed.
- 5.2.2. Training for traffic management professionals is no different in concept from training for any other professional discipline. Professionals will be trained through a combination of:
- ◆ “traffic course modules” taken as part of the academic-degree courses normally followed by engineers or planners;
 - ◆ vocational or “on-the-job” training usually delivered by senior staff or by project based technical assistance;
 - ◆ training in specialist areas through implementation contracts (such as ATC) where a training program in the use of equipment is included as part of a contract;
 - ◆ short special topic courses during employment;
 - ◆ overseas visits-study tours to gain exposure to state-of-the-art concepts;
 - ◆ full time specialist courses such as post graduate degrees in transport.

5.3 Training for traffic police

- 5.3.1. Training for traffic police varies greatly from country to country. Most countries have a traffic police force separate from “criminal or security” police. Traffic police are often a national level force although city traffic police forces also exist and in some cities both forces work in parallel (such as Venezuela, Mexico) and it is not always straightforward to determine the respective areas of national and city traffic police responsibility.
- 5.3.2. Traffic police training is mostly carried out at police-run training centres. Issues in police traffic management are well known and include:
- ◆ emphasis on routine policing such licence checking, stolen vehicles, city-checkpoint security controls etc rather than on traffic matters (traffic scheme enforcement particularly selective enforcement techniques, dealing with traffic emergencies, accident reporting and analysis, etc);
 - ◆ under-resourced training centres;
 - ◆ lack of quality training and thus unfamiliarity of field police with traffic law and regulations;
 - ◆ lack of refresher or follow up training following basic training; and
 - ◆ lack of appreciation by the traffic police for the objectives of traffic management policy.

5.4 Training for traffic management professionals in Bank projects

- 5.4.1. Most professional staff training for traffic engineers and planners in developed cities is based on pre-work academic courses at universities-colleges-institutes followed by practical training during subsequent work with traffic authorities or consultants. The same process applies in developing countries where traffic matters are recognised as important (Brazil, Chile, and similar). At the opposite extreme, in some other countries, universities-colleges-institutes do not offer appropriate traffic courses and cities do not have strong traffic departments which can offer career paths or structured training programs to traffic professionals.
- 5.4.2. Many Bank transport projects have included some element of training in urban transport although not all of that training has been in traffic management. However, there is little detailed evaluation of the impact of the training components – neither its effectiveness in increasing professional capabilities nor its sustainability. In 1986, the World Bank Policy Study “Urban Transport”¹⁵ stated that “particular emphasis needs to be placed on training” and “traffic management projects are thus expected to focus on bolstering institutional frameworks and on training” (underlines - this Review). In general, there is limited evidence that projects have “focussed” on training in traffic management in the last 10 years. Some training interventions have been included (mainly training through working with TA and by overseas visits) but even in these cases, the programs were relatively modest and there are no known evaluations. There have, or are proposed to be, exceptions including the (i) Mexico Medium Sized Cities Project, (ii) Venezuela Urban Transport Project and (iii) Mumbai Urban Transport

¹⁵ World Bank Policy Study “Urban Transport”, 1986 page 42, and 43 ISBN 0 8213 0755 X

Project. These projects include structured training programs for traffic and transport professionals and police (Venezuela only) and, while not without difficulties in implementation, in projects which have been implemented they are highly regarded in their respective countries. The format is described in detail in subsequent paragraphs.

- 5.4.3. There is reluctance by cities to spend project resources on staff training. Cities wish to spend resources on physical measures and the view that staff, once trained, “*will anyway leave for the private sector*” is not uncommon. It is difficult for cities to appreciate that when trained people leave city employment, society at large still benefits. The problem can of course be temporarily overcome by contracting staff undertaking sponsored or paid training to stay with the city for a period of time after training or, if they leave, to reimburse the city with the costs of training. There have been projects in which staff have been required to give a commitment to stay with the employing agency for extended periods¹⁶.
- 5.4.4. Traffic management agencies need trained staff. In many countries, traffic management is not an established part of universities-colleges-institute curriculae. It is understood that some universities in developed countries have “twinning” arrangements with universities in developing countries. This is clearly a worthwhile practice but further research is necessary to determine if (i) the practice is widespread, and (ii) what can be done to encourage it. Development agencies have, or had, long term training-technical assistance in a limited number of countries (e.g. GTZ in San Jose, Costa Rica and DfID in Colombo, Sri Lanka) but there are no known traffic management based long term programs.
- 5.4.5. There have examples of city “twinning” in the transport and traffic area – for example, in the past in Nigeria (Ibadan and Gothenburg), Vietnam (Hanoi and Gothenburg), Mexico (Mexico City and Curitiba) and no doubt others. The practice is clearly worthwhile but further research is necessary to determine (i) if it is effective and (ii) how it can be expanded.
- 5.4.6. Despite these possibilities, they are few in number and, in the short term, it is city traffic management agencies which must train their own staff. Of course, there are cities which have the capability to carry out practical training on “real schemes” but, there are undoubtedly many others which need assistance. Bank or similar projects can assist but need to take a much more systematic approach than has been taken up to now. The directions of a comprehensive approach would include:
- a) Promotion by the Bank of the need for training – the Bank should raise the profile of training for traffic management and promote training needs more forcefully during project preparation;
 - b) Distribution of training programs in Bank projects – TA for traffic management in Bank projects tends (not always) to be city specific and while this may play a valuable part in training, TA training applies only to the particular city. The training program including in the Mexican Medium Sized Cities and Venezuela UTP project (see below) is interesting as the training programs were aimed at all medium sized

¹⁶ Indian Railways obtained undertakings from mid range staff to commit to employment for 5 years; while this was not aimed specifically at "training", the same principle would be used for staff who have undergone training.

urban areas rather than a few project cities; this principle may have application elsewhere;

- c) Need for training assessment guidelines - where training has been included in projects, it has rarely appeared to have been systematic and there is no evidence (other than Mexico and Venezuela) of sustainability. Most traffic planners engaged in project preparation (whether from the city, the Bank or Bank consultants) are not training specialists and there is a need for the Bank to establish guidelines to assist project preparation of training components. Such guidelines would cover:
- ◆ how to assess training needs;
 - ◆ the design scope and direction of training programs;
 - ◆ the preparation of implementation programs (which might be through TA or local institutes or subject to bid);
 - ◆ the establishment of targets and measures of effectiveness;
 - ◆ monitoring effectiveness.
- d) Need for career path for professional traffic management planners-engineers - as part of the institutional development process it is necessary to ensure a career structure for trained traffic engineers within cities.

5.4.7. As an example of a structured approach to training programs, the Mexico Medium Sized Cities (MSC) project is noted (the program covered more than traffic management). Although no doubt improvement could be made, the program design provides an example of an attempt at a comprehensive and structured program. A similar program was included in the Venezuela UTP project (subsequent to the Mexico MSC Project). The main features are summarised below:

A Professional Staff Training Program – Mexico Medium Sized Cities

Objectives

- To train a nucleus of professionals in transport in the short term to improve understanding of transport concepts and issues and to develop capabilities in traffic management in medium sized cities
- To assist in establishing long term training

Proposed Program

- The original program comprised (i) intensive courses of about 4 month duration comprising 4 modules delivered in sequence although the modules were not continuous to minimise staff absences from their duties (ii) updating courses, (iii) overseas training for a selected group from the intensive courses and (iv) an evaluation program
- Total cost was estimated at project Appraisal at about US\$2 million;

Intensive Course Modules

- The intensive course modules were the foundations of the program and comprised lectures, workshops and case studies in (i) transport planning, (ii) traffic management, (iii) public transport planning and (iv) transport evaluation and economics

Procedures

- The scope of intensive courses was defined as part of project preparation
- Detailed course preparation and delivery was subject to international competitive bidding from training agencies, institutes and universities
- Participants for training were drawn from a large number of medium sized cities in Mexico; the costs of staff attendance at the courses, which were held in a limited number of centres, were borne by the Project

Results

- The monitoring program is now being undertaken but the program is regarded as successful in that (i) it has raised the profile of traffic and transport work in cities which had little background in the sector, (ii) the most successful cities under the project sent staff for participation in the training program; these subsequently formed the foundation of traffic departments and institutes in their respective cities and (iii) the courses have been taken over by a Mexican university and are being continued.

Conclusion

- A final view on the program must await the results of the evaluation process (itself an important component of the program) but the program is one of the very few attempts to pursue training on a systematic basis (a similar program was carried out in Venezuela) and has much to commend it.

5.5 Academic training

5.5.1. The foregoing has been largely concerned with practical training for traffic planners particularly associated with, or part of, World Bank or projects from similar funding agencies. However, at a broader level, not all cities/countries have universities-colleges-institutes able to offer basic, academic traffic management courses. This will not be easily changed on a project basis. A vicious circle is also at work; unless there are opportunities for a professional and respected career in traffic management, then universities-colleges-institutes will not offer appropriate courses but unless there are trained professional staff, it is difficult to create the profession. This dilemma reinforces the priority case for the creation of a responsible and powerful "traffic management agency" (see Chapter 4).

5.5.2. Even if universities-colleges-institutes in developing cities offer traffic management courses, due to lack of exposure to current practice in the field and there is a need to

assist in improve standards of academic training. Agencies such as the WBI or other international agencies could perhaps play a role in this area. For example, WBI has often run project -based transport courses in their Washington HQ but these are expensive to run, reach relatively very few people and are short in duration. More use could be made of modern technology and communications. Investigations could be made of the practicality of establishing an Internet based, interactive courses in traffic management for engineers and planners working in developing cities. There of course practical difficulties – a program would require contracting a training institute or university to design, set up and manage such a course and there are issues such as language, managing the course, funding and so forth but as PC-Internet connections are now commonplace in developing cities, such a course could reach a wide audience.

5.6 Training for traffic police in Bank projects

5.6.1. Traffic police training in traffic management has been, or is being, included in a number of Bank urban transport projects such as San Jose (Costa Rica), Cairo (Egypt), Colombo (Sri Lanka), Moscow (Russia) (proposed), Mumbai (India) (proposed), Hanoi-Ho Chi Minh (Vietnam)(proposed), Venezuela, Karachi (Pakistan) and Calcutta (India).

5.6.2. Police components in Bank projects usually comprise three main categories of intervention

- a) Equipment to assist traffic regulation enforcement such as patrol vehicles, communications equipment etc;
- b) Technical assistance for traffic accident reporting and analysis systems; and
- c) Technical assistance for training for traffic regulation enforcement.

5.6.3. As far as is known, there are few evaluations of the impacts of traffic police components and thus only qualitative views can be given and, as with many aspects of the Review, generalisations which cover the range of city types in developing countries are virtually impossible.

5.6.4. Preparation of traffic police traffic management components is invariably difficult. The reasons include:

- a) lack of appreciation by the traffic police of their role in traffic management. As noted in Chapter 4, traffic police have a different approach to, and objectives of, traffic management compared to traffic planners. The main objective traffic police is to “*keep traffic moving*” particularly traffic on main routes. However, traffic police are not skilled in achieving a balanced approach to traffic movement. The extreme examples have been demonstrated in cities like Bangkok and Manila where traffic police manage traffic signals manually and although they achieve high traffic throughputs, they cause immense delays. Changing this culture has proved difficult particularly where innovative schemes (for the traffic police) are involved. For example, sustained enforcement-success of with-flow bus lanes, standard in developed cities, has proved difficult in many developing cities. Enforcement failure reduces the number of valuable options available to traffic planners;
- b) the independence of traffic police from the city traffic administration and their powers and ability to act in a uni-lateral manner. In some cities, traffic police have

powers to introduce traffic measures without reference to other agencies and as such can undermine traffic strategy. On the other hand, it must be said that in some cities, the traffic police is the only agency ready to take action to resolve serious traffic issues (such as the installation of median strips in Colombo to prevent crossing traffic-accidents);

- c) the desire of the traffic police to maintain control over what they perceive as “their functions”. This applies particularly to traffic signals systems. The integration of traffic police and city traffic authorities can prove difficult;
- d) the view sometimes held by the traffic police that their training programs are adequate, need no outside “interference” and that there are legal, security and institutional constraints (for example, the national status of some traffic police forces) to change and traffic planners are an interference; and
- e) as with traffic management training for planners, there is a reluctance to commit project resources to a non-physical program.

5.6.5. Clearly, traffic management measures should be made as “self enforcing” as practicable. There are obvious traffic measures which require little enforcement (such as one way streets) but compliance with other regulations depends largely on drivers’ perception of risk and the implications of being subject to enforcement action. Road signing and marking should direct drivers clearly and where possible schemes should be as close to “self enforcing” as practicable. Schemes should “design out” the ability and inclination for drivers to commit traffic offences and example might include:

- a) strong direction of traffic through physical measures (channelisation, physical dividers between bus and traffic streams for bus priority measures, etc) to prevent prohibited movements;
- b) guard-rails-barriers to discourage illegal parking at kerbsides; and
- c) traffic calming on local roads to limit speeds.

5.6.6. Nevertheless, if traffic management is to be successful and is to become increasingly sophisticated (for example the use of time based schemes or selective vehicle prohibitions as used in developed cities has much to offer in developing cities if they can be made to work) then the traffic police must be involved in traffic management development and design stages. For this participation to be effective, police must be better able to understand traffic matters and this involves improved training and better promotion of traffic management by city traffic planners to the traffic police.

5.6.7. It has been noted in Chapter 3 that traffic police corruption in the enforcement of regulations and the application of sanctions is a serious issue in some countries. The resolution of the issue is complex and will involve a combination of actions and procedures. Training can assist by creating appropriate attitudes among the traffic police.

5.6.8. As with training for professional transport planners and engineers, a systematic approach is needed to train traffic police in traffic regulation matters. Training for traffic police is a specialist task and few traffic engineers have an adequate background to identify and plan appropriate programs. Programs can only be devised by traffic police specialists. Furthermore, operational methods of traffic police forces vary widely

from country to country and training must conform with local cultures (although of course, it will sometimes be advantageous to improve operational practices) and have a high local input in its preparation. Project preparation guidelines are needed. Although not yet applied, the procedures suggested for the systematic preparation of a police training program in the Moscow Urban Transport Project are worthy of further consideration:

Approach to Traffic Police Training

- A traffic police training specialist with wide experience of modern traffic enforcement procedures would be appointed to co-ordinate the preparation of the training program;
- The specialist together with a small group (2 or 3) of senior local police staff (including the director of police training) would review traffic police current working practices and training methods and assess strengths and weakness;
- The group would select a number of cities-countries to visit to observe best traffic police practice in the areas identified from the review;
- Following the visits, the scope and content of the training program would be prepared jointly by the specialist and the local group of police; the training program would (i) define the scope of a “train the trainers” program and (ii) define an implementation program with the aim of ensuring sustainability and thus, the schedule would include basic training, refresher training etc
- TOR would be prepared to seek proposals from specialist police training institutes or agencies to prepare the curricula of the “train the trainers” program in detail and for its delivery. The appointment for the delivery of the “train the trainers” program would be made through normal competitive procedures with bids sought from appropriately qualified police training institutes or agencies world-wide
- Following "training of the trainers", the trainers would deliver basic and refresher program to traffic police personnel on a continuous basis
- Indicators of effectiveness and targets would be established and their attainment monitored to assess the performance of the program

- 5.6.9. Finally, the traffic police should be exposed to the principles and objectives of traffic management, especially at "mid range" officer level. Traffic police do not require intensive traffic management scheme planning and design courses but it is suggested that basic traffic planning courses should be included in normal traffic police training such that the police become aware of the principles and rationale for various traffic management measures and techniques which they will be called upon to enforce.
- 5.6.10. In parallel with “training for enforcement”, if the traffic police-traffic management authority relationship is to be successful and the full benefits of a trained traffic police realised then it is stressed that:
- a) The areas of traffic responsibility between the traffic police and the traffic management agency must be clearly defined (this has been discussed in Chapter 4);
 - b) The traffic management agency must ensure good contact and consultation with traffic police in the early stages of planning and design of any scheme or measure. Unless traffic police are involved at the outset, they will not be able to provide the practical view that is necessary for the successful operation of traffic schemes (this has been discussed in Chapter 4); and

5.7 Human Resources

- 5.7.1. The TOR pose questions such as “*have the number of people in traffic management increased over the last 20 years*” and “*how many people are there (in the sector) and how do the ratios compare with developed countries*”. Without a comprehensive survey or inventory of various types and sizes of cities world wide, no quantified response can be given to these types of questions and such an inventory was outside the resources available to the Review. As far as is known, very little research has been done in the area and thus only a qualitative view can be given.
- 5.7.2. Definition of the appropriate level of human resources in traffic authorities depends greatly on at least the following factors:
- a) the manner in which functions in the road traffic sector are organised at city level. For example, whether the traffic signals system is part of the police or a city traffic authority responsibility, whether traffic planning is carried out by a separate planning agency (as is the case in Manila) or institute (as was the case in Moscow, is the case in Sao Paulo and is emerging in Mexico Medium Cities) or by the traffic authority (many cities) or the extent to which national “ministry” (as was the case in Bangkok) is involved and numberless other combinations; and
 - b) the numbers of staff engaged in traffic management depends greatly on the extent to which consultants are used either in the conventional sense (for studies, for development of specific projects and designs etc) or the extent to which day-to-day services are contracted out. As noted in Chapter 4 there is growing trend in some developed cities to contract out many traffic management functions. At the extreme end of the spectrum, a city could contract out all responsibilities for traffic management provided (i) the traffic policies and objectives are defined, (ii) the traffic authority has adequate technical capability to supervise the “traffic management consultant/contractor”. There are however implications which may not be acceptable to a city – for example, the private sector “traffic management consultant/contractor” will need designated powers to place and manage implementation contracts with suppliers or contractors using public funds. While safeguards can be developed, this may pose legal problems. However, on the other hand, contracting out traffic management functions may make sense in some circumstances. In particular, where cities have difficulties in recruiting staff (because of low salaries and/or lack of any defined career path for traffic staff), then contracting out services is a potentially useful policy. Of course, both carrying out traffic management in-house or contracting out implies that a city is willing to devote adequate resources to traffic management.
- 5.7.3. In broad terms, the impression is gained that cities underestimate the numbers of staff required for good traffic management. Mumbai (a city of over 12 million population) is probably typical. Until very recently, Mumbai probably had less than 5 professionals engaged in traffic matters (apart from the traffic police). Clearly, even with a relatively low car ownership, a city the size of Mumbai cannot function effectively with such limited staff levels in the sector. The position was due to a range of factors:
- ◆ General constraints on city finance and staffing (it is probable that other departments are also under-staffed);
 - ◆ Lack of recognition of the importance of traffic management;

- ◆ Lack of clearly defined traffic role for the city;
- ◆ Lack of career structure for traffic management professionals; and
- ◆ Low salaries compared to the private sector

5.7.4. The way cities attempt to overcome these types of problem depend very much on local circumstances. However, the use of semi-independent agencies such as the CET in Sao Paulo has much to recommend it. Such agencies are freed from the constraints of city administration, offer career paths and reasonable salaries to professionals and have a clearly focussed role. As noted in Chapter 4 CET in Sao Paulo employs some 250 professional staff and this level of staffing for metropolitan area of Sao Paulo, with a population of some 12 million, with a car ownership of some 150 per 1000 population is clearly needed. As previously noted, similar agencies are reported from other Brazilian cities such as Rio de Janeiro, Belo Horizonte, Campinas and Santos. Some other Latin America cities have also followed the independent institute route although not usually for all traffic management functions – usually for policy preparation and planning (e.g. Curitiba (Brazil), Leon and Ciudad Juarez (Mexico)). Alternatively, the increased use of contracted out services may offer opportunities. Contracting out has certain analogies to BOT in the supply of roads or mass transit in that its success is likely to depend on (i) well prepared contracts and (ii) a well informed and expert client for supervision and control. There is scope for demonstration projects in this area and as noted in Chapter 4, the case of Vila Velha in Brazil may provide useful experience.

5.8 Conclusions on Training-Human Resources

5.8.1. Conclusions are summarised as:

Conclusions on Training and Human Resources

- Successful and sustained traffic management requires an adequate numbers of (i) trained professional staff in the “traffic management agency” and (ii) trained traffic police for the enforcement of traffic regulations.

Training for traffic management professionals

- Previous Bank urban transport stated policy was to “*focus on bolstering institutional frameworks and on training*”. Many projects have included some technical assistance (TA) to traffic agencies and while this TA has often had some training role, there is no particular evidence that many past traffic related projects have “*focussed*” on training in the last 10 years nor has there been any known systematic evaluation of training. The notable and important exceptions were the Mexico Medium Sized Cities and the Venezuela Urban Transport Project where comprehensive training programs were included in the projects; evaluation of the successes and issues of these programs is required
- There is need to take training “more seriously” and (i) promote training within traffic projects (ii) consider ways of spreading training outside specific project cities (iii) development of guidelines for assessment of training needs and preparation of training components for traffic management
- Further research is needed on the success and potential for expansion of (i) relationships between universities in developed and developing countries and (i) twinning of cities in developed and developing cities.

Training for traffic police

- Traffic schemes should be designed to minimise enforcement effort and to “design out” the ability and inclination for drivers to commit traffic offences;
- Nevertheless, traffic schemes will always require good enforcement for success. Many traffic police forces are neither well trained in current methods of traffic management enforcement nor do they appreciate the role and function of traffic management. Improved and systematic training of traffic police is needed and as with professional staff training, guidelines are needed for assessment of

training needs and preparation of training components for traffic police.

Human Resources

- It is impossible to give general guidelines on what should be optimum level of traffic management personnel since this depends greatly on (i) the manner in which traffic functions are organised in cities and (ii) the size of a city and the level of traffic problems faced.
- Nevertheless, it is probable that many cities underestimate and under-provide the staff required for good traffic management as a consequence of (i) general constraints on city finance and staffing (ii) lack of recognition of the importance of traffic management; (iii) lack of clearly defined traffic management role for the city and (iv) lack of career structure for traffic management professionals
- To give traffic management status, to provide staff with career paths and reasonable salaries, and prevent a "skills drain" the case for "independent traffic institutes", on the model of Sao Paulo and Brazil generally, is worthy of consideration;
- There is a good case for contracting out traffic management functions and some traffic regulation enforcement functions (such as parking regulation enforcement) provided (i) there are no legal constraints to utilising the private sector to deal with public resources and (ii) the city traffic authority has adequate capabilities to set policy, objectives, targets and supervise outputs; this in itself will require trained traffic management personnel in the city traffic authority. Contracting out of full scale traffic management functions may offer potential but more documented experience from those cities where has been used, is needed

6. TRAFFIC MANAGEMENT AND ROAD SAFETY

6.1 The road safety problem

6.1.1. In parallel with the current “Review of Traffic and Demand Management”, a background paper has been prepared entitled a “Review of Road Safety in Urban Areas”¹⁷ (termed the “Safety Review” in this Chapter) and the basic findings were:

- ◆ *“road networks contribute to a significant proportion of countries’ national road traffic crash (RTC) problem with 36 to 69 per cent of all crashes occurring in urban areas.*
- ◆ *Vulnerable road users dominate the urban RTCs with pedestrians being the most vulnerable group in the poorer countries. The majority of the victims come from the underprivileged sectors of society.*
- ◆ *Urban RTCs involve a high proportion of buses and commercial vehicles. They also predominate on links rather than at junctions highlighting the dangers of the current emphasis on capacity expansion often at the expense of vulnerable road users.*

6.1.2. The incidence of road accidents in urban areas clearly justify one of the objectives (see Chapter 2) of traffic management – namely to “improve the quality and safety of the traffic and transport system. However, a comprehensive road safety policy and improvement program must be wider in scope than traffic management measures alone. As the “Safety Paper” states, “Road safety activities, including road safety engineering, should not be assumed to be the same as traffic engineering” and while traffic management has a part to play in road safety policy, the way forward for road safety policies and programs suggested by the “Safety Review” should be comprehensive and include:

- ◆ *“Urban safety improvements should be separately identified even if for practical reasons they are treated as components of national or urban development projects.*
- ◆ *Road safety should be managed effectively as part of cities’ overall development strategies and transport plans i.e. in line with the planners’ vision for the cities. All urban and transport policies have a potential for safety impact and safety should always be considered.*
- ◆ *The management approach is critical to the success of plans and implementation. It should be multi-sectoral and include strong involvement of the stakeholders and community participation.*
- ◆ *Successful implementation of road safety strategies will depend upon public and political commitment, the strength of the implementing agencies and the resources available. Development projects should devote sufficient resources*

¹⁷ “A Review of Road Safety in Urban Areas”, TRL and Ross-Silcock Ltd, DfID, May 2000 (Draft Final Report)

to these aspects and, in particular, focus on establishing a sustainable road safety unit in large cities.

- ◆ *A safety culture within the road authority should be developed with other units such as maintenance and planning learning how they can contribute to the reduction of crashes. Road-user safety should be the responsibility of the road authority as a whole, and all units, not just that of traffic/safety engineering.*
- ◆ *Road safety management will also require the co-operation of a variety of local government sectors and NGOs and private businesses. A strong co-ordinating body or lead agency will be necessary to ensure implementation. It is not possible to recommend a specific model for such co-ordination but it is clear that the organisation must be capable of planning road safety projects, securing a budget, implementing the projects and monitoring their effectiveness.*
- ◆ *Some element of road user charges should be devoted to the improvement of urban roads and their safety with a rational approach to proportioning funds.*
- ◆ *Public-private partnerships could have considerable potential particularly where the private sector has a commitment to the development of their city. The partnerships should not replace government led safety organisations but provide the necessary impetus in the interim to generate resources and speed up implementation.*
- ◆ *Road safety measures should be focused on improving the safety of the vulnerable that will in the main come from the poorest sectors of urban society. Likely measures will include better facilities for pedestrians and two-wheelers reduced vehicle speeds, traffic calming and safer public transport. Changes need to be introduced through an understanding of the needs of target groups and not by top down approaches alone. Measures should be integrated and their implementation preceded by consultation and publicity.*
- ◆ *Road safety programmes need to be based on good crash information. Medical databases and secondary indicators should be considered as well as improved police systems both for planning and monitoring purposes.*
- ◆ *Research is needed to develop new approaches to road safety particularly to change the behaviour of vulnerable communities and the drivers of public service vehicles. Evaluation of approaches is vital, as is dissemination of the lessons learned. The Global Road Safety Partnership (GRSP) is a key focal point for accessing road safety information and disseminating recommendations.*

6.1.3. It is clear that a safety policy will be multi-sectoral and will involve traffic agencies, highway agencies, traffic police, emergency services, NGO's and community based groups, legislative bodies and so on. A multi-sectoral, co-ordinating road safety agency or committee is needed to co-ordinate implementation of a program which is likely to include, at least the following key actions:

Key actions within a comprehensive urban road safety program

Actions/improvements are likely to be needed in at least the following areas:

- **Accident data reporting and analysis**
- **Accident prevention including promotion of "safe" traffic management designs (such as appropriate standards, speed limits and speed controls, recognition of vulnerable system users in scheme design etc**
- **Accident reduction by traffic management improvements at problem sites**
- **Enforcement of traffic regulations**
- Vehicle testing and inspection
- Driver training and testing
- Traffic education for children
- Publicity
- Road safety monitoring and research
- Emergency services and first aid
- Road safety legislation
- Establishment of financial mechanisms to implement road safety programs
- Establishment of a lead agency and/or a "Traffic Safety Committee" to co-ordinate inter-agency safety programs
- Community participation in the development and implementation of safety programs

6.1.4. While the program is broadly based, it can be seen that conventional traffic management actions (the highlighted actions in the box above) form an important part of a comprehensive approach. It is beyond the scope of the present Paper to deal with all the aspects of a comprehensive road safety program and the remainder of the Chapter deals with the "traffic management" aspects of road safety.

6.2 Role of traffic management in road safety

6.2.1. The role of traffic management in urban traffic safety may be considered under the following categories:

- a) Accident data reporting and analysis;
- b) Accident prevention including promotion of "safe" traffic management designs (such as appropriate standards, speed limits and speed controls, recognition of vulnerable system users in scheme design etc;
- c) Accident reduction by traffic management improvements at problem sites; and
- d) Enforcement of traffic regulations comprises two broad areas of action.

6.2.2. In general, the majority of the actions are the responsibility of the "traffic agency" (see Chapter 4) but the traffic police have two vital roles to play in the traffic safety area; the traffic police are responsible for (i) the collection of accident data at the scenes of accidents and (ii) the enforcement of traffic regulations on which safe traffic operations depend. In many developing countries there is a need for greatly enhanced expertise within the traffic police, including in the road safety area (Chapter 5). As with all other aspects of traffic management, close liaison must be maintained between the "traffic management agency" and the traffic police.

6.3 Accident data reporting

- 6.3.1. It is a truism that accident prevention policies and programs should be based on sound data. The collection and reporting of data at accident scenes is a function of the traffic police and not of the “traffic management agency”. The role of the “traffic management agency” is to retrieve accident data from the traffic police and to analyse those data to form the basis for local (“blackspot”) or route or area wide traffic management actions.
- 6.3.2. While it is invariably the case that personal injury accidents should always be reported to the traffic police, in developing cities, the “Safety Review” notes that “*official databases (of accidents) are incomplete, due to under-reporting, and the quality of the data recorded also varies according to the priority given to accurate reporting by the police.*” Issues affecting under reporting and data quality include:
- a) lack of police training in completing comprehensive accident reports to include all relevant site and accident event data;
 - b) imprecise data particularly accident location data;
 - c) lack of police numbers and mobility to ensure comprehensive or timely recording of accidents;
 - d) traffic police corruption which can result in informal arrangements with participants not to report accidents;
 - e) weak insurance systems which results in compensation claims being settled privately and accidents under-reported;
 - f) systematic bias against “less important” against groups - generally low income people etc; and lack of “follow - up” accident reporting (particularly on fatalities) from hospitals and emergency centres.
- 6.3.3. It is not the function of the present “Traffic and Demand Management Review” to detail the actions necessary within traffic police forces to improve the gathering of accident data but it is noted that the resolution of these issues often requires far reaching changes in the traffic police including:
- a) police attitude to recognition of the importance of accurate, unbiased and complete data collection;
 - b) police procedures for collection and processing data and training of police in those procedures;
 - c) allocation of adequate funding to ensure that the traffic police have resources (staffing, training, field equipment to record accident data, office equipment to process data etc) to fulfil their accident reporting responsibilities; and
 - d) active participation of the traffic police in the “Traffic Safety Committee” or equivalent (see box in para 6.1.4).

