A TRAFFIC MANAGEMENT STRATEGY FOR COLOMBO CITY

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A paper to be presented at the Annual Session of the Institute of Engineers Sri Lanka Colombo
1997
Abstract

This paper examines options available for managing road traffic in and around the City of Colombo. A number of policy measures are proposed, among them auto restraint measures; demand spreading and structural land-use adjustment as potential approaches in managing the growth of demand for road spaces as against the sustainable provision of road space itself. Increase in road spaces is also analysed in terms of sustainability within a multi-modal and balanced transport system for Colombo. In order to achieve this state of transport functionality within the city, a number of Transport Demand Measures (TDMs) are proposed in this paper. This paper also incorporates into the strategic proposal where relevant, ideas and recommendations that have been expressed over several years.

Since the paper has as its focus, the strategic plans as overall policy options - the detailed feasibility of individual projects and programmes outlined here have been considered to be outside its scope, although general viability of each of them has been discussed.
1.1 INTRODUCTION

According to traffic counts undertaken by the University of Moratuwa (UOM, 1995) the City of Colombo, presently attracts on an average weekday, over 840,000 people from outside its limits. This is considerable when compared to the 638,000 population estimated to live within the Colombo Municipal Council (CMC) area. These persons come to Colombo for a number of reasons as shown in

![Trip Purpose Distribution](image)

*Figure 1.*

These trips are essential for the socio-economic continuity and growth of the city. The ability to transport passengers and goods to and from a city and within-it in an acceptable manner, is essential to improve its economic productivity and to uplift the living conditions of its people.
In a modern city, this acceptability would be assessed in terms of speed, directness and comfort of travel. Other issues such as environmental pollution and negative impacts to living conditions such as results of accidents, loss of privacy etc. are also becoming increasingly important urban issues.

The cost of transport is important for the economic sustainability of a city. It includes all the aforementioned elements. For example, the cost of transporting a worker to the city would be the total of the cost of operating the mode of transport, the time loss to the employee, the fatigue due to the trip and any adverse impact on the state of the mind of the employee. These are dependant on the mode of transport used. Therefore, the mode of transport becomes an important feature in producing an acceptable form of transport within the city.

On the one hand, private vehicles are considered a very acceptable form of travel by their users, provided of course it is affordable. Many persons would consider the possession of a motor vehicle high on the list of priorities when their personal budgets allows such a purchase. However, when increasing numbers of people seek private travel, then there is an increasing demand on the available road space.

Figure 2 shows that from 6AM to 7PM during a typical weekday around 275,000 vehicles cross the CMC boundary (both directions). Within the city, roads such as the Havelock Road at Thunmulla;
CWW Kannangara Mw at Lipton Roundabout; Baseline Road at Borella; Galle Face Centre Road; Armour Street at Maradana and D.R. Wijewardena Mawatha have recorded 13 hour flows over 40,000 vehicles.

When compared with the available capacity of these roads, the average index of volume to capacity (V/C ratio) is over 0.6. For Sri Lankan driving habits and vehicle composition, this corresponds to average speeds of around 25 kms/hr. From recent surveys conducted by the Traffic Management Unit, Ministry of Highways, it has been observed that peak period travel on the main arteries to the city, such as on Galle Road between Moratuwa and Kollupitiya is around 14 kms/hr, while off-peak average is around 27 km/hr. The travel speed in some sections such as in Dehiwela-Bambalapitiya area are seen to be around 7 kms/hr during peak periods.

The ability of the road system in the Colombo City to handle the increase in demand for space is clearly seen as having reached critical proportions. Moreover, only the Marine Drive, extension of Duplication Road and Mattakkuliya Bridge projects are earmarked as additional capacity for implementation in the next 5-10 years for traffic entering Colombo City. This would however add only around 6 lanes of road space, when the requirement to maintain an average 30 km/hr speed of travel by the year 2005 would be around an additional 20 lanes of traffic.

This would increase the cost of transport within the city since the cost of congestion too has to be added to the operating cost of the different modes of transport. Presently, the cost of congestion within the Colombo Metropolitan Area has been estimated at Rs 10 billion per annum (Kumarage, 1995). This as a percentage of the GDP of the region is around 5%. However, with diminishing road speeds, this percentage is anticipated to increase sharply. Bangkok is reported to lose 35% of its GDP due to congestion.

