TOWARDS THE ESTABLISHMENT OF A COST-EFFECTIVE TRAFFIC FACILITIES PROGRAMME

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ABSTRACT: *Costs of the implementation and maintenance of the infrastructure of road transport including traffic management devices are generally met by Government. In Victoria, the Road Traffic Authority (R.T.A.) is one of the two State Government authorities (along with the Road Construction Authority) involved in this work. Works and services provided through the R.T.A.'s Traffic Facilities Programme (T.F.P.) are implemented to meet road safety goals and the objectives of the State Government's Economic and Social Justice Strategies.*

The R.T.A. uses a variety of techniques and processes in project selection and evaluation in its attempts to maximise the transport services it provides from the public funds that it administers. This paper describes these techniques and processes and illustrates the transport services provided by summarising the results of the quantified evaluations so far carried out.

ESTABLISHMENT OF A COST-EFFECTIVE TRAFFIC FACILITIES PROGRAM

INTRODUCTION

Costs of the implementation and maintenance of the infrastructure of road transport including traffic management devices are generally met by government.

In Victoria the Road Traffic Authority (R.T.A.) is one of the two State Government authorities (along with the Road Construction Authority) involved in this work. The functions of the R.T.A. expressed in the Victorian Transport Act (1983) include:

* to develop and implement road safety strategies;

* to develop and implement traffic management strategies and practices;

* to develop and supervise regulations applicable to road traffic;

* to purchase, design, construct, erect, install, maintain and operate traffic signals

by the provision of works and services through its Traffic Facilities Program (T.F.P.).

The goals and objectives of the T.F.P. are related to road safety and to meeting the objectives of the State Government's Economic and Social Justice Strategies. Therefore the T.F.P. has Components which relate to safety, to the improvement of the management of road transport to assist long term economic development and to equitable allocation of road transport works and services to all road users.

The R.T.A. is using a variety of techniques and processes in project selection and evaluation in its attempts to maximize the transport services it provides from the public funds that it administers. This paper describes these techniques and processes and illustrates some of the types of transport services provided by summarising the results of the quantified evaluations so far carried out.

BACKGROUND

The R.T.A.'s Traffic Management Division consists of:

* three geographic Regions, two metropolitan and one rural;
* three central service Groups providing program development, drafting, and finance and administration services; and
* a technically based Group providing specialised services relating to traffic signals.

The Traffic Management Division is responsible for the management of the T.F.P. which is one of the State's Roads Programs. This program utilises the Program Budgeting approach which sets specific objectives for each program and has an emphasis on post evaluation to measure the cost-effectiveness of the program towards those goals and objectives.

The T.F.P. until the end of 1986/87 has consisted of four Components. The Components and the expenditure in each is indicated in Table 1. The proposed program for 1987/88 is presented in Appendix A. This new program will be structured on the Traffic Management Division's main objectives, the type of transport services provided to meet those objectives, and the client groups who receive the benefits from those transport services.

TECHNIQUES AND PROCESSESS

The techniques and processess used to attempt to maximize the benefits obtained from T.F.P. work relate to project selection, post implementation evaluation of impacts and feedback to regional managers, designers and project selectors.

These techniques and processess can be applicable either at the treatment level (e.g.roundabout), program Component level (e.g.Accident Blackspot) or at overall Program level. Table 2 summarises the measures used, the level at which they are applicable and the reason for their use.

Project Selection

The project selection responsibility is carried by the Regions as they have an understanding of the needs of their region and of the likely overall impacts of proposed works. Some tools have been developed to assist them in carrying out this task the major ones of which are the Quantified Warrants (Q.W.) which can provide assistance in ranking projects in cost effectiveness terms against each other both within Regions and between Regions.

The Q.W.s used by the R.T.A. were developed along the lines of those used by the Department of Main Roads in New South Wales. The Q.W.s differ from traditional warrants used by many road authorities to set guidelines for the installation of traffic control devices in that they attempt to assess the potential benefits obtained from the project and express these in a way which is consistent with economic assessment.

The Q.W.s developed are:

* Safety. The past accident history of the site is obtained and a standard accident reduction factor for the treatment type is assumed allowing the estimation of an annual accident saving. A further development involves the adjustment of this accident reduction factor depending on the relationship between the existing accident rate (accidents per 10^7 vehicles) and the typical accident rate for the treatment proposed. This is then divided by the annualised cost of the project to provide an estimate of its cost effectiveness for safety benefits. Recent analysis of actual benefits obtained from projects has indicated that from a sample of 219 projects that 50% of the total safety benefits were obtained from the first 14% of projects in cost terms ranked by this Q.W.. (Pak Poy 1987).