6.4 Accident data analysis

- 6.4.1. The safety functions of the “traffic management agency” generally commence with retrieval of accident data from the traffic police. The development of improvement actions is similar to the development of any traffic management scheme – problem identification, definition of remedial actions, design, implementation and monitoring. Even recognizing the weaknesses of data, there is often no systematic, periodic transfer of data from traffic police to the traffic management agency. Data are frequently retrieved on an *ad hoc* basis to resolve particular accident problems, for example, due to political or public pressure at an obvious “blackspot” and thus only the most competent traffic management agencies have a methodical approach to accident analysis. A methodical approach requires:
- a) the traffic management agency to obtain data on a regular basis. It is necessary for the traffic management agency to establish close liaison with the traffic police and to institute procedures to ensure the periodic and systematic transfer of accident data;
 - b) ideally, procedures to obtain data from emergency centres and hospitals on the outcome of serious accidents; very often if death is not instantaneous at an accident scene, the event does not enter the records in a correct manner; and
 - c) procedures to be established within the traffic management agency to allow the accident data to be analysed to determine problematic sites, periods, groups, trends etc. This analysis can be done manually with great effect (e.g. accident occurrence maps) but given that data needs to be maintained and analysed over a length period (say 3 years) to obtain meaningful results, the analysis should be PC based. Various proprietary accident analysis software¹⁸ but any simple data base software package can be used.

6.5 Traffic management role in general prevention of road accidents and reduction of road accidents at specific sites

- 6.5.1. Traffic management may be said to have two basic functions in the road safety area:
- a) Prevention -- promotion of standards, concepts and designs (and review of existing schemes-designs) to ensure that traffic schemes and roads operate safely and in particular, that vulnerable road user groups are protected; and
 - b) Accident reduction at specific problem locations - development of traffic management measures to reduce accident at “blackspots” or on problem routes-areas (for example, accidents to vulnerable road system users – such as pedestrians – may not be concentrated at a particular site but may occur more generally in the road network).

¹⁸ For example, the UK TRL's Microcomputer Accident Analysis Package (MAAP)

6.6 Accident prevention

- 6.6.1. Prevention of accidents is influenced by the approach to design and the types of policies and measures included in a city's traffic management. The following paragraphs discuss traffic safety in the context of (traffic regulation enforcement is discussed subsequently):
- a) promotion of safety within scheme planning and design and safety audits;
 - b) planning and design of speed limits and appropriate speed controls (traffic calming) controls; and
 - c) planning and design for recognition of needs of vulnerable road users

6.7 Accident prevention - approach to scheme design and safety audits

- 6.7.1. Although the "traffic management agency" may have a separate road safety group with the responsibility to analyse accident data, promote safety programs and review schemes for safety impacts, safety should be regarded as an integral part of any traffic management scheme design and should be an important evaluation criterion governing the acceptance of any scheme or measure.
- 6.7.2. In some countries, notably UK, the concept of "Independent Safety Audit" is applied. All but the simplest of schemes are subject to scrutiny by traffic management designers who were not involved in the original scheme planning and design. The Audit evaluates schemes solely from a safety standpoint against pre-defined criteria and standards which define the safety of all user groups. The Audit may be carried out by non-involved staff of the "traffic management agency" or by independent consultants. In some developing cities, it is acknowledged that there may be few experienced traffic management staff and lack of resources for the employment of consultants. Nevertheless, the savings in social costs from the introduction of "safe" schemes should more than offset costs and the independent safety audit is worth consideration as part of the normal design process.
- 6.7.3. **Accident prevention - speed limits and controls including traffic calming**
- 6.7.3. The "Safety Review" states, "*speed enforcement and area-wide speed limits are effective in reducing crashes*". A policy of realistically defined, network wide speed limits is an essential part of traffic management strategy and speed limits and controls are powerful actions in reducing the severity of accidents. However, "*urban speed limits are rarely enforced, as traffic police rarely have the means or the incentive to enforce speed limits*".
- 6.7.4. Speed limits on main roads can be enforced by the traffic police by various means - direct measurement by radar guns, static or mobile camera enforcement, following vehicle etc. There is no doubt that in many developing cities, speed limit enforcement is ineffective and traffic police programs are needed to improve speed enforcement and the training and equipment needed is discussed in Chapter 5.
- 6.7.5. Traffic calming can also reduce traffic speeds. As noted in Chapter 2, a traffic strategy should be based on a hierarchy of roads and traffic calming must be related to that

hierarchy. Traffic calming on main roads must be treated differently from traffic calming on lesser roads. On main roads, it would add to accident hazards to introduce some of the more extreme physical traffic calming measures which are used to reduce traffic speeds (see below). However traffic management techniques are available to assist to slow traffic on main roads, including:

- a) positive signs and road markings emphasising speed limits;
- b) “rumble devices” which involve surfacing the carriageway in materials which create noise or vibration when crossed by vehicles and thus warn drivers of approaching hazards;
- c) “bar markings” which comprise lateral road markings (lines at right angles to the road) on high speed approaches to urban junctions; the lines are increasingly closely spaced as the junction is approached and create a visual effect such that drivers slow;
- d) road texture and colour on the approaches to critical locations (junctions, pedestrian crossings etc); and
- e) linking of traffic signal timings at successive junctions to control and maintain a desired safe speed of traffic progression.

6.7.6. On lesser roads, a wide range of physical traffic calming measures for speed control (and in some cases, to limit traffic volumes) has been used, particularly in European cities. Typical measures include:

- a) pedestrian refuges which narrow the effective road width, control vehicle overtaking and do not permit vehicles to reach high speeds
- b) road-speed control humps which reduce vehicle speed. These can take various forms including humps (i) with gradual vertical slopes which cause vehicles to slow, (ii) with sharp vertical slopes which require vehicles to more-or-less stop and (iii) which combine up and down stream slopes with a flat central area (used since they are slightly more “bus friendly” than conventional humps)
- c) road narrowing such that some classes of vehicle cannot use the road (such as trucks)
- d) road narrowing such that only one direction of vehicles can pass at one time – thus opposing vehicles must give way
- e) chicanes such that vehicles have to following a tortuous route through a short section of road and thus must reduce speed
- f) raised junctions comprising a plateau or flat topped road hump built across an entire junction
- g) planting which can be used to change the perceived width of a road to cause traffic to slow
- h) and many similar measures.

6.7.7. It is undoubtedly the case that most of the foregoing measures reduce traffic speeds on less important roads. However, it is not clear if in developing cities they might:

- a) introduce new hazards – for example, in developed cities, where road narrowing or chicanes have been used, there is anecdotal evidence that the measures can be hazardous;

- b) result in increased environmental damage as vehicles slow or stop (in most cases as a result of the poor design of speed humps in developing cities) at humps and accelerate immediately after, thus increasing emissions; and
- c) result in increased accidents due to poor design – the “absolute stop” road hump currently used in many developing cities is, again anecdotally, reported to increase the likelihood of increased “nose-tail” vehicle collisions.

6.7.8. It should be stated that the foregoing views are largely subjective and result from discussions with city traffic practitioners but are disputed by some professionals. It is clear that while the principle of traffic calming on less important roads appears to offer advantages:

- a) more research is needed to determine the impacts of such measures in developing cities; and
- b) design standards for speed humps and other devices and criteria for their appropriate application in developing cities, are needed.

6.8 Accident prevention - measures to assist vulnerable road users

6.8.1. Pedestrians (particularly children) and cyclists are among the most vulnerable road user groups. Since both “modes” should be encouraged on grounds of (i) positive poverty impact, (ii) reduction in traffic congestion and (iii) positive environmental impact. A positive attitude is needed within a traffic strategy to provide facilities to improve their safety. Traffic management possesses a wide range of techniques for protection of pedestrians and cyclists from conflicts with general traffic including the following (see Chapter 7 for a full discussion on pedestrian and bicycle measures):

- a) footways - at its simplest, the provision of footways of adequate width which are well maintained and unencumbered by hawkers, stalls, dwellers etc and with protection guard-rails-barriers where appropriate, will do much to reduce traffic-pedestrian conflicts on main roads;
- b) at grade pedestrian crossings - inclusion of appropriate phases in signal controlled junctions or by separate traffic signals “mid block” is essential to assist pedestrians in dense urban road networks;
- c) grade separated pedestrian crossings – both either over- or under-passes are used. However, such crossings must be carefully designed and located. It has been reported that there is a tendency for car-enthusiastic city administrations to locate grade separation to assist cars rather than pedestrians; if over- or under-passes are inconveniently sited, they will be ignored by pedestrians and the accident hazard could be increased as pedestrians retain their original, non-protected surface crossing. It is noted that grade separation is costly, particularly under-passes and many countries seek to capitalise on the potential financial support from the private sector by locating retail space in under-passes. Retail in pedestrian underpasses has been particularly successful in Japan, Republic of Korea and more recently, in Mumbai. Two aspects need to be recognized in planning pedestrian underpasses combined with retail development namely, (i) it is necessary to ensure that there is adequate pedestrian capacity and that retail development does not inhibit pedestrians simply crossing the road and (ii) that a secure environment is provided to pedestrians when retail developments are closed at night. The latter can involve good lighting,

CCTV and even guards but it must be recognized that in some cities, the security problem is severe and there will be no alternative except to close underpasses after dark;

- d) pedestrianised areas and streets – generally are part of a wider traffic management strategy with more general objectives but undoubtedly have safety benefits;
- e) bicycle lanes and tracks – bicycle lanes and tracks undoubtedly improve safety and the general environment for cyclists. However, the lanes present some difficult design problems – particularly where tracks or cycle-ways are alongside roads and must use the same junctions as general traffic. This is demonstrated in Leon, Mexico where cycle lanes have been implemented in a central median but with no protection for cyclists to join or leave and with the need to cross three lanes of traffic to access-leave the lanes. Various methods have been sought to overcome this problem; the simplest is traffic signals for cycles. More complex arrangements are used in some cities in Europe where “advanced areas” for cyclists are used at traffic signals; cyclists are given reservoir road space in front of general traffic at signal stop lines and into which the cycle lane feeds; cycles are then positioned in front of traffic and provided with an “early start” from the signals¹⁹. However, this requires a high degree of driver observance and in many developing cities is likely to be unenforceable. More reported experience and research is needed from developing cities on safe ways to deal with cycle lanes and traffic at the same junction.

6.9 Accident reduction at specific problem sites

- 6.9.1. The “Safety Review” states “*There is little evidence (of) crash reductions from urban (road-traffic) improvements in developing countries but there are a few promising results from junction improvements, the construction of segregated lanes for non-motorised vehicles and the introduction of speed breakers*”. This is not a particularly positive endorsement of traffic improvements but it is contended that the view is more attributable to lack of data and monitoring than lack of efficacy.
- 6.9.2. While the occurrence of road accidents cannot be reduced by physical traffic management measures alone, traffic management can do much to alleviate specific problems – particularly those arising from past poor traffic engineering designs or from known conflicts. Accident countermeasures may range from:
 - a) simple actions such as improved road marking and signing to ensure that drivers receive clear, unambiguous directions to
 - b) junction modifications such as re-phasing traffic signals or prohibition of some movements to reduce conflicts or minor realignments to
 - c) comprehensive re-design or treatment of road sections to balance the needs of all road users and to provide safe facilities.
- 6.9.3. A well-run "traffic management agency" should approach safety on a comprehensive basis - safety considerations should be part of all scheme planning and design. It is likely that, in the past in many cities, safety has not been a prime consideration as traffic growth has continued and as traffic agencies have struggled to keep up with the

¹⁹ “Sign up for the bike”, Design Manual, Centre for Research and Contract Standardization and Traffic Engineering, ISBN 90-6628-158-8, Aug 1993

provision of enhanced system capacity. A priority task for a "traffic management agency" should be the conduct of a safety review of its city's traffic system and preparation of a comprehensive traffic management "safety" program. The program would be integrated with the overall traffic management strategy described in Chapter 3 (stressing "capacity" for people not vehicles) and is likely to include:

Components of a comprehensive, traffic management review and program aimed at accident reduction

It is axiomatic that all traffic schemes should be designed with safety in mind. Designs should encompass the needs of all road users - motorized vehicles, public transport vehicles, non motorized vehicles and pedestrians. However, a review of the safety aspects of the traffic system and a comprehensive program aimed specifically at reduction of traffic accidents will include some or all of the following actions:

Road and Junction Layout - changes may be necessary in road or junction layouts to ensure:

- vertical and horizontal alignments (including adequate sight lines) are adequate to allow safe operation at the prescribed speed for all motorized and non motorized vehicles
- traffic conflicts which could arise from lack of lane consistency, variations in cross section are eliminated by either physical works or by

Road Surface – changes may be necessary to roads and other surfaces

- to reduce likelihood of motorized vehicles skidding
- to repair unevenness and/or-pot holes to prevent hazardous avoiding action by vehicles especially by two wheel motorized and non motorized vehicles

Road Markings-Signing-Lighting – changes may be necessary to:

- road markings and signing to ensure that drivers and other system users receive clear, unambiguous warnings of hazards and are directed along prescribed routes, lanes etc
- street lighting (which will have security as well as road safety benefits)

Traffic System Management – changes may be necessary to:

- speed limits to ensure they are consistent and appropriate
- removal of hazardous-obstructive parking
- elimination of conflictive traffic movements at junctions, to/from side roads etc by improved junction controls such as clearly defined priorities, signal control, roundabouts.
- segregation of vulnerable modes from motorised modes through provision of adequate, well maintained footways²⁰, pedestrian only schemes, NMT lanes etc
- facilities to provide safe and convenient pedestrian crossing of roads
- facilities to provide safe bus stopping and passenger access to/from stops

- 6.9.4. The impacts of accident countermeasures require careful assessment and in particular to ensure that safety measures – as with traffic capacity improvements –do not simply transfer problems. For example, it is evident that if there is a high incidence of pedestrian accidents at a site, then the segregation of pedestrians and traffic will reduce those pedestrian accidents. However, it is essential to ensure that (i) pedestrians are not penalised by imposing unreasonable diversions which may themselves generate accidents as people ignore the new and inconvenient facilities or (ii) no new accident hazards are created e.g. increases in new types of accidents such as vehicle-vehicle accidents due to inappropriate traffic signals to assist pedestrians.

²⁰ A detailed description of footway issues and policies is given in Chapter 7 "Traffic Management and Poverty"

6.10 Traffic regulation enforcement

- 6.10.1. Traffic regulation enforcement by the traffic police is essential to safe traffic operations but in many developing cities is ineffective. Enforcement is discussed in the context of traffic police training and equipment programs in Chapter 5 but key issues are:
- a) Under-trained traffic police;
 - b) lack of police numbers;
 - c) lack of police mobility and equipment; and
 - d) traffic police corruption and perception that traffic police are often unfair.

6.11 Safety experience in World Bank traffic projects

- 6.11.1. Road safety is often stated as one of the objectives of traffic management components of Bank projects – for example, in Moscow and Mumbai (not yet approved), Dhaka (only recently approved), Seoul, Taegu, Bogota, Zimbabwe, Hanoi, Bangkok, etc. A number of projects include components although these are often less-than-comprehensive and usually include either (i) attempts to establish an accident data recording system and/or (ii) a "blackspot" program. However, as the "Safety Review" notes, there has been little, if any, systematic evaluation of past Bank project components and thus no impact analysis is possible. As with other aspects of traffic management, there is a clear need for more rigorous:
- a) definition of safety objectives and targets at project appraisals;
 - b) systematic safety programs; and
 - c) monitoring of targets and indicators.

6.12 Conclusions

- 6.12.1. The conclusions of the Chapter may be summarised as:

Conclusions on Traffic Management and Road Safety

A high proportion of traffic accidents occur in urban areas. A comprehensive urban road safety policy requires a multi-sectoral approach including programs for driver training and testing, education, publicity programs aimed at selected groups of road users, vehicle roadworthiness testing, securing funds for road safety actions, community participation and monitoring and research. Some form of multi sectoral "Traffic Safety Committee" is required to initiate and co-ordinate safety policies and accident reduction programs. While a comprehensive safety program is broader than traffic management alone, traffic management actions should be an integral and important part. The traffic management aspects of a safety program are likely to include actions in the following areas:

Accident reporting

Data from accident sites are collected by the traffic police and, in developing cities, many data bases are incomplete due to under-reporting and poor quality of data. Accident policies and programs should be based on sound data analysis. Improved data bases are necessary and require improved police training and systems and changes in police attitudes to eliminate bias - often against low income road users.

Accident Data Analysis

In many cities, accident analysis is reactive and confined to reported problem sites; there is no systematic, periodic transfer of data from the traffic police to the traffic management agency or systematic evaluation for program planning. Improved procedures are necessary. While analysis can be done manually with great effect (e.g. accident occurrence maps), data for both identification of accidents and for monitoring of

improvements needs to be maintained and analysed over a lengthy period (say 3 years) to obtain meaningful results; analysis should be PC based.

Accident Prevention

As part of its role in planning traffic strategy and designing schemes, the traffic management agency should:

- Promote safety throughout scheme planning and design; the concepts of safety audits (in which all but the simplest of schemes are subject to scrutiny by traffic management designers who were not involved in the original scheme planning and design) is worthy of consideration;
- Plan and design of speed limits and appropriate speed controls including traffic calming measures
- Plan and design policies and measures to meet the needs of vulnerable road users including pedestrians (particularly children) and cyclists

Accident Reduction

A well run "traffic management agency" should approach safety on a comprehensive basis and a priority task should be the conduct of a safety review of the city's traffic system and preparation of a comprehensive "traffic management safety program". While the occurrence of road accidents cannot be reduced by traffic management measures alone, they can do much to alleviate specific problems by:

- simple actions such as improved road marking and signing to ensure that drivers receive warnings of hazards and are given clear, unambiguous directions to lanes, routes etc
- junction modifications such as re-phasing traffic signals or prohibition of some movements to reduce conflicts or minor realignments
- comprehensive re-design or treatment of road sections to balance the needs of all road users and to provide safe facilities.

Traffic Regulation Enforcement

Enforcement of traffic regulations by the police is essential to safe traffic operations but in many developing cities, traffic police are ineffective, training and equipment are lacking (see Ch 7 for detailed discussion).

Safety Experience in World Bank Projects

Road safety is often stated as one of the objectives of traffic management components of Bank projects but there has been little, if any, systematic evaluation of the components and thus no impact analysis is possible. There is a need for more rigorous

- definition of safety objectives and targets at project appraisals;
- systematic safety programs; and
- monitoring of targets and indicators

7. TRAFFIC MANAGEMENT AND POVERTY

7.1 Introduction

- 7.1.1. *“Transport is an intermediate service – it is a means to an end. Transport alone cannot reduce poverty Transport reduces absolute poverty mainly by increasing economic efficiency – by lowering costs and prices and enhancing opportunities”²¹.*
- 7.1.2. In most cities in the developing world, travel by the urban poor is by bus, para-transit, walking and cycling. Regular travel by taxi, motorised rickshaw-taxi (such as cities in India) or similar cities tends to be by the better off and, of course, car travel is not a mode available to most poor people. Even in cities where suburban rail is predominant (such as Mumbai), road based transport comprising buses and walking play major roles. In cities where metros exist, it is still probable that most mechanised journeys are by bus (see Mass Rapid Transit paper).
- 7.1.3. There are no known studies or research on the impact on poor people of urban traffic management. It appears to be the implicit view that urban transport projects need not be focussed explicitly on poverty reduction since some reduction in poverty will result by increasing economic efficiency through general improvements in the transport system arising from reduced travel times, costs and, fares as a result of lower costs. Thus, it is implicitly assumed that good traffic management can assist the urban poor by improving general transport operating conditions. This is probably the case as the modes used by the poor -- buses-walking-bicycling -- will benefit from appropriately directed traffic management. However, the TOR go on to pose the question *“to what extent is TM used to improve conditions for private vehicle users rather than pedestrians, bicycles and buses”*. This of course implies that traffic management measures tend to favour cars and thus the richer section of the community.
- 7.1.4. Traffic management measures should be planned and designed in accordance with the objectives given in Chapter 2, namely, the primary objective of traffic management should be to improve travel for *“people”* and not necessarily *“vehicles”*. Not only will this lead to the most efficient use of scarce road space (“1 bus carries 30-40 times more passengers than 1 car in only 3 times the road space”) but the policy will have a positive poverty impact.
- 7.1.5. Traffic management directed towards modes and measures which favour *“people”* and not *“vehicles”*, will include:

²¹ Poverty and Transport, C Gannon and Zhi Liu, Transport Division, TWU, World Bank, TWU – 30, Sept 1997

- a) Measures to assist public transport generally but in developing cities mainly bus transport through bus priority measures including the positive reallocation of road space from cars to buses;
- b) Pedestrian facilities; and
- c) Bicycle facilities.

7.1.6. As with all aspects of the traffic management sector, there are no straightforward answers “*to what extent is TM used to improve conditions for private vehicle users rather than pedestrians, bicycles and buses*”. (from TOR). In developed cities, the acceptance that full and unrestrained car use cannot be accommodated has led to a traffic management strategy which positively promotes “*people*” and not “*vehicles*” and thus places assistance to buses, pedestrians and bicycles at the top of the hierarchy of traffic management actions.

7.1.7. In cities in most Latin American countries, traffic management places great emphasis on seeking to improve on street bus operations through busways or bus lanes. Many Latin American cities also have pedestrianised areas or streets, particularly in the city centres. Although not strictly “traffic management”, road paving in poor areas is undertaken to provide bus access and most of these roads are provided with pedestrian footways. Pedestrian facilities for safe crossing of streets is perhaps less well handled. There are examples of bicycles schemes but bicycles are not a major mode. In other regions, the situation is less encouraging as regards measures to assist buses-pedestrians-cycles. There are of course examples of cities with bus priority measures but these are relatively few compared to say Brazil, where almost all cities of significant size have bus priority measures; the same applies to well designed pedestrian and bicycle measures. The experience and issues on buses-pedestrians-cycles are discussed in the following sections.

7.2 Other traffic management including Area Traffic Control (ATC) and poverty impact

7.2.1. Prior to discussion of issues surrounding measures for buses-pedestrians-cycles in relation to poverty impacts, it is necessary to consider the implications of other traffic management actions. Some traffic management that is directed primarily towards cars (such as junction capacity improvements) may improve general traffic flow and thus assist buses and while poverty reduction is not an explicit objective, the poverty impact may still be positive. However, measures such as the provision of more car lanes at the expense of pedestrians or bicyclists clearly does not have poverty impacts as an explicit objective and is likely to have an adverse poverty impact.

7.2.2. Area traffic control (ATC – computerised control of traffic signals) is now almost universal in application or is being planned in developing cities. For example, recently implemented or proposed ATC schemes include Mumbai, Urumqi, Guangzhou, Leon, Guadalajara, Monterrey, Bangkok, San Jose Hanoi, Ho-Chi-Minh, Moscow, Manila (the latter 8 cities not Bank project financed) and no doubt many others. ATC is seen by most cities as a fundamental traffic management measure. For example, a review²²

²² Traffic Management and Road Safety in World Bank Projects in Chinese Cities, A Review, 12 July 1999 (draft), Ms G Frame for the Bank.

of traffic management in Chinese cities has placed a very high importance on ATC and suggests “make an appropriate ATC system the heart of traffic management components in Bank urban transport projects” (Table 11.4 of reference) in order to elevate the status of traffic management as well as achieving traffic benefits.

- 7.2.3. ATC is primarily a traffic management tool aimed at all traffic. Bus priority may be included in ATC systems depending on the system. For example, the UK considers three types of bus priority in ATC²³:
- a) Passive priority: within fixed time, plan-by-time-of-day systems, bus stops and dwell times can be input into the programs used to calculate signal timings using BUSTRANSYT. Signals timings are calculated, and weighted, to recognise the differences between bus movements and other traffic. For responsive ATC systems, bus links can be similarly weighted. The benefits of passive bus priority are limited – maybe 5% reduction in bus journey times. Furthermore, in developing cities, where there are very high bus flows and unpredictable bus stop times, the approach may have small value;
 - b) Active priority: individual buses are detected on traffic signal approaches and signal timings modified to allow buses priority; this is more straightforward for fixed time, plan-by-time-of-day systems but is feasible for responsive ATC systems. Again, with high bus volumes in developing cities, the approach may not be straightforward; and
 - c) Bus tracking: requires a system to track all buses at all times on-street. The ATC system has to have an interface with the bus tracking system such that the arrival times of buses at junctions can be predicted and the signals adjusted accordingly. The system requires all buses to participate in the tracking system which, with the large numbers of buses, companies, types of vehicle in some developing cities, would be problematic.
- 7.2.4. Thus, while there are measures which may be included in ATC systems to assist buses, those measures are complex, relatively costly add-ons to basic ATC, some are not yet fully developed and they may not be appropriate for the developing city context. In general, ATC is most likely to benefit all traffic, which will include, but not concentrate on, buses and is probably essential for a well managed city. Poverty impacts are likely to be positive but in developing cities, poverty impacts (together with the most efficient use of road space) are best achieved by physical bus priority lanes and busways.

7.3 Reallocation of road space from cars to buses – bus priority

- 7.3.1. Buses are (or perhaps will become, as in China or some Indian cities currently with little formal public transport system) the backbone of the transport system for many cities, and will remain so, for the foreseeable future. Buses are important, *inter alia*²⁴, to the poor and positive reallocation of road space from cars to buses will assist operations and

²³ Transport in the Urban Environment, Institution of Highways and Transport, UK, 1997 (<http://www.iht.org>)

²⁴ Clearly buses should not be regarded as exclusively for the poor – that would be a great mistake. Buses are a valid MRT mode and with appropriate physical measures, priority and organization can compete favourably with LRT. Quality bus services is considered in Chapter .. – Demand Management and in the parallel background paper on “Mass Rapid Transit” (HFA/TTC)

will capitalise on the efficiency of buses in using that road space. Experience in developing cities varies greatly world-wide; for example:

- a) In Latin America, there are many cities where road space has been reallocated to buses to provide bus priority and bus lanes on either on a system-wide basis or a scheme-by-scheme basis. Bus lanes and busways exist in probably 100's of cities with notable systems or extents in Curitiba, Porto Alegre, Sao Paulo, Bogota, Lima, Quito, Santiago, Mexico City, Leon, many other others;
- b) In Asia, there are few developing cities which have allocated extensive road space to bus priority and busways. As far as is known, these include only Bangkok, Manila, Madras and Kuala Lumpur. It is surprising that there are so few bus lanes in many major and medium sized cities that operate conventional bus systems. However, in at least the three former cities, enforcement of with-flow bus lanes (as opposed to the contra flow bus lanes which constitute most of the Bangkok lanes) remains problematic.. It is noted that in Chinese cities, a limited number of segregated busways are proposed under Bank projects but indications are that these will not be easy to implement nor to gain political acceptance;
- c) Less is known about cities in Africa but it is thought there are few bus priority measures outside the schemes introduced many years ago in the Bank project in Abidjan.

7.3.2. The lack of bus priority, outside Latin America, is likely to arise from a combination of reasons. In some cities:

- a) the absence of a conventional bus system and the reliance on para –transit makes bus priority very difficult to implement due to the high volumes of relatively small vehicles, e.g. Manila;
- b) bus services are embryonic - buses are few in number, bus service is of poor quality and the bus is regarded as the transport of last resort e.g. some cities in China, Hanoi etc;
- c) the problems of enforcement of “complex” bus lane schemes which require vehicle selectivity (buses versus others) are viewed as too great to overcome;
- d) there is a lack of understanding of the objectives of bus priority and politicians are unwilling to commit to measures which adversely affect the (rich) private cars users;
- e) buses are regarded as a second class mode and preferential treatment over cars, or even over other public transport modes (such as trams in some Eastern European countries), is unacceptable; and
- f) there is a lack of trained-experienced professional staff with sufficient vision to appreciate the benefits of road space reallocation to buses.

7.3.3. The trend in developed cities is completely the reverse of developing cities (outside Latin America). Road space reallocation to buses from cars on a highly preferential basis is increasingly accepted in many richer developed cities, (in most western European cities including in UK, France, Holland, Italy etc but also understood to be the case in Australia and no doubt others. This policy is underpinned by (i) the acceptance that full demand for private car use can never be accommodated in cities, (ii) car demand must be managed, (iii) buses are efficient users of scarce road space and

(iv) improved quality of bus services offers an alternative to private car travel. This is a strong rationale for the justification of reallocation of road space from cars to buses.

