TRANSPORT SYSTEM MANAGEMENT - PROCESS AND APPLICATION

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ABSTRACT: Transport System Management (TSM) is a planning and design process for transport system improvements. Its key goal is conservation of economic and social resources, energy, environmental quality and the overall quality of urban life. This is achieved by means of the co-ordination of operating, regulatory and engineering programs.

A formalised process for TSM is presented and practical applications illustrated.

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INTRODUCTION

What is TSM? What is the point of this paper? A more than casual glance at the subject will reveal that it is more than traffic management. But how much more? Misconceptions arise because of its origins. TSM originated in the United States of America, at a time following the decline of the freeway philosophy; that is, authorities went straight from a freeway policy to a TSM policy. In Australia, the freeway policy was not accepted to the same degree. Making up the balance was traffic management. Thus TSM in Australia is only a partially new policy. However it still has something worthwhile to offer.

Transportation Planning

> The objectives of transportation planning are to develop a transport system which conveys goods and people in a safe, economic and equitable manner.
>
> This objective is applicable for whatever scale of finances are available for transportation resources.

Essentially, as spending on the transport system increases, the primary road system is updated to accomodate traffic demands and public transport is expanded to serve all sectors of the community. Transport improvements therefore seek to achieve safer and more economic transport, usually in the form of new facilities.

As spending decreases, the primary road system becomes crowded and traffic diverts onto non-traffic routes; public transport does not serve all the community. Transport improvements therefore seek to balance the service provided to all sectors of the community. This is achieved by maximising the efficiency and productivity of the primary transport system.

In a wider sense, the equitable objective of transport planning should also seek to reduce total expenditure on transport, thereby allowing for higher expenditure on other social activities. Similarly, the impact on other social activity can be reduced by measures to reduce noise and air pollution and stress associated with transport, such as the actual or potential conflicts between children and vehicles.

As the non-transport (or equity) issues of transport planning increase, the evaluation of any proposal becomes more complex. Non-transport issues increase as the system becomes more crowded and as spending on transport is reduced.

Also, as the transport system becomes more crowded, then any action taken is likely to affect more than one section of the system. This effect can be adverse or beneficial. This reaction must be recognised by, and communicated to, all planners involved in implementing any action.

> Transport System Management is a process which includes evaluating non-transport issues in conjunction with safety and economic issues.
>
> The prime purpose of TSM is one of co-ordinating operating, regulatory and engineering programs to achieve maximum efficiency and productivity of the system as a whole and of improvements to the system.

Co-ordination can be achieved at three points in the planning process. Firstly, the goals to be achieved by any section of the transport planning network should be known by planners in other sections. This will allow the planner to consider benefits and conflicts outside his immediate or normal field of responsibility. Secondly, the actions of one agency should indicate all benefits which can be achieved by other authorities and these must be acted upon.

Thirdly, the existing system of financing transport improvements affects the planning process and has two undesirable features:

One, it opposes the impetus toward integration of transport actions that characterises the entire TSM planning process. Each agency functions as a separate entity conforming to the particular process through which funds are obtained and dealing with problems of restrictions on their use, timing and amount.

Two, funding is not equally available to all TSM agencies. Funds from combined Federal and State sources are more readily available in some areas, such as public transport, than in others. This cannot help but encourage planners to weight their plans in favour of activities for which momentarily more assistance can be obtained. The resulting plan may not be at the optimum balance of activities for the community.

> TSM plans must be reviewed in a manner which distributes funds in the most beneficial way.

The range of problems handled cannot be individually assessed and therefore this will require a uniform system of presenting costs and benefits of schemes to a review committee.

Goals are one of the most important factors in transportation planning. They are determined at all levels in the community. Goals that can be achieved are restricted by the resources available for transport improvements.

The expectations of the level of services provided for each urban activity varies within a metropolitan area. A deficiency in the transport system as expressed by, say, a lack of public transport or excessive traffic on a residential street should therefore be determined by the local community. Other deficiencies such as the level of congestion that is acceptable on a main road are usually compared on a metropolitan level, but even at this level, variations in standards are accepted. Hence, as the transportation system becomes more crowded and road traffic demand disperses throughout the system, then the proportion of local goals tends to increase.