* Operational. Recently an operational Q.W. has been developed which provides a coarse estimate of the likely impacts on traffic delay of a project, in cost-effectiveness terms, after consideration of the traffic volumes, numbers of lanes, treatment proposed and annualised cost. (Pak Poy 1987)

The Q.W. values are automatically calculated when the details of the project are entered into the Program Management System (P.M.S.) a computer system which has been developed by the Traffic Management Division to assist in the management of works for the T.F.P..

While the Q.W.s focus on only some aspects of the impacts of traffic management works, in particular the impacts at the site in isolation, they can provide a valuable input into the overall decision process.

At Component level this technique can be used to estimate the total road safety cost-effectiveness for the component by summing the expected accident savings and costs at the treatment level.

Post Implementation Evaluation

As a result of its adoption of the Program Budgeting philosophy and to ensure that its design standards and operating procedures are appropriate the Traffic Management Division is involved in post implementation evaluation.

A factor which has limited evaluation processes in most organisations is the cost involved in carrying them out on a systematic basis with the cost of data collection a major item. T.M.D. is attempting to overcome this problem by:

* integrating the evaluation process with the design and operation processes so that data required for these functions can be stored for use in evaluation

* the use of computer technology in the collection, storage and distribution of this data for all users and in the evaluation process.

The program of data collection for evaluation is based on an identification of the data required to give an unbiased impression of the impacts of a particular component of the program, comparing these requirements with the data collected or to be collected as part of the design or operation functions and attempting to fill the gaps in a cost-effective manner.

A range of "before" and "after" road safety evaluations have been carried out so far using the technique developed by Tanner (1958). These evaluations have been labour intensive and time consuming because of the difficulties in determining site history data (treatment type and implementation date) and obtaining works cost data for projects carried out some years ago. The development of the P.M.S. has meant that this information is recorded electronically. Recent developments in this system to link it with the State Accident Record system and to develop "before" and "after" software should mean that a wide range of road safety evaluations should be possible at both component and treatment type levels.

To estimate the operational benefits of T.F.P. works the approach being adopted is to carry out computer modelling backed by a limited number of field surveys. These include:

* Some pilot evaluations of the impact of works on delay and fuel costs at an isolated intersection using the Intersection Simulation Model (INSECT) which allows comparisons between unsignalized and signalized situations.

* Use of the Signalised Intersection Design Research Aid (SIDRA) to estimate the delay and fuel costs due to changes in signal phasing.

* The use of the Cycle Length Offset (CLOFFSET) computer program developed by D.M.R. in New South Wales to assist in the design of signal linking schemes but which includes an estimate of the economic value of the travel time and fuel saving benefits of the scheme. The modelling approach is particularly significant in this area because of the costs involved in obtaining meaningful results from traditional travel time surveys.

The use of qualitative surveys is being investigated to assist in identifying the system wide impacts of the works and services provided as well as the impacts on the complete range of road users including pedestrians, freight, public transport users and cyclists. Some of the techniques described above do not address area wide issues or allow for consideration of the variations between user group and within user groups.

To assist in the efficient management of resources studies which highlight resource allocation considerations such as projections of the long term financial implications of current programs (e.g. signal maintenance) and simple linear programming models have been carried out.

RESULTS

Results and conclusions from various evaluation studies undertaken at treatment, component and program levels of the T.F.P. can give an indication of the transport services provided.

Treatment Level

"Before" and "After" accident studies have been undertaken by the Traffic Management Division for low cost treatments involving the control of right turn phases as part, or all, of the treatment (Nguyen et al, 1986), new intersection signals (Nguyen et al, 1987) new pedestrian operated signals (Liew et al, 1987), and intersection signal remodels (Pentelow et al, 1987).

The results of these studies summarised in Table 3 indicate that for the sample of sites analysed, there was a statistically significant reduction in all types of casualty accidents after the treatment was implemented compared to the number expected if the treatment was not implemented (58% reduction for new traffic signals, 38% reduction for low cost treatments and 29% for signal remodels). Analysis of new pedestrian operated signals indicated that on safety grounds alone, the sample size of 62 sites was relatively too small to provide any conclusive results in statistical terms on cost-effectiveness.

This latter study highlighted the need to look at an overall perspective in determining the cost-effectiveness of various treatments. In the case of pedestrian operated signals, equity may be a major consideration in their installation to allow pedestrians fair share and usage of road space. It should be noted that the average works costs of treatments in the samples in these studies may not be always representative of the costs of similar treatments in the T.F.P.