- 7.3.4. It seems evident that if bus priority is adopted as an integral part of traffic management policy, then the poor as important, but not the only, users of bus services will benefit. The TOR poses the question “*how can priorities in road space reallocation be changed*”. By-and-large, developing cities in Latin America have gained acceptance for bus priority. This can only have been brought about by resolving the issues noted above by better planning, better information to decision makers, better enforcement, better image for buses, better dissemination of information on the benefits of bus priority and by the implementation of schemes which work well and are able to generate political support. In particular, in some cities in Latin America, politicians have realised the potential of busways. Unlike fixed-track systems, busways can be delivered quickly and offer have proved to be successful. For example, while extending well beyond "traffic management", the case of a major busway on a strategic corridor in Quito (Ecuador) is a good demonstration of what can be achieved. The scheme was approached on a system wide basis and includes, as well as a segregated busway, new trunk line buses, re-organized feeder bus service, integrated fares, high quality bus stops and so on. The scheme cost about US\$5 million per km including buses (say some 25% of the cost of a rail based system) and was implemented in about 2 years. Again, the case of Curitiba is rightly known world-wide as the best example of a bus based transport system. The success of the Curitiba transport system with its segregated busways, range of bus services (trunk, feeder, inter-district, express etc), integrated fares, private sector operation, transport-land use integration, etc show what can be achieved with inspired political direction and continuity and professional planning.
- 7.3.5. To summarise, attitudes to road space reallocation can be changed and sound bus based systems can be achieved. The Bank can play an important role by promoting the “people” objective rather than the “vehicle” objective of traffic management.

7.4 Pedestrian facilities

- 7.4.1. It is a truism that most travellers are pedestrians at one stage or another in their journey (except for the door-to-door car users who can no longer be contemplated as a reasonable proposition in a modern, heavily trafficked city). However, pedestrian travel is vital for the poor in particular. For example, in Indian medium sized cities, walk can represent 20%-30% of all journeys and in other low income countries, the position is similar²⁵.
- 7.4.2. There are of course good examples of pedestrian treatment such as
- ◆ Pedestrianisation of many central squares in Latin American cities;
 - ◆ Comprehensive pedestrianisation and environmental treatment in cities like Curitiba, some streets in Bogota;

²⁵ Urban Transport in Asia, An Operational Agenda for the 1990's, Peter Midgley, Technical Paper 224, 1994, ISSN 0253-7494, Annex Table 11 shows percentages of walk journeys as between about 20% and 50% of all trips

- ◆ Although not “traffic management”, in many Latin American countries, road paving in poor areas is undertaken to provide bus access and most of these roads are provided with pedestrian footways

7.4.3. At a minimum, pedestrians need to be able to walk in a safe and convenient manner to/from a mechanised mode (bus or para transit or possibly train) and possibly, the poor, for the whole of their journey. However, pedestrian needs and facilities are often the least well designed and treated within a traffic management strategy. The issues are, particularly in poor cities:

- a) Footways are not always provided, particularly in outer areas of cities – it has been reported in some developing cities that “*the percentage of roads having sidewalks is generally less than 5% in small and medium sized cities*”²⁶;
- b) Pedestrian needs are subjugated to vehicle needs and footways are often utilised, legally (China, Hanoi (for motorcycles) etc) or illegally (many examples but including Lima, Bogota, Cairo, etc) for parking of private cars;
- c) Footways are reduced to make way for road widening and increased vehicular capacity (reported from India);
- d) Capacities of footways do not meet pedestrian volumes-demands in city centres, close to rail or bus stations etc;
- e) Where footways are provided, they are often encumbered by street traders, pavement dwellers (estimated at some 35% of footway surface in Indian cities) and disrupted by poor maintenance. Thus, footways can be unusable by pedestrians causing them to walk in the road at risk of accident and impeding traffic. There have been instances in some cities where street traders have been forcibly removed with little regard for their persons or their livelihood. While it is accepted that street traders are an inconvenience to pedestrians and do often cause obstruction, it is the duty of the traffic management agency to seek a balanced policy to free the footway while meeting reasonable needs of the street traders;
- f) Footways are obstructed by illegal encroachment by shop owners beyond their frontage limits (e.g. Colombo);
- g) Footways lack continuity with frequent breaks for accesses to frontages premises and businesses;
- h) Public utilities (water, drainage, phones etc) are often located under the footway and repairs and replacements to utilities are often carried out with little regard for pedestrians or for satisfactory reinstatement after works;
- i) Pedestrians are not provided with safe facilities to cross roads and where road crossing facilities are provided, those facilities are often neither well designed nor safe. In particular, the “walk with traffic” approach at traffic signals is sometimes included in schemes but stands no chance of effective utilisation due to lack of driver understanding and lack of enforcement. Where pedestrian clearance times are provided at traffic signals, they are often insufficient for pedestrians to make the crossing in safety (e.g. Moscow);

²⁶ “Walk and Bicycle Travel Characteristics in Indian Cities” Yash Pal Sachdeva (Urban Transport Policy ISBN 90 5410 989 0)

- j) Pedestrian grade separation is provided in some cities but it is often badly sited (away from pedestrian desire lines), badly maintained and cleaned and thus makes use minimal (e.g. Colombo)

7.4.4. A new, much more positive and proactive approach to pedestrian measures is needed. This includes:

- a) better pedestrian design guidelines and standards for dissemination to potential transport project participants;
- b) establishment of guideline procedures for dealing with street traders and street dwellers in an equitable manner (the experiences in the Colombo Urban Transport Project and Mumbai Urban Transport Project may be of assistance);
- c) increased intensity of dialogue with cities which wish to subjugate pedestrians to vehicles (apparently this issue applies in particular to China); and
- d) institutional mechanisms to ensure that public utility companies reinstate footways after works. Developed cities have powers to impose financial penalties on utility companies if footways (or indeed roads) are (i) excavated without permission, (ii) remain in an excavated state longer than the period granted by the permission and (iii) reinstated badly. Such powers and a mechanism should be sought by the traffic management authority of developing cities

7.5 Bicycle facilities

7.5.1. In most cities, bicycles²⁷ are forced to compete with motorised vehicles although there are exceptions such as:

- ◆ in a number of Chinese cities where some streets or parts of roads are allocated to bicycles only;
- ◆ in Latin American cities, a number of specific bicycle ways have been constructed (Lima, Bogota, Leon, etc) but schemes are few in number and bicycles are not regarded as a important mode;
- ◆ in Asia, there are some examples of NMT (rickshaws) and MV physical separation schemes such as in Dhaka but again these are few in number. In India²⁸, although there are many medium sized cities with very high bicycle use averaging some 20%, “*bicycle tracks are not available in most cities except for cities such as Delhi, Madras and Pune and that too for very small lengths*”;
- ◆ in Africa, it is believed that there are few bicycle facilities.

7.5.2. Thus, bicycle facilities are probably under-represented in traffic management strategies. Conceptually, bicycles are an attractive form of transport – relatively low cost, well suited to short urban trips, environmentally friendly, very flexible offering a high degree

²⁷ The term “bicycles” is used in this Chapter rather than NMT as the discussion is mainly concerned with personal mobility.

²⁸ The paper by Yash Pal Sachdeva “Walk and Bicycle Travel Characteristics in Indian Cities” (Urban Transport Policy ISBN 90 5410 989 0) in 1998 showed that cycling represented 20% of trips in medium sized cities and can reach 37% (Nagpur – population 1.77 million).

of personal mobility and so on. However, as with footways, the problems faced by bicycle transport are well known:

- a) Increasing motorization (including increased motor bicycle-ization) and thus increasing safety problems for bicycles particularly at heavily trafficked intersections;
- b) Reduction in street space for bicycles as pressures for road space increase from motorised vehicles and they are given preferential treatment and road space removed from bicycles;
- c) Longer distance journeys as urban sprawl continues;
- d) Affordability of bicycles by poorer sections of the community;
- e) Social attitudes to cycling – “backward”, “second class” etc;
- f) Lack of interest by urban traffic planners and government bureaucrats;
- g) Poor physical design of bicycle facilities;
- h) Security of bicycles against theft (at terminal points of journeys etc) and personal security of users

7.5.3. A few words of caution need to be expressed prior to suggesting that bicycle measures should be a strong recommendation within an urban transport strategy.

- a) First, in some cities, bicycle facilities have been introduced with the hope rather than the expectation of encouraging bicycle use and are not, nor are likely to, meet any existing, or realistic potential, demand. Bicycle paths have been constructed simply because they were “easy” to build at no inconvenience to others and are able to appeal to politicians eager to present an environmentally sound image.
- b) Second, it is reported in that in China (where most use is made of bicycles) that bicycles are incompatible with modern transport, they are regarded as “backward” and that they are gradually being sidelined at the expense of motorised (particularly two wheel motorised) vehicles. The situation is demonstrated by the failure to implement, under a Bank project, the majority of the proposed bicycle-only schemes in the Shanghai UTP I and other projects. It has been stated²⁹ that the “*Bank may be fighting a losing battle on NMTs and if they are a critical issue for the Bank then NMT measures need to be backed up with (loan) covenants*”. A strong technical and environmental case for bicycle measures in appropriate conditions can be made and to overcome this fundamental policy difference, it is necessary to continue to promote the case (see below) and to improve bicycle measure planning and design.

7.5.4. Although bicycles in many developing cities are likely to be used by the poorer sections of society, there will still be potential users who find bicycles unaffordable. In Lima, the Peru Transport Rehabilitation Project included a bicycle component that is beyond a simple cycle track and offers an innovative example. The component

- ◆ financed a segregated bicycle only way between a low income area and a major employment area;

²⁹ Traffic Management and Road Safety in World Bank Projects in Chinese Cities, A Review, 12 July 1999 (draft), Ms G Frame for the Bank Table 11.4

- ◆ provided a line of credit to enable potential users to borrow funds (US\$100 maximum) to purchase bicycles; the line of credit was managed by a municipal bank but, most importantly after a very slow take-up, a private firm promoted the line of credit; and
- ◆ liaised with employers to provide safe and secure bicycle storage facilities at the places of work.

7.5.5. Bicycles can have a role in the traffic system. The role may vary greatly with level of city development, traffic conditions, extent of public transport and personal incomes. In some cities such as in India and China (at least currently), the bicycle role is very important and improvement measures are likely to have a positive poverty impact. In other cities, it may be possible to promote an important role. Bicycles should be treated as an integral part of the traffic management system and strategies should be designed to capitalise on their strengths. In the past, the potential role for bicycles was stated³⁰ by the Bank to be as follows; while various details of the case can be questioned, the general direction is still reasonable.

Potential Roles for Non-Motorised Vehicles

Bicycles can be competitive and complementary with other modes in meeting personal mobility needs

- For short trips between 0.6 and 7.0 kms (on flat or undulating terrain) where bicycles would be faster than walking and more energy efficient than motorised transport
- For commuting trips to public transport facilities (bike-and-ride) as alternatives to walking or motorised “park and ride” (provided secure storage can be provided for the bicycles)
- For trips within neighbourhoods (or residential-environmental areas)
- Where extraneous motorised traffic is incompatible with the local environment
- For trip making by low income residents as a faster alternative to walking and-or cheaper alternative to public transport
- Bicycle rickshaws can play a useful role within the passenger transport system and can also be used freight transport
- For local non motorised para transit services in cities where wages are low and where there is a substantial surplus labour
- For taxi, ambulance and school trip services in low income areas which are inaccessible to motorised vehicles and-or which cannot afford their services
- For small scale delivery services within central business districts and residential areas
- For small freight haulage for micro-enterprises and within wholesale market areas

7.6 Demand management and poverty

7.6.1. Chapter 9 describes demand management issues in detail. However, it would appear that the poverty impact case for demand management, particularly congestion pricing, is strong in many developing cities. Generally, it is the rich who own and drive cars and thus

- a) the direct costs of congestion charging are not borne by the poor;
- b) public transport improvements should be integral parts of a congestion pricing scheme; and

³⁰ Box 3.9, Urban Transport in Asia, An Operational Agenda for the 1990's, Peter Midgley, Technical Paper 224, 1994, ISSN 0253-7494

- c) revenues from congestion pricing could be used to improve quantity and quality of public transport.

7.7 World Bank project traffic management components and poverty

- 7.7.1. Previous Bank³¹ urban transport policy made little mention of any linkage between poverty reduction and transport. The view appears to have been taken that transport projects need not be focussed explicitly on poverty reduction since some reduction in poverty will result by increasing economic efficiency through general improvements in the transport system. As noted above, provided measures are aimed at “*people*” and not “*vehicles*”, this is probably the case.
- 7.7.2. In principle, most recent Bank projects appear to be generally consistent with this approach and most traffic components investments include some measures for buses, pedestrians and to a lesser extent, NMT. However, probably more could be done to promote traffic management measures with direct poverty alleviation impacts. A brief review of some current projects is shown in the following table and this demonstrates that while such measures are included, in the context of each city, they are relatively small in scope. It is considered that in the context of poverty impact and traffic management, the main Bank roles should be to promote the cases for traffic management for buses-pedestrians and where appropriate NMT and to ensure that the modes are at the forefront of traffic strategy discussions in cities.

³¹ The 1986 World Bank Policy Study – Urban Transport, ISBN 0-8213-0755-X

Project ³² (date)	Traffic management measures with immediate poverty alleviation impacts in selected recent projects		
	Buses	Pedestrians	Bicycles
Mumbai Urban Transport Project (2000)	<ul style="list-style-type: none"> 11 km contra flow bus lane demonstration scheme 	<ul style="list-style-type: none"> 1 subway footway repair program as part of bus priority demonstration scheme pedestrian-over-rail footbridges as part station area improvements 	<ul style="list-style-type: none"> None
Moscow Urban Transport Project (2000)	<ul style="list-style-type: none"> None 	<ul style="list-style-type: none"> 1 pedestrian cross-road subway (the city is constructing numerous other pedestrian subways with own resources) 	<ul style="list-style-type: none"> None
Dhaka Urban Transport Project (1998)	<ul style="list-style-type: none"> Bus lanes 	<ul style="list-style-type: none"> 40 km footway repairs to existing footways 10 footbridges pedestrian-traffic signals 	<ul style="list-style-type: none"> NMT routes off main roads Pilot NMT network including infrastructure NMT-MV segregation
Vietnam Urban Transport Project (1998)	<ul style="list-style-type: none"> None 	<ul style="list-style-type: none"> None 	<ul style="list-style-type: none"> NMT-MV segregation
Guangzhou City Centre Transport Project (1998)	<ul style="list-style-type: none"> 5.4 kms bus lane 	<ul style="list-style-type: none"> 1.9 kms footway 30 at grade pedestrian signal controlled crossings 	<ul style="list-style-type: none"> 2.4 kms bicycle route
Lianong Urban Transport Project (Shenyang)	<ul style="list-style-type: none"> Busway Bus lanes 	<ul style="list-style-type: none"> Pedestrian improvements at junctions 	<ul style="list-style-type: none"> Segregated NMT and MV routes

7.8 Evaluation of traffic management schemes to include poverty impacts

7.8.1. Traffic management schemes within World Bank projects are generally evaluated by the application of conventional transport planning evaluation procedures. The World Bank places great emphasis on economic evaluation and thus in general, requires benefits of transport investments to be expressed in monetary terms. The main quantifiable benefits arising from a component usually include

- ◆ Savings in travel time (and thus travel cost) for people using the transport system;
- ◆ Savings in vehicle operating costs; and
- ◆ Savings in accident costs.

7.8.2. It is not within the scope of the Review to discuss in detail the procedures for assessing these savings nor the approach to the determination of input parameters which have proved contentious in the past (such as the value of person time in working time, value

³² All data sources are Bank draft or final PADs

of person time in non-working or commuting time etc). However the following important points are noted:

- a) Conventional economic analysis of traffic schemes usually gives very high economic rates of return (EIRR) where those schemes improve bus and traffic speeds as (i) schemes are often relatively low in cost and (ii) time savings usually apply to many vehicles (both public and private) and travellers;
- b) Provided person time savings of all transport system users affected by a scheme are included in the analysis (and there have been cases in the past where the World Bank has been reluctant to include person time savings), a quantified economic evaluation includes, *ipso facto*, some poverty impact (as most travellers use public transport users in developing cities have lower incomes than car users);
- c) Conventional economic evaluations do not include benefits for pedestrian schemes (there are exceptions for pedestrian schemes such as accidents - see below) or bicycle schemes. There are no standard procedures for the economic evaluation of these measures and thus the poor, who are likely to make use of such measures, may suffer. It is sometimes the case that pedestrian measures are "carried" by the benefits to traffic and buses; for example, complete rehabilitation of the footways has been included in a bus priority scheme in the proposed Mumbai UTP although no pedestrian travel time benefits have been included. However, such an approach does not deal with the pedestrian or bicycle measures which are proposed as "stand alone" schemes;
- d) Environmental impacts are rarely assessed in quantified terms in the economic evaluation of traffic management schemes. To a large extent, this is due to lack of analytical tools (or time and resources) for application to traffic management schemes. Some traffic planning programs (such as the traffic signals assessment program TRANSYT) provide, as an output, fuel consumption savings as a proxy, for environmental impacts;
- e) Some pedestrian schemes are assessed in quantified terms:
 - ◆ accident impacts are conventionally included in quantified economic evaluations but it must be recognized that (i) the base data is likely to be incomplete (see Chapter 6) and (ii) "with" scheme assessments of accident reductions is extremely problematic;
 - ◆ some pedestrian road crossing facilities are assessed in quantified terms by the assessing the benefits of reduced delay to traffic flow. While there are undoubtedly benefits, the danger is that pedestrians are subjugated to vehicle needs and the schemes may inconvenience pedestrians while still providing vehicle benefits.

7.8.3. It is considered that quantified economic evaluation or "cost-benefit" analysis is an incomplete analytical base for traffic management schemes. A complete evaluation should address, as well as economic return, policy impacts, environmental impacts, poverty impacts, quality impacts etc and should not rely solely on evaluations expressed in monetary terms.

7.8.4. An alternative to economic led evaluation is to base scheme evaluations on some form of a logical, objective led framework. Essentially, a framework seeks to define the objectives of a scheme and to assess the extent to which those objectives are met - in

quantified terms where possible but in subjective terms where neither data nor methodology exist. An objective led evaluation requires definition of

- ◆ Policy goals which define the broad goals that the urban transport strategy aims to achieve;
- ◆ Objectives to achieve the goals; and
- ◆ Indicators to demonstrate the extent to which objectives are attained.

7.8.5. A typical evaluation framework, for say a "corridor based bus priority scheme" is shown in the following table. It is stressed that the table is illustrative and is intended to show that more than economic evaluation is involved. The specific contents of a framework will vary with individual schemes and, of course, for small schemes, may be much simplified.

GOALS	OBJECTIVES	INDICATORS	NOTES
To improve the efficiency and quality of transport along the corridor for people	To achieve a net community benefit	<ul style="list-style-type: none"> ▪ Cost-benefit analysis of those impacts which can be quantified (bus, bus passenger, general traffic, accidents etc) 	Quantified indicator
	To increase bus commercial speeds and to increase bus reliability	<ul style="list-style-type: none"> ▪ Bus commercial speeds ▪ Bus passenger journey times 	Quantified indicators (NOTE: care must be taken in final evaluation to avoid double counting with cost-benefit noted above)
	To avoid increases in traffic congestion by restraining private vehicle travel (1)	<ul style="list-style-type: none"> ▪ Car volumes ▪ Bus patronage - car use ▪ Commuter parking provisions 	Quantified indicators (NOTE: care must be taken in final evaluation to avoid double counting with cost-benefit noted above)
	To improve bus service quality ³³	<ul style="list-style-type: none"> ▪ Bus headways-frequency ▪ Numbers of bus stops with improved passenger facilities ▪ Numbers of bus stops with improved accessibility ▪ Passenger information 	Statement of facilities provided and subjective assessment of impacts in each category
	To encourage cycling	<ul style="list-style-type: none"> ▪ Kms of bicycle ways ▪ Numbers of priority facilities at junctions and other facilities 	Statement of facilities to be provided and subjective assessment of impacts
	To encourage walking	<ul style="list-style-type: none"> ▪ Kms of new or improved footways ▪ Numbers of road crossing facilities (at grade at junctions, grade separated etc) and other facilities 	Statement of facilities to be provided and subjective assessment of impacts

³³ Assuming new buses are not part of the scheme

To improve safety of the transport system	To reduce road traffic accidents of all system users (vehicles, bicycles, pedestrians)	<ul style="list-style-type: none"> Numbers of accidents 	Quantified indicators
	To improve security of use of public transport (buses) both on and off vehicles	<ul style="list-style-type: none"> Potential for attack 	Statement of facilities provided (such as lighting, phones, CCTV etc) and subjective assessment
To contribute to the improvement of the traffic related environment	To reduce vehicle emissions	<ul style="list-style-type: none"> Changes in vehicle emissions 	Quantified indicator (if data available)
	To reduce noise pollution	<ul style="list-style-type: none"> Changes in noise impacts 	Quantified indicator (if data available)
	To keep unwanted traffic out of environmentally sensitive areas	<ul style="list-style-type: none"> Traffic flows in designated areas 	Quantified indicator
	To reduce severance caused by traffic	<ul style="list-style-type: none"> Changes in severance and access for local residents 	State of facilities provided and subjective assessment
	To minimize land expropriation necessary to achieve transport objectives	<ul style="list-style-type: none"> Extent of land - property expropriation 	Quantified indicator
To promote efficient use of resources	To provide a cost effective scheme consistent to overall traffic management strategy	<ul style="list-style-type: none"> Capital cost Operating cost Maintenance cost Revenue (if any) 	Quantified indicators
To ensure implementation	To ensure that the scheme is consistent with defined traffic management strategy		Subjective assessment
	To ensure that the scheme is publicly and politically acceptable		Subjective assessment based on public consultation-participation
	To ensure that the scheme is affordable		Subjective assessment in relation to city budgets

7.9 Conclusions on traffic management and poverty

7.9.1. Conclusions are summarised as:

Conclusions on Traffic Management and Poverty

General Case

- Transport assists in reducing poverty mainly by increasing economic efficiency – by lowering costs and prices and enhancing employment and social opportunities; traffic management can contribute
- In most developing cities, travel by the poor is by bus, para-transit, walking and bicycling. Traffic management measures can assist policy of poverty reduction by adhering to the objective of *“people”* and not necessarily *“vehicles”*; thus measures aimed at *“bus-bicycle-walk”* modes are consistent with poverty reduction policies

Reallocation of road space to buses

- Issues – the general lack of bus priority, outside Latin America, arises from a combination of reasons:
 - the absence of conventional bus systems and the reliance on para –transit makes bus priority very difficult to implement due to the high volumes of, largely undisciplined, relatively small vehicles
 - bus services are embryonic in some cities - buses are few in number, bus service is of poor quality, buses are regarded as a second class mode and bus priority is not considered justified
 - the problems of enforcement of “complex” bus lane schemes which require selective treatment for vehicle categories (buses versus other vehicles) are viewed as too great to overcome
 - there is a lack of understanding of the objectives of bus priority and politicians are unwilling to commit to measures which adversely affect the (rich) private cars users;
 - lack of trained-experienced professional staff with sufficient vision to appreciate the benefits of road space reallocation to buses
- Good design can address some of these issues but more is needed - better information to decision makers, better enforcement, better image for buses, better dissemination of information on the benefits of bus priority and so on. In developed cities, the acceptance that full and unrestrained car use cannot be accommodated has led to traffic management strategies which positively promote *“people”* and not *“vehicles”* and thus places measures for buses, pedestrians and bicycles at the top of the hierarchy of actions. Developing cities are likely to have to adopt the same policy as traffic congestion worsens.

Pedestrian facilities

- Issues – commonly faced include:
 - Footways are not always provided, particularly in outer areas of cities
 - Pedestrians are subjugated to vehicle needs with (i) lack of safe facilities to cross roads (ii) footway reduction to make way for increased vehicular capacity etc
 - Capacities of footways do not meet pedestrian volumes-demands
 - Footways often encumbered by street traders and (in some countries) pavement dwellers and thus are unusable by pedestrians
 - Footways lack continuity with frequent breaks for accesses to frontage premises and businesses
 - Public utilities (water, drainage, phones etc) often located under footways and excavation for repairs and replacements to utilities are carried out with little regard for pedestrians or with unsatisfactory reinstatement
 - Pedestrian grade separation often badly sited (away from pedestrian desire lines), badly maintained and cleaned and thus pedestrian use minimal

A new, much more positive and proactive approach to pedestrian measures is needed. This includes:

- better pedestrian planning and design guidelines and standards for dissemination to potential transport project participants;
- establishment of guideline procedures for dealing with street traders and street dwellers in an equitable manner
- increased dialogue with cities which wish to subjugate pedestrians to vehicles;
- powers and institutional mechanisms to ensure that utility companies reinstate footways after works. The traffic authority should have powers to impose financial penalties on utility companies if footways (or indeed roads) are (i) excavated without permission, (ii) remain in an excavated state longer than the period granted by the permission and (iii) reinstated badly

Bicycles

- Issues commonly faced include:
 - increasing motorization (including increased motor cycle-ization) and thus increasing safety problems for bicycles particularly in mixed traffic at heavily used intersections
 - Reduction in street space for bicycles as pressures for road space increase from motorised

- vehicles and they are given preferential treatment and road space removed from bicycles;
- Longer distance journeys as urban sprawl continues
- Affordability of bicycles by poorer sections of the community
- Social attitudes to bicycles – “backward”, “second class” etc
- Lack of interest by urban traffic planners
- Poor physical design of bicycle facilities
- Security of bicycles against theft (at terminal points of journeys etc) and personal security of users
- Bicycles can be competitive and complementary with other modes in meeting personal mobility needs and should be treated as an integral part of the traffic management system. Strategies should be designed to capitalise on their strengths such as usefulness for short trips, non polluting, affordability, small scale freight etc
- Some countries do not regard bicycles as a viable, long term transport mode. Thus care must be taken to ensure that this is not a self fulfilling prophecy and that bicycle schemes are planned to meet a real (or a realistically assessed) need and are not constructed in locations which are “easy”, an inconvenience to no one (basically cars) and are of little value to users and potential users

Demand management

- Demand management, particularly congestion pricing, will have a positive poverty impact. Generally, it is the rich who own and drive cars and thus (i) the direct costs of congestion charging are not borne by the poor (ii) public transport improvements should be integral parts of a congestion pricing scheme and will assist the poor and (iii) revenues from congestion pricing can be used to improve the quantity and quality of public transport.

General traffic management measures - have positive and negative poverty impacts:

- some traffic management measures are directed primarily towards cars (e.g. junction capacity improvements) but will assist buses as part of general traffic; thus, while poverty impacts may be secondary, they will still be positive;
- in some cities, traffic management has sought to provide more car lanes at the expense of pedestrians or bicycles; not only are poverty effects negative but the measures are not likely to meet the “people” objective;
- ATC is almost universal feature of traffic management strategies and is probably essential to any well traffic-managed city. ATC has been criticised as “car orientated” and without positive poverty impact. Benefits are most likely to accrue to all traffic but this will include buses and in some cases, bicycles. In developed countries, ATC techniques exist to emphasise bus operations and these may be appropriate in more advanced cities although in the first instance, buses are best assisted by physical bus priority lanes and busways

Bank traffic projects and poverty

- In principle, most recent Bank traffic components of projects are consistent with a “poverty approach” as most include measures for buses, pedestrians and to a lesser extent, bicycles/NMT.
- However, while such measures are included in current Bank projects, in the context of any city, they are relatively small in scope.

Bank traffic management projects will always be limited in numbers and scope. The Bank role, in the context of poverty impact and traffic management, should be to promote the case for traffic management for buses-pedestrians and where appropriate NMT and to ensure that these modes are at the forefront of traffic strategy discussions in cities

Evaluation

- Traffic management schemes usually result in high economic rates of return when assessed on a conventional basis. To ensure that schemes are “people” and not “vehicle” orientated and that poverty impacts are included as a valid part of the assessment, evaluations should include person time costs. Even then, there are measures which are difficult to assess by conventional economic means - notably bicycle and pedestrian schemes (although many of the latter are often justified on reduction of accidents alone) and a more comprehensive, objective lead framework approach should be considered.

Research

- There are no known studies or research on the impact on poor people of urban traffic management; case studies are needed

8. TRAFFIC MANAGEMENT IN BANK PROJECTS

- 8.1.1. When traffic management is funded under Bank, or under other international agency, it rarely is a “stand alone” investment and is included as part of wider urban transport projects. Furthermore, the boundary line between traffic management and “modest infrastructure” is difficult to draw, e.g. (i) the improvement of a single capacity constraint, such as widening a narrow bridge, necessary to ensure consistent capacity along a corridor, may be classed as a “traffic management” component in some projects or (ii) a bus lane aimed at protecting buses from the effects of traffic congestion at a specific junctions may be “traffic management” whereas a similar bus lane grouped within a network may be classed as “mass transit”. Care is necessary in deriving general conclusions from so-called “traffic management” components.
- 8.1.2. In the last 10 or so years, significant “traffic management” participation by the Bank and other international agencies has taken place in about 32 projects, of which:
- a) World Bank - 29 projects;
 - b) Inter American Development Bank – 2 projects;
 - c) Asian Development Bank – 1 project; and
 - d) European Development Bank – (TBD) projects.
- 8.1.3. For the 17 out of the total of 32 projects for which cost data are immediately available, investment in traffic management totalled about US\$450 million; typically, “traffic management” represented an average of either (i) about 10% of total urban transport project costs or (ii) about 30% of costs if extensive bus priority was involved³⁴).
- 8.1.4. In the case of World Bank, Implementation Completion Reports (ICR) are available for some projects. However, the effectiveness of the traffic management components is difficult to assess from the ICR’s. Thus the following issues and observations are largely subjective but borne out by the evidence from a number of projects.