This would lead to a number of socio-economic problems identified as:

(a) loss of competitiveness in the export market
(b) inflationary prices due to unproductive resources
(c) migration of businesses to peripheral areas resulting in spreading of the city and increase in transport and other utility service costs, which in turn impact (a) and (b) above.
(d) increase in environmental pollution
(e) social discontent and loss of political goodwill

Figure 3 shows the increase in traffic at five of the entry points to the city during the period 1961 to 1992. The average increase in the period 1961 to 1979 has been around 2.8% p.a., while in the period 1979 to 1992 this has increased to 5.4% p.a. Generally speaking, this rate of growth is comparable with the rate of growth of the GDP. Thus for Sri Lanka’s anticipated economic growth rate of between 4 to 7 percent, the required road space would need to be doubled every 10 to 17 years. This would translate to building atleast one four lane highways into the city every 4 years or so.
As in most other countries, it is increasingly difficult, and well neigh impossible, to provide road space to keep up with the demand for it. Sri Lanka, like these other countries facing road congestion problems, will clearly be unable to meet the growing demand for road space by building more roads. Even if Sri Lanka could afford such highway and expressway investments, we should learn from many cities world over that have embarked on such ambitious highway building programmes in the 1970's and 80's. The congestion in these cities even to date, continues unabated as more roads have increased more motorisation.

Highway building has become an extremely controversial and politicised issue in these countries thus making the addition of road space much slower than the demand for it. The environmental concerns and the issues of safety and privacy have increased the social cost of highway building particularly in urban areas. Thus many cities have at the present times, abandoned policies of constructing new roads in favour of Transport Demand Management methods.

2. TRANSPORT DEMAND MANAGEMENT

The alternative method of Transport Demand Management seeks to maintain a balance between the demand for transport and the supply of transport infrastructure necessary to meet this demand. In Sri Lanka, the approach hitherto has been more traditional with continuing attempts at providing new roads or the widening of existing roads to meet this growing demand. Transport Demand Management measures that have been most widely used world over include:

(i) Structural Land Use Re-Development
(ii) Introducing Auto Restraint Measures
2.1. SPREADING OF TRANSPORT DEMAND

Most transport demand problems arise due to the peaking characteristic of the demand for transport. The 'Morning Peak', 'Office Peak', 'School Peak' etc are identifiable traffic patterns in Colombo. The spreading of such peak traffic demand is a proven method of flattening the peak demands by about 10-20%. Specially after the recent adjustment to the clock, their is evidence to indicate that the morning peak is very sharply peaked at around 8 am.

There are a number of ways in which this could be achieved in Colombo. They are

**Staggered Hours**
With staggered hours, different work groups are assigned to begin work at different times. Spacing arrivals at specified intervals before and after conventional work, shopping & school hours allows workers to travel at times when traffic moves more freely and more seats are available on Public Transport.

**Flex-time**
Flex-time is a scheduling practice that allows individual employees to choose their own schedules within company-set guidelines. Most flex-time arrangements allow employees to begin work as early 7 a.m. or as late as 9.30 a.m. and many allow workers to vary their arrival times from day to day. Flex-time works well for office workers who work independently and can exercise a certain amount of discretion over the scheduling of their work.

**Compressed Work Week**
Considered as an extreme measure, four-day work weeks allow employees to complete 40 hours of work in four 10-hour days. The system is often called 4-40. Four-forty systems have a double impact on travel to work: one day of commuting is eliminated each week; and the early arrivals and late departures built into the ten-hour days mean employees travel before and after the rush hour peaks.

Changes effecting the spreading of the peak are administrative decisions that could be implemented in the short-term. The analysis of the morning peak traffic demand as shown in Figure 1, reveals that 17.8% of the vehicular flow is comprised of school traffic. This traffic is mostly attracted to a few schools in Colombo City. A significant proportion of these are private schools. A separate study of traffic demand for International Schools conducted by the UOM indicates that over 80% of students arrive by private or hired vehicle, with the ratio of vehicles to students in the range of around 0.6.