The performance of the system related to any goal that is accepted will depend upon the general level of service provided by the transport system. Therefore, a standard may be derived for each goal, and locations (or areas) of the system which do not achieve this standard may be termed deficient. The standard may vary within a metropolitan area, as some standards will be determined by localities.

The transportation planner therefore has goals to achieve which are translated into standards and from which deficiencies are identified. However, it is immediately recognised that when a goal is achieved then community expectations will invariably set a higher standard for that goal and transport improvements will seek to achieve the new goal. Hence, transportation planning is a cyclic process in which standards are either increasing or decreasing, depending upon resources spent.

Many of the studies conducted in the past have been TSM studies, in this sense it is not new, however the general reduction of funds plus increasing non-transport issues require a full TSM approach to the transport system.

Terminology

Summarizing the terminology used in this paper:

Goal	- A generalised statement of targets for improvements to perceived problems of transport systems.
Strategy	- A description of techniques for effecting improvements to transport systems.
TSM Technique	- A defined way of changing transport systems characteristics.

Deficiency - A situation where some element of a transport system is operating below the standard of acceptability.

TSM Scheme - A statement of actions for improvement of the transport system with specified objectives for achievement. The TSM scheme identifies the extent to which it is cost effective to achieve the identified goals. A scheme is usually a group of techniques. There can be alternative TSM schemes for the same area, depending on the importance assigned to each goal.

TSM WORK PROCESS

The TSM process depends heavily on communication and co-operation between the different authorities and the different levels within an authority. The process is initiated whenever a new transport related issue is raised, or when a major change to some component of the system, often funding, requires a reappraisal of current strategies.

The TSM Work Process is illustrated in Figure 1.

New Demand/New Issue

The process is thus initiated by either a new demand on the system or a new issue emerges. Either can occur when new technological changes are introduced into the system.

The system monitoring and goal development are interdependent. In some situations it might be more appropriate for goals to be stated before a system monitoring program is initiated.

Monitor System I

This comprises an inventory of all pertinent information. At this point this is more at a macro-level.

In the general sense, the purpose of monitoring the system is to identify the changing pattern of a deficiency as the implementation cycle proceeds.

Development of Goals

The objectives of goals development are:

(a) To translate any new issues that arise into goal(s) for achievement and to prepare reports giving details of:
- the situation of the system relative to the goal(s),