³⁴ Only in the case of Vietnam UTP was the proportion significantly higher as the project has been totally classified as “traffic management”

8.2 Long implementation periods:

8.2.1. Most past urban transport projects have had long and in some cases extended, implementation periods (Mexico UTP 11 years, Tunisia UTP I and II 8-9 years, Jamaica 9 years etc). It is not possible to determine whether the traffic management components extended over the same periods as the projects but it seems likely. The effects of long implementation periods on traffic management are considered to be as follows and suggestions to alleviate the problems are made in subsequent sections:

- a) Political commitment and changing priorities –implementation of traffic schemes requires political commitment. Long implementation periods often span a number of city administrations, policy priorities are changed and components cancelled (e.g. implementation of all the TSM components of Mexico UTP was cancelled despite considerable design effort); and
- b) Relevance of traffic management components – supply side traffic management (as opposed to demand management) is aimed at the alleviation of short term traffic congestion problems and at providing immediate operational improvements and efficiency impacts. In many cases, traffic management components are designed prior to project appraisal to overcome the problem of slow start up and slow disbursements. Quite often, there is protracted delay between project design and loan agreement and commencement of project implementation. This delay can be many years as has been the case for proposed projects in Mumbai, Vietnam, Moscow, Manila and no doubt others. By the time of implementation, the situation has changed – traffic has increased, roads have been built, political commitment has changed and so on – traffic management projects designed years before may no longer be relevant.

8.3 Lack of Ownership

8.3.1. Traffic management measures are not always “owned” by the city and by its technical agencies and this has resulted in the cancellation of traffic components from wider transport projects. The factors will vary from city to city but local ownership is not always embraced or maintained over time as a result of:

- ◆ lack of appreciation of the concepts and thus the importance of traffic management by cities;
- ◆ changes of personnel in the “traffic agency” or at the political level;
- ◆ lack of traffic management agency with sufficient powers to pursue schemes;
- ◆ a view that traffic management is a price to pay for the involvement of the Bank in wider urban transport investment such as new roads and that there is little real enthusiasm in the city to pursue the measures and ultimately cancellation of components.

8.3.2. “Ownership” is necessary for successful implementation and this requires cities to be convinced of the policy goals and objectives and project preparation has not always secured the necessary level of commitment from cities.

8.4 Lack of public involvement

- 8.4.1. There are few known public involvement initiatives in past Bank traffic management related projects. It is reported that limited components of the Manila UTP have been subject to public consultation and the proposed Mumbai UTP includes public consultation for traffic schemes. In developed cities, public involvement in traffic management is vital and no policy or scheme can be implemented without some level of public information and consultation. Public consultation is also reported to be increasingly common in other countries and this may be one significant gain from the formation of a professional traffic management agency (in Brazil CET/RIO, CET/SP, BHTRANS etc employ public hearings). The issues and the manner in which public involvement may be approached and increased in developing cities are described in Chapter 10.

8.5 Project scope and policy content

- 8.5.1. It would be impossible to analyse the content of all traffic management components in Bank projects within this Review. The general points which stand out are:
- a) Lack of attention to demand management in general; although congestion pricing is theoretically the “best” demand management policy (see Chapter 9), it is conceded that there are immense difficulties in gaining acceptance and in implementation. However, although there are weakness and problems, parking policy offers a first step but few Bank projects have taken up parking;
 - b) Public transport (bus) priority and pedestrian measures are regarded, rightly, by the Bank as effective and efficient measures and should form essential components of urban traffic strategy. In recent projects, these measures, particularly bus priority have been promoted (e.g. Bogota, Lima, Mumbai, Manila, Mexico Medium Sized Cities, and others). However, in some cases, bus priority is not well understood and has been included in Bank projects with little enthusiasm³⁵ by the cities concerned; and
 - c) Most Bank traffic management projects are small elements of wider urban transport projects and even smaller elements of city-wide traffic strategy. Nevertheless, some traffic management project components appear to lack a policy context. Given the Bank's status more could be done under projects to achieve policy changes in the sector particularly in the areas of parking (demand management) and public transport priority (in countries outside Latin America where the cause is well advanced).

8.6 Lack of sustainability

- 8.6.1. Inadequate attention has been given in project design to the fundamental factors needed for sustainability of traffic management namely (i) a capable traffic agency, (ii) systematic training for professional staff in traffic management activities, (iii) an appropriate institutional framework within which the agency can work and (iv) adequate funding for the agency to plan, design, implement and manage traffic measures.

³⁵ Traffic Management and Road Safety in World Bank Projects in Chinese Cities, G Frame, 2nd Draft 12 July 1999

8.7 Monitoring of effectiveness

- 8.7.1. Establishment of realistic monitoring indicators and the collection of the necessary data is important to (i) assess if schemes are successful and should be replicated, (ii) if schemes require modification to become successful and (iii) to demonstrate to sceptical authorities that measures such as bus priority are highly effective. Monitoring indicators are often not well defined in projects and it has been difficult to determine quantified data to use in this Review. While it is accepted that monitoring of traffic schemes is complicated by the impact of traffic growth, more attention should be paid to the development of realistic indicators and guidelines are required for the establishment of those indicators.

8.8 Institutional Arrangements

- 8.8.1. As described in Chapter 4, institutional arrangements for traffic management are key to the success of a program and are rarely treated in a comprehensive manner in projects.

8.9 Areas for action to improve traffic management components

- 8.9.1. It is difficult to recommend specific actions since, as has been stressed in this Review, traffic management is highly city specific and depends greatly on city size, traffic problems, institutional and technical starting point etc. However, some key areas which need to be addressed include:
- 8.9.2. Institutions – there is a need for greater attention to traffic management institutional arrangements. Projects should ensure that there is a capable traffic agency in place or being created, an appropriate institutional framework within which the agency can work and adequate funding for the agency to deal with traffic management on a continuous and sustainable basis (see Chapter 4);
- 8.9.3. Project scope and implementation period - the problem of long implementation periods is difficult to resolve and solutions have been sought for many years. For example, in 1983, a review³⁶ concluded that slow start ups (and presumably slow implementation) could be reduced by:
- ◆ *Improving technical preparation of projects;*
 - ◆ *Identifying potential delay factors and taking steps to eliminate them at the project preparation stage;*
 - ◆ *Exercising caution in transferring responsibilities from one police to civilian agencies;*
 - ◆ *Exercising caution in packaging together strong policy measures and physical improvements;*
 - ◆ *Producing guidelines for ATC;*
 - ◆ *Providing a continuous program of technical assistance and training from preparation through implementation.*

³⁶ A Brief Review of World Bank Experience in Traffic Management, R Barrett, Dec 1983, Internal Bank Paper

- 8.9.4. It is probably true that if projects make few institutional changes (e.g. police versus traffic agency responsibilities) and address few policy issues (e.g. parking), then implementation might be speeded up. However, this misses the point. Traffic management projects should aim not just for implementation of simple measures, they should aim to establish traffic management as a sustainable part of city transport strategy. It is a vital part of the Bank's role to foster sustainability and simple, short term, quick disbursing traffic management projects do not necessarily achieve this aim. However difficult it may be, traffic management in general, and Bank projects in particular, should deal with institutional arrangements and policy matters. The keys to improved implementation performance are (i) as with all else, the existence or establishment of a competent traffic agency (discussed fully in Chapter 4), (ii) the commitment of decision makers and (iii) increasingly public support.
- 8.9.5. With respect to project design policy and long implementation periods, there appear to be two approaches:
- a) design as many of the traffic management components before loan processing as possible. Provided loan processing proceeds rapidly this is the conventional course. However, there is a risk that significant delays in both loan processing and implementation will cause the measures to become outdated. If delays arise, it must be accepted, and will be necessary to persuade cities, that schemes should be subject to review and possibly re-design before implementation; or
 - b) do not design measures before loan processing but agree the direction and objectives and develop measures as the project proceeds on a programmatic approach. This risks slow start up and requires greater supervision. It is reported that the Bank's supervision budget has been much reduced over the last few years. Thus, if this more programmatic course is adopted, mechanisms for supervision of the technical content and design of traffic schemes are essential. This could of course be carried out by contracted consultants and the costs borne within the project. However, there is likely to be difficulty in persuading cities to include resources for "supervision and (effectively) quality control". Nevertheless, the programmatic approach offers improved city-responsiveness to measures and a budget and provides a work program which can be used to build the experience and credibility of the traffic agency. The proposed Moscow UTP contains a significant element of this approach; the effectiveness should be monitored and used to inform future projects.
- 8.9.6. Guidelines – some aspects of project preparation (i) are new to many cities and the cities lack expertise or (ii) have received inadequate attention or (iii) have caused problems in project development. Project processing could be assist by the development of guidelines for some aspects such as:
- ◆ institutional arrangements (see Chapter 4);
 - ◆ public involvement in traffic management (see Chapter 10);
 - ◆ training (see Chapter 5);
 - ◆ planning and procurement of ATC (see Chapter 3.);
 - ◆ programmatic approach to traffic management components and
 - ◆ monitoring.

8.10 Conclusions

8.10.1. Conclusions are summarised as:

Conclusions on Traffic Management in Bank Projects

Experience in developed and well managed developing cities shows that traffic management:

- is an essential element of any city transport strategy to achieve optimum efficiency from the system;
- is fundamental to realise the potential of more costly transport infrastructure and system investments;
- costs are small and the benefits are exceptionally high;
- can have positive poverty impacts by concentrating on the movement of people and not necessarily vehicles

It is axiomatic that a development agency such as the World Bank or DfID should support traffic management. Nevertheless, there have been problems in implementation. Implementation completion reports give little information on the success or otherwise of traffic management components of Bank projects. This in itself indicates that improved ex-post evaluations are required but there are important issues to be overcome concerning long implementation periods; ownership; public involvement; project scope; sustainability, monitoring and institutional arrangements. It is difficult to recommend generally applicable actions to overcome these issues since traffic management is highly city specific and depends greatly on city size, traffic problems, institutional and technical "starting point". However, key areas which need to be addressed in Bank projects and to which greater project attention is needed include:

- Institutional arrangements - projects should ensure that there is a capable traffic agency in place or being created, an appropriate institutional framework within which the agency can work and adequate funding for the agency to deal with traffic management on a continuous and sustainable basis;
- Project scope - traffic management projects should aim not just for implementation of simple measures, but should aim to establish traffic management as a sustainable part of city transport strategy and despite the difficulties, traffic management projects should deal with institutional arrangements and polices
- Implementation period - cases have existed where traffic management components designed during project preparation are outdated before implementation due to protracted periods of project and loan processing. A more programmatic approach to traffic management components should be considered with loan funds allocated to "traffic management programs" and not defined schemes. Not only does this allow schemes to be developed which are responsive to current traffic conditions but it also provides an opportunity for the traffic management agency to become established and credible by designing and implementing schemes. Some traffic projects are moving in this direction. It accepted that more supervision would be needed but the possibility should be investigated to contract this supervision to the private sector as part of the project
- Guidelines – some aspects of traffic management project preparation and implementation are new to many cities and thus cities lack expertise. Project processing could be assisted by the development of guidelines for some aspects such as:
 - institutional arrangements (see Chapter 4)
 - public involvement in traffic management (see Chapter 10)
 - training (see Chapter 5)
 - planning and procurement of ATC (see Chapter 3)
 - programmatic approach to traffic management components (this Chapter)
 - monitoring (this Chapter)

9. DEMAND MANAGEMENT

9.1 Introduction

9.1.1. Chapter 2 has outlined the trend that as city populations and economies grow and as car ownership and use increase, the likelihood is for worsening urban traffic congestion. While all cities need a well developed road network, road construction-capacity, even if it was affordable, will not be able to keep pace with growth in travel demand; furthermore, new roads generate traffic. Policies are needed to deal with inevitable increasing urban traffic congestion. Increasing traffic congestion may inhibit traffic growth in urban areas but (i) drivers have shown themselves to be extremely resilient to congestion and (ii) congestion is economically inefficient and environmentally damaging as a method of dealing with excess traffic demand.

9.2 Rationale for demand management³⁷

9.2.1. The effects of traffic congestion include (i) economic disbenefits arising from loss of time, increased vehicle operating costs, etc (ii) congested traffic produces more pollution per vehicle kilometre than smoothly flowing traffic (iii) congestion prevents bus and other road based public transport operators from providing a reasonable level of service, (iv) city centre congestion encourages dispersal of journeys to outlying city areas where current congestion is lower but to where it is likely to spread. The basic economic rationale for demand management is that unless the price directly incurred by travellers in making journeys covers the full costs of the journey, their travel will impose a net cost on the community. The full costs of road use by car includes both the personal costs which the traveller incurs (vehicle running costs, fuel, parking etc) and the social costs which the traveller imposes on the community, through adding to congestion and increasing the potential for accidents, as well as the adverse impacts on the environment, through creating noise, atmospheric pollution and contributing to severance. As the marginal costs imposed by a road user on others vary by location, time and traffic conditions so, ideally the charges incurred by road users should also vary. In developed cities, the argument for managing travel demand has, however, broadened beyond that based on economic efficiency. This reflects increasing concern about the environmental and social impacts of congestion on urban communities and the need to seek sustainable cities. Although the construction of additional or alternative road capacity can alleviate some of the effects of congestion, the benefits are most likely to be offset, unless growth in traffic volumes is restrained. Limitation on funds available for investment in urban transport has also contributed to the debate about the extent to which (i) users should pay full costs of the provision of the road system and (ii) demand should be restrained to match the supply (of roads) which can be provided.

9.2.2. Based on this rationale, the objectives of urban traffic demand management policy are:

³⁷ "Transport in the Urban Environment", Chapter 21, IHT, UK, 1997

- a) to reduce traffic congestion; and
- b) to reduce adverse traffic related impacts on the city environment.

9.3 Demand management measures

9.3.1. All demand management tools aim to increase the costs of road use either explicitly through charges (parking or congestion charges or fuel prices) or implicitly (through limitations to movement) such that road user costs more closely approach full costs of travel. Demand management and restraint in traffic volumes may be realised by a range of measures, many of them well beyond the concept of "traffic management" and often dealing with national policy (e.g. fuel pricing). Potential demand management measures may be divided into the following categories:

- a) Parking - controls and pricing of public car parking and of other parking such as private non residential parking;
- b) Control of use of vehicles by regulation – controls on the use of vehicles may be achieved by:
 - ◆ access controls to specific areas by regulation such as “odd-even” number plate bans
 - ◆ physical barriers to movement to selected areas such a pedestrianised streets and environmental areas etc; and
 - ◆ road space reallocation from inefficient users of road space (cars) to efficient users of road space (buses and public transport generally).
- c) Pricing – including
 - ◆ measures to discourage vehicle ownership and use such as including vehicle license fees, fuel prices, etc; and congestion
 - ◆ congestion charging through a range of schemes aimed at reducing car use in specific areas and at specific times including supplementary licensing, cordon pricing, road tolls etc;
- d) Incentives to efficient and/or "green" modes - including
 - ◆ measures to improve public transport;
 - ◆ measures to encourage walking and cycling;
 - ◆ car pooling
- e) Planning -
 - ◆ Staggered work hours; and
 - ◆ disincentives to travel through land use and development policies to reduce overall demand for travel.

9.4 Integrated Policy

9.4.1. Need for planning - measures designed to satisfy one objective may conflict with others. For example, parking policies aimed at restraint of long term city centre parking may encourage increased volumes of through traffic by "releasing" road space and a scheme would require careful planning. There can also be significant differences between the short and long run effects of some measures. For example, city centre parking restraint

may provide short term relief but may in the long term encourage growth of new local centres remote from the city centre with their own congestion problems. A package of measures needs careful planning to achieve a balance of objectives relating to the particular traffic characteristics of a city.

- 9.4.2. Need for parallel improvements particularly public transport - Theoretical research³⁸, indicates restraint measures alone will not meet urban transport and environmental objectives and that “*combinations of car restraint and public transport improvement appear to work better than either in isolation, at least in their effect on travel to city centres*”. A coherent policy is likely to include a combination of measures - both disincentives to travel by inefficient modes and incentives to travel by efficient (public transport) modes. It is widely accepted that both for public acceptability reasons and demand management measures should be implemented in parallel with public transport improvements including quality improvements to offer alternative transport to restrained car users. This view is demonstrated in the few existing cases where direct pricing methods are employed (cordon or area congestion charges) - revenues from charging schemes have been earmarked for public transport improvements.

9.5 Parking controls for demand management

- 9.5.1. Parking control and pricing is the most commonly applied demand management measure in developed and developing cities. At its most basic, in many developing cities, parking policy is limited to the control of the supply of on-street parking (usually simple parking prohibitions on main roads) to avoid obstruction to moving traffic and this approach has little effect on demand. However, on-street parking controls, as good practice, should be part of a normal traffic management strategy and has been discussed in Chapter 3.
- 9.5.2. Parking controls and charging do have some restraint potential. While parking controls may have some effect on vehicle ownership³⁹, the conventional aim, as a restraint policy, is to reduce car use by regulating/limiting parking space/capacity and by positive allocation of available parking space between different groups of user – usually seeking to deter long stay car commuting since travel-to-work car demand is the primary cause of peak hour congestion and results in high marginal social costs (each vehicle interferes significantly with the operation of others and there is the accumulated effects of air pollution and environmental degradation). However, parking as a restraint measure has weaknesses for at least the following reasons:
- a) the control of parking affects only trips with a destination in the area subject to the parking controls. Used by itself, therefore, parking control may reduce travel to an area (typically city centre) but at the same time unless other measures are taken, the reduced congestion will benefit vehicles passing through the controlled area and is likely to result in increased "through" traffic flows which will absorb the released capacity;
 - b) the availability of drivers and chauffeurs in developing cities which means that cars do not have to park on a long stay basis; cars can remain on-street in charge of

³⁸ “Better Public Transport for Cities”, CIT, UK, June 1996

³⁹ For example, the reported Japanese experience where it is not permitted to own a vehicle in some cities unless a parking space can be demonstrated.

drivers and/or can move frequently and thus escape parking charges or parking enforcement;

- c) significant parts of the parking stock in many cities may not be in the control of the traffic management authority. Car parking which is publicly available and operated by the private sector can theoretically be influenced by the traffic authority by incorporating “restraint-level” parking charge rates within the license to operate the car park or, at the extreme, by closure of places. However, in developing cities, these are not easily enforced actions;
- d) an even more difficult problem applies to “private non-residential” (PNR) parking which may be in the ownership of private sector companies and/or of central and local government agencies themselves around ministries and city government offices. For a parking policy to have real restraint effects, it is necessary to have control of, or at least influence over, this PNR parking. This has proved difficult in both developed and developing cities; issues and measures in relation to PNR include:
 - ◆ minimum standards - in many cases the private sector building-related parking may have been constructed as a direct response to city parking standards for building permissions. There are many developing cities, even in city centres, where minimum rather than maximum parking standards are required and this minimum standard encourages car use and can permit lower-than-realistic parking charges;
 - ◆ "free" employee access to PNR parking - if parking spaces are provided as a “benefit” to employees then anyone with a free, and guaranteed, parking space provided at the place of work does not bear the full costs of their journey to work. Thus, some form of charging is justified. In developed cities, the parking can be treated as “benefit in kind” on which tax on income is payable by drivers. This requires an efficient personal taxation system which may not apply in many developing cities. There are moves in some developed cities to impose a “work place parking levy” whereby an employer pays a (high) levy to the traffic authority for the each parking place on the premises or alternatively closes the space. The policy is being actively considered in the UK and is typically described⁴⁰ as *“In the case of the workplace parking levy, the (policy)will enable a levy to be charged on (i) all parking at categories of property where parking provision is predominantly for use by those at their workplace - such as parking at offices, factories, warehouses and educational establishments (where parking provided for students would be included); and (ii) parking for employees at buildings where employee parking is likely to be a minority of total on-site parking - such as parking at retail outlets, leisure centres and hospitals etc”*.
 - ◆ control of PNR - “PNR” parking places can be closed if they are those under the control of central and local governments. Conceptually this is simple but practically it is difficult (“discrimination against public employees”, “no alternative transport system”, “cars needed throughout the day for work purposes”, “heads of departments need cars” etc).

⁴⁰ Consultation Paper on Fighting Congestion through Local Authority Road User Charges and Work Place Parking Levy, Scottish Executive, 2000

9.5.3. Nevertheless, despite the problems and weaknesses, a comprehensive parking policy is likely to be the starting point for demand management in most cities. Paying for parking is the least contentious of the user charges and some elements of parking control are usually in place and widely accepted (if not enforced or with realistic charges) in most cities. Furthermore, a realistic charge structure can provide net revenue to cities for use in transport system improvement provided that either a city exercises control over levels of charges for publicly available parking operated by itself or has retained some control over parking charges for contracts let to private sector parking operators-suppliers. Thus, the main strands of a comprehensive policy would include:

- a) On street - limited numbers of spaces with significant charges in non obstructive locations coupled with measures to prevent generated/through traffic (bus lanes, positive reallocation of "released" road space to buses, traffic routing schemes etc) and measures to prevent circulation by employed drivers;
- b) Off street – publicly available - control over parking charges (both those operated by the city and those operated by the private sector) and if necessary limitations on number of places and on new permissions;
- c) Off street – private-non-residential - a range of measures including an attempt to control existing provision (at least central and local government offices), control on future provision (by modifying parking standards to a "maximum" basis), imposition of some form charge system – either on providers (work place parking levy type policies) or users (personal tax type policy);
- d) Efficient parking enforcement and administration which is not only efficient but proof against fraud and corruption; and
- e) Earmarking of net revenues for transport system improvements.

9.6 Use of vehicles – demand management by regulatory control

9.6.1. Demand can be managed by regulations to control the use of vehicles. Various versions of the “odd and even” number plate scheme are relatively common in developing cities (as far as is known, the only developed city using the technique is Athens). The basic scheme permits vehicles with “odd” and “even” registration plates to enter the target area on alternate days. Not all schemes are aimed at reducing traffic congestion alone and the primary objective of some of largest schemes (e.g. Mexico City and Santiago de Chile) is to reduce vehicle emissions. Some examples are:

- a) Lagos, in the past, used the odd-even number plate applied to the centre of the city but for the types of reasons described in the following sections, it is understood that the scheme is no longer operational;
- b) Mexico City used a scheme which prohibited car use throughout the federal district with number plates ending in “1” and “5” on Mondays, “2” and “6” on Tuesday etc for the 5-day working week (the “Hoy No Circula” scheme);
- c) Bogota⁴¹ used a scheme in which 40% of private vehicles cannot operate in the city between 7AM and 9AM and between 5.30PM and 7.30PM in accordance with designated number plates as follows:

⁴¹ Informe Final - Medicion de Tiempos de Viaje Programa de Pico y Placa, PIV Ingenieria Ltda for Secretaria de Transito y Transporte de Santa Fe de Bogota, FONDATT, Oct 1998

Days on which vehicles cannot circulate	Number plate end digit
Mondays and Wednesdays	1 and 2
Mondays and Thursdays	3 and 4
Tuesdays and Thursdays	5 and 6
Tuesdays and Fridays	7 and 8
Wednesdays and Fridays	9 and 0

- d) Santiago de Chile introduced a scheme which operated only on days on which atmospheric pollution reaches emergency levels; in this case, all vehicles except buses, taxis and police-emergency vehicles were prohibited from circulation for 2½ hours in the morning and 3½ hours in the evening on the six principal road axes which connect the outer and centre of the city – in effect the scheme provided reserved streets for public transport on the main axes;
- e) Seoul (in the past) is understood to have used a scheme in which cars were prohibited for use if the last digit of the number plate corresponded to the last digit of the date and thus applied 3 days per month but was not equitable if the number plate ended in “1”;
- f) Sao Paulo uses a scheme over a wide central area (within the Inner Ring - about 15km diameter) in which 20% of vehicles (“1” and “2” on Mondays etc) are prohibited from 07:00-08:00 and 17:00-20:00 for weekdays;
- g) Manila uses a scheme which prohibits certain vehicles, again identified by number plates, from operating on the main traffic arteries during peak periods;

9.6.2. There are obvious risks to the “odd and even” policy and its variants. The schemes may:

- a) encourage an increase in the number of vehicles owned, to provide households with both odd- and even-numbered (or other numbers to avoid the system in force) vehicles;
- b) induce more trips by permitted private vehicles than were made by those vehicles before the prohibitions were introduced;
- c) generate increased taxi trips if taxis are excluded from the scheme; taxis may be just as, if not more, polluting than conventional cars;
- d) present a fraud and evasion problem (false number plates);
- e) not provide a long term solution as it will be undermined by growth in vehicle ownership over time; and
- f) be undermined by concessions-exemptions (e.g. for example for "official" vehicles); this is believed to have happened in Lagos.

9.6.3. Some observers think that the schemes are unhelpful. For example, a study of the Mexico City scheme⁴² stated “A ban restricting each car from driving on a specified work-day is found to have increased total driving. Since an additional car effectively

⁴² Rationing Can Backfire: The ‘Day Without a Car’ in Mexico City; Gunnar S. Eskeland (Public Economics Division Policy Research Department The World Bank) and Tarhan Feyzioglu (The World Bank and Georgetown University), September 8, 1995

represents additional “driving permits”, many households have bought an additional car, and increased driving. Greater use of old cars, congestion effects and increased weekend driving may also have contributed to this disappointing result: The ban has high welfare costs, and appears to deliver none of the intended benefits - quite on the contrary”

9.6.4. On the positive side, the "odd-even" or similar schemes:

- a) are almost always accepted by the public as they demonstrate a commitment by government to take positive action to reduce congestion and related air pollution
- b) are less difficult to enforce than feared (applied in Mexico City, Bogota, Santiago etc) and even if there are infringements, provided enforcement is reasonably efficient, the fines can finance the increased enforcement effort;
- c) if acted upon, can give a “breathing space” (in all senses) to develop something better; and
- d) generally assist road based public transport at least in the short term as traffic flow conditions do improve (Bogota reports 20% increase in average travel speeds) and might reduce car use if coupled with public transport improvements (although no data exist to verify).

9.7 Use of vehicles – demand management by physical measures

9.7.1. Traffic can be managed through the use of physical measures, designed to make the use of motor vehicles less attractive. Measures may reduce speeds or extend travel distances or prevent access to certain areas. Typical measures are:

- a) pedestrianisation – widely used in city centres in both developed and developing cities and increasingly pedestrian streets are used in developing cities;
- b) route-area controls - the most well known being Gothenburg which has sought to limit traffic within the city centre, by creating a system of cells between which there is no direct access for cars. To move between cells, drivers have to return to a ring road which encircles the controlled area or use public transport for direct access;
- c) roadspace reallocation to disadvantage car users explicitly and to encourage public transport use through re-allocation of road space to public transport (see discussion in Chapter 7) and/or to multiple occupancy vehicles. While the primary objective of bus priority schemes in many cities is to enhance public transport services, there is frequently a secondary objective of seeking to discourage car use. Positive discrimination against ‘inefficient’ use of roadspace by vehicles with only a driver is extensive in the USA through the use of ‘HOV’ (high occupancy vehicle) facilities in which road lanes are designated to vehicles with 2 or more commonly 3 occupants.

9.7.2. While the use of such measures may reduce traffic in the target areas (usually a city centre) they are unlikely to reduce demand overall, unless coupled with other measures such as parking policy. While physical means may be successful in managing demand to the extent that cities are made more pleasant (pedestrianisation) and transport is more efficient (reallocation of road space to public transport and high occupancy vehicles), such measures are unlikely to have a great impact on car use. Essentially, the measures create restraint-by-congestion. While this is unlikely to result in paralysing congestion,

the reactions of car drivers will be complex – times of journeys will change, patterns of journeys will change and in the long run, land uses will be affected. Demand management by physical means – pedestrianisation, bus priority, HOV etc – is likely to be a complement to, and part of, a comprehensive policy and not a stand alone restraint policy.

9.8 Pricing - demand management through charges on vehicle use and ownership

9.8.1. Vehicle ownership and use taxes are not primarily aimed at restraint. Taxes on vehicle ownership and use (through fuel taxes) are important sources of revenue for public finance and their basic purpose is not to rationalise the use of transport modes. These taxes have a high yield and can be argued to have a re-distributive effect (richer households have more cars, more expensive cars, drive more and consume more fuel and thus pay more tax than lower income households). Clearly if taxes are high enough, there will be some effect on use (see subsequent discussion on ownership charges and Singapore and on fuel prices) but in principle, such charges do not address specific congested urban areas nor specific congested times. They are "blunt instruments" and do not manage demand where and when it is most needed.

9.9 Pricing - demand management through fuel prices

9.9.1. The economic rationale for congestion charging is that the users of motor vehicles do not perceive, and do pay, the true user costs of using their vehicle, even when traffic flows reasonably freely. There is, therefore, a case for using fuel charges (taxation) to ensure that the generalised cost of car travel reflects more closely the costs of car use.