2.2 AUTO RESTRAINT POLICY

An analysis of the modal share of private to public transport is shown in Figure 4. It is observed that only 20.6% of vehicle flow is made up of buses. Buses do however, carry 62.5% of the passengers crossing the CMC boundary. Private vehicles such as cars, motor cycles and vans make up 72.4% of the vehicle flow but carry only 25.0% of the passengers. The balance share is carried by para-transport namely three wheelers, taxis and chartered vans The railway carries only 10% of the road share. An estimated 1.7 million passenger trips are made across the city boundary.
Figure 5 shows that while the rail modal share has been steady over the last 10 years, the buses have lost their share from 65% in 1985 to 57% in 1995. This modal shift from bus to private vehicles has meant that although the demand for passenger travel has increased by 4.5% p.a. the demand for road space has increased by 6% p.a. When estimated modal shares for 1961 are superimposed, the trend is most evident. Thus, most of the roads mentioned previously, will reach absolute saturation within the next 5 years where gridlocks will become frequent and peak period travel speed say from Mt. Lavinia to Kollupitiya would drop to less than 10 kms/hr.

Among these; an auto restraint policy for certain parts of Colombo is an imminent necessity if particularly, the CBD areas (defined as the areas of Fort, Pettah, Maradana, Slave Island and Town Hall) are to be cost-effectively accessible for productive economic activity. An auto restrain policy is aimed at improving the utilisation of limited transport infrastructure facilities. Thus High Occupancy Vehicles such as Buses are favoured instead of Cars. Tolls, permits and parking fees are used as instruments of increasing the cost of using private transport such that the demand for public transport would increase. However, such a policy would yield fruit only if high quality public transport alternatives are made available to present motorists. The auto restraint measures that could be considered are:

**Physical Restrictions**
These maybe the most severe restrictions ranging from the extreme measures such as total banning to more softer measures such as allowing vehicles with a minimum number of passengers or the issue of permits for a fee or allowing alternate even/odd numbered vehicles.
Parking Restrictions
These are aimed at limiting the number of parking spaces available, such that although the ability to enter would remain, the ability to park the vehicle, especially for long periods would be reduced. This maybe effected by means of a physical reduction in parking spaces made available for public use.

Tolls
Electronic Road Pricing is becoming an acceptable and efficient method of pricing road usage. The ability to charge electronically gives it flexibility to vary charges according to areas and time periods. The objective is that by varying the toll, the demand for road space could be maintained at an economically optimum level. This method of electronic road pricing should be pursed in the long-term. In the meanwhile, locality oriented road pricing may have to be through parking fees. In this instance the parking fee is actually a surrogate for use of premium road space as well. In this course of action, some cities levy a charge for even private parking spaces and add the same charge for the public spaces mentioned in (b) above.

Therefore a number of these Auto Restraint Measures (ARMs) are urgently required in order to quickly arrest the worsening traffic conditions and imminent gridlock traffic situations and to send the correct 'signals' for a viable city development in the future. The following ARMs are recommended for the short-term implementation:

Limiting of Parking Spaces in Fort & Pettah and Parking Permits

(i) It is recommended that all on-street parking in Fort & Pettah be converted to Permit Parking. These permits could be sold by the CMC in the form of a sticker and valid for one month at a time. The number of permits issued need not be limited. However if the demand is high, then the price could be increased till a balance is reached.

(ii) In addition to the on-street parking, a pre-determined amount of off-street parking (multi-story or otherwise) should be operated by the UDA. They would be open for use by anyone and a rate of say Rs 25 per hour at a minimum of 2 hours and maximum daily rate of Rs 200 should be charged.

Park and Ride Facilities
Park & Ride Systems have been used in many countries world over. Their success depends on how well planned they are; the attention given to meticulous detail such that motorists are attracted to using them and how well they are supported by the wider transport policies.
From the Colombo Traffic Survey (UOM, 1995) it has been observed that nearly 50% of all trips made into the city are destined to the CBD (Figure 6) areas of Fort, Pettah, Slave Island, Maradana and Town Hall. Moreover, the road network in this area is sufficiently dense in order to provide access by a good bus service. A Park & Ride service should therefore concentrate on servicing the auto restrained areas of the CBD as a first step in the short-term.