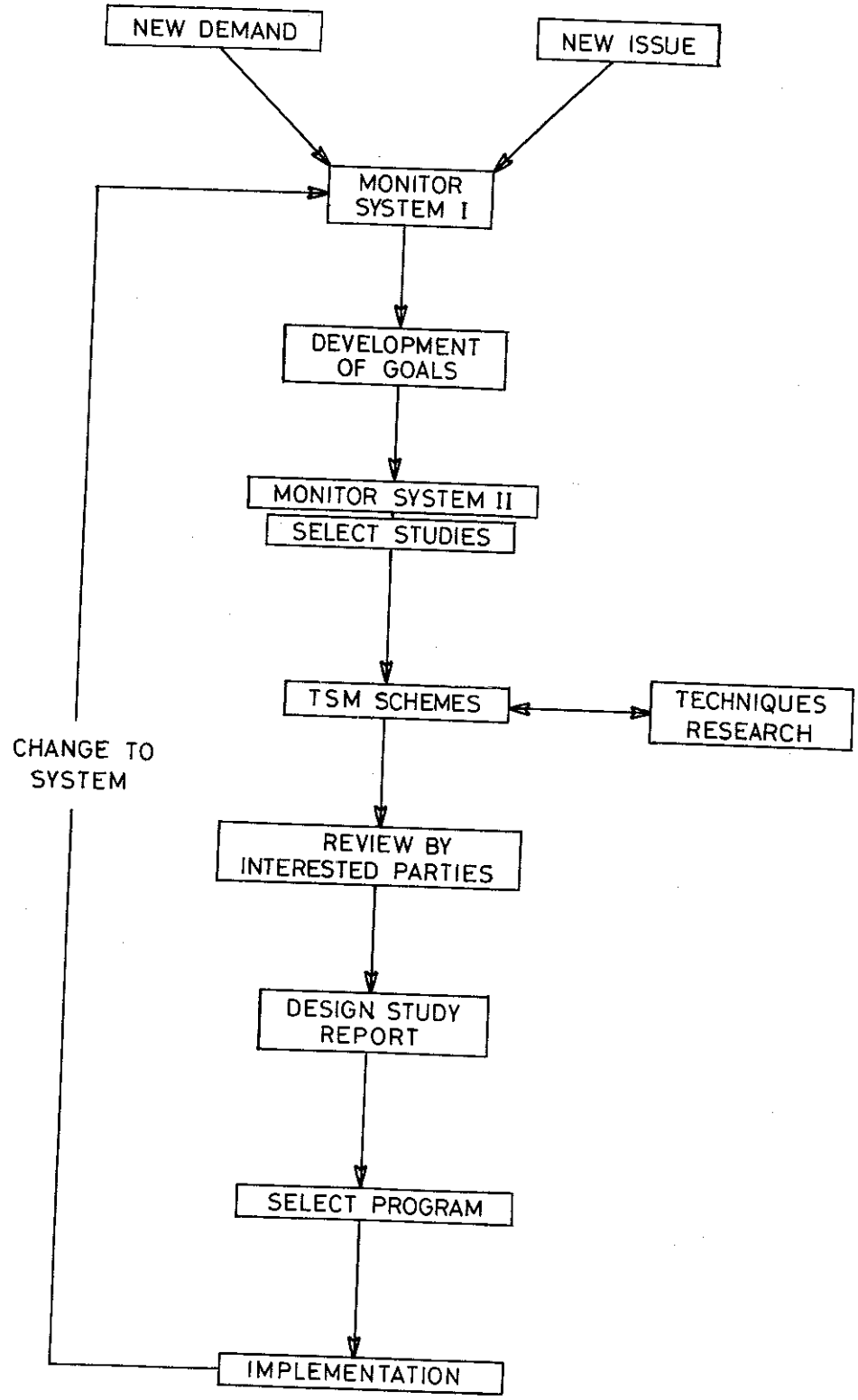

FIGURE 1. TSM Work Process

- the feasible strategies for achieving the goal(s),
- means of measuring the performance of the strategies.

(b) To evaluate the impact of changes to the system on old goals and means of achieving them.

Monitor System II

With the new goals defined, the system monitor can occur at a more detailed level than previously. As an example, in cases where the goal was improvement of bus services, the inventory of information should include:

- the network of streets,
- the network of bus routes,
- current travel times, delay points and occupancies,
- the spatial distribution of population,
- the bus timetable,
- the size of the bus fleet.

From this inventory, possible strategies can be constructed and the means of measuring the progress in pursuit of the strategy can be developed. Thus an inventory of pertinent data should show the deficiencies in the system and suggest strategies for achieving the goal and indicate measures of performance of the system. Situation and strategy reports are the outputs of this section.

Select Studies

Studies are selected to optimise planning resources and to concentrate effort into areas where solutions are most needed. The selection is based on:

(a) Lists of deficiencies,
(b) The Situation Report for the goal (which indicates achievements and growing problems),
(c) The Strategies Report (which indicates measures available),
(d) Past studies of areas,
(e) The program of extended projects,
(f) Approximate funds available (for each group of deficiencies, for all its faults - see earlier).

The final part of study area selection is the definition of areas of influence. In general, the area of influence extends from the central deficiency to nearby deficiencies and from them to more remote deficiencies.

Whilst the definition of study areas is important in controlling resources, the study boundaries should not be considered fixed. During the study design, other strategies or local deficiencies may require an extension

of the study area.

TSM Schemes

The purpose of this is to prepare schemes to reduce or eliminate the nominated deficiencies in the study area. The output should include comments relating to flexibility and implementation procedures.

Figure 2 illustrates the development of TSM Schemes.

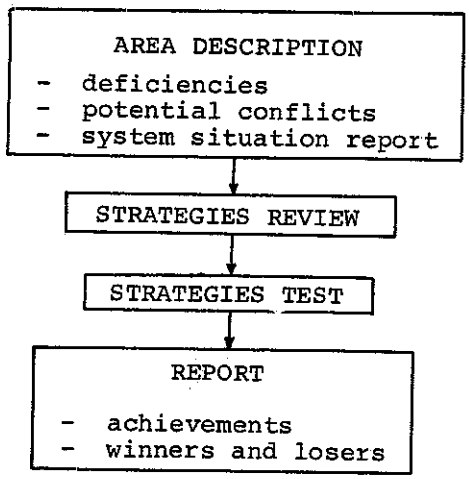

Figure 2: Development of TSM Schemes.