9.9.2. Fuel prices vary widely from country-to-country but are not related to purchasing power of the society in which they apply or to domestic oil production of a country nor to the need to manage car demand - prices are largely determined by political factors. The wide disparities of gasoline prices are demonstrated in a recent study⁴³ and are summarised as follows:

Policy	Typical Countries	Price of gasoline in US Cents per litre
"High fuel taxation"	European Union ⁴⁴ (Germany, France, UK, Italy etc) and specific others (e.g. Hong Kong)	78-136
"Medium fuel taxation"	Tanzania, Malawi, Madagascar, etc	47-74
"Low fuel taxation"	Ethiopia, Ghana, China, USA etc	28-36
"Subsidisation including oil producing"	Turkmenistan, Indonesia, Saudi Arabia etc	9-16

9.9.3. Since fuel consumption is proportional to distance travelled, fuel prices reflect vehicle, to an extent, vehicle use. However, increasing the price of fuel is an indiscriminate

⁴³ GTZ Study – 1998 – precise reference to be added

⁴⁴ Since the study was completed, the costs of crude oil have risen and pump prices have increased in parallel; for example, the study gives UK gasoline prices at 111 US cents/litre; current prices (June 2000) are 133 US cents per litre

policy to address demand management. Increases in fuel prices apply at all times, peak/congested and off peak/un-congested, and for all journeys and for all vehicles. Generally, while urban fuel surcharges have been used (e.g. Colombia), fuel price increases cannot be targeted to specific times or to specific congested areas (such as city centres) and thus do not manage demand where and when that management is most needed. Although, as noted above, urban differential fuel pricing has been applied there could remain issues of fuel would be bought in lower price zones outside a city to be used within the city and administration of city based fuel prices may not be straightforward in many countries. It has been argued that as there is great disparity between marginal fuel cost per vehicle kilometre and the marginal social cost per vehicle kilometre, and as fuel taxes have limits (the recent public protests in UK demonstrate that fuel prices cannot be increased indefinitely particularly without commensurate improvements in public transport), then fuel tax cannot be relied upon as a restraint mechanism for congested urban areas. It is generally concluded:

- a) Fuel prices may be an element of a national demand management policy and may discourage some unnecessary vehicle use generally but, although there has been little study on the effects in urban areas;
- b) As fuel prices do not address vehicle use at specific congested (city) locations nor specific congested times, they are not a responsive measure for reducing city traffic congestion; and
- c) Urban fuel surcharges can provide revenue which, with appropriate distribution, can be used to improve the transport system.

9.9.4. It is noted that differential fuel pricing has been used to encourage the use of unleaded gasoline for environmental reasons, for example, in Mexico City. While the policy appears to have been successful in commencing to alleviate harmful emissions, it is not aimed at demand management.

9.10 Pricing - demand management by restraint by taxes on vehicle ownership

9.10.1. Vehicle ownership, and thus car growth, may be influenced by import duties on vehicles, sales taxes and annual licence fees. In 1986, the Bank stated⁴⁵ “*Excise and ownership taxes are not likely to provide an optimum (sic) solution to congestion. Their chief value is that they can usually be adopted relatively quickly within the framework of existing legislation and thus can serve as stopgap measures until more effective control measures are devised and implemented*”. There seems little reason to change this view; as with fuel prices, generalised taxes on vehicle ownership are national in application, do not address the specific problem of congestion and pose political and equity problems.

9.10.2. The major exponent of taxation to restrain vehicle ownership is Singapore. Singapore imposes high costs on vehicle ownership within the context of a balanced transport policy which also includes increasing the capacity and the quality of the Island’s public transport and highway systems and the management of demand through road–use pricing and parking controls. Initially, Singapore exercised control on car ownership through high import duties and high annual charges, with a charge–structure designed to encourage the scrapping of older cars and to discriminate against company car–

⁴⁵ A World Bank Policy Study, Urban Transport ISBN-0-8213-0755-X, 1986

ownership. However, continued rapid growth of vehicle ownership led to a decision, in 1990, to introduce absolute limits on the number of vehicles which could be registered through a Vehicle Quota System⁴⁶. The target was to reduce the annual increase in vehicles owned to three percent. Prospective buyers of new vehicles have to bid for a 'Certificate of Entitlement' (COE) in a monthly tendering process within a predetermined supply of COE's. Depending on the category of vehicle, the premium has resulted in a premium of some 400% above *c.i.f.* car prices in most of the 1990's.

- 9.10.3. The Vehicle Quota System has enabled Singapore to control its vehicle fleet but it must be regarded as a special case and generally it is doubtful if such restraints on vehicle ownership could be applied in most developing or developed countries for at least the following reasons: (i) political acceptability, (ii) as disposable income increases, pressure will arise for increased ownership (e.g. Korea), (iii) local vehicle manufacturing interests will impose pressure, (iv) Singapore is a single city/island and registering vehicles outside the city or transport in rural areas are not issues and (v) even with the Vehicle Quota System in operation and an excellent public transport system, congestion pricing in Singapore still forms part of the package.
- 9.10.4. There are other measures to restrain ownership, although at this stage they are likely to have a fringe effect on demand management, including:
- a) In parts of Japan, for example, it is necessary to prove that a parking space is available before a car can be purchased;
 - b) In Europe, there are a number of "pilot" or small scale measures such as (i) in UK and some other countries, there are moves to sponsor inner city housing development, in which the purchasers of houses covenant not to own a car and arrangements are being made for ready access to rented vehicles on favourable term, (ii) community owned cars for sharing on a "needs" basis etc. Such measures while interesting can make no short term impact on demand management in congested cities.

9.11 Pricing – demand management through congestion charging

- 9.11.1. Traffic congestion can be stated to result because of imperfect pricing of car use and thus congestion charging would appear to be the most rational means by which demand for vehicle journeys can be balanced with supply of road space. Congestion road user charging would normally involve either:
- a) cordon charging in which vehicles pay a charge to enter a designated area or cross zonal boundaries within it; charges may vary by vehicle type, by time of day and day of week; or
 - b) area charging in which vehicles pay a charge for keeping or driving a vehicle within the boundary of a charged area.
- 9.11.2. Schemes may comprise either cordon or area charging or a combination of the approaches. At its simplest, schemes may be based on a requirement of drivers to purchase and display a paper permit or disc which is subject to manual checking and is likely to be enforced by stopping of illegal vehicles. At its most sophisticated, a scheme

⁴⁶ Motorization in Singapore, Christopher Willoughby, Draft Bank Document 1/2/00

may be based on electronic charging (or recognition of valid paid permits) of free-flow traffic based on communication between a device in a vehicle and equipment on the roadside and may be priced by time as well as by location; in this case, follow-up of illegally operated vehicles requires a full and accessible vehicle licence-ownership data base which must be nation-wide.

9.11.3. In theory, electronic charging would allow vehicles to be charged on the basis of vehicle speed, time spent in a charged area, or distance travelled. However, as far as is known, no schemes exist where charging is based on speed or time spent in the designated area. Speed related systems have been considered but they may encourage dangerous driving behaviour, such as speeding and rat running to minimise the charge to be paid. There is also evidence of a strong driver preference for knowing in advance what the charge to be levied would be, as part of the process of deciding whether and how to make journeys. Administration and enforcement of "speed related" or "time spent" schemes could also be more complicated. Pure distance-based charging is not an option with the technology currently available (each individual vehicle would have to be tracked), but it would be possible to divide up an area into a number of small zones (each with a charged cordon) as a proxy. This would also have the benefit of being able to capture orbital as well as radial journeys and journeys within the designated area. It is noted that the Singapore ERP does allow charges to be geared to time of day and thus increased during peak periods⁴⁷.

9.11.4. It has been stated⁴⁸ that a "good" road pricing system should include the following characteristics:

a) User point of view

- ◆ User friendliness – easy to understand
- ◆ Transparent – charges evident before trips undertaken
- ◆ Anonymous – privacy of users assured
- ◆ Prepayment or post-payment possible;

b) Traffic authority point of view

- ◆ Efficient – charges should reflect true user costs
- ◆ Flexible – responsiveness to demand, peak-off peak etc
- ◆ Reliable – chances of incorrect charges to users minimised
- ◆ Enforceable
- ◆ Secure – free from fraud
- ◆ Provide for occasional user
- ◆ Revenue-cost test – positive condition for "commercial viability"

c) Society's point of view

- ◆ Benefit-cost – positive

⁴⁷ Peak period charging does exist on toll roads (France, USA etc) but of course presents far fewer operational problems than area wide congestion charging.

⁴⁸ These criteria are reproduced in "Congestion Charging Mechanisms for Roads – An Evaluation of Current Practice, Timothy D Hau, Policy Research Working Paper WPS 1071, World Bank 1992" but derive from various previous works including those proposed by Smeed (UK) for London in 1964

- ◆ Minimum implementation disruption
- ◆ Minimum environmental intrusion
- ◆ Provides for mixed traffic
- ◆ Modularity to integrate with other measures e.g. parking, public transport improvements
- ◆ Tolerant to culture of non-compliance with traffic regulations
- ◆ Perception of fairness

9.11.5. It is not proposed to discuss all the criteria for congestion pricing or how they may be achieved in detail – that is not the function of this paper and a “Comparison of Road Use Charging Mechanisms” is presented in Table 5 of Hau’s paper (reference above as WPS 1071). The current Review concentrates on issues involved in implementation of congestion pricing schemes.

9.11.6. Over 8 years ago, in his paper on road pricing, Hau (reference above as WPS 1071) notes over 100 references for papers, articles, evaluations and the like relating to various forms of congestion pricing schemes. While it is undoubtedly the case that the reference library has increased since then, the paper reported that only about 6 congestion pricing schemes were in operation and even then some of these do not have “true” restraint as their main objectives but are aimed at revenue raising (e.g. Trondheim). The position on implementation is little different today. However, there is a current up-surge in interest due to the opportunities offered by high technology for INV (in-vehicle units), AVI (automatic vehicle identification), smart card technology and the like. Undoubtedly the real costs of such technology are reducing and reliability is increasing and thus “automatic” congestion pricing is becoming a practical and affordable technological possibility and Singapore introduced electronic road pricing in 1998. Even with this trend, issues such as the practicality of tracing offenders through the vehicle licensing system, which in some developing countries is not well developed, means that manual enforcement systems will remain the only viable policy in the short term.

9.11.7. In addition to the transport rationale for congestion pricing, there is a strong poverty impact case in many developing cities. Generally, it the rich who own and drive cars and thus (i) the direct costs of congestion charging are not borne by the poor and (ii) public transport improvements should be integral parts of a congestion pricing scheme and (iii) revenues from congestion pricing could be used to improve quantity and quality of public transport.

9.11.8. Congestion pricing raises revenues. In some cities, this has been a primary rationale and "selling point" for a congestion pricing scheme (e.g. Trondheim). It seems likely that congestion pricing can only be "sold" to system users if the revenues are retained in the transport system, particularly for the improvement of the public transport system. For a major city, the revenues can be large. In London, it has been estimated that a charge of US\$7.5 per day for cars and US\$22.5 per day for commercial vehicles would generate net revenues (after scheme management) of US\$750 million per year⁴⁹. This

⁴⁹ "Hearing London's Views" A Discussion Paper on the Mayor's Proposals for Congestion Charging in Central London, GLA, July 2000.

level of net revenue should permit significant improvements to the transport system. The potential for raising revenues should be particularly attractive to developing cities.

9.11.9. However, these advantages, beg the question as to why there are not more schemes in current use and none in developing cities, or for that matter, developed countries. The reasons are likely to be various and include- together with responses - the following:

a) Political opposition – charges on driving are unpopular with a vociferous section of society - (some) “car drivers”. In developed countries, this represents a high proportion of people but in developing countries, this represents a smaller but perhaps more influential section of society. While there is a clear economic case for congestion pricing as most car drivers in most cities do not pay realistic user costs, car drivers do not perceive this cost and transport planners and politicians have failed to explain the rationale and the system the benefits. Response: congestion pricing needs to be explained and "sold" to the public. The manner in which the case is presented should recognize that various transport users will perceive schemes very differently. There are at least four groups of motorized road users to which the case would need to be addressed:

- ◆ existing public transport users who do not have cars available - it is evident that this group would support a scheme provided it is comprehensive and includes public transport improvements;
- ◆ existing public transport users who are close to acquiring a car - a scheme may persuade this group to defer their car purchase if the public transport improvements are significant;
- ◆ "higher income" car users - these have an income and value their time sufficient to be persuaded that the benefits of reduced congestion justify their support (and payment of charges) for a scheme; and
- ◆ "lower income" car users - this group who would find the congestion charge high enough to restrain their car journeys and it has to be accepted that this group would offer most opposition. It has been argued that a scheme which enables the "higher income" car driver to make improved journeys, albeit at increased cost, while restraining "lower income" car users is inequitable. However, in developing cities the overwhelming majority of people travel by public transport and it is these public transport travellers would gain most - both travel time and benefits of investment in public transport from "high income" drivers' revenues; it is impossible to meet all user groups needs to the same extent and it has to be accepted that that "lower income" car users may be penalised;

b) Legal problems – at least two legal issues have arisen in the consideration of schemes in developing cities, namely: (i) direct charging for road use is not always possible under a city's existing legislation and (ii) the legal and administrative framework may not be in place (or easily realised) for the tracing and fining of offenders. Response: firstly, it has to be accepted that congestion charging may require changes in traffic legislation; this is an added reason for a highly skilled-professional agency to be created to deal with implementation. Secondly, it is essential that a congestion-charging scheme includes procedures for the identification-tracing-fining of offenders. If electronic charging coupled with "remote enforcement" (essentially, number plate recognition using cameras) is used for a congestion charging area or cordon, then a full, easily accessible national

vehicle registration ownership data base is required. It is probable that very few developing cities possess such a system and thus an immediate action scheme must be designed around a "paper based", manual enforcement procedure;

- c) Institutional weakness - there is no doubt that a congestion pricing scheme requires a competent traffic and transport planning agency to plan, design, implement and moreover manage a scheme on a continuous basis. Response: as described in Chapter 4 competent traffic planning agencies are not present in many developing cities. However, the implementation of a congestion charging scheme will be complex and even with a "traffic management agency" in place, more is likely to be needed. An agency is required with sufficient professional skills and vision to deal with political issues, public consultation, publicity, traffic and transport planning, operational management, enforcement, financial administration and numerous other aspects. The magnitude of the task cannot be underestimated and developing cities contemplating congestion pricing will have to seek new ways to develop schemes. The creation of a multi-disciplinary team for the development of a scheme will be a minimum but the self-financing nature of congestion charging suggests that the whole process - planning, design, implementation, operation, management - might be contracted out; however, there is no known experience of this approach;
- d) Congestion Pricing is not a "stand alone" policy - In some developed countries (for example in UK where congestion pricing is at the top of current transport agendas in many cities) there is concern by cities that if they introduce congestion pricing then there will be migration of business and commerce to neighbouring cities which do not introduce pricing. In a like manner, it has been argued that congestion pricing in the centre of a city will transfer economic activity to outer, presently un-congested, areas of the city. While land use changes are not instantaneous and while travel patterns depend on many factors, these arguments need to be addressed. Response: in broad terms is that (i) congestion pricing will increase, not penalise, city efficiency and should make the city more attractive to business and commerce, (ii) congestion pricing should not be regarded as the only transport policy for a city; indeed, the revenues from a congestion pricing scheme should be earmarked for improvements to the transport system as a whole and to public transport in particular and thus maintain the viability of the congested area and (iii) land use controls have to be exercised.

- 9.11.10. Cordon pricing versus area pricing -cordon pricing is most easily understood, and probably the most practical, scheme. It can offer the advantages of straightforward enforcement at a well defined set of locations (although supplementary cordons are theoretically possible), does not need to deal with residents in any special way (as with area licensing) and has flexibility of pricing by time of day which can be easily adjusted. Lack of a national, accurate, up-to-date, easily accessible vehicle registration system for tracing offenders may be a bar to remote enforcement say by cameras and vehicle number plate recognition (see also subsequent discussion on electronic pricing) and this may dictate that direct enforcement at the cordon is needed. Thus a scheme may not be feasible unless there is adequate road space (or adequate road space can be constructed similar to "toll plazas") for direct enforcement actions. Area pricing (essentially the purchase of a licence to operate within an area) has been proposed in the past as it affects all journeys to/from and within an area and theoretically allows enforcement to be applied to stationary vehicles although this raises issue of how to deal with parked vehicles which may legitimately be out of use. However, there are no

known operational schemes and in particular, enforcement poses difficult practical problems.

9.11.11. Manual/paper based or electronic - the emerging issue is whether cordon or area pricing should be a manual, "paper based" scheme or should be based on some form of electronic charging. Experience of the early Singapore Area License Scheme shows that a "paper based", manually enforced cordon pricing scheme is feasible; simple technology is not a bar to congestion pricing in developing cities. In the past (Hau, previously referenced) concluded that manual, labour intensive systems had a better cost-benefit ratio than electronic road pricing. However, in the last 2 years, electronic pricing has been shown to be operational (in Singapore) and may become a viable technical alternative as costs of equipment reduce in real terms. The considerations which might affect selection of a manual or electronic scheme in a developing city include:

- a) Manual cordon pricing may only be feasible where road network cordon crossings are few (such as Singapore, Mumbai, Lagos, Bangkok etc); the physical problems of locating and administering on a consistent, daily basis a large number of control points may be difficult to achieve although contracting out the entire scheme seems to offer a clear way forward;
- b) Electronic pricing with some form of stored value-credit (as Singapore) in-vehicle offers efficiency and effectiveness as charges can be geared to traffic conditions and times of day⁵⁰ and a balance can be achieved between optimum use of road space and charges;
- c) Electronic pricing raises operational-administrative issues in developing cities which could include:
 - ◆ tracing scheme violators will be a problem in many cities as national, centralised, accessible vehicle registration records are not likely to be available. On-the-spot fines for violators may be the only enforcement policy possible and as noted above, this has serious implications for feasibility of cordon schemes in that road space is required to deal with offenders, there is the possibility of corruption arising from a direct fine system and the numbers of offenders and thus congestion induced may be so great that the benefits of the scheme are eroded;
 - ◆ electronic charging schemes requires a complex administrative set-up to install in-car equipment (it is believed to have taken Singapore over a year to fit all in-vehicle units although this is not the only electronic charging system), to sell smart cards or levy charges etc. Again, these problems are not insurmountable in more advanced cities such as Moscow or Sao Paulo but could be difficult, even if contracted out, in many less developed cities;

9.11.12. Parallel measures - congestion pricing should be part of a comprehensive package of measures which would include:

- a) Improvements in public transport quantity and quality must be part of an overall restraint policy; in particular, traffic congestion approaching the priced area is likely and public transport (bus) priority on street is necessary on the approaches

⁵⁰ Motorization in Singapore, Christopher Willoughby, Draft Bank Document 1/2/00 (para 50-51)

- b) The disposition of revenues collected from road pricing should be made explicit to the public and is crucial to success and public acceptability; revenues from schemes should be earmarked for improvements to the transport system as a whole and to public transport in particular;
- c) Land use controls to discourage prevent migration of activities (and congestion) to other locations

9.12 Restraint through land–use and development controls

- 9.12.1. As travel demand is dependent on land use disposition, it should theoretically be possible to reduce overall demand for travel through control of land-use. Indeed, it can be argued that much of the increase in the use of cars is a direct result of policies which have permitted, even encouraged, the dispersion of major activity centres to the fringes of urban areas and beyond. Many of these locations are not readily accessible by public transport and, with concentration into larger units for retail, education, healthcare and recreation, few people live near enough to access them by foot or bicycle.
- 9.12.2. The need, at least, to curtail, if not reverse, some of these trends is recognised in most European cities⁵¹ and new processes are sought to provide to facilitate access by public transport, bicycle and on foot. In particular development policies can be used to control the extent of parking in new developments. For example, in UK, apart from restrictions on absolute parking capacity, local authorities are empowered to permit development with an attached condition that a defined percentage of travellers must use public transport; development owners must close parking spaces or pay fines if that proportion is not reached. In Paris, for large companies, financial-tax benefits accrue if a proportion of employees use public transport and so on.
- 9.12.3. However, in developing cities, it is noted:
 - a) congestion is severe and land use controls are a medium to long term policy (another factor in favour of congestion pricing which is an immediate policy);
 - b) competition between adjacent localities can seriously reduce the effectiveness of well–intended policies; if there is a choice between accommodating the requirements of a major project, which will enhance the local economy, by relaxing stringent policies or, seeing the project go elsewhere, by maintaining those policies, many authorities will opt for the former; and
 - c) land use control policies need a strong institutional and planning agency to define and to implement land use policy through the planning framework. Many developing cities lack these essentials.
- 9.12.4. Despite these problems, ultimately, every city should seek to reduce travel demand by integrated land use control and transport policies. Although examples are few and include Singapore, the case of Curitiba (Brazil) must be mentioned. *“Curitiba has used, since 1965, land use planning, the hierarchy of road network, an economic development policy and public transport to co-ordinate the parameters for the location and density*

⁵¹ The Review is not sufficiently familiar with land use control policies in other continents, particularly North America.

of homes, work, recreation, services and commerce"⁵². The city continues to develop its land use in relation to transport. The Inter American Development Bank (IDB) has recently completed participation in a project that includes enhancement of the bus terminals at the out-of-town ends of major trunk line corridors. The terminals are being developed as local centres with facilities for shopping, local services (the municipality has established offices at each terminal), utility companies, offices, sports etc. It is reported that the IDB is currently also participating in a loan project with the State of Parana (of which Curitiba is the state capital) to replicate the Curitiba experience in medium sized cities (about 1 million population) throughout the State to integrate land use and transport. The Curitiba experience has been documented in the technical literature over the last two decades and is an example to the rest of the world. Other cities can clearly learn from Curitiba⁵³ but those cities need to understand that the success of the Curitiba system cannot be copied immediately and directly - the Curitiba system was developed over some 20 years, was founded on a strong planning institute (IPUUC) and benefited from political continuity.

9.13 Conclusions

- 9.13.1. As city populations and economies grow, car ownership and use will increase and urban traffic congestion will worsen. Although the construction of additional or alternative road capacity can alleviate some of the effects of congestion, (i) even if they are affordable, new roads generate traffic and (ii) the benefits are most likely to be offset by congestion unless growth in traffic is managed and restrained. Policies are needed to deal with inevitable increasing urban traffic congestion.
- 9.13.2. The objectives of an urban traffic demand management policy are to
 - a) reduce traffic congestion consistent with improved economic efficiency and personal mobility; and
 - b) reduce adverse traffic related impacts on the city environment. The rationale for demand management is that vehicles should pay a realistic price for the full costs of their journeys either by direct charging or by indirect means
- 9.13.3. Conclusions with respect to the possible policies are summarised as:

⁵² Innovative land use and public transport policy, the case of Curitiba, Brazil, Jonas Rabinovitch, Land Use Policy, Vol 13, No 1, 1996

⁵³ It is understood that Curitiba receives, on average, about 1 technical visit per week from other cities.

Measure	Key Advantages	Key Disadvantages	Experience and Conclusions
<p>Parking controls and management through</p> <ul style="list-style-type: none"> ▪ On street parking prohibitions ▪ On and off street charged parking ▪ Control of charges and supply of off and on street parking 	<ul style="list-style-type: none"> ▪ least contentious demand management instrument ▪ most widely understood by public and likely to be most easily accepted ▪ can raise significant revenue ▪ charges have re-distributive effect as generally car-owning “rich” pay the charges 	<ul style="list-style-type: none"> ▪ on street parking controls in congested areas can generate traffic by releasing road space for through traffic; ▪ parking controls need high level (costly) enforcement ▪ parking charges and enforcement can be corrupt ▪ use of chauffeurs-drivers means cars do not have to park and thus avoid controls ▪ charges for publicly available off street parking may not be in control of the traffic agency ▪ private off street parking not likely to be control of traffic agency 	<ul style="list-style-type: none"> ▪ parking controls are used to some extent in most developing cities but with the main objective to eliminate obstructions to traffic flow on main roads rather than to manage demand ▪ a parking policy is essential to good traffic management practice and despite the problems and weaknesses, a parking policy is likely to be the starting point for demand management in most cities; parking should be charged since car drivers should pay the full costs of their journey and parking is a part of any journey made by car; free parking would be a subsidy to car users ▪ a parking policy will not be effective as a restraint measure unless the traffic agency controls a large fraction of <u>all</u> parking and can co-ordinate charges for on-street, publicly available off street and private non residential parking within a consistent policy. This is not easy to achieve, particularly for private non residential parking (where local taxes on parking places such as “workplace parking levies” would be needed and moreover would need to be passed on to drivers in some way to act as a disincentive to car travel) ▪ enforcement-sanctions-tracing offenders-corruption have posed difficulties in many developing cities; to some extent utilising the private sector, including for operation of on-street charged parking, can assist overcome the problems ▪ while parking charges alone are unlikely to have the congestion-relief effect required, <u>charged parking should be part of an integrated policy</u>
<p>Use of vehicles – demand management by regulatory control such as “odd-even” number plate prohibitions and variants based on number plate identification such as prohibitions for selected days, for selected hours and for selected roads</p>	<ul style="list-style-type: none"> ▪ cheap to implement ▪ almost always accepted by the public as a demonstration of commitment by city authorities to take positive action to reduce congestion and related air pollution ▪ less difficult to enforce than feared; experience in Mexico City, Bogota, Santiago etc) and even if there are infringements, provided enforcement is reasonably efficient, the 	<ul style="list-style-type: none"> ▪ encourages an increase in the number of vehicles owned, to provide households with both permitted vehicles for any day; ▪ induces more trips by permitted vehicles than were made by those vehicles before the prohibitions were introduced; ▪ possibility of fraud and evasion problem; ▪ not a long term measure as undermined by growth in vehicle ownership over time; ▪ undermined by concessions- 	<ul style="list-style-type: none"> ▪ Many cities have used variants of “odd-even” scheme including: <ul style="list-style-type: none"> ▪ Lagos (odd/even but now no longer operational) ▪ Mexico City (2 days per week but being phased out) ▪ Bogota (peak period prohibitions 2 days per week) ▪ Santiago de Chile (total exclusion for 2½ hours per day on main arteries during air pollution emergencies) ▪ Seoul (2 or 3 days per month defined by last digit in number plate) ▪ Sao Paulo - (2 days per week, peak hours) ▪ Manila (prohibitions on main arteries in peak periods), ▪ The only scheme which has been subject to detailed analysis of impacts (as opposed to measurements of vehicle speed) indicates that dis-benefits may outweigh benefits in medium term (Eskelund etc al, see reference). ▪ The measures cannot be regarded as a long term solution. However, the basic measures are relatively simple to implement (although complex restrictions by time or location such as that in Manila are not

Measure	Key Advantages	Key Disadvantages	Experience and Conclusions
	<p>finances can finance the increased enforcement effort</p> <ul style="list-style-type: none"> ▪ if acted upon, can give a “breathing space” to develop something better; ▪ generally assists road based public transport at least in the short term as traffic flow conditions do improve. 	<p>exemptions (e.g. for example for government vehicles);</p>	<p>always understood) and there are short term benefits. Provided the time when the scheme is effective can be used to develop a more comprehensive and sustainable measure, such measures may be worthwhile, particularly when they are aimed at emergencies such as air pollution alleviation (Mexico City, Santiago de Chile etc)</p>
<p>Use of vehicles – demand management by physical measures such as</p> <ul style="list-style-type: none"> ▪ pedestrian areas ▪ environmental cells ▪ road space reallocation to buses or high occupancy vehicles 	<ul style="list-style-type: none"> ▪ The measures are likely to result in more “liveable” cities ▪ Road space reallocation to buses will increase bus performance and improve public transport and may result in some mode shift 	<ul style="list-style-type: none"> ▪ The measures do not impose direct restraint on cars and are unlikely to have great impact on traffic demand ▪ If the measures result in traffic congestion and-or long diversions, effects may be negative – particularly environmental impacts 	<ul style="list-style-type: none"> ▪ Bus priority and pedestrian schemes are conventional traffic management measures aimed at “people” and not “vehicles” and experience and issues have been noted in other sections of the Review; ▪ The measures are likely to have considerable merit in increasing urban transport efficiency but do not impose direct restraint on car use: <ul style="list-style-type: none"> ▪ Pedestrian measures are essential to improve walk journeys and to promote safety and “liveable” cities but are unlikely to affect car demand ▪ Bus priority will improve the quality of bus services which may cause some mode change but not likely to have great impacts on car demand. ▪ These types of measures should be pursued in their own right but should also be part of the incentives within a more comprehensive demand management policy.
<p>Pricing - demand management through charges on vehicle use and ownership such as</p> <ul style="list-style-type: none"> ▪ Fuel prices ▪ Registration taxes on vehicles and other ownership taxes 	<ul style="list-style-type: none"> ▪ Raises revenue which may be used to improve the transport system ▪ Fuel tax and ownership charges have re-distributive effect as generally car-owning “rich” pay 	<ul style="list-style-type: none"> ▪ fuel prices apply at all times (peak and off peak), for all journeys and for all vehicles; thus they do not manage demand where and when it is most needed ▪ Differential fuel pricing for urban areas has been used (Colombia) but does not address specific congestion problems and may have some problems such as fuel bought in lower price zones outside a 	<ul style="list-style-type: none"> ▪ Use - fuel consumption is proportional to distance travelled and thus fuel prices reflect vehicle use to some extent. However, fuel price does not discriminate against use of vehicles at congested times and in congested locations. Fuel tax does not address the problems of city specific congestion ▪ Ownership - Singapore is probably the only country which applies a policy with the primary aim of limiting the vehicle fleet. It seems unlikely that the locational and institutional circumstances which allow the “Vehicle Quota System” to operate in Singapore could be replicated in other countries and, in any event, as with fuel prices, the vehicle ownership taxes are indiscriminate in dealing with urban congestion ▪ Taxes on vehicle ownership and fuel are important sources of revenue

