

AUSTROADS RESEARCH REPORT

**A Framework for Appraisal and
Evaluation of Travel Demand
Management Measures**



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A Framework for Appraisal and Evaluation of Travel Demand Management Measures

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A Framework for Appraisal and Evaluation of Travel Demand Management Measures



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- Department of Main Roads Queensland
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SUMMARY

Austrroads commissioned this study into the evaluation of Travel Demand Management (TDM) measures. By building on the *National Guidelines for Transport Systems Management in Australia*, an appraisal and evaluation framework has been developed which provides a nationally consistent approach to appraisal and evaluation of TDM measures. This framework will provide a basis for more informed choices between non-infrastructure and infrastructure solutions, a better understanding of how and when to use TDM measures and it will also enable TDM investment decisions to be considered and integrated with other investment choices. The appraisal and evaluation framework is governed by two key inputs – the objectives and stakeholder consultation. The objectives play a key role as inputs to a number of components of the process. Stakeholder consultation can be viewed as a continuous part of the process, whether it is conducted formally or informally, as the process proceeds.

A TDM Measure Selection Toolkit is outlined to guide the selection of a set of short-listed TDM measures which are then subjected to appraisal. The Selection Toolkit comprises a Selection Checklist, which identifies a series of steps to be followed in identifying appropriate TDM measures, and a TDM measure Selection Table, which draws on the temporal and spatial character of the underlying problem to highlight potentially relevant TDM measures.

The short-listed set of TDM measures are then subjected to an appraisal process. Appraisal is not a single step in the process but can be likened to a two stage sieve. The first coarser sieve (Short-list Appraisal) is intended to identify options which are unlikely to survive the more detailed appraisal stage which follows. The second stage sieve (Rapid Appraisal) prunes the list of candidates so that the strongest would proceed to the development of a business case as a basis for a final decision to implement. Short-list Appraisal is based on an assessment of the anticipated outcomes, and the confidence of achieving those outcomes. The Short-list Appraisal process relies on scoring the alternative against a range of criteria. The scores on the 'outcomes' and 'confidence' dimensions then provide a basis for identifying options worthy of subsequent more detailed appraisal and business case development. Rapid Appraisal is based on a Strategic Merit Test and Rapid Benefit Cost Analysis. The framework emphasises that appraisal is often an iterative process where options may be refined on the basis of the understanding developed through the process of conducting the appraisal.

The final step of evaluation is the process of reviewing the outcomes and performance of an initiative after it has been implemented. It is essential that consideration be given to the design of the evaluation prior to implementation. The design of the evaluation includes specification of the measures to be used to assess whether the objectives have been achieved and the monitoring methods to be employed to collect the necessary data. It is also critical for data to be collected prior to implementation so that measures can be compared 'before' and 'after' the TDM measure is implemented.

Ultimately the success of the evaluation will depend on:

- the extent to which the process is driven by the underlying objectives
- the extent to which stakeholders have been engaged through consultation conducted as an integral part of the whole process
- whether appropriate preparation and resources are being devoted to the design of the evaluation, and in particular to ensuring that the appropriate data is collected in a timely fashion (specifically 'before' and 'after' implementation) to enable an informed assessment to be made of the success of the TDM measure.

The application of the framework is illustrated through three case study examples which focus on applications typical of problems likely to be encountered in