Strategies review and test can often best be stated and communicated by means of tables. A table of relevant strategies versus identified deficiencies could be as follows:

TSM Objective(s): Stated .....

Deficiency	List of Deficiencies in Order of Importance	
	Deficiency 1	Deficiency 2
Strategy 1 (i) (List (ii) available (iii) techniques Strategy 2 (i) ..... (ii) ..... (iii)	.... State whether technique should be considered.	....

Conflicts produced by techniques should next be examined. For example:

Identified Deficiency: Stated .....

TECHNIQUE EXAMINED	POTENTIAL CONFLICT	COMMENTS
Techniques (i) ..... (ii)	Conflict(s) (i) ..... (ii) ..... Briefly note likely conflict(s) against corresponding technique.	General comments relevant to technique.

The TSM Schemes Report should include a table of the form:

TSM Goal:
Identified Deficiency: Stated .....

Recommended Action (s)	Estimated Cost	Description of Winners and Losers	
Alternative 1	$	Winners:	Losers:
.....		.....	.....
.....		.....	.....
.....	$	.....	.....
Alternative 2			
.....			
.....			
.....	$		

Note that this table is not a substitute for the normal design and evaluation process.

Techniques Research

The objectives of this task are:

(a) To prepare lists/reports on all current techniques used in transportation system planning relevant to the study area,

(b) To conduct research into techniques either introduced from overseas experience, or considered by design studies, where considered appropriate.

Review by Interested Parties

The object of the review is to present a summary of design studies to interested parties at a stage when they may contribute to reducing the conflicts or improving the benefits derived from that plan.

Changes to the transport system invariably impinge upon a range of government departments and will involve compromises.

The essence of a TSM study is the development of alternative plans to solve major and minor deficiencies in the system. In this there is an admission that not all problems may be solved at any one time in any area, but that as many benefits as possible should be achieved with each increment of improvement.

Feedback from both local government and the public can form a very important part of this review. A general rule of thumb is that if most local goals are achieved then some metropolitan goals can be achieved, not, the other way around.

Design Study Report

This report covers the TSM schemes as modified by the review by interested parties. The report should contain the following information:

(a) Proposed plan of schemes,

(b) Costs, losers and achievements,

(c) Flexibility (in implementation),

(d) Alternatives.

A revised version of the final table produced under TSM schemes would thus be produced.

The flexibility report should pay due attention to the fact that there can be alternative schemes for the same area, depending on either the importance assigned to each goal or what techniques cannot be implemented because of overiding local opposition. The flexibility report addresses itself to the implementation team, indicating which parts of the plan are critical and which can be delayed or omitted if necessary. It also contains any requirements in the staging of the schemes.

Select Program

The function of program selection is to review the plans and schemes and allocate funds in accordance with priorities. The output is a series of transport and non-transport schemes for implementation.

The first step should list projects in order of benefit-cost priority, taking into account external constraints, particularly budget and technical constraints in implementation, and of the importance of each project relative to the major deficiency.

The final step is to combine each of the TSM plans into an implementation program.

Implementation

One aspect of the implementation of the plans which should not be overlooked is the monitoring of the system before and after the implementation. At the one extreme, a simple 'before' period and single 'after' period survey might suffice. At the other extreme, a constraint monitoring at all aspects of the system might need to be carried out over a long period of time before conclusions as to the success or otherwise of the plan can be reached.

One important point which should not be forgotten is that you do not simply implement a scheme and then sit back and hopefully match the benefits rolling in. The scheme may require continuing management to adjust and tune to local conditions. This does not necessarily represent a deficiency in the original scheme, but is an example of scheme development. Thus a plan should not be implemented under a great fanfare and then defended at all cost. It should be recognised from the start that there are not many perfect solutions in the at times unquantifiable field of transportation, and that ongoing flexibility of a scheme is essential.