2.3 STRUCTURAL LAND-USE RE-DEVELOPMENT

The City of Colombo has historically developed a strong core due to the largely radial road and rail network connecting it to the rest of the country. Colombo Fort and Pettah which were the core (or Central Business District) areas for a number of years has in the last decade and a half started spreading out to surrounding areas mainly due to restricting accessibility. The effective CBD has now spread into a much larger area as defined earlier. As a measure to ease this ‘crowding’, the administrative functions are gradually moving out of these areas to Kotte.

Parallel with the development of the core CBD, the main highway arteries; all of which radiate from this CBD; has led to high residential growth, particularly over the last two decades. The lack of building control and regulations to preserve mobility on these arteries has led to unrestrained commercial development of roadside properties. The net result is that the core or CBD cannot be serviced adequately as the travel speeds are restricted while passing through highly built up areas.

In spite of measures that could be taken to increase the mobility on these corridors (dealt with elsewhere in this paper) the capacity limitations will inevitably restrict the economic efficiency of the CBD. The land-use counter measure to maintain an equilibrium between land-use and transport will then have to target a policy whereby strong circumferential transport corridors are created and supported by structural changes in the land use.

Circumferential roads (such as the Outer Circular Road) will then be successful in diverting part of
the existing traffic on the congested corridors. However, it will only be well formulated land use policies that properly establish the potential Growth Centres in the periphery that will economically (and perhaps financially) support such a road. More importantly such a road should enhance the agglomeration concept of the Colombo Metropolitan Area such that the integral relationship of mobility and accessibility between the Port, Commercial, Administrational, Residential and Service areas are closely knit to each other and provided at the least cost both in economic and social parameters.

The Colombo Metropolitan Regional Structure Plan prepared by the Urban Development Authority (UDA, 1996) has worked out the scenario for the planned development of the Western Province around a number of Growth Centres. The transport strategies proposed to achieve this land-use plan are geographically identified as follows:

**Strategy for Inter-Regional Transport**
The basic strategy for inter-regional transport is to plan for mobility between different regions in the country at speed that would be acceptable to attract regional development. This would mean

(i) An inter-regional highway and railway network which will have operating speeds of at least 100 km/hr.
(ii) A network that can by-pass densely developed areas such as the CMR in order to promote mobility between other areas.

**Strategy for Intra-regional Transport**
The objective of intra-regional transport system is to provide a balance of mobility and accessibility between the different trip generators and attractors. The present intra-regional road system provides satisfactory access but lacks the speed of transport on key suburban corridors, reducing the mobility, within the CMR.

The railway on the other hand, has generally acceptable mobility but severely lacks in accessibility as large parts of the CMR do not have convenient access to rail for intra-regional travel.

**Strategy for Inner City transport (CMC Area)**
The problems of transport requirements within the CMC are different to those outside. Trips are shorter in length and therefore accessibility has to be high. A satisfactory level of mobility having a network speed of 30 km/hr would be extremely functional. Measures would have to be introduced to manage limited road space.

2.4. **HIGHWAYS:**

2.4.1. **Access-Controlled Inter-Regional Highways**

A Network of Inter-Regional Access-Controlled Highways is proposed in the Report on the Transport Infrastructure & Service Requirements for the Colombo Metropolitan Region (UDA, March 1997).

Transport links such as a North-South Highway between Matara and Katunayake and a East-West Highway aligned in a Northeasterly direction from Colombo are considered vital for the successful growth and sustainability of that growth by the year 2010. In this light, the long-term process for managing transport within Colombo area has also to be initiated immediately since the planning, design, financing and construction of such facilities take several years.

For the estimated corridor flows for an average 8% growth rate for passengers and 5% for freight by the year 2010. It has been shown that the desired land use plans cannot be sustained with the existing
inter-regional transport infrastructure. Therefore, the following strategy options have been recommended:

(a) Increase & Improve Public Transport & Manage Demand on Existing Highways
(b) Increase Infrastructure Capacity
(c) Combination of (a) & (b) above.