On the assumption that a standard accident reduction factor for each treatment type can be applied (as assumed in the QW technique described earlier), results from these studies could be used to estimate safety benefits and safety cost-effectiveness obtained from various treatment types in the program as a whole (Table 4). Actual "before" and "after" analysis and consideration of accident severity could lead to a reassessment of these estimates.

Component Level

"Before" and "after" accident studies using the technique developed by Tanner (1958) have also been undertaken at the Component Level for the Accident Blackspot Component, Signal Co-ordination program and the Fairway program (Table 5).

For the Accident Blackspot Component, a "before" and "after" analysis for a sample of 46 sites indicated that there was a statistically significant reduction in the number of casualty accidents by 46% equivalent to a savings of 2.4 accidents per site per year (Richardson et al, 1987). As this sample consisted of mostly signal remodel sites, these results could not be interpreted as indicative for the whole Accident Blackspot Component.

TABLE 3

SUMMARY OF RESULTS - "BEFORE" AND "AFTER" ACCIDENT STUDIES ON TREATMENT TYPES

	LOW COST TREATMENTS	NEW TRAFFIC SIGNALS	SIGNAL REMODELS	PEDESTRIAN OPERATED SIGNALS
SAMPLE SIZE (SITES)	20	82	33	62
REDUCTION (-) OR INCREASE (+) IN CASUALTY ACCIDENTS (%)				
Pedestrian	-18NS	-40NS	-24NS	+14NS
Cross-Traffic	-41NS	-84**	-46**	NA
Right-Against	-65**	+52**	-39**	NA
Rear-End	+56*	-31*-	-3NS	-15NS
Other	-27NS	-66**	+9NS	+1NS
All Types	-38**	-58**	-29**	+1NS
AVERAGE DIRECT WORKS COST (March, 1984 $)	32,800	40,000	37,600	NA
ACCIDENT SAVINGS/ SITE/YEAR	1.66	1.9	0.87	NA
COST-EFFECTIVENESS RATIO (Total cost ie. Direct Works, Salaries & Overheads, R=10%)	5.2	5.6	2.6	NA

Notes: Sources: Liew et al (1986), Nguyen et al (1986), Nguyen et al (1987), Pentelow et al (1987).
NA : Not Applicable
NS : not statistically significant at a level of 0.10
*- : statistically significant at a level of 0.10
* : statistically significant at a level of 0.05
** : statistically significant at a level of 0.01 or higher

TABLE 4

1985/86 TRAFFIC FACILITIES PROGRAM -
SUMMARY OF SAFETY COST-EFFECTIVENESS OF SOME
TREATMENT TYPES RANKED BY
QUANTIFIED WARRANT [1]

	AVERAGE DIRECT WORKS COST (85/86$m)	POTENTIAL[2] REDUCTION IN CASUALTY ACCIDENTS (%)	POTENTIAL[3] ACCIDENT SAVINGS/SITE YEAR	SAFETY COST-EFFECTIVENESS RATIO (Total Cost, R = 10%)
Signal Remodel	30,000	29	0.46	2.74
New Roundabout	91,000	60	0.41	1.19
New Intersection Signals	42,000	58	0.47	1.61
New Pedestrian Operated Signals	20,000	0	0	0

Notes: (1) Works cost of these four treatment types constitute about 45% of the T.F.P. for 1985/86.

(2) Standard accident reduction factor obtained from various "Before" and "After" studies undertaken by the Road Traffic Authority (see Table 3) and the Road Construction Authority.

(3) Assumes standard accident reduction factor applied to the number of "before" accidents per site per year.

TABLE 5
"BEFORE" AND "AFTER" ACCIDENT AND OPERATIONAL STUDIES
FOR COMPONENTS - SUMMARY OF RESULTS

	ACCIDENT BLACKSPOT COMPONENT (Safety)	SIGNAL CO-ORDINATION WORKS (Safety)	SIGNAL CO-ORDINATION WORKS (Operational)	FAIRWAY (Operational)
SAMPLE	46 sites (Signal Remodels only)	50 sites	13.5 km section of Maroondah Highway	East and West Preston Routes
REDUCTION (-) OR INCREASE (+) IN CASUALTY ACCIDENTS (%):				
Pedestrian	-24NS	-16NS		
Cross-Traffic	-63**	-8NS		
Right-Against	-56**	-34**		
Rear-End	-29*	+28*-		
Other	-32*	-9NS		
All Types	-46**	-7NS		
ACCIDENT SAVINGS/ YEAR/SITE	2.4	NA		
TRAVEL TIME SAVINGS			21% reduction in journey time, 14% reduction in fuel costs	5% reduction in tram travel time peak direction
AVERAGE DIRECT WORKS COST (MARCH, 1984$)	32,800	NA		
COST-EFFECTIVENESS RATIO (Total Cost ie. Direct Works, Salaries and Overheads, R = 10%)	10.0	NA	35 (Maroondah Highway) 25 (Rest of Melbourne) 10 (Rest of Melbourne, adjusted for cost)	