Measure	Key Advantages	Key Disadvantages	Experience and Conclusions
		<p>city to be used within the city</p> <ul style="list-style-type: none"> ▪ Taxes on ownership unlikely to be possible on city specific basis as vehicles would be purchased and registered outside the city ▪ Public tolerance of very high levels of charge without apparent (public transport) gain may limit prices and thus have little effect on demand 	<p>for public finances but do not target (by location, by time etc) the alleviation of urban traffic congestion; this plus public intolerance for very high levels of tax, indicate that the instruments are not likely to be effective in alleviating urban traffic congestion</p>
<p>Pricing – demand management through congestion charging including:</p> <ul style="list-style-type: none"> ▪ Cordon pricing ▪ Area pricing 	<ul style="list-style-type: none"> ▪ increases transport efficiency, reduces environmental impact of traffic and defers or obviates need for heavy investment in urban roads ▪ can be implemented in a short time scale ▪ can be designed to target traffic congestion at specific areas and specific times – variable prices enables highly efficient balance of demand with congestion to be achieved ▪ self financing and generates revenues for parallel public transport improvement and other city transport investments ▪ congestion charges have re-distributive effect as generally car-owning “rich” pay ▪ manual-paper based cordon charging has been shown to be effective and 	<ul style="list-style-type: none"> ▪ political commitment and public acceptability not easy to obtain ▪ operational feasibility issues <ul style="list-style-type: none"> ▪ congestion pricing requires a competent traffic and transport agency to plan, design, implement, enforce and moreover manage a scheme on a continuous basis; only “advanced” developing cities likely to be able to comply but the process may be contracted out although there is no experience ▪ cordon pricing by manual means may not be feasible if there are large numbers of cordon road crossing points and/or no centralised, easily accessible vehicle registration records to trace offenders 	<p>The main conclusions with respect to congestion pricing are as follows:</p> <ul style="list-style-type: none"> ▪ There are only some 6 urban road pricing schemes (there of course many tolled highways or bridges or tunnels) and of those, perhaps only Singapore has, as its primary aim, the restraint of road traffic. The experience from the limited number of schemes show congestion pricing is operationally feasible and effective in reducing congestion and limiting demand.. Important schemes, such as Trondheim, are aimed to raise funds for transport infrastructure development although at the same time seek to “use the system as a traffic regulation tool”. ▪ Cordon pricing is most easily understood, and probably the most practical, scheme. Lack of a national, accurate, up-to-date, easily accessible vehicle registration system for tracing offenders may be a bar to automatic enforcement, (e.g. cameras and vehicle number plate recognition). Direct enforcement at the cordon may be needed but may not be feasible unless there is adequate road space (or adequate “toll plazas” road space can be constructed) for enforcement actions. ▪ The emerging issue is whether cordon pricing should be manual, “paper based” or should be based on some form of electronic charging. Experience of the original Singapore Area License Scheme shows that a “paper based”, manually enforced cordon pricing scheme is feasible; simple technology is not a bar to congestion pricing in developing cities. Electronic pricing has been shown to be operational (in Singapore) and may become a viable technical alternative as costs of equipment reduce in real terms. Selection between manual or electronic systems must consider, <i>inter alia</i>, the following: <ul style="list-style-type: none"> ▪ Manual cordon pricing may only be feasible where road network

Measure	Key Advantages	Key Disadvantages	Experience and Conclusions
	operational (Singapore)	<ul style="list-style-type: none"> ▪ area pricing is likely to be beyond the current scope of some developing cities; ▪ electronic pricing could overcome direct enforcement problems (lack of space) but is likely to be outside the immediate scope of many cities unless centralised, easily accessible vehicle registration records are available 	<p>cordon crossings are few (such as Mumbai, Lagos, Bangkok etc);</p> <ul style="list-style-type: none"> ▪ Tracing scheme violators will be a problem in many cities if electronic pricing is used unless a national, centralised, accessible, up-to-date vehicle registration record is available; ▪ Direct charge-checking and on-the-spot fines for violators may be the only enforcement option for many developing city potential cordon schemes but the implications on road space, corruption and congestion at charging points needs assessment ▪ Electronic charging schemes requires a complex administrative set-up to install in-car equipment, to sell smart cards or levy charges and to enforce against offenders. Although the problems are not likely to be insurmountable in more advanced cities, they could pose difficulties, even if contracted out, in many less developed cities; ▪ Congestion pricing should be part of a comprehensive restraint policy which would include: <ul style="list-style-type: none"> ▪ Improvements in public transport quantity and quality; ▪ A explicit policy on the disposition of revenues collected from road pricing to improve public transport and is crucial to success and public acceptability; ▪ Land use controls to discourage prevent migration of activities (and congestion) to other locations
Restraint through land use development controls	<ul style="list-style-type: none"> ▪ Reduced demand for travel offers economic, sustainability (at a minimum reduced fuel consumption), social and environmental benefit 	<ul style="list-style-type: none"> ▪ medium to long term policy – does not address immediate traffic congestion problems ▪ land use control policies need a strong institutional and planning agency to define policy and to implement that policy through the planning framework. Many developing cities lack these essentials. 	Improved integration of transport – land use is the goal of most cities. As travel demand is dependent on land use disposition, it should theoretically be possible to reduce overall demand for travel through control of land-use development. It can be argued that much of the increase in the use of cars is a direct result of policies which have permitted, even encouraged, the dispersion of major activity centres to the fringes of urban areas and beyond. Many of these locations are not readily accessible by public transport and, with concentration into larger units for retail, education, healthcare and recreation, few people live near enough to access them by foot or bicycle. Cities like Curitiba demonstrate the benefits of linking land use development and transport – less travel, shorter journeys, lower cost journeys etc.

10. TRENDS IN TRAFFIC MANAGEMENT

10.1 Introduction

- 10.1.1. This Chapter reviews some traffic management trends in developed cities which may have application in developing cities (some of the aspects have been noted in previous Chapters).

10.2 Public involvement

- 10.2.1. In developed cities, public involvement in traffic and transport development is an increasingly integral part of the planning and implementation of any traffic and transport scheme. There are good reasons for involving the public in traffic matters including:

- a) traffic planners are unlikely to know any particular city area as well as those who use it regularly; often, local people are not only well aware of the problems but also have positive ideas about what kinds of measure might be appropriate;
- b) increasingly, traffic schemes require changes in public attitudes and behaviour if they are to succeed in their objectives (e.g. bus priority) and the more a scheme is supported by the groups affected, the more likely that the scheme will be implemented successfully;
- c) where there are financial constraints, such that a traffic agency has to choose between conflicting claims on resources, schemes are more likely to be adopted if there is evidence of strong local support; and
- d) traffic schemes can have a major impact on the areas where people live, work and carry out their daily activities; increasing numbers of people feel that they have a democratic right to be consulted, especially if the city is going to take any action which would materially affect their way of life.

- 10.2.2. The “public” in the broadest sense, includes all those who have an interest in a scheme and comprise three broad categories of people:

- a) those who use the traffic system affected by the measures;
- b) those who are affected by the proposed traffic scheme, principally those who live, work, shop, run their businesses etc. in the area concerned; and
- c) those who provide transport services.

- 10.2.3. “Involving the public” can encompass a wide range of processes and three levels of public involvement are usually identified:

- a) information: where the public is notified about a proposed scheme; this is essentially a one-way process, in which information is disseminated from the traffic agency to the public via press releases, publicity hand outs, etc and informs users what is expected and how a scheme will operate;

- b) consultation: where the views of the public are sought, at various stages of scheme or strategy preparation and implementation. The views are input to the planning process but this remains under the full control of the traffic agency professionals who may recognise the results of the consultation in design. This may be termed as a “one–way process with feedback; and
- c) participation: where the public are brought into a two–way dialogue with the traffic agency professionals and have a direct influence on the outcome of the process and, as a result, can changes in attitudes and perceptions on both sides.

10.2.4. Involving the public takes times and resources. However, in developed cities, it is considered that this effort is off set by achieving support for schemes and the subsequent ease of scheme implementation.

10.2.5. As far as is known, there is little public involvement in Bank traffic management projects⁵⁴. It is not known if many developing cities have statutory obligations to undertake public involvement but it is considered however, that the process will become inevitable over time. This will be particularly the case where innovative schemes are proposed such as congestion pricing.

10.3 Area Traffic Control (ATC)

10.3.1. In developed cities, the trend is undoubtedly towards traffic demand responsive systems, increasingly with facilities to assist on street bus operations. Chapter 3 has stated that ATC is a proposal in almost all Bank projects with a traffic management component but there has been reluctance in Bank projects to include “state of the art” demand responsive system due to costs and perceived problems of maintenance. As the real costs of high technology equipment decreases and the reliability of equipment increases, many more developing cities will seek “state of the art” (some form of demand responsive”) systems and it is considered that this is inevitable. However, ATC has a very chequered history of contract failure, dispute and procurement difficulties (*“The troubled phase I UTC system (in Bangkok) is still not functioning properly due to poor co-operation from the traffic police and some ongoing contractual difficulties”*⁵⁵) and in the past has lacked sustainability (Bombay and Manila systems implemented under Bank projects in the 1980’s are more-or-less out of commission). As noted in Chapters 3 and 4, there is a need for (i) ATC guidelines to developing cities and (ii) a sound institutional arrangement for the planning, procurement, and management of ATC.

10.4 Road Space Reallocation – Bus Priority

10.4.1. Bus priority is an effective measure to meet traffic strategy objectives - it favours people and not vehicles and enables roads to be used efficiently. Reallocation of road space from cars to buses forms part of the traffic strategy of most developed cities. The extent to which reallocation is pursued varies but, there is an increasing trend for positive, preferential reallocation such that buses can be freed from the effects of traffic congestion at all times of the day and over their complete route itinerary. Due to road

⁵⁴ Public consultation is proposed for the traffic schemes in the Mumbai UTP and, it is believed, have taken place for some schemes in the Manila project.

⁵⁵ Asian Tigers – P Sayeg, Traffic Technology International, UK and International Press, June-July 2000

width constraints, it is not always possible to provide physical measures (bus lanes and/or busways) and other management measures such as traffic metering-traffic queue relocation with bus lane “by-passes” are now used.

10.5 Packaging of Measures

10.5.1. Chapter 3 states that traffic management is most effective if applied on a comprehensive basis in corridors or city areas. Two UK traffic management based initiatives are interesting in that they have implemented the “package” approach in a major city; for example:

- a) “quality partnerships” have been developed with the objective of improving the complete bus service along a route. A “quality partnership” is an agreement reached between the equivalent of the traffic management agency, the bus operator and local municipalities to improve all aspects of bus-based journeys along a route – to improve the “quality” of service. Measures include traffic management measures to assist buses (bus priority, junction improvements, signals systems etc), off-bus improvements (bus stops, shelters, pedestrian access to/from bus services etc) and bus improvements (better buses, passenger information, etc). Each agency contributes to the cost of the package which is marketed to the public as an integrated scheme;
- b) “Red Routes”- in 1991, a Traffic Director for London was appointed to develop traffic management measures over a network of 500 kms (315 miles) of the more important roads in London with a view to reducing congestion. The network was termed the “Red Route” network because of the purpose designed kerbside red-coloured “no-stopping” markings and red-bordered signs. While the objectives of the network can be debated – in the first instance, bus priority was not allowed to affect unduly traffic capacity and cars benefited although this has now changed – the initiative is interesting particularly from the institutional standpoint. In effect, the responsibility for comprehensive traffic management treatment of main roads throughout the city was given into the responsibility of one office. The office contracted all design work to local authorities which in many cases used consultants. The single responsibility and the concentration on the most important and heavily trafficked roads has been effective; the measures were largely designed and implemented by 2000.

10.6 Development Gain

10.6.1. Large scale city development (shopping centres, large office complexes etc) rely on good road based (car, bus, pedestrian) access but they also create high travel demand. A trend has emerged to seek contributions from developers for the improvement of the transport system and to “compensate” for the impact of large scale development. In some cases developers have financed public transport services but typically, developers contribute to the traffic management costs of improving access roads, junctions or other traffic measures.

10.7 Road Pricing

- 10.7.1. Generally, over the last few years, there has been a resurgence of interest in congestion pricing although little new implementation. To some extent, the renewed interest has been stimulated by the potential of automatic electronic charging and enforcement systems. Singapore electronic road pricing (ERP) was implemented in 1998 and other cities have more limited electronic pricing mechanisms such as electronic toll collection (mainly on toll roads and barrier crossings (bridges etc) but also in the urban context such as the Trondheim cordon scheme). There are various forms of electronic pricing (for example, all vehicles in Singapore have an in-vehicle unit supplied by government) and not all would be feasible for developing cities and Hau (see Chapter 9) suggested in 1996 that “paper based”, manual systems would be more appropriate. This may still be the case for a large number of cities particularly as electronic-automatic charging systems (i) rely on access to complete and national vehicle licence-ownership records and (ii) should be operational at all times (unlike say ATC which has built in fall backs in the case of failure). However, technology is developing rapidly, real costs are reducing and following experience of implementation in cities other than Singapore, ERP is likely to become the norm.

10.8 Contracting out and new forms of traffic management institutions

- 10.8.1. It is common in both developing and developed cities to contract out to the private sector specific tasks such as operating parking or maintenance of traffic signals. In some developed cities, the contracting out process has been taken further and has been applied to a broad range of traffic management planning, design and implementation functions. In other countries, notably Brazil, independent traffic companies or institutes have been created and full scale contracting out has been used (Vila Velha, Chapter 4). Both actions – contracting out to independent institutes and contracting out a wide range of functions - may have application in developing cities particularly to overcome traffic management staffing issues (poor municipal salaries and lack of career paths).

10.9 Traffic calming

- 10.9.1. Speed limits and controls are powerful actions in reducing the severity of accidents. Speed limits on main roads must be enforced by the traffic police. In developed countries there is increasing use of remote enforcement using cameras, number plate recognition etc. Such means need full and accessible driver licence-vehicle ownership records and these are often not available in developing cities although may be possible in some more developed cities.
- 10.9.2. Traffic calming can also reduce traffic speeds and has found increasing use in developed cities over the last 10 years. On main roads, various measures exist to reduce speeds and warn drivers of approaching hazards (such as changes in road texture or colour or markings: speed may also be reduced by the linking of traffic signal timings to control and maintain a desired safe speed of traffic progression). On lesser roads, a wide range of physical traffic calming measures for speed control (and in some cases, to limit traffic volumes) has been used, particularly in European cities. Measures include road narrowing, indirect road alignment, speed control humps-tables of various forms, roads width which prohibits use by certain classes of vehicle (usually trucks) etc. The measures are described in more detail in Chapter 6. Some of these measures will find

application in developing cities but a high standard of design is required to ensure that the measures do not themselves (i) adversely affect buses (poorly designed speed humps and buses are incompatible) or (ii) introduce new traffic hazards or (iii) result in increased environmental damage, for example, as vehicles slow or stop and then immediately accelerate after speed humps, thus increasing emissions. While the principle of traffic calming appears to offer advantages, more research is needed to determine the impacts of such measures in developing cities and the design standards and criteria appropriate for application.

10.10 Bicycles

10.10.1. In developing countries, particularly in Europe, there is an increasingly positive attitude towards encouraging bicycle travel. Bicycles are efficient for short-medium journeys - they are flexible, affordable by all but the poorest sections of society, emission-free and, with good planning, do not add to traffic congestion. There is scope in developing countries for better use of cycles. This does not mean that European or developed city standards should be adopted - design standards consistent with developing countries opportunities and constraints need to be applied. Care must be taken to ensure that bicycle schemes are planned to fulfil a real (or a realistically assessed) need and are not implemented in locations which are “easy”, an inconvenience to no one (basically to cars) and thus are of little value to users and potential users

10.11 The potential for transport telematics

10.11.1. In developed countries, advanced transport telematics (ATT) to promote intelligent transport systems (ITS) is expected to contribute to increasing efficiency in travel and transport. Application potential in developed countries includes:

- ◆ automatic vehicle location (AVL) for bus systems enabling operators to tailor operations more closely with passenger demand;
- ◆ automatic vehicle recognition for traffic regulation and traffic speed limit enforcement;
- ◆ real-time information for passengers at bus stops;
- ◆ network wide real time information on traffic conditions and routes and variable message signing to inform drivers thus enabling them to plan their journeys to avoid congested times and places
- ◆ stored value and smart card technology for inter mode public transport fares;
- ◆ electronic toll collection (ETC);
- ◆ electronic road pricing (ERP - see Chapter 9 and above);
- ◆ demand management through "tele-working" to avoid commuting.

10.11.2. Not all such applications are likely to be appropriate for all developing cities – for example, in cities where bus services are operated by 100’s of private operators there seems little chance of real time information at bus stops or AVL. However, there are many advanced cities in developing countries where automatic enforcement technology or ERP or ETC technology will increase transport efficiency. Even in poorer cities, some of the techniques are thought to offer efficiency gains and are under test (e.g. stored value bus tickets in Mumbai).

10.12 Conclusions

10.12.1. Conclusions are summarised as:

Conclusions on Trends in Traffic Management

As technology and as public expectations change, a number of trends have emerged which will find increasing application in developing cities:

- Public involvement - public involvement in traffic and transport development is an increasingly integral part of the planning and implementation of traffic and transport schemes. Public involvement varies from (i) information to (ii) consultation to (iii) participation. Public involvement takes time and resources but the effort is off-set by achieving public support for schemes and thus fewer problems with implementation. It is not known if many developing cities have statutory obligations to undertake public involvement but it is considered that the process will become inevitable over time, particularly where innovative schemes are proposed such as congestion pricing
- Area Traffic Control – the trend in traffic signal control in developed cities is towards traffic demand responsive ATC systems. There has been some reluctance in Bank projects to include “state of the art” demand responsive ATC system due to costs and perceived problems of, and capabilities for, maintenance. Real costs equipment are reducing, reliability is increasing and demand responsive ATC can improve the status and image of traffic management agencies and the systems will be increasingly justified in more advanced cities developing cities. However, ATC is not without problems and (i) there is a need for ATC planning and procurement guidelines for developing cities and (ii) sound institutional arrangements must be in place for the planning, procurement, and management of ATC.
- Road space reallocation-bus priority – developed cities recognize that roads cannot meet full car demand in urban areas and that buses, as the most efficient users of road space, should be freed from the effects of traffic congestion at all times of the day over their complete route itinerary. Reallocation of road space from cars to buses to provide effective priority is an important part of traffic strategy. The extent to which reallocation is pursued varies but, the trend is increasing for positive road space reallocation to buses and techniques are available to provide priority where road space is highly constrained, (e.g. traffic metering-traffic queue relocation with bus lane “by-passes”). Road space reallocation from cars to buses should find increasing application in developing cities.
- Packaging of measures - there are moves to involve all agencies -- traffic management agency, local councils, bus operators, highways agency -- in integrated programs with each agency contributing both support and finance for their respective areas of responsibility; the trend may find application in developing cities
- Development gains – contributions from property developers for the improvement of the transport system and to “compensate” for the traffic impact of large scale development are now common in developed cities. In some cases, this "gain" is realised by developers financing public transport service operations but typically, developers contribute to the traffic management costs of improving access roads, junctions or other traffic measures affected by proposed developments. Developing cities would do well to seek similar gains; the experience of cities such as London and Hong Kong offer good examples.
- Road pricing - generally, over the last few years, there has been a resurgence of interest in congestion pricing although, regrettably, little new implementation. To some extent, the renewed interest has been stimulated by the potential offered by automatic electronic charging and enforcement systems and it is only a matter of time before more restraint schemes, using electronic road pricing (ERP), are introduced in major cities. A constraint on application of ERP in developing cities is likely to be the absence of automatically accessible, full vehicle license-ownership records for enforcement purposes.
- Contracting out and new forms of institution– contracting out of functions to the private sector occurs both in developed and some developing cities. In addition to standard functions (e.g. parking, traffic monitoring etc) (i) contracts have been issued to private companies for conduct of all or most traffic management functions or (ii) autonomous companies or institutes with responsibility for traffic management have been created. These approaches may assist in overcoming traffic management staffing issues (poor municipal salaries and lack of career paths).
- Traffic calming - is widely used in developed cities to control vehicle speeds and improve quality of life. The techniques can find application in developing cities provided high standards of planning and design are adopted; research is needed on the impact of traffic calming in developing cities and for development of appropriate design guidelines and standards.
- Bicycles - developed cities have adopted policies and design standards to promote bicycle use. There is perhaps greater scope for promotion of bicycle travel in developing cities but appropriate planning

and design city standards should be adopted.

- Potential for transport telematics – developed cities are increasing using electronic advanced technology for traffic management measures – enforcement using automatic vehicle recognition, dynamic route signs, electronic pricing for tolls (or potentially for congestion pricing), etc. In more advanced cities in developing countries, such measures could increase efficiency of traffic operations.

11. ANNEX A - TERMS OF REFERENCE

Department for International Development World Bank Urban Transport Strategy Review

Review of Experience in Traffic Management and Demand Management in Developing Countries

Terms of Reference 3rd.Draft

Background

1. Over the last decade the World Bank has significantly increased its intervention in the urban transport sub-sector. As a consequence the Transport Sector Board of the Bank has decided that the development of a new urban transport strategy, consistent with the general transport policy framework and the new urban development strategy, should be a priority activity for FY 2000. The objective of the activity would be to review world-wide experience as the basis for providing operational guidance to the Bank urban transport activity for the next 10 years. The proposed sector initiative is thus of the very highest strategic significance.

2. The review to be undertaken under these terms of reference will be one of a number of topic reviews commissioned in support of the World Bank Urban Transport Sector Review. While commissioned by DFID, the work will be supervised by urban transport staff of the World Bank to whom outputs will be submitted. It is intended that it will be widely disseminated, and shall be incorporated in the materials to be subject to consultation throughout the development community.

Objectives

3. The purpose of this review is to examine experience and good practice in traffic management in developed and developing countries, with particular attention being given to the institutional requirements for sustainability. A wide range of traffic management instruments and areas of application should be covered. The review should cover the experience of the World Bank and, as far as practicable, other Donor Agencies, in the planning, design, implementation, operation and maintenance of traffic management measures in towns and cities in developing countries, as an aid to

- (i) determining the issues on traffic management to be discussed in the UTS review.
- (ii) suggesting the strategy for traffic management to included in the UTS

In this context, the review should also consider whether there are traffic management measures and instruments currently being applied in the developed world which could have application in the developing world, but which so far are only finding limited use.

Scope of Work - Traffic Management.

4. The review will be conducted by reviewing previous generic reports or sections of Bank reports, or reports by other donors. It will be informed by the experience of the consultant in both developed and developing countries. Where appropriate, interviews should also be conducted with Bank (and other donor) task managers, and consultants with experience in traffic management in cities in developing countries. Specific topic areas to be covered are discussed below:

Past and current practices and trends in traffic management.

5. What general trends emerge – what has happened to traffic management in urban areas in developing countries. Is TM taken seriously or is it only practised if/when donors are present. Is it traffic management or just traffic engineering? Does TM have any professional kudos? Is there an understanding of the traffic and economic benefits? How does what has happened in developing countries compare with what happened in the early days of development of traffic management in the developed world?

Institutional arrangements for traffic management.

6. What are the most common arrangements? To what extent do specialist TM units exist? Are these in engineering depts. or part of the police? And at what level of government? What degree of interagency co-operation is there, particularly between the police and the traffic engineers/managers? What are the advantages/disadvantages/pitfalls of the different arrangements? Which appear to work best? Which appear to be the most sustainable?

Human Resources and Training

7. Have the numbers of people working in TM increased substantially over the past 20 years? Just how many are there, and how do the ratios compare with developed countries? How are people trained – is there reliance on domestic tertiary education, foreign or is training largely in service vocational? What is the most appropriate means of making the most effective use of the resources that are available? Should local resources be leveraged through use of foreign advisors, or should TM services be contracted out to foreign or local consultants? What role have donors played, have they been effective, and should they do more in defining training programs and delivery mechanisms?

Standards, guidelines and procedures.

8. What technical materials are being used? Is there a reliance on foreign material, or is there emergence of locally produced guidelines, adapted/customized from International Good Practice? Are central govt. units providing guidance, or is it coming from bi-lateral and international agencies? What role have donors played, have they been effective, and should they do more in assisting countries to develop and disseminate guidelines? A review of scheme planning, design and procurement procedures and issues would be included.

Content of Traffic Management Components.

9. Review the traffic management and road safety components of projects funded by the World Bank and other agencies, and the experience gained and lessons learnt Out of the list of possible components, which have been included, which have been most successful/sustainable and what are the trends? Possible components include:

- Junction channelisation
- Signing and lining
- Traffic signals
- Area Traffic Control (ATC)
- Pedestrian facilities
- Facilities for bicycles and other NMT
- Bus priority
- Parking management, control and pricing
- Road safety (Institutional arrangements and practices, accident data collection and analysis and remedial engineering, enforcement and education)
- Road User Education
- Enforcement (Equipment, training)
- Traffic calming
- Institutional development and training

Linkage to poverty reduction, needs of the poor and economic development.

10. To what extent is TM used largely to improve conditions for private vehicle users, rather than pedestrians, cycles and buses. How can priorities in allocation of road space be changed? Is TM seen as a tool to assist the less well off? Is it seen as a means to make the most efficient and effective use of road space?

Scope of Work - Demand Management

11. The review should also examine the current level of knowledge and understanding of Demand Management in developing Countries, and determine the objectives, nature and location of demand management measures being considered. The review should consider to what extent the concept of demand management is understood in developing countries and to what extent management of demand for private transport is considered to be necessary and/or desirable by governments.

12. The review should also document demand management techniques being used or contemplated, including, but not limited to:

- Parking control and pricing
- Active policy support and investment to make walking cycling more attractive as means of transport through provision of safe and convenient facilities, and allocation of road space for these modes
- Bus priority
- Active Policy support for maintaining/increasing public transport mode share
- Heavy taxes on car purchase
- Cordon Pricing

- Area licensing schemes

13. The role of donors in supporting (or not) and offering advice on demand management should be discussed. Based on the results of the review, discuss the nature of advice that donors should give in the future. Assess the potential for introduction of demand management in developing countries, and the conditions (and timeframe) under which such potential could be realised.

14. The review should also consider the current level of knowledge and understanding of Demand Management in the developed world, and determine the objectives, nature and location of demand management measures being considered. Comments should be made on demand management measures currently being applied or considered for application in the developed world which could have application in the developing world.

Schedule and Reporting

15. A short inception report in *five* copies will be submitted within *three-four* weeks of instructions to proceed with the project. The inception report will outline an assessment of data availability and the cities proposed for evaluation.

16. The draft final report will be submitted in *ten* copies within *sixteen* weeks of instructions to proceed with the project. The draft final report will present both the findings of the investigation and the data upon which the findings are based.

17. The final report in *twenty* copies will be submitted within *two* weeks of receiving Bank comments on the draft final report.

18. Each report (inception, draft final, and final) will be submitted in an electronic format acceptable to the Bank (for example, Microsoft Word). All raw data files, intermediate calculations, and final calculations and spreadsheets, graphics, model runs (if any), and working papers files will also be submitted in electronic format.

Staffing

19. It is envisaged that this study will require *three* person-months of professional work. It will be the consultants' responsibility to mobilize a team which can do justice to the requirements of the study. The resource input should include at least two person weeks of review contribution from a practising traffic management expert in a developing country

Bank Responsibilities

20. The Bank undertakes to give the consultants access to all available data in Bank sources that are relevant to this study.

21. Gerhard Menckhoff will be the Project Manager for the study and provide liaison between the consultants and the Bank.

12. ANNEX B --- COMMENTS ON TRAFFIC MANAGEMENT TECHNIQUES

It has been stressed in Chapter 3 that most traffic management techniques which have found application in developed cities are equally worthwhile in developing cities but general lessons and "recommendations for technical success" for specific traffic management measures are difficult to define as measures:

- are highly site specific
- are most effective if applied on a comprehensive basis ("area-wide" or "corridor") rather than as isolated interventions
- are rarely "stand alone" - bus priority will need parking controls, pedestrian measures, junction improvements etc
- will not usually comprise physical interventions alone; regulatory supporting actions (changes to traffic laws, enforcement etc) are necessary;
- must be set within a traffic policy and thus enables "measures of effectiveness" to be defined and the extent of each intervention to be planned
- must be set within a defined road hierarchy.

However, Annex B Annex B summarises the objectives, characteristics of common types of traffic management measure in terms of rationale, issues, the general experience and conclusions in developing cities and Bank projects. The categories used are:

- **On-Street Parking Management and Control**
- **Bus Priority**
- **Traffic Signals and "Area Traffic Control"**
- **Traffic Management for Trucks (Commercial Vehicles)**
- **Pedestrians and "Public Space Management"** (see also Chapter 7 – Traffic Management and Poverty)
- **Non Motorised Transport (NMT)** (see also Chapter 7 – Traffic Management and Poverty)
- **Road Signs and Markings**
- **Traffic Capacity Improvements at Junctions**
- **Enforcement of Traffic Regulations** (see also Chapter 5 – Training and Human Resources)
- **Environmental Components of Traffic Management- Traffic Calming**

On-Street Parking Management and Control

Rationale and Objectives - Managing stationary vehicles is as important as managing moving vehicles. Illegal or inconsiderate kerbside parking and/or stopping of vehicles:

- obstructs traffic flow and causes congestion; this is a particular problem for buses which are often severely affected by illegal and indiscriminate kerbside parking; and
- can be a safety hazard particularly to pedestrians and NMT when parking on footways forces pedestrians into the road with consequent safety and congestion problems.

Traffic management is first concerned with on-street parking. However, a comprehensive parking policy is needed in any city and should deal with (i) on street parking, (ii) off street publicly available parking, (iii) non-residential off street parking (such as for shops, offices etc) and (iv) residential parking. The control of all categories of off street parking requires broader planning instruments and longer timescales than are usually employed in “basic traffic management” and the role of comprehensive parking controls in “Demand Management” is discussed in Chapter 9).