APPLICATION

The Traffic Authority of New South Wales is currently researching the application of TSM techniques and processes. The principal goal initially determined by the Traffic Authority was that schemes should be developed to give priority to high occupancy vehicles. This involved a two-stage TSM process. Firstly, an analysis was made of metropolitan transport deficiencies. The output of this was a listing of the problem areas. Three of these areas were chosen for local government area (LGA) size TSM studies. Thus this metropolitan analysis was only a part application of the process, stopping short of regional TSM schemes.

The complete application of the TSM process to one of the LGA size study areas is currently proceeding. The Review by Interested Parties has proved to be one of the most time consuming parts of the process.

A summary of these applications of the process is illustrated in the appendix.

Some general comments on the manner in which TSM varies from 'normal' traffic management practices is contained below.

Non-Transport Issues

Consider a traffic situation where the existing system has a volume/capacity (V.C.) ratio of 0.80 (80 percent of the available capacity is being used) and assume that in the general area this is acceptable i.e. there is no goal to improve this in the area because the resources are not available. (V.C. ratios are used in these examples purely to simplify the discussion, they are only one component of TSM).

The defined deficiencies are vehicular intrusion into residential areas and lack of opportunity for pedestrians to cross a main road.

If a new traffic management plan can be introduced which achieves a V.C. ratio of 0.65 then it is possible to use the gain from 0.65 to 0.80 to reassign traffic from the residential streets or provide more pedestrian crossings (or opportunities to cross by reducing the cycle time of the signals).

Restrictive Measures

This example indicates the need for discussion at policy levels when defining goals. Supposing there is a policy to improve public transport, this can be interpreted to mean at all costs public transport travel times must be improved. Hence if the V.C. ratio for other vehicles changes from 0.80 to 0.90 (implying more delays) then assuming no other conflicting goals, this is an acceptable TSM scheme if public transport goal is usually translated into a low order goal which reads "The overall time taken on the system should not be reduced". Another conflict goal in this case may be the use of fuel which would increase at V.C. 0.90. This could wipe out this strategy used and may lead to a parking strategy at the trip end which resulted in a transfer to public transport and hence aims to reduce the V.C. ratios below 0.90.

Land Use Compromises

In the same way as transport strategies have to be reduced to achievable goals - i.e. a V.C. 0.65 goal is unachievable as a short term metropolitan goal therefore V.C. 0.80 may be acceptable in inner areas. Land Use planning strategies should also be varied when necessary. For example if an area is experiencing a V.C. ratio of 0.90 and one strategy is to rezone a commercial area to 1.5 from 1.0 plot ratio and this is known to achieve the desired economic point at which development will take place then if the real change in employment is small it should be considered

as an acceptable scheme for comparison with other schemes.

Private Enterprise Funding

This form of funding is acceptable in most states and is a useful form of funding in that the hidden benefits elsewhere in the system are not considered. For example a new shopping centre may push the V.C. ratio from 0.80 to 1.10 when the regional goal is 0.70. A scheme which achieves 0.70 and is paid for by the developer (say 80%) is acceptable particularly as this development will reduce the expansion of other centres nearby. (Acceptable is used here always assuming that the local council etc. has no conflicting goals).

Major Projects

TSM is often critisised as a series of low cost schemes which are a panacea to all the problems. It is not. There will still be the problems that say require $2m to reduce from V.C. 0.80 to 0.70 and because of changes in the system these schemes will not move up the 'annual' list. Similarly other deficiencies related to other goals (particularly local goals which can reflect higher than 'normal' standards) will remain in the lists.

These defined deficiencies will greatly aid the evaluation of major projects. For example a local scheme may achieve 80% of the goals in the area. Various other schemes nearby may achieve other goals. A pattern of deficiencies may indicate that one major project (or one stage of that project) could be built which would resolve these particular deficiencies.

In the traditional approach the benefits of a major project would be based on economics, the disbenefits often included non-transport issues. A metropolitan area which had conducted numerous TSM studies would have a list of unresolved non-transport issues some of which could be resolved by major facilities. I.e. noise intrusion of a Freeway may be 'balanced' by vehicular intrusion in a residential area located well away from the Freeway, not necessarily because that traffic was being diverted but because other diverted traffic created opportunities to redistribute the local demands.