<u>Notes:</u> Sources : Nguyen et al (Nov, 1985), Richardson et al (Jan, 1987), Pentelow et al (Draft, 1987), Negus (1985), MTA (1986)

NA : Not applicable
NS : Not statistically significant a level of 0.10
*- : Statistically significant at a level of 0.10
* : Statistically significant at a level of 0.05
** : Statistically significant at a level of 0.01 or higher

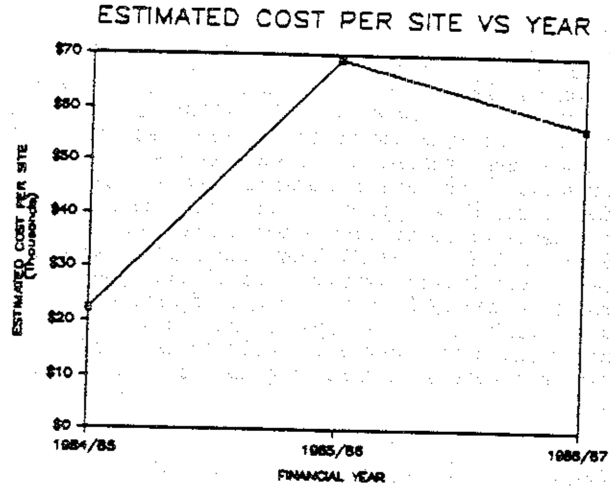
Some assessment of the safety returns from the Accident Blackspot Component as a whole has been initiated. As depicted in Figure 1, overall preliminary trends indicate that the average number of "before" accidents per site per year have been steadily decreasing (from 3.7 in 1984/85 to 2.5 in 1985/86 to 2.3 in 1986/87) as the sites with the worst accident records in the State would have been treated in the earlier years. In safety cost-effectiveness terms, again assuming that a standard accident reduction factor could be applied to each treatment type the safety cost-effectiveness of this program has been estimated as 2.4 in 1985/86 and 3.9 in 1986/87 assuming a 10% discount rate. Given the relatively higher average cost of the type of Accident Blackspot works in the 1985/86 and 1986/87 financial years possibly as a result of greater operational considerations in work designs compared to 1984/85 it could be expected that the safety cost-effectiveness of this program was considerably higher in 1984/85.

For the Signal Co-ordination program, a "before" and "after" accident analysis for a sample of 50 sites (Table 5) indicated that there were changes in accident severity but no significant changes in accident numbers (Nguyen et al, 1985). Benefits in travel time and fuel savings from traffic signal linking on a 13.5 kilometre section of Maroondah Highway have also been estimated in a "before" and "after" study (Negus, 1985).

Limited "before" and "after" studies have been undertaken for the Fairway program. A study on the East and West Preston route (MTA, 1986) indicated that travel time savings to tram passengers of between 5 to 16% can be expected (Table 5).

Program Level

With the assumption that a standard accident reduction factor can be applied to works carried out in the T.F.P., overall safety cost-effectiveness estimates have been derived for the respective Components in the 1985/86 T.F.P. (Table 6). Similarly, the results from the East and West Preston survey (MTA, 1986) and the Maroondah Highway survey (Negus, 1985) have at this stage been applied to estimate benefits from the Fairway and Signal Co-ordination programs respectively.



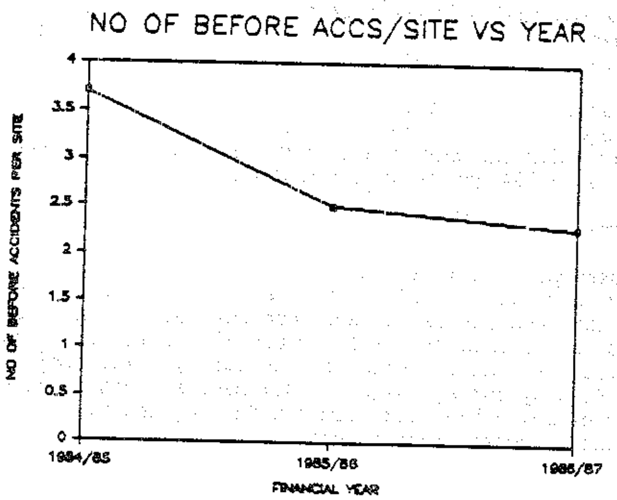


FIGURE 1
ACCIDENT BLACKSPOT COMPONENT - PRELIMINARY TRENDS

Table 6 also indicates the various system impacts of the various programs which have not yet been quantified but which should be taken into consideration to provide a comprehensive assessment of the Traffic Facilities Program.