Objectives - the objectives of an on-street parking policy are to:

- maintain traffic flow by ensuring that moving traffic is not obstructed by stationary vehicles;
- improve the safety and quality of the traffic system by controlling hazardous and inconsiderate parking such as on footways;
- provide for essential servicing of frontages premises, business etc; and
- make some contribution to demand management by targeting controls and charges on certain areas and on certain vehicle users (“car commuting” - see Chapter 9 Demand Management).

Types of Intervention – the general case for street parking policies was set out in the Bank Policy Study “Urban Transport” in 1986 and remains largely unchanged. There is a wide range of measures which may be considered to implement on-street parking controls and the possible measures, and their advantages and disadvantages, are:

Measure	Typical Advantages	Typical Disadvantages
Kerbside prohibitions on parking and loading	<ul style="list-style-type: none"> ▪ Low implementation cost ▪ Can be geared to needs such as time of day or side of street to permit permit servicing, loading-unloading in off peak etc 	<ul style="list-style-type: none"> ▪ Enforcement difficult and costly ▪ Generates no revenue ▪ No contribution to demand management and unless other measures are taken can encourage increased through traffic (see Chapter 9 but ideally “released” road space should be used for measures such as bus priority)
Direct charges (pay on arrival-departure) to on-street personnel	<ul style="list-style-type: none"> ▪ Some contribution to demand management provided released road space used for measures such as bus priority ▪ Enforcement straightforward ▪ Low implementation cost ▪ Generate revenue 	<ul style="list-style-type: none"> ▪ High operating cost ▪ Fraud unless spaces “sold” to an independent operator in which case, enforcement may be a problem
Parking meters	<ul style="list-style-type: none"> ▪ Enforcement straightforward ▪ Some contribution to demand management provided released road space used for measures such as bus priority ▪ Generates revenue ▪ Charge rates can be geared to a defined policy (e.g. favour short stay- penalise long stay) 	<ul style="list-style-type: none"> ▪ Expensive to procure-install ▪ Operating costs high ▪ Theft and fraud
Ticket	<ul style="list-style-type: none"> ▪ Some contribution to demand 	<ul style="list-style-type: none"> ▪ Maintenance

Measure	Typical Advantages	Typical Disadvantages
dispensing (pay and display) machines	<p>management provided released road space used for measures such as bus priority</p> <ul style="list-style-type: none"> ▪ Enforcement straightforward ▪ Generates revenue ▪ Cheaper than meters ▪ Charge rates can be geared to a defined policy (e.g. favour short stay - penalise long stay) 	<ul style="list-style-type: none"> ▪ Theft and fraud ▪ Operating costs significant but less than meters
Pre-purchase cards cancelled and displayed by user	<ul style="list-style-type: none"> ▪ Some contribution to demand management provided released road space used for measures such as bus priority ▪ Enforcement straightforward ▪ Generates revenue ▪ Cheap to implement (sales of cards can be through private sector) ▪ Charge rates can be geared to policy (e.g. favour short stay- penalise long stay) ▪ Price changes relatively easily 	<ul style="list-style-type: none"> ▪ Fraud ▪ Some reduction in parking authority income as outlets needed for card sales
Parking permits	<ul style="list-style-type: none"> ▪ Some contribution to demand management provided released road space used for measures such as bus priority ▪ Enforcement straightforward ▪ Can be restricted to specific users ▪ Generates revenue 	<ul style="list-style-type: none"> ▪ Fraud ▪ Administrative effort

Inclusion in Bank traffic management projects/component Few Bank projects have included comprehensive parking measures. The known recent Bank projects which have considered parking are:

- Moscow UTP (proposed) - parking study to determine strategy
- Mumbai UTP (proposed) - demonstration on-street parking scheme with intent to expand to most densely developed part of the city under the project but deferred by borrower and parking development plan throughout project substituted
- China – “Bank projects have some element of parking provision in their TMC’s” but the impression is that it is relatively minor component in that “parking (in Chinese cities) most would benefit from a comprehensive parking study”⁵⁶

Comments and issues – On street parking control and management is an important part of traffic management as vehicle ownership and parking demand grows. Most of the parking measures in the above table have been used to some extent in developing cities but very few cities have comprehensive parking strategies. An on street parking policy must combine (i) parking prohibitions to maintain traffic flows and to assist public transport (released road space should be used for buses) on main roads at least during peak periods, (ii) charged parking to discourage long stay parking while permitting short stay parking, in un-obstructive locations, for commercial, shopping or business activities and (iii) facilities for servicing, loading and unloading. Issues are:

- Parking enforcement. Enforcement actions against illegal parking, including away from main roads, in hazardous and obstructive locations is essential but often poorly applied. Illegal parking is mostly dealt with by the traffic police but in many cities, the police have neither man-power nor inclination to deal with the problem on a comprehensive basis. Operation and management of charged parking is not a

⁵⁶ Traffic Management and Road Safety in World Bank Projects in Chinese Cities, G Frame, 2nd Draft July 1999

traffic police role and is better carried out by some form of “parking agency” but issues arise over the enforcement as the “parking agency” is not always provided with adequate powers to apply sanctions. Corruption in relation to illegal parking and charged parking is often an issue;

- In some cases, traffic laws are inadequate to permit effective on street parking policy; for example, the levels of charge allowed by law may be unrealistically low and the “parking agency” has only limited powers to levy fines on offenders;
- On-street charged parking involves little investment, should be self financing and can raise revenue for other traffic investments but many developing cities fail to capitalise on the potential of realistically charged parking. Most cities collect charges through public sector agencies but kerb space can be contracted out to the private sector (e.g. Mumbai) and, provided the levels of charge are defined in accordance with the city’s parking strategy, is an effective mechanism.
- On-street charged parking policy in some developing cities is undermined by the use of drivers and chauffeurs since such cars have no need to park unattended. Resolution of the issue is difficult but must rely on strong enforcement of a “no-stopping” (as opposed to no parking) policy;
- Provided parked vehicles do not impede traffic on main routes, some cities have little perception of the need to introduce a parking policy. In particular, footway parking is not only obstructive to pedestrians but as the tendency grows, pedestrians are forced into the street with both safety and traffic congestion implications;
- Charged parking is often the most widely understood and accepted first (and possibly only) step in a demand management policy; the implications are discussed in Chapter 9 - Demand Management.

Lessons on street parking - In Bank projects there have been few parking components and parking control and management has received little attention. However, parking pressures will increase as vehicle ownership and use grows and at a minimum, an on-street parking policy is an essential element in a well-managed traffic system. On street parking, at least in central and congested areas, should be charged since charged parking can assist in managing demand (see Chapter 9) and car drivers should pay the full costs of their journey (as parking is a part of any journey made by car and free parking would be a subsidy to car users). Few developing cities appear to have, or are developing, well managed on street parking policies. The traffic police are not the appropriate agency to plan, operate and manage a parking policy and some form of “parking agency” (as part of, or responsible to, the traffic management agency – see Chapter 4) is required but responsibilities for fines or other sanctions on illegally parked vehicles often requires rationalisation and changes in traffic laws will often be necessary to ensure (i) clear responsibilities for planning, management (including enforcement of fines etc), (ii) realistic charges and (iii) realistic levels of fines or other sanctions against offenders. Charged parking policies require little investment for implementation, should be self financing and may be contracted-out; many developing cities are not capitalising on the revenue potential. There is virtually no investment role for the Bank but it is necessary that Bank traffic management projects encourage cities to include a parking management and control policy within their traffic strategy

Bus Priority

Rationale and Objectives Urban buses are frequently unable to provide rapid and reliable services due to the effects of endemic traffic congestion in peak periods (and sometimes all day) and at other times, due to random traffic events, such as illegal kerbside parking. The objectives of bus priority measures are to:

- protect buses from the effects of traffic congestion and thus reduce delays to buses and passengers
- improve the reliability and thus attractiveness of bus services;
- increase and improve mobility for members of the community, particularly the poor, without access to private transport modes;
- contribute to demand management by providing an efficient and quality alternative transport service.

Types of Intervention – Bus priority interventions are of three basic types:

- Traffic regulation exemptions – buses may be exempted from prohibitions applied to general traffic (such as banned turns) to improve directness of bus journeys and to reduce bus and passenger journey distances;
- Traffic signals applications – (i) buses may be selectively detected at traffic signals and thus be given preference over other vehicles to pass through signalled junctions; detection is commonly through the use of transponders on buses but higher technology systems are being used; (ii) traffic signals can be used to meter traffic into narrow road sections or city areas where other bus priority is not possible due to restricted road space, and buses are provided with bus lanes to by pass the relocated traffic queues (sometimes termed queue location management);
- Preferential re-allocation of road space from general traffic to buses – (i) bus only lanes either operating full or part time and either with-flow or contra-flow, or (ii) busways, segregated from general traffic to the maximum extent practicable, and (iii) bus only (and pedestrian) streets.

Inclusion in Bank traffic management projects/components – bus priority has been included in a some recent Bank projects. Measures have usually been bus lanes or busways; typical measures have been:

City-Project	Type of Measure ⁵⁷
Bogota, Colombia	Major segregated busway under implementation (Ave 80) but the scheme is beyond scope of “normal” traffic management as major road reconstruction involved; a city-wide network of segregated busways planned and is reported upon in the parallel Background Paper “Mass Transit in Developing Countries”
Cala Region, Philippines	A segregated busway is proposed for inclusion in project but as with Bogota (above) major construction involved
Dhaka, Bangladesh	Bus priority proposed
Guangzhou, China	5.4 kms of bus lane proposed in city centres
Liaoning, China	Proposed (i) Shenyang busway and some bus lanes; (ii) Fushun busway; (iii) Anshan busway.
Mexico Medium Cites	Various cities, notably Puebla, Leon, Ciudad Juarez planning segregated busway systems, similar to Curitiba
Mumbai	One major contra flow bus lane/traffic management scheme proposed for inclusion in project
Urumqi, China	Some bus lanes proposed - risk of elimination from project

Note- the busways in Chinese cities are under development but it is reported that there is some risk of non-implementation due to doubts over inadequate bus services/buses, lack of experience in design of innovative busways lack of impetus arising and lack of city ownership and understanding.

Comments and Issues – Buses are, and will remain, the backbone of public transport systems in most developing cities. Efficient bus services are vital to achieve maximum effectiveness from the road network, to offer an acceptable alternative to non-essential car use and to provide mobility for the poor (see Chapter 7). Few bus priority measures have been included in Bank projects over the last few years. However, outside Bank projects, there has been more progress in cities in both developing and developed counties. For example, in recent years schemes have been introduced or are planned in Taipei, Kuala Lumpur, Seoul and other Korean cities, Quito, Lima, Mexico City (contra flow), Moscow (contra flow

⁵⁷ For full description of current busways in developing cities, see parallel paper “Mass Rapid Transit”, HFA/TTC for DfID/World Bank May 2000

trolleybus lanes), Singapore and of course (i) the Curitiba system continues to be consolidated (with assistance from an IADB Loan) and (ii) in European countries traffic management for buses including bus lanes, traffic signal activation etc are widespread and increasing. The possible reasons for the limited number of schemes in Bank projects include:

- lack of understanding of the objectives of bus priority; politicians are unwilling to commit to measures which adversely affect the (rich) private cars users and provoke local opposition due to changes in access, servicing, etc; over-coming such opposition may be politically unacceptable
- the absence of conventional bus systems and the reliance on para –transit makes bus priority difficult to implement due to the high volumes of, largely undisciplined, relatively small vehicles. Even where larger buses exist, bus congestion can be an issue (e.g. Av 10 in Bogota where mini and midi bus flows exceed 1000 per hour). Bus lane and busway schemes work best when there is some control over their use by buses. In a fully deregulated bus system where buses are small vehicles, bus volumes are high on major routes and bus standards are low (particularly relating to emissions), successful bus priority through bus lanes and busways may be difficult to achieve
- bus services are embryonic in some cities (e.g. China) - buses are few in number, bus services are of poor quality, buses are regarded as a second class mode and thus bus priority is not considered desirable nor justified
- the problems of enforcement of “complex” bus lane schemes which require selective treatment for vehicle categories (buses versus other vehicles) are viewed as too great to overcome. Enforcement of non-physically segregated bus priority, traffic management schemes has always proved difficult on a consistent basis (for example, in the past in Bangkok, Manila and other cities). Enforcement problems have undermined confidence in bus priority. Although bus lane enforcement is also an issue in developed cities, advanced technology is increasingly used with real time cameras to observe offenders and this coupled with high fines may alleviate the problem; the techniques may be applicable in more advanced developing cities;
- lack of trained-experienced professional staff to deliver good designs and with sufficient vision to appreciate the benefits of road space reallocation to buses. Poor planning and design of bus priority schemes has caused schemes to be abandoned either before implementation (such as busways in San Jose or Caracas or bus lanes in Mumbai and others) or not to work well when introduced (such as EDSA bus lanes Manila or busways Puebla);
- poor maintenance of simple schemes aspects (such as road markings, signs etc) has reduced the prospects of effective enforcement and eventually has caused schemes to be abandoned
- some schemes have resulted in environmental problems arising from the poor standards of buses and their concentration onto confined busways e.g. emission-air pollution problems in Ave Caracas, Bogota and severance problems in e.g. Av 8 de Julho, Sao Paulo

Lessons – Bus priority comprises busways, bus lanes, bus priority at traffic signals, bus streets, and exemptions of buses from general traffic prohibitions (such as banned turns). As with all traffic management, bus priority policy depends on specific city conditions but in situations where traffic congestion exists and where buses play a major role, there is strong case for bus priority.

In developing cities, where bus priority has been considered, most effort has concentrated on busways and bus lanes as the more management related measures (such as selective bus detection at signals and traffic metering-queue relocation-bus lanes schemes) are complex to design and manage. Furthermore, in cities where the bus system is deregulated, it is impossible to organize (for examples to equip all buses with the necessary hardware).

It has been accepted in many developed cities that full and unrestrained car use cannot be accommodated. This has led to traffic management strategies which concentrate on the movement of “people” and not “vehicles”, place bus priority at the top of the hierarchy of traffic actions and positive reallocation of road space from general traffic to buses. Developing cities are likely to have to adopt similar policies as traffic congestion worsens. As buses are efficient users of scarce road space, bus priority is one of the most effective traffic management techniques to improve system efficiency, to assist demand management (by providing an alternative to car use) and to assist poverty alleviation; bus priority should be a fundamental element of any traffic strategy. However, in developing cities, bus priority can be difficult to implement for both technical and political reasons and issues to be overcome include (i) political and local opposition to road space reallocation to buses, (ii) bus priority design and operation where small para-transit vehicles predominate, (iii) exceptionally high bus flows and bus-on-bus congestion which may mean the need to

combine bus priority with bus system reorganisation and (iv) where bus systems are only just developing and buses are regarded as a second class mode.

In Latin America generally, and particularly in Brazil, Bogota (Colombia) and Quito (Ecuador), busways and bus priority is at a very advanced level. However, in other regions, this is not the case. There is a need to promote bus priority to the public, decision makers and politicians to convince them of the advantages; this could include (i) dissemination of planning and design guidelines to cities with little experience in the area to regions outside Latin America and (ii) visits by decision makers and by technical staff to cities with successful bus priority systems although care is needed to prevent direct and un-thinking attempts to translate the experience; for example, there have been cities which have tried to adopt the physical arrangements (the busways) of the “Curitiba experience” without recognition the Curitiba system is an integrated plan involving the bus organisation, the traffic system, a CBD traffic-pedestrian-parking scheme, land use planning and controls and has been under development for many years. During planning, much greater public consultation efforts are needed (see Chapter 10) to explain schemes and to enable designs to respond to local concerns.

Traffic Signals and “Area Traffic Control”

Rationale and Objectives. The objectives of traffic signals are:

- To control traffic movements at conflict points (usually junctions but also at pedestrian crossings or vehicle merges) in order to maximise road capacity and to ensure safe operation
- To assist realise traffic management strategy by giving priority to buses, by assisting pedestrians and cyclists, by regulating traffic demand through managing traffic queuing.

Traffic signals can be linked together to co-ordinate the operation of signals over a route, a corridor or an area. In developed cities, area wide co-ordination has been proved to provide significant benefits in terms of journey times, number of times traffic stops and so on. Where co-ordination is under the control of a central computer, the system has been termed “Area Traffic Control or ATC” (in some countries “Urban Traffic Control” or UTC is used as the system can be used to control more than junctions such as variable message signs for car parks or directions, congestion monitoring and other management facilities). There is an increasing trend towards systems which respond dynamically to traffic flows.

Types of Intervention – three general categories of traffic signal schemes exist.

- Traffic signals at isolated junctions or sites (such as pedestrian crossings) to resolve an accident or capacity-conflict problem;
- Linked traffic signals at a number of junctions usually along a corridor using non-computer methods such fixed cable or cable-less linking. The latter operate by synchronising each signal through the use of the regular pulses from the electricity supply with a battery back-up in case of power failure. Linking schemes can be used for small groups of signals in locations where central computer control is not justified;
- Area wide systems (ATC) to control and co-ordinate all signals and to provide the ability to implement various management strategies such as public transport priority, emergency routes, queue management etc. The following ATC systems exist:

System	Basic Approach
Fixed plan control Systems	An ATC system in which the signals operate with a number of pre-designed “plans” (signals timings for all junctions) each of which is designed to meet various traffic conditions (peak, off peak, weekend etc) and is switched into operation at pre-determined times or by a command from the control centre. Plans are designed offline by programs such as TRANSYT, TRAFNETSIM etc and for which extensive traffic data collection is necessary.
Traffic responsive – plan selection	An ATC system in which traffic flow is monitored throughout the network by some form of vehicle detection (such as inductive loops set in the road and connected to the control system); the most appropriate signal control plan is selected automatically from a “library” of pre-determined signals timing plans and switched into operation
Traffic responsive – plan generation	An ATC system in which traffic is monitored throughout the network by some form of vehicle detection (such as inductive loops set in the road and connected to the control system) and using the traffic flow data, signal control plans are generated by the system itself and then implemented (e.g. SCATS system)
Traffic responsive – centralised and local adaption	Traffic is monitored throughout the network by some form of vehicle detection (such as inductive loops set in the road and connected to the control system) and using the traffic flow data, signal control timings at all junctions are continuously modified (within transitional limits) by a central computer and implemented in a dynamic manner (e.g. SCOOT system - central, UTOPIA and PROLYN systems - local)

The equipment required for each ATC system is similar and comprises (i) on-street signal traffic controllers at junctions, pedestrian crossings etc (ii) communications network (telephone cables or dedicated cables or radio etc) to transmit traffic data and signal system commands two-way between the local or central computers in the control rooms or local centres and the junctions, (iii) data transmission equipment both at junctions and at the central control room, (iv) a central and/or local computer to manage the system and (v)

for traffic responsive system, on street traffic detectors (inductive loops, micro-wave, video-processors etc). Many schemes have ancillary equipment such as CCTV to enable the control room operators to monitor conditions.

Inclusion in Bank traffic management projects/component – ATC now features in many Bank urban traffic projects; most cities propose some form of traffic responsive systems and it would not be possible to list all schemes. Experience of implementation is very mixed and ranges from schemes implemented on time, on budget and without problems (e.g. Leon, Mexico in a Bank project) to schemes involving issues of procurement, specification and agency responsibilities which have proved impossible to resolve and thus eliminated from projects (e.g. Moscow in a proposed Bank project) to schemes which have taken many years to implement, including re-bidding due to procurement problems (e.g. Bangkok although not a Bank project).

Comments and Issues – The advantages of co-ordinated traffic signals control are well documented – reduced overall delays, reduced stop-go traffic flow, optimisation of traffic capacity, improved safety (when pedestrian facilities are incorporated) and decreased downtime for signals as a result of rapid and accurate fault report (inherent in most systems). However, there have been problems in selection, procurement and sustainability and of ATC systems:

- System design – increasingly, the issue has arisen as to whether the benefits of traffic responsive-dynamic ATC systems are adequate to justify the increased costs and complexity compared to fixed plan systems. Fixed plan systems require more traffic engineer intervention, traffic data to be collected and updated (a time consuming task in cities where traffic growth rates are high and development is rapid) and are regarded by some cities as “yesterday’s technology”. Traffic responsive systems require more complex (proprietary) software and hardware, mainly for traffic flow detection and this must be maintained at a fully operational level for the system to function well. Responsive systems require less traffic engineer intervention but this in itself may be a problem in that traffic engineers may rely on the responsiveness of the system rather than plan and manage the traffic themselves. However, in general, the trend will be to traffic responsive ATC systems as (i) real costs of equipment are likely to reduce, (ii) detection equipment is now more reliable than formerly and (iii) even though the marginal benefits of traffic responsive systems may be limited, particularly in congested traffic conditions where there is little point in “responding” on main routes, the increase in cost can probably be justified by those marginal operational benefits and by improvement in the image and importance of the traffic management agency and traffic management as a policy;
- Design and Procurement – planning, design and procurement of ATC under Bank projects has been problematic; issues include:
 - the desire of cities to (i) retain the incumbent equipment suppliers (of an existing ATC system or of existing signals) or (ii) specify proprietary systems or (iii) use supplier credit for at least part of a system. Such arrangements make compliance with ICB guidelines difficult. Probably the only solution within a Bank project is for the ATC system to be regarded as a counterpart loan contribution (provided the specified system is regarded as technically satisfactory);
 - the lack of specialist experience of some city traffic authorities in ATC which may lead to inadequate or poorly defined functional specifications and bid documents and thus disputes and delays in implementation (some systems have been out to bid 2 or 3 times);
 - the difficulty of reconciling the level at which designs and specifications are prepared to ensure that the system will operate as intended, satisfactory potential suppliers are not ruled out but unsatisfactory potential suppliers are ruled out;
 - the difficulty of combining an ATC system with other traffic management actions which are necessary to ensure that the system works efficiently and that traffic operations and safety are improved; there is no point in introducing state of the art ATC equipment but perpetuating poor junction design;
- Institutional responsibilities - operations – in developing cities, traffic signals are often a traffic police responsibility. However, responsibility for planning, design, operation etc of ATC systems is more appropriate to traffic engineers. It is necessary to ensure that a satisfactory arrangement between traffic engineers and police is obtained (see Chapter 4 Institutional Arrangements)

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- Institutional responsibilities - maintenance– at this stage, there are few demand responsive ATC systems in developing cities on which to base maintenance experience but there have been cases where maintenance of fixed plan schemes has failed (e.g. Manila). A maintenance plan must be part of system design. In some cities, this can be handled readily by the traffic management agency (e.g. Leon, Sao Paulo, Curitiba etc) but in others it will be necessary to include an extended period for maintenance or staff training or a combination in the supply-installation contract.

Lessons – ATC is a key feature of Bank traffic management projects/components. The incidence of traffic responsive systems is likely to increase since real costs are reducing, reliability is increasing and, although the operational benefits of demand response systems may be marginal over simpler systems, (i) the benefits are real and (ii) they raise the image and confidence of the traffic management agency. In the past, there have been design, specification, procurement, responsibility and maintenance issues and there are examples of schemes which have failed at the design and bidding stages and have not been sustainable. Procurement has been a special problem due to the desire of cities to (i) retain suppliers (of an existing ATC system or of existing signals) or (ii) specify proprietary systems or (iii) use of supplier credit for at least part of a system and these arrangements make compliance with ICB guidelines difficult. Probably the only solution within a Bank project is for the ATC system to be regarded as a counterpart loan contribution (provided the specified system is regarded as technically satisfactory). Many cities do not have the necessary background or expertise to deal with the issues and (i) there is a need for model documents and procedures for the planning and procurement of ATC systems and (ii) although consultants can be employed, training of local staff and budget resources are vital to ensure sustainability. The institutional arrangements for the system need to be clearly defined if the best is to be obtained; in general, ATC systems should be the responsibility of the traffic management agency and not the traffic police as the technology has moved beyond the areas of competence of most traffic police.

Traffic Management for Trucks (Commercial Vehicles)

Rationale and Objectives An efficient road freight transport system is essential to city and national economies and this is recognized in the primary objective of traffic management – to improve the efficiency of movement of “*people and goods*”. “Trucks” have a negative image arising from valid concerns over adverse environmental impacts (noise, emissions, visual intrusion), their contribution to traffic congestion (size and slowness) and the physical damage caused to roads (often due to overloading). The wider policy issues affecting trucks such as the potential to shift freight to other modes (rail), vehicle standards (size, safety, weight, driver qualifications etc), regulation of the industry (licences, axle load testing, entry to the market etc) and break bulk terminals (to break loads into smaller units which can be carried by trucks more suitable for urban use) must be part of a comprehensive truck policy but clearly outside the scope of “traffic management”. However, traffic management can play a part and the objective of urban traffic management with respect to trucks-commercial vehicles is

- to improve the efficient distribution of goods while at the same time ensuring that adverse traffic and environmental impacts of trucks-commercial vehicles is minimised.

Types of Intervention – general traffic management measures which improve traffic flow (junction capacity, removal of bottlenecks etc) will also improve the circulation of trucks-commercial vehicles although of course not necessarily deal with the environmental issues. Specific traffic management measures aimed at trucks include:

- the provision of on-street and off-street loading-unloading facilities to ensure that delivery vehicles do not impede traffic flow;
- designation of trucks routes, together with traffic management measures along those routes, to improve operational efficiency and to protect sensitive areas from trucks;
- combined truck and bus only lanes have been pursued by some cities but are not to be generally encouraged as (i) the operational characteristics of buses (with regular stops) and trucks (with slow acceleration etc) are incompatible and (ii) if bus volumes are high then trucks will have a negative effect on bus operations and vica-versa;
- measures to mitigate the environmental impact of trucks such as regulatory controls on area entry by size or by time;
- provision of truck parks where trucks can wait for short periods of time to (i) break loads and transfer to suitable sized vehicles for use within cities, (ii) to await pre-arranged deliveries and hours at which they are permitted to enter the city.

Inclusion in Bank traffic management projects/component – as far as is known, there are few, if any, specific truck-commercial vehicle traffic management measures in Bank projects. The one exception is the proposed traffic management scheme to develop a truck route to/from the port in the proposed Manila UTP.

Lessons – Efficient urban road freight distribution is essential but must be carried out with minimum traffic and environmental impacts. An urban traffic management truck policy is part of traffic strategy and is likely to involve measures such as truck routes, designated loading areas, break bulk terminals (where appropriate) and “no go” areas for environmental protection. Specific measures to assist trucks, and to protect the environment and other road users are almost entirely absent from Bank projects. It is noted that (i) the road freight industry is a private sector operations and care is needed to avoid imposing truck restrictions-facilities which restrict operations to the extent that they are not commercially viable (such as truck terminals which are implemented by cities without recognition of commercial reality) and (ii) truck policy must extend well beyond traffic management to deal with truck loading limits, fuel substitution (diesel-CNG), regulation of the industry (licences, axle load testing, entry to the market etc), terminals etc. It however, clear that “trucks” is a neglected area in traffic and transport projects.

Pedestrians and “Public Space Management” (see also Chapter 7 – Traffic Management and Poverty)

Rationale and Objectives Walking is an indispensable and integral part of the urban transport system and in developing cities, walking is often a very high percentage of trips, particularly by the poor (see Chapter 7). People should be able to make walk journeys conveniently, in reasonable comfort and in safety from conflict with road traffic. The objectives of a pedestrian policy are:

- to improve pedestrian mobility by the provision of convenient facilities enabling walk journeys to be made without excessive diversion;
- to improve safety by protecting pedestrians from conflict with vehicles;
- to improve pedestrian quality and encourage walking by ensuring that footway, road crossing and other facilities are provided, well maintained and unencumbered.

Types of Intervention – the range of pedestrian facilities to meet the objectives could include:

- new footways and paving of existing footways;
- at-grade pedestrian crossing facilities of roads at traffic signal junctions or at conveniently located at-grade signal controlled pedestrian crossing facilities;
- grade separated (underpasses or overpasses) road crossing facilities conveniently located;
- pedestrian protection such as guard-rails at sites where pedestrians are vulnerable (e.g. near schools, shopping areas, etc) to channelise pedestrians to safe (and convenient) road crossings);
- integrated programs (“Public Space Management”) involving all of the above plus pedestrianised areas or streets and high quality environmental treatment (paving, planting, recovery of public space formerly used as garbage dumps, informal parking lots etc).