CONCLUSION

Three questions were asked in the introduction to this paper. Firstly, what is TSM? TSM is a work process, the goal of which is to achieve maximum efficiency and productivity of the transport system, while also taking into consideration non-transport issues. Details and examples of the steps in the work process have been presented. The second question asked the point of this paper. In essence, the point is the communication to transport professionals

of a work process which has benefits to the community, if applied on either a small or large scale. Thirdly, how different is TSM to traffic management? The theory and examples given illustrate the added scope that TSM gives to transport planning, beyond what traffic management can offer. However a definitive answer cannot be given to this question, since it is situation dependent. It is hoped that the scope has been sufficiently outlined for the individual transport professional to answer this question for himself.

TSM is not the ultimate answer, for the same reason that there are no complete perfect solutions to given transport problems. Under different goals/constraints, different solutions can be produced. Transport problem solving requires goals, information, balanced assessments and communication.

Nothing is new in transport planning but to provide an expanding transport profession with a sense of direction is an achievable goal.

APPENDIX

A.1 TSM PROCESS - METROPOLITAN ANALYSIS

New Issue

Goal of reducing the impact of congestion on high occupancy vehicles. This is both an issue and a goal.

Monitor System 1

Inventory, consisting of:

- Sydney's road network, consisting of both arterial roads and significant minor roads,
- Sites of major queuing for all vehicles, based on qualitative assessments of length and severity of queuing in a.m. peak, p.m. peak and off peak,
- Significant bus routes and volumes,
- Traffic volumes,
- Geographic control cordons.

Development of Goals

Primary goal of reducing delays to high occupancy vehicles.

Secondary goal of reducing delays to all vehicles.

Monitor System II

From initial inventory, feasible strategies to achieve goals are:

- Increase capacity of roadway through traffic engineering techniques,
- Give priority to high occupancy vehicles,
- Reduce the number of cars by encouraging people to travel by bus.

From inventory, define measures of performance - 'congestion assessment units'.

Select Studies

Using congestion assessment units, define:

- Overall degree of queuing,
- Major queuing on arterial roads,
- Major queuing related to appreciable bus volumes,
- Major queuing related to retail centres.

A combination of the above determines the choice of study areas.

This is the extent of this application of the TSM process.

A.2 TSM PROCESS - LEICHHARDT STUDY AREA

New Issue

Metropolitan goals of reducing delays to all vehicles, particularly high occupancy vehicles.

Monitor System

Inventory of:
- Road network,
- Current traffic management,
- Area traffic demand,
- Samples of area traffic volumes, occupancies, travel times,
- Samples of bus volumes, occupancies, travel times.

Deficiencies defined:
- Delays to public transport, particularly in the off-peak period,
- Delays to vehicles,
- Intrusion into residential streets by through traffic,
- Environmental deficiencies adjacent to commercial centres.

Development of Goals

Goals derived from deficiencies:
- Reduce bus travel time,
- Reduce bus variability,
- Reduce travel time for all vehicles,
- Reduce accidents,
- Reduce noise,
- Reduce intrusion of through traffic into residential streets.

Monitor System II/Select Studies

'Before' study:
- Vehicle volumes, occupancies, classifications, at selected points on all major routes through area,
- Area traffic volumes, from all previous counts available,
- Car travel times on all major routes,
- Bus volumes, occupancies, travel times, as measured at three control points on Parramatta Road.

These provide the measures of performance.

Potential strategies/techniques:

(a) Parramatta Road
- Restriction at right turns,
- Lane weaving,
- Tidal flow,

- Parking restrictions,
- Priority vehicle lanes,
- Bus priority techniques,
- Improved signal co-ordination to reduce air, noise pollution.

(b) Area off Parramatta Road

Strategies

- Improve through routes,
- Reduce traffic intrusion by local management schemes.

Techniques

- Directional traffic controls,
- Street closures,
- Road re-alignment and widenings.

Techniques Research

- 'S' lanes,
- 'Head-of-queue' Transit lanes,
- Heavy vehicle lanes.

TSM Schemes

- 16 schemes developed, based on above strategies and techniques,
- Scheme costs estimated,
- Scheme 'winners'/'losers' identified,
- Flexibility of combination of schemes outlined.

Review by Interested Parties

This is the current stage of the process.

REFERENCE

Stapleton Transportation Planning Pty. Ltd., Nicholas Clark and Associates, (1978). "Transport System Management - Procedures and Applications in Sydney". Prepared for Traffic Authority of N.S.W.