CONCLUSION

The R.T.A. Traffic Management Division have implemented road works and services through the Traffic Facilities Program to a total value of $170 million since the beginning of the 1983/84 financial year. This investment of public funds is aimed at providing road safety and vehicle operational benefits along with other benefits in the areas of economic development, quality of life and equity which are not so readily quantifiable.

A number of techniques and approaches are being developed to provide feedback on the effectiveness of treatments, program Components and the Program as a whole. These include:

* the use of Quantified Warrants to assist in project selection

* the integration of evaluation with other aspects of the implementation of the program to minimise double handling of information and to provide ready assess to relevant evaluation information.

* the development of "before" and "after" road safety evaluation techniques including computer linking of accident statistic and site works history data bases.

* the integration of computer modelling and traditional survey techniques to estimate operational benefits.

* the development of a computer based Program Management System which has been a major contribution to many of these initiatives.

Studies carried out so far have quantified some of this road safety and vehicle operational benefits of works carried out and have indicated that the cost-effectiveness of the types of works carried out is high.

While the techniques descibred are currently in the development stage they have the potential to lead to further efficiencies in the provision of these transport services from the public funds available.

TABLE 6

ESTABLISHMENT OF A COST-EFFECTIVE TRAFFIC FACILITIES PROGRAM

1985/86 TRAFFIC FACILITIES PROGRAM: SUMMARY OF COST-EFFECTIVENESS DATA

COMPONENTS	IMPACTS NOT YET QUANTIFIED					PRELIMINARY QUANTIFIED IMPACTS		
	Safety Impacts	Traffic System Operation	Economic Development improvements	Equity improvements	Land Use and Environmental Improvements	Cost-Effectiveness Ratio (Total Cost,(2) @ R=10%(4%))	Benefits	Data Source (1)
Accident Blackspot		Delay, Fuel Consumption				Safety: 2.4(3.5)	0.5 accidents saved/project/ year	Predictions on accident savings using P.M.S. data
Fairways	Reduction in exposure to accidents through spatial separation of public transport and other vehicles	Reduced travel time variability, system impacts		Extra provision to pedestrians		Tram Travel Time Savings: 3.1(4.1)	5% reduction in tram travel in peak direction	Study on East and West Preston route (1986)
Bus Route & Modal Interchanges	Reduction in exposure to accidents	Reduced travel time variability, system impacts		Pedestrian Improvements		Safety: 1.25(1.80)	0.3 accidents saved/project/ year	Predictions on accident savings using P.M.S. data
Signal Co-Ordination Works	Reduction in Accident severity	Provision of info. about the road system, impact on road network	Freight impact, marketing of SCRAM technology		Land Use Support	Delay and Fuel Savings: 10.9 (14.4)	21% reduction in journey 14% reduction in fuel costs	Maroondah Highway survey (1982).
Other RMO (including freight, bicycles, land use)		System Impact	Freight Impact	Extra provision to cyclists	Land Use Support	Safety: 1.3(1.9)	0.25 accidents saved/project/ year	Predictions on accident savings using P.M.S. data
Maintenance	Reduction in accidents	Delay, Fuel consumption						
Isolated Treatments				Provision to pedestrians	Improvements to developing areas	Safety: 0.97(1.4)	0.15 accidents saved/project/ year	Predictions on accident savings using P.M.S. data

NOTE: (1) P.M.S. is the RTA's Program Management system which is a computerised data management system providing key information about the Division's past, present and proposed projects.
(2) Total cost includes works cost, salaries and overheads costs.

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APPENDIX A

PROPOSED TRAFFIC FACILITIES PROGRAM STRUCTURE - 1987/88

Level 1 - General Directions - Sub-Programs

- Traffic Engieering Safety
- Mobility

Level 2 - Clients - Components

- General Road Users
- Car Users
- Pedestrians
- Bicyclists
- Motorcyclists
- Tram Users
- Bus users
- Taxi Users
- Freight
- Emergency Services
- Tourists
- Traffic Impacted
- External

Level 3 - Services - Activities

- Planning
- Monitoring
- On-Road Treatments
- Interchanges and Terminals
- Parking
- System Operation
- Maintenance
- Communications
- Advisory Services
- Approval Services
- Research and Development
- Regulation Preparation

DW5:PL4