2.4.2 Increasing Mobility of Intra-Regional Arterial Roads

The basic strategy for intra-regional road transport within the Colombo Metropolitan Region (CMR) would not necessarily be the provision of a network of new roads but to improve the mobility of selected existing corridors. It is envisaged that improvements proposed in this section would improve average road speeds to around 30-40 km/hr, throughout the corridor. The eight corridors so identified for this purpose are:

- A1- (Colombo - Kandy Road) Upto Kadawatha (18 kms)
- A2- (Colombo - Galle Road) Upto Panadura (28 kms)
- A3- (Colombo - Negombo Road) Upto Ja-Ela (20 kms)
- A4- (High Level Road) Upto Kottawa (22 kms)
- B5- (Colombo - Horana Road) Upto Polgasowita (20 kms)
- B10- (Low Level Road) Upto Kaduwela (15 kms)
- A1Sp- (Parliament Road) Upto Talangama (15 kms)
- (Baseline Road) Improving & Extending of road upto Attidiya (8 kms)

Technically, a urban artery with a centre median should carry up to 2000 vehicles per hour per lane under ideal conditions. The corresponding speed at which this maximum flow should occur should be around 30 kms per hour. However, flow studies conducted by the UOM (1997) indicate that the maximum flow per lane on typical divided urban arteries is only around 1200 vehicles per hour. The corresponding speed at such flow conditions is only 20 km/hour.

Improvements to Corridor Flows

There is therefore evidence to indicate that certain improvements to smoothen the traffic flow on these arteries can increase both capacity and speed by up to around 50%. Most of these measures are those that can be achieved in the short and medium term and without much financial outlay. However, strong political will is essential in restoring waning road user discipline and restricting the hitherto unlimited access on the City's arteries. These are:

a) Progressively banning of all on-street parking over the next three years. Discuss with business communities on provision of alternate off-street parking facilities.
b) Provide limited turn-out for picking-up drop-off purposes.
c) Provide signalisation of intersections, and possible synchronisation to permit platoon flow with particular attention to bus flows.
d) Investigate and develop parallel roads, when even minor parallel streets are available. This permits their use for collector-distribution, such that openings to the corridor roads may be reduced.
e) Reduce abutting access. By unifying parcel access to the corridor highways using local street networks and drive ways, a major disruptive element to free flow of speed can be reduced.
f) Prohibition of right turns, except at signalised intersections.
g) Signalise all pedestrian crossings.
h) Imposition of land use control and building regulations on land abutting these corridors and at intersections with roads having over 10,000 vpd.
i) Widening to four lane and re-definition of road cross-section with lane markings and segregation to provide appropriate facilities for local traffic mix.
j) Restriction of slow moving vehicles such as carts and tractors, with bicycles accommodated on a separate track or parallel street.
k) Control of stray animals and processions.
l) Implementation of a co-ordinated system of road works, road maintenance and improvements.

m) Improved paving quality to facilitate movement and improve drainage and to prevent capacity reductions during and after rains.

n) Where possible, to convert Parking Lanes to Bus Only Lanes (similar to Red Routes in U.K.), with a view to imposing measures to increase use of high occupancy vehicles.

Control of Parking & Levying of Fees on Major Arteries

In order to maintain adequate mobility into the CBD area in particular and within the city in general, some roads in the network should be managed at a higher level of mobility. Mobility of a road is generally measured by the available travel speed on the road. Travel speed reduces drastically when parking is allowed on a road and when unrestricted access to individual plots of land and turns to roads is allowed. A number of measures are recommended in order to achieve this.

(i) Firstly, it is recommended that parking be clearly designated either within properly constructed parking bays or as a well marked out parking lane. Proposed Parking restrictions are as follows:

<table>
<thead>
<tr>
<th>In the direction to CBD</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Four Lane Highway Sections</td>
<td>7AM to 12 Noon</td>
</tr>
<tr>
<td>Six lane Highway Sections</td>
<td>7AM to 10 AM</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>In the opposite direction, away from CBD</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Four Lane Highway Sections</td>
<td>12 Noon to 7 PM</td>
</tr>
<tr>
<td>Six Lane Highway Sections</td>
<td>4 PM to 7 PM</td>
</tr>
</tbody>
</table>

Parking Wardens could be deployed for this purpose. They should manage the parking and also collect fees.

(ii) The UDA should also engage in a urgent program to locate, designate and reserve land for parking at several locations within the city. As a short term program it should target at reserving at least 20 such locations for car parks within the areas of Maradana, Town Hall, Slave Island, Armour Street, Borella, Dematagoda, Kollupitiya, Wellawatte, Thimbirigasyaya, Pamanakade, Kirullapone, Nupegodda, Maharagama, Mt. Lavinia, Dehiwela, Kiribathgoda, Kadawatha and Ja-Ela. Such parks could be immediately operated by the UDA and later developed as BOT projects into multi-story car parks. These parks are to accommodate the existing demand for on-street parking that would be eliminated when parking restriction are placed on these arteries.

2.4.3. Inner City Highways

The following new constructions are identified to improve the highway network in the Inner City area.

Bicycles Lanes

To incorporate 2 bicycle lanes on the proposed Marine Drive from Wellawatte to Fort and extend to Modera along the sea front. School children and office workers may be encouraged to use this.

Baseline Road Improvement & Extension

This dual three lane highway is presently under improvement construction from Kelani Tissa roundabout to Kirulapone to meet with High Level Road (A4). The trace for the extension to Attidiya to meet with Galle Road (A2) has to be finalised. The highway has to be carefully designed on a limited access basis and treated as a high mobility route as indicated earlier.
Marine Drive
This could be designed as a two-lane distributor road to support the functioning of Galle Road as a high mobility road.

Extension of Duplication Road
The present extension of Duplication Road to Dharmarama Road, Wellawatte should be connected to alternate road path which follows, Anderson Lane, Hampden Lane, Sri Saranankara Mawatha, Karagampitiya Road and perhaps by constructing a new link, to connect to Templers Road, Mt. Lavinia.

Mattakkuliya Bridge
The proposed bridge over the Kelani River at Mattakkuliya will provide a parallel road for Northbound traffic from the CBD area via Alutmawata Road across the Kelani River and along Hekitta Road to Ja-ela and Negombo

2.5. RAILWAYS:

The key to the efficient management of traffic lies in the amount of improvements that could be made For an improved public transport service strategy with private vehicle restrain methods, the modal shares at the CMR and CMC boundaries could be reasonably pegged at goals set out in Table 1. The resulting flows are given in Table 2.

<table>
<thead>
<tr>
<th>Corridor</th>
<th>Total Passenger/day</th>
<th>Estimated Rail Passenger/day</th>
<th>Estimated Road ADT/day</th>
</tr>
</thead>
<tbody>
<tr>
<td>A2 Colombo - Galle Road (Aluthgama) Coastal Line</td>
<td>190,000</td>
<td>57,000 (30%)</td>
<td>21,000 (LOS - D)</td>
</tr>
<tr>
<td>A1 Colombo - Kandy Road (Yakkala) Main Line</td>
<td>480,000</td>
<td>192,000 (40%)</td>
<td>46,000 (Saturated)</td>
</tr>
<tr>
<td>A3- Colombo - Puttlam Road (Kochchikade) Negambo Line</td>
<td>340,000</td>
<td>51,000 (15%)</td>
<td>46,000 (Saturated)</td>
</tr>
<tr>
<td>A4-Colombo - Ratnapura Road (Hanwella)</td>
<td>300,000</td>
<td>*</td>
<td>48,000 (Saturated)</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>1,310,000</strong></td>
<td><strong>300,000 (23%)</strong></td>
<td><strong>161,000</strong></td>
</tr>
</tbody>
</table>

* Due to poor alignment of the existing KV Line, its suitability as an inter-regional railway even if restored may be limited and not significant
2.5.1. Improvements to Inter-Regional Railways

The present railway network serves all provinces. A 20-30% rail modal share of inter-regional travel should be a target for the year 2010. To provide an effective inter-regional service, no new track is necessary, but speed must improve to 100 km/hr and an adequate fleet of reliable rolling stock must be available. Railway improvements must include the following.

a) Rehabilitation of Permanent Way and other structures to permit 100 km/hr trains.

b) Development of signalling and other communication systems.

c) Improvements to stations and improving inter-modal access.

d) Reflecting & systematic replacement of rolling stock.

2.5.2. Improvements to Intra-Regional Railways

In order to increase rail usage within the CMR to the targeted 30% (with 50% at peak times), it would be necessary to consider the required increases in capacity and new lines.

Treble Track to Ragama
Track capacity is reached for this section of the main line. The third line presently under construction is of the highest priority. Good modal shares of 19% at the CMR boundary and 28.5% at CMC boundary indicates that this is a competitive rail line, on which further modal shift and demand growth is probable.

Double Track to Kalutara
Although the Coast Line carries 15-17% of the passenger trips, a modal shift from road to rail is of extreme importance in the Galle Road corridor. Railway has better speeds on this corridor, but higher capacity is required by double tracking upto Kalutara South. This was proposed in 1966 and is presently under study by the Sri Lanka Railways.

Double Track between Ragama and Negombo
The additional track is essential to improve speed and compete with road traffic on the Negombo corridor where present rail share is only 3.1% at the CMC boundary and 3.7% at the CMR boundary.

New Rail Link
The Sri Jayawardenapura Road (A1Sp), Cotta Road and Kollonnawa Road carry a daily volume of over 270,000 passengers, matching the other major corridors which are in the range between 205,000 to 374,000 passengers. The viability may exists for a new rail link on this corridor. A loop from Dematagoda, via Kolonnawa, Kotte, Pannipitiya to Ratmalana has been proposed by Senanayake (1995). The section from Kotte via Pannipitiya to Angulana seems less feasible at the present time. However, with improved rail services, such a route may be used for circumferential type travel.

Electrification
A number of reports have been made on the feasibility of electrifying the Colombo suburban rail network. The first of these studies was undertaken by Pacific Consultants International in 1980 (PCI, 1981). Since then several reviews have been made. An extensive network of over 200 kms of electric lines have been proposed extending upto Kalutara, Kottawa, Kurunegala and Kochchikade (Wickramasinghe Committee, 1995). The section, Kalutara to Veyangoda would form the most essential section of track with extension to Negombo to follow. The speed restrictions due to poor alignment of the KV line however, makes this line more favourable for consideration as a light rapid transit way.
Demand Responsive Scheduling
A uniform headway baseline service has been proposed by UOM (1993). Present demand patterns suggest that such a service could operate between Kalutara and Veyangoda at frequencies of 10-15 minutes in the peak period and 30 mts during off peak. Computerised scheduling would be required to manage both suburban and long distance trains on the same tracks.

Improved Bus-Train Transfer Facilities
Well designed and functional, inter-modal transfer facilities for transfer between bus and rail must be emphasised with facilities for drop off passengers at each railway station within the Colombo Metropolitan Area.

2.5.3. Inner City Railway Network
The present railway is not suited for transport within the CMC. Thus rail transport within the city would have to be on a system such as Light Rapid Transit. Such a system though expensive will be required eventually. However, a People Mover System as proposed below could be introduced much sooner.

Provision of People Mover System (PMS)
A PMS has been proposed for the inner city area covering the areas of Fort, Pettah, Maradana, Slave Island, Town Hall. A high quality, technology such as trams, light rapid transit or low-floor buses may be considered. The PMS serving the inner city area could be extended to provide commuting facilities to some suburbs. The conversion of the KV Line from conventional rail is one such right of way available. A second extension could be made from Narahenpita via Kirulapone to Wellawatte along the banks of the canals presently under rehabilitation.

2.6. TRAFFIC

2.6.1. Traffic Management Council (TMC)
The road authorities namely; the Road Development Authority (RDA), the CMC and the Western Provincial RDA together with the Police are responsible for the day to day management of the traffic in the City. Several committee have been the regular forum for the discussion and decision making where inter-agency participation has been required.

Although there is much awareness of the nature of the traffic problems and the direction of the available solutions, the success of these committees has been marginal. Consequently, traffic management has basically operated with the CMC, Police and RDA etc. carrying on their individual work programs. Due to the lack of a collective body responsible for traffic management in the Colombo area there is no public accountability, with most agencies 'passing the buck' when it comes to public outcry. Thus a Traffic Management Council is considered necessary. The main function of this Council should be

(a) To address traffic management issues, problems and complaints received with respect to the defined area
(b) To collectively arrive at binding Traffic Management Policy Decisions such as with respect to tolls; parking fees and permits; parking restrictions; enforcement strategies, public transport facilities; park and ride services; clearance of sidewalks etc which need to be worked out on an area-wide basis.
(c) To formulate a scheme to disburse funds collected from the parking permits and fees to pay
for highway improvements, park and ride services; public transport improvements and other costs associated with traffic management. This financial relationship should be strongly fostered in order to effect systematic and holistic improvement to prevent large economic losses arising due to traffic congestion.

(d) To develop a method of implementing traffic management schemes; to monitor their progress and reviewing same periodically.

2.6.2. Traffic Management Schemes

Colombo and its environs have a number of inherent weaknesses in the traffic management schemes presently in place. These locations should be identified and small studies made thereof for low-cost improvements in the short-term. Some of the areas to be studied should include:

(i) Identify Locations for Signalisation (Intersections and Pelican).
(iii) Formulation of One-Way traffic circulatory schemes where possible.
(iv) design of Local Traffic Management Schemes such as turn prohibitions, one-way streets, reversible lanes etc.
(v) Development of a procedure for Incident Management System (such as when an accident occurs).
(vi) Traffic Management Procedure for Road Works
(vii) Re-organise parking arrangements especially for three-wheelers and buses
(viii) Formulate an effective Traffic Enforcement Scheme to be implemented by the Police both within CMC and outside to be commissioned in the short-term.

2.6.3. Improved Traffic Enforcement

An improvement in making traffic enforcement effective needs urgent attention. While a clear policy and plan for this is necessary and should be formulated in the short-term, the long-term institutional limitations of the Traffic Police also needs priority investment and attention.

2.7. BUSES

As shown in Table 1, bus transport, together with railways will be required to play a dominant role in providing transport. The transport required is not only in terms of quantity but in qualitative improvements to the present bus service. This is an absolutely essential pre-requisite in order to maintain the modal shares presently enjoyed by the bus service (without losing further to private vehicles) the bus passenger share which is around to 55 percent at the CMC boundary and at 70 percent at the CMR boundary. With past trends showing bus passenger growth to be less than that of private vehicles, the bus industry must undertake a number of improvements in order to attract and retain this target modal shares. These are:

a) Re-structuring and providing for the financial viability of bus companies.
b) Single bus operators should be grouped into an entity capable of operating a professional service.
c) Continuously update routing, fleeting and scheduling of buses based on demand patterns and highway development. To achieve the aforementioned modal shares and given that bus productivity will increase by the proposals made above, the operational bus fleet within the CMR should increase from the present 9,000 vehicles (300,000 seats) to 12,000 vehicles (450,000) seats by the year 2010. This means that over and above the 6% replacement for attrition, the fleet should grow at 3% p.a., making the requirement of new buses for the CMR about 800 per year from 1997 to 2010.
d) A high quality, multi-modal transport centre has been proposed for Pettah. The land presently
occupied by the Manning Market is best suited for this purpose. Such a transport centre should provide for inter modal transfer between, rail, PMS, inter-city bus and local bus.

2.8. FREIGHT TRANSPORT

The growth of freight transport within the CMR and CMC has been around 3% p.a. during the past decade. This is except for the growth of port related freight traffic which is expected to grow at 13% p.a. The Hanwella Road (B10), Kandy road (A1) and Negombo Road (A3) bear most of this increase since the Inland Container Freight Stations are mostly located on these roads. To accommodate the freight demand due to the development of the New Port of Colombo, the management of freight transport would require the following:

a) The creation of Inland Container Depots (ICD) to handle growth of domestic container traffic which is estimated at 9% p.a. by the CUTS study (Halcrow-Fox Associates, 1996). Several such locations would be necessary to accommodate the anticipated increase in container movement. According to the CUTS analysis, a minimum of 15,000 truck movements would be necessary for a road based movement by the year 2005. Hunupitiya and Ratmalana are identified for rail based ICD's and Biyagama for a road based ICD.

b) Relocation of the whole of Manning Market to Orugodawatte and part of Pettah Dry Goods Wholesale Markets to the same location. The connection to the Inter-Regional Highway Network and Baseline Road will give the relocation good collector distributor features.

REFERENCES

- University of Moratuwa, Study of Off-Peak Railway Scheduling, 1993.