Inclusion in Bank traffic management projects/component – many Bank projects include some pedestrian facilities; typical interventions are:

- many traffic schemes integrate some pedestrian facilities such as improved footways and pedestrian crossings facilities at signal schemes (Mumbai UTP) or pedestrian-traffic segregation (all China projects), Vietnam (pedestrianised treatment of Hanoi Central Area), Dhaka (footways, pedestrian bridges etc) and so on
- in a limited number of cases (only Colombo UTP is known), Bank projects have sought to resolve street trader obstruction to recover the footway for pedestrian use in a planned and equitable manner (many cities outside Bank projects have taken a more aggressive approach and moved street traders by force of law);
- pedestrianised city centre areas are common in many cities and Bank projects have included schemes in the Mexico Medium Sized Cities project (Leon, Ciudad Juarez, Mexico), Hanoi (Vietnam) and one highly successful integrated program of “Public Space Management” program under the Bogota UTP

Comments and Issues – issues in pedestrian programs include:

- lack of recognition of pedestrian needs – in some cities, serving pedestrians by providing convenient, good quality facilities is a low priority. Pedestrians are often viewed as the least important member of the transport hierarchy and, if pedestrian facilities are provided, they may be focussed on the control of pedestrians in order to assist motor vehicle flow rather than on serving pedestrian needs;
- maintenance-repair – utilities are mainly located in the footway. Utility companies have a poor record of footway reinstatement after repair works or introduction of new services. The result can be un-usable footways with pedestrians forced to walk in the roadway with both safety and traffic congestion problems. City agencies lack the necessary administrative powers to co-ordinate works and to ensure that footways are reinstated in a proper manner.
- encumbered footways - footways are often obstructed by poles, signs, advertising, vehicle runs offs, illegal parking, hawkers and traders, encroachment of shop displays and in some cities, “footway dwellers” (e.g. Mumbai). Under these conditions, footways are un-usable and pedestrians are forced to walk in the roadway with both safety and traffic congestion problems. The resolution is complex and involves enactment and enforcement of regulations by city governments including equitable policies for relocation of street traders and, in some cases, footway dwellers

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- token facilities – pedestrian facilities are provided which have no prospect of successful operation. For example, marked but uncontrolled mid block pedestrian road crossings have been provided in some cities but the standards of driver observance of such that the facilities are ignored and unsafe. Again, pedestrian facilities are provided because they are easy to implement but do not serve pedestrian needs without unacceptable diversions (this has applied to some pedestrian subways and footbridges) and this of course has the effect that pedestrians ignore the facilities and walk in the road – no purpose having been served;
 - integrated plans – some projects have included integrated pedestrian plans in city centres or areas (as noted above in some Mexican cities and the Bogota “Public Space Management” but such programs in Bank projects are not common;
 - institutional - there is often no real recognition of the pedestrian problem by city government

Lessons – Pedestrians have not been very well served by many developing cities. There is a wide range of issues (i) lack of recognition of pedestrian needs, (ii) even when pedestrian measures are provided, they are focussed on the control of pedestrians in order to assist motor vehicle flow rather than to serve pedestrian needs (iii) poor footway maintenance and reinstatement after works rendering them unusable, (iv) footways encumbered by street traders, frontage occupiers and street dwellers (v) provision of token pedestrian facilities which are neither in the right place nor can be used safely (vi) lack of institutional capacity to deal with pedestrian issues. A new, much more positive and proactive approach to pedestrian measures is needed. This includes:

- better pedestrian design guidelines and standards for dissemination to potential transport project participants;
- establishment of guideline procedures for dealing with street traders and street dwellers in an equitable manner (the experiences in the Colombo Urban Transport Project and Mumbai Urban Transport Project may be of assistance);
- increased intensity of dialogue with cities which wish to subjugate pedestrians to vehicles (apparently this issue applies in particular to China); and
- institutional mechanisms to ensure that public utility companies reinstate footways after works. Developed cities have powers to impose financial penalties on utility companies if footways (or indeed roads) are (i) excavated without permission, (ii) remain in an excavated state longer than the period granted by the permission and (iii) reinstated badly. Such powers and a mechanism should be sought by the traffic management authority of developing cities.

Non Motorised Transport (NMT) (see also Chapter 7 – Traffic Management and Poverty)

Rationale and Objectives Non motorised vehicles include bicycles (including various forms of “bicycle taxi”), human-drawn vehicles and animal-drawn vehicles; however, bicycles” are the predominant NMT mode in traffic management and the Review is confined to bicycles. In principle, bicycles offer low cost personal mobility assisting lower income groups, are well suited to shorter trips (say up to 7 or 8 kms), are non polluting and generally comply with a “sustainable approach” to transport. Objectives of traffic management for bicycles are:

- to improve safety by protecting cyclists from conflict with motorised vehicles
- to improve the quality of cycling by the provision of facilities which enable journeys to be made conveniently and which and encourage bicycle use

Types of Intervention – The number, and existence, of bicycles varies greatly in developing cities. For example, bicycles account for between 25%-80% of non-walk trips in Asian cities but the level and use in Latin American Cities is very small. As with all traffic management, highly city specific approaches, policies and measures are needed. To meet the objectives, bicycle measures include:

- NMT/bicycle lanes or tracks either (i) purpose constructed or (ii) created by reallocation of existing road space to provide separate lanes or (iii) use of existing local streets with supplementary infrastructure where necessary to ensure continuity (such as was proposed in Shanghai II UTP). In suitable cases, bicycle facilities may be shared with pedestrians (as is common in Europe and Japan);
- Traffic management measures on existing road to assist cyclists including junction treatment (segregated approaches to junctions, advance stop lines and special signals and paths at junctions, etc);
- Secure bicycle parking areas particularly at places of work to counter theft; and
- Lines of credit or other financial support to encourage bicycle ownership (not strictly “traffic management” but could be an integral part of a bicycle policy).

Inclusion in Bank traffic management projects/component - within recent Bank projects, NMT/bicycle facilities have included:

City-Project	Type of Measure and Status
Dhaka, Bangladesh	Pilot NMT network using secondary roads and segregation of NMT and MV on some major roads
Guangzhou, China	2.4kms NMT route - proposed and likely to be implemented; concern that NMT facilities are not exclusive and may face enforcement problems
Liaoning, China	Various NMT exclusive routes in Shenyang and Anshan (4kms) - schemes are under development and likely to be implemented but concern has been reported that designs may marginalise-restrict NMT's
Lima, Peru	Approx 10 kms cycleway – implemented with associated with a line-of-credit to provide loans for users to purchase bicycle
Manila, Philippines	A cycleway proposed for inclusion in project
Mexico Medium Cites	55 kms of segregated cycleway – implemented
Shanghai MTP II, China	19.4kms of NMT exclusive bicycle route proposed but concern has been reported that <ul style="list-style-type: none"> ▪ routes are being converted to other uses (e.g. motor tri-bicycles) and ▪ some not implemented as a result of (i) lack of ownership of the proposals forced upon city government during project preparation, (ii) city government desire to meet needs (e.g. parking and servicing) of motor vehicles as first priority
Vietnam	Road reconfiguration proposed into (i) “fast” traffic and (ii) 2-wheel traffic including motor cycles and NMT

Comments and Issues – issues in bicycle/NMT programs include:

- increasing motorization (including increased motor cycle-ization) has increased safety problems for bicycles particularly in mixed traffic heavily used intersections
- reduction in street space for bicycles as pressures for road space increases from motorised vehicles and they are given preferential treatment and road
- longer distance journeys as urban sprawl continues
- affordability of bicycles by poorer sections of the community
- lack of interest by urban traffic planners and social attitudes to bicycles – “backward”, “second class”. There is a view in some cities (reported to be especially the case in China) that bicycles are considered to impede motor vehicles, are outdated technology and that bicycle measures should be aimed at segregation-elimination rather than provision of good facilities etc. Contrary to Bank advocacy of bicycles as a viable transport mode and there is pressure to release road space occupied by bicycles for use by motor vehicle or to divert bicycles onto long and inconvenient routes
- poor physical design of bicycle facilities which increases rather than reduces hazards to cyclists such as lack of control at junctions and no resolution of conflicts with motor vehicles;
- security of bicycles against theft (at terminal points of journeys etc) and personal security of users
- there is a dilemma over the provision of bicycle facilities in some cities where there is no, or very little, current bicycle use. Enlightened planners may consider bicycles a desirable aim and may promote bicycle measures but the issue arises as to whether facilities should be provided to encourage the use of bicycles and release possible suppressed demand or facilities should not be provided and the resources deployed to more urgent traffic needs. There is no simple answer to this dilemma except that (i) careful research, including public consultation, can be an aid to decision making and (ii) if facilities are provided, they should not suffer from tokenism; examples exist where bicycle lanes have been constructed because it was easy to do so rather than fulfil an existing or potential need and thus the lanes lack real utility and are little used.

Lessons – Bicycles are an efficient mode, suitable for various urban journeys bicycles and available to at least some of the poorer sections of the community. Bicycles should be treated as an integral part of the traffic management system and strategies should be designed to capitalise on their strengths (see Chapter 7 – Poverty). However, as motorization increases, bicycle use becomes more hazardous. Planning must determine that bicycle schemes fulfil a real (or a realistically assessed) need and are not constructed in locations which are “easy”, which inconvenience no one (basically cars) and thus are of little value to users and potential users.

Road Signs and Markings

Rationale and Objectives – Information for drivers and other traffic system users (pedestrians, cyclists etc) is essential for good traffic management. The objectives of road markings and road signs are to advise, warn, control and direct all modes to ensure that traffic management schemes operate safely and efficiently

Types of Intervention – road signs and markings are key parts of any traffic management scheme. A comprehensive signing program will include (i) warning signs of approaching hazards and/or changes in road layout (junction, signals, etc), (ii) regulatory signs (speed limit, no entry, buses only etc) and (iii) information or directions. Road pavement markings guide traffic paths, define areas of road with special restrictions (bus lanes, no parking etc) and control movement (no overtaking etc).

Inclusion in Bank traffic management projects/component – It has been some time since explicit signing and marking programs have been included in Bank projects. Previously, signs and markings were undertaken by direct labour groups in the employment of municipalities and cities. Bank projects supported these groups with equipment for sign manufacture, road marking maintenance, training etc. Today, most municipal or city works functions are under contract and the Bank rarely considers financing direct works agencies, including those involved in road markings or signs..

Comments and Issues – in many developing cities:

- the numbers and sizes of regulatory signing are often inadequate;
- signs are poorly sited;
- signs and road markings have poor visibility at night;
- in some cases, signs are unclear to drivers – for example, there have been cases where a country's national standard lacks a sign (e.g. for bus lane regulations) and inappropriate signs from other countries-standards are used;
- signs and pavement marking suffer from poor materials and lack of durability, poor maintenance and, in some cities, the road surface makes road markings difficult
- there are institutional problems such as (i) responsibility for marking and signing is not always clearly designated between the traffic management agency and the traffic police, (ii) the traffic management agency lacks expertise in designing and supervising signing and marking programs, (iii) the traffic management agency lacks a realistic budget for implementation and maintenance of a continuous signing and marking program.

Lessons - Many traffic systems suffer from inadequate signing, poor siting of signs, lack of visibility of signs (especially at night), inadequate signing standards, poor materials and lack of budgets for continuous signing and marking upgrading and maintenance. Regulatory and warning signing and road marking are essential elements of any traffic regime. It is indisputable that good, city-wide signing and road marking can assist development and maintenance of driver discipline, safety and can support enforcement. In general, as a result of the disappearance of direct labour agencies in cities, the Bank has no project investment participation in signing and road marking programs. Improvements in general marking and signing are closely linked to the existence of an effective traffic management agency – even if all works are contracted, the planning and supervision of signing and marking measures should be an important function of the city traffic agency (see Chapter 4 – Institutional Arrangements).

Traffic Capacity Improvement at Junctions

Rationale and Objectives – urban road networks tend to operate below potential capacity, largely attributable to the constraints imposed by junctions. Junctions are the critical capacity elements in an urban road system and are where delays, accidents and emissions are concentrated. The objectives of a junction improvement program are to:

- alleviate traffic congestion by providing adequate capacity for vehicular traffic such that the level of service at the junction is compatible with that provided on the upstream/downstream roads
- ensure that the capacity provided is consistent with the traffic management strategy of favouring “*people not vehicles*”; where buses-bus passengers are important elements of the junction flow, economic evaluation should be used to determine the “optimum capacity” arrangements;
- minimise accident risk and severity, particularly for vulnerable users such as cyclists and pedestrians
- minimise adverse environmental impacts of traffic by reducing fuel consumption through reductions in the number of speed changes and the number of stops/starts required at the junction;

Types of Intervention – The hierarchy of alternative junction layouts which cater for increasing levels of traffic flows are:

- uncontrolled junctions without any designated priority;
- priority junctions;
- roundabouts
- isolated traffic signal controlled junctions
- junctions under ATC
- grade-separation

Inclusion in Bank traffic management projects/component – all traffic components in Bank projects invariably include junction improvements. It has been noted in Chapter 1 that the current Paper is not intended as a design manual it would be unrealistic to present design guidelines – innumerable manuals exist (ii) nor would it be possible to summarise world-wide experience of junction improvements – design depends on unique city circumstances. Thus, this section of the Paper presents some qualitative observations of common junction operation and planning issues in developing cities.

Issues and Lessons of Junction Design – all junctions should be planned and designed in accordance with a range of design reference traffic flows and to recognise site constraints. Some particular issues and lessons which apply in developing cities include:

- Traffic signal timings at existing junctions are often not adjusted to deal with actual traffic distribution. Traffic flows and distribution change over time due to growth in vehicles, changes in development etc and many traffic signals at isolated junctions are not adjusted to deal with these changes. Appropriate signal timing settings can increase junction capacity at virtually no cost but the simple action requires (and therefore reinforces the need for) a competent traffic management agency to monitor signal timings and to make the necessary modifications on a continuous basis;
- Manual intervention by the traffic police on traffic signal controlled junctions occurs in some cities where traffic congestion is severe (in the past in Bangkok, Manila, etc). Such practice should be discouraged/prevented as traffic police are unable to assess either interaction between junctions (even though radio contacts are used) or understand the concept of saturation flow on which traffic signal design-capacity is based;
- Simple channelisation at signal controlled and other junctions separates traffic conflicts, controls angles of potential traffic conflict, accommodates traffic turning movements safely, protects pedestrians and provides them with facilities to cross one traffic stream at a time, enables traffic control devices (signs, signals etc) to be mounted appropriately and protect them from traffic damage, discourages prohibited traffic movements and so on. The cost is small and the benefits large. However, in many developing cities, there is reluctance to use “heavy” channelisation and junctions are “spread out” resulting in undirected traffic movements and conflicts, safety problems pedestrian problems; much greater use of “heavy” channelisation will increase capacity and safety;

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- Pedestrians are often not provided with facilities to cross at signal controlled junctions. There is a wide range of options – simple pedestrian phases within the signal cycle, channelisation/islands to allow pedestrians to cross part of the road rather than full road width, removal of kerbside obstructions so that pedestrians have good visibility and are not impeded from crossing, ancillary pedestrian signals close to, and connected to, the main signals etc; greater attention to pedestrian needs at junctions is required in many cities;
 - Road markings can do much to improve junction efficiency. It is recognised that driver discipline may not be particularly good in some cities but even so, well set out road markings (i) can make a significant difference to junction operations and (ii) assist the traffic police by providing a base for enforcing traffic regulations (e.g. by marking turn lanes with turn-only arrows and signs)
 - Lane balance and consistency of layout – it is not uncommon to find fewer lanes downstream of a junction than on the approach (aside from turn only lanes); this can cause traffic conflicts and safety problems on the immediate exit to junctions and can result in capacity reduction; a junction program should seek to ensure lane balance at junctions and if changes in road cross sections are inevitable, make the transition away from junctions
 - Instances have occurred where grade separation of junctions has been introduced without due regard for (i) downstream effects – traffic queues are simply transferred, (ii) impacts on bus services – buses cannot usually use flyovers or underpasses as bus stops cannot be provided and thus passenger objectives are not met and often, the remaining ground level road is reduced in capacity with adverse impacts on buses; improvement of junctions by grade separation needs to be placed in the context of the immediate surrounding network and the impact on all users needs to be recognized.

Enforcement of traffic regulations (see also Chapter 5 – Training and Human Resources)

Rationale and Objectives - Compliance with traffic regulations by all road users is essential to ensure (i) road safety, (ii) efficiency of traffic movement and (iii) that traffic management schemes operate as planned. Compliance with traffic regulations depends largely on driver's perception of risks and the implications of being subject to enforcement action. Traffic schemes work best if they are designed to be "self enforcing" (where traffic movements are controlled as far as practicable by physical measures such as islands, medians, channelisation etc) but contravention of regulations can be deterred by making the penalties imposed for offences severe. Many traffic schemes fail to realise their potential due to poor enforcement and this applies particularly to schemes which provide priority to one category of vehicle such as bus lanes or bicycle lanes. The objective of enforcement is to

- ensure that road users comply with traffic regulations so that the traffic system may operate safely and that traffic schemes and policies may meet their objectives

Types of Intervention – Enforcement of traffic regulations is generally the responsibility of the traffic police although some activities, such as enforcement of parking regulations, may be the responsibility of other agencies such as a "parking authority". Within Bank projects, components to assist traffic regulation enforcement have comprised:

- Equipment to assist enforcement actions which may include
 - parking control equipment (tow trucks, wheel locks etc)
 - communications equipment to enable traffic police to manage the traffic system
 - on-street enforcement equipment (patrol cars, motor bicycles etc)
 - office equipment (pc's etc) to assist record keeping, tracing offenders etc;
- Technical assistance and equipment:
 - for training to the traffic police;
 - to establish accident reporting and analysis procedures;
 - to aid development of appropriate traffic regulations/codes
- In a limited number of cases, other high tech equipment has been proposed such as speed limit registration (radar) equipment, CCTV with vehicle number plate recognition.

Inclusion in Bank traffic management projects/component – traffic police components have been included in many Bank projects including San Jose (Costa Rica), Cairo (Egypt), Colombo (Sri Lanka), Moscow (Russia) (proposed), Mumbai (India) (proposed), Hanoi-Ho Chi Minh (Vietnam)(proposed), Venezuela, Karachi (Pakistan) and Calcutta (India). There are there are no known evaluations of the components.

Comments and Issues – as noted above, it is desirable that traffic management schemes are made as "self-enforcing" as possible; the maximum use of physical measures should be included to reduce conflicts (e.g. medians), to direct traffic (e.g. channelisation) and to segregate vehicles (e.g. kerbs to separate traffic and buses in bus priority schemes). Such measures are not always possible due to problems of available road width and access for residents or servicing and thus "paint and sign" schemes, often relying on time based regulations (e.g. peak and off peak), are required. In these cases, good enforcement is essential and issues which have occurred include:

- perspective of traffic management – traffic police often have a different perspective on traffic management than traffic planners. The main objective traffic police is to "keep traffic moving" particularly traffic on main routes. However, traffic police are not skilled in achieving a balanced approach to traffic movement. The difference in approach is demonstrated by:
 - in Bangkok, and perhaps in Manila, traffic police manual intervention in traffic signals control (with the provision of excessively long cycle times) has been contrary to all conventional, efficient signals practice advocated by traffic planners;
 - concentration by traffic police on technical offences and routine traffic policing (such as "licence checking") rather than rather than on regulating moving traffic
 - lack of interest in pedestrian measures

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- the desire of the traffic police to maintain control over what they perceive as “their functions”. This applies particularly to traffic signals systems; the integration of traffic police and city traffic authorities can prove difficult;
 - working practices – traffic growth rates in many developing cities is high and the work load and working practices of traffic police need to keep pace with the changes. Often, working practices are not responsive to the new traffic conditions and fundamental attitudinal changes are required. The conservative approach of traffic police forces plus the constraints imposed by the current legal requirements mean that changes are not easy to plan nor to implement;
 - training – the view is sometimes held by the traffic police that their existing training programs are adequate, there is no need for “outside interference” and that there are legal, security and institutional constraints (for example, the national status of some traffic police forces) to change (see Chapter 5 – Training and Human Resources)
 - corruption –regrettably, there are examples where traffic police accept illegal pay-offs from offenders of traffic regulation and traffic schemes are brought into disrepute and fail to meet their objectives;
 - equipment procurement – procurement of police equipment has proved problematic due to (i) police unfamiliarity of Banks procurement guidelines, and (ii) the desire of the police to procure specific equipment.

Lessons - Traffic schemes should be designed to minimise enforcement effort and to “design out” the ability and inclination for drivers to commit traffic offences. Nevertheless, this cannot be fully achieved and traffic schemes will always require traffic police enforcement of regulations for their success. Many traffic police forces in developing cities are under-equipped, not well trained in traffic management enforcement and nor do they appreciate the role and function of traffic management. While projects can provide equipment for the traffic police, the most important advances will be obtained through (i) improved and systematic training of traffic police and (ii) review of, and changes if necessary in, working practices to respond to actual traffic conditions and suggestions are made in Chapter 5 to initiate these programs. Additionally, it is noted in Chapter 4 – Institutional Arrangements that while responsibility for traffic management planning, design etc should rest with the “traffic management agency”, traffic police must be involved and the police’s views on practicality and enforcement sought and recognised at all stages of scheme planning and design

Environmental components of traffic management- traffic calming

Rationale and Objectives – Traffic has diverse adverse impacts on the city environment including noise, visual intrusion, emissions/air pollution, accidents, severance of communities and so on. A comprehensive strategy is needed to reduce these environmental impacts and would include an integrated program comprising:

- an air quality control program including:
 - monitoring of vehicle emissions to provide the scientific base to plan remedial measures and to assess effectiveness of interventions;
 - vehicle testing-inspection programs to reduce vehicle emissions;
 - vehicle and/or engine substitution programs;
 - fuels programs including clean fuels, substitute fuels, vapour recovery programs; etc
 - Development and adoption of improved vehicle standards, etc
- a road safety program (discussed in detail in Chapter 6)
- a comprehensive traffic strategy with clearly defined objectives to improve travel for “people” and to manage demand

Types of Intervention – although not all traffic management measures are implemented for environmental reasons, environmental impacts can result and should be used as part of an objective lead analysis for schemes. For example, environmental gain can result from schemes which:

- improve traffic flow (such as traffic signals linking) and thus reduce stop-go traffic operation and reduce fuel consumption;
- change routeing (e.g. trucks) to less sensitive areas and reduce noise and visual intrusion;
- assist pedestrians and reduce severance caused by traffic;
- reduce accidents (see Chapter 6)
- reduce traffic demand by encouraging public transport and environmentally friendly modes such as walking and cycling)

“Traffic calming” is a specific traffic management technique with the specific objective to improve quality of life and accidents, by reducing vehicle speed, noise etc through environmentally sensitive areas. Traffic calming on main roads must be treated differently from traffic calming on lesser roads.

On main roads, it would add to accident hazards to introduce some of the more extreme physical traffic calming measures which are used to reduce traffic speeds (see below) but traffic management techniques are available to assist to slow traffic on main roads, including positive signs and road markings emphasising speed limits;

- “rumble devices” which involve surfacing the carriageway in materials which create noise or vibration when crossed by vehicles and thus warn drivers of approaching hazards;
- “bar markings” which comprise lateral road markings (lines at right angles to the road) on high speed approaches to urban junctions; the lines are increasingly closely spaced as the junction is approached and create a visual effect such that drivers slow;
- road texture and colour on the approaches to critical locations (junctions, pedestrian crossings etc); and
- linking of traffic signal timings at successive junctions to control and maintain a desired safe speed of traffic progression.

On lesser roads, a wide range of physical traffic calming measures for speed control (and in some cases, to limit traffic volumes) has been used, particularly in European cities. Typical measures include:

- pedestrian refuges which narrow the effective road width, control vehicle overtaking and do not permit vehicles to reach high speeds road-speed control humps which reduce vehicle speed. These can take various forms including humps (i) with gradual vertical slopes which cause vehicles to slow, (ii) with sharp vertical slopes which require vehicles to more-or-less stop and (iii) which combine up and down stream slopes with a flat central area (used since they are slightly more “bus friendly” than conventional humps)
- road narrowing such that some classes of vehicle cannot use the road (such as trucks)
- road narrowing such that only one direction of vehicles can pass at one time – thus opposing vehicles must give way

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- chicanes such that vehicles have to following a tortuous route through a short section of road and thus must reduce speed
 - raised junctions comprising a plateau or flat topped road hump built across an entire junction
 - planting which can be used to change the perceived width of a road to cause traffic to slow

It is undoubtedly the case that most of the foregoing measures reduce traffic speeds but it is not clear if in developing cities they might:

- introduce new hazards – for example, in developed cities, where road narrowing or chicanes have been used, there is anecdotal evidence that the measures can be hazardous;
- result in increased environmental damage as vehicles slow or stop (in most cases as a result of the poor design of speed humps in developing cities) at humps and accelerate immediately after, thus increasing emissions; and
- result in increased accidents due to poor design – the “absolute stop” road hump currently used in many developing cities is, again anecdotally, reported to increase the likelihood of increased “nose-tail” vehicle collisions.

Inclusion in Bank traffic management projects/component – two aspects are noted:

- traffic related environmental impact is usually mentioned as an evaluation for Bank traffic management projects although the evaluation is not often particularly convincing
- few traffic calming measures are known

Comments and Issues – general traffic management measures and demand management are considered elsewhere in the Review but “traffic calming” is a traffic management technique specifically orientated to safety and environmental improvement – through seeking to reduce vehicle speed and traffic volumes particularly through sensitive areas. There are very few traffic calming measures in developing cities with the one exception of the widespread use of speed control humps. Comments are:

- speed control humps require great care in design otherwise the impacts can be negative; more research is needed to determine the impacts of such measures in developing cities; and
- design standards for speed humps and other devices and criteria for their appropriate application in developing cities, are needed.

Lessons – Traffic management promotes smooth traffic flow and thus can make a general contribution to improvements in the traffic emissions and measures such as truck routes can have positive environmental impacts. However, unless demand management actions are taken (see Chapter 9), increases in traffic capacity may be taken up rapidly by vehicle growth and by suppressed demand and thus the measures may make little overall difference to emissions. On main roads speed control techniques such as “rumble devices” to warn drivers of approaching hazards, “bar markings to reduce speed on approaches to urban junctions, road texture and colour on the approaches to critical locations and linking of traffic signal timings at successive junctions to control and maintain a desired safe speed of traffic progression should find greater application. On lesser roads, traffic calming might be appropriate. Care is needed to ensure that the most common measure – the speed control hump – is well designed and does not introduce new hazards. More research is needed to determine the impacts of such measures in developing cities and design standards for speed humps and and criteria for their appropriate application in developing cities, are needed.

13. ANNEX C – TYPES OF ACTIONS TO BE CONSIDERED IN A TRAFFIC MANAGEMENT STRATEGY

Category	Traffic Measures	Regulations-Operations
Traffic Circulation	<ul style="list-style-type: none"> ▪ basic traffic engineering including (i) road markings and (ii) road signing ▪ Area Traffic Control (ATC) (computer controlled traffic signal systems area-wide) using (i) fixed plans-by-time-of-day or (ii) responsive or (iii) dynamic ▪ isolated junction improvements by physical measures including (i) channelisation, (ii) limited widening (iii) turn lane additions ▪ traffic circulation schemes applied on a corridor basis or area wide including (i) one way streets systems (ii) turning movement controls (iii) elimination bottlenecks by physical works ▪ traffic metering into congested areas with bus lanes to overtake relocated traffic queues ▪ road space reallocation and management including (i) bus priority (see below) (ii) tidal (reversible) flow schemes (iii) HOV schemes (iv) “no car” lanes 	<ul style="list-style-type: none"> ▪ modifications to traffic regulations to enable physical and operational measures to be implemented and enforced
Public transport (buses) priority	<ul style="list-style-type: none"> ▪ exemptions for buses from general traffic regulations at specific sites/junctions ▪ bus priority detection at traffic signals ▪ bus priority lanes either full or part time and either with flow or contra flow ▪ traffic metering into congested areas with bus lanes to overtake relocated traffic queues ▪ segregated busways ▪ park-and-ride ▪ bus system “quality” measures (terminals, stops, information etc) 	
On street parking management and servicing-access controls	<ul style="list-style-type: none"> ▪ on street parking programs (including charged systems by meters or other means) ▪ off street parking programs and policies (including charged systems) ▪ physical controls on access and/or servicing (eg truck routes) 	<ul style="list-style-type: none"> ▪ out-of-hours servicing to frontage premises ▪ time based truck prohibitions ▪ enforcement of parking controls
Demand management	<ul style="list-style-type: none"> ▪ parking charges ▪ various forms of car bans such as “odd-even”, “one day without car” etc ▪ cordon pricing ▪ area pricing ▪ environmental/no traffic areas etc 	<ul style="list-style-type: none"> ▪ indirect user charges such as fuel surcharges, license fees etc

Category	Traffic Measures	Regulations-Operations
Enforcement of traffic regulations	<ul style="list-style-type: none"> ▪ enforcement equipment (CCTV, photo recording of offenders, etc) 	<ul style="list-style-type: none"> ▪ traffic police training
Road safety	<ul style="list-style-type: none"> ▪ traffic engineering measures to correct poor design and operation of roads and junctions ▪ traffic engineering to eliminate “blackspots” 	<ul style="list-style-type: none"> ▪ see complementary Background Paper on Road Safety but could include: ▪ establishment of accident data bases and analysis systems to direct improvement programs; ▪ traffic police enforcement actions ▪ public information, campaigns etc
Pedestrians	<ul style="list-style-type: none"> ▪ pedestrian road crossings both at-grade and grade separated ▪ footway improvements – widening – paving - protection ▪ pedestrian streets 	<p>Establishment of mechanisms to</p> <ul style="list-style-type: none"> ▪ ensure reinstatement of footways after public utility works; ▪ deal with street traders, street dwellers
Bicycles and other NMT’s	<ul style="list-style-type: none"> ▪ NMT facilities such as: (i) junction crossings (ii) separate lanes – cycleways (iii) networks of cycleways (iv) storage facilities for bicycles 	<ul style="list-style-type: none"> ▪ incentives for bicycle purchase
Trucks	<ul style="list-style-type: none"> ▪ designated truck routes including all basic traffic management to ensure successful operation 	<ul style="list-style-type: none"> ▪ defined on and off street loading-unloading zones and their enforcement ▪ peak hour loading-unloading prohibitions ▪ vehicle size-access regulations
Environmental management	<ul style="list-style-type: none"> ▪ traffic calming ▪ traffic free – pedestrian streets – protection of residential areas from through traffic 	
Institutional	<ul style="list-style-type: none"> ▪ creation of “Traffic Management Agency” through institutional reform and technical assistance programs <p>Training programs for transport professionals and traffic police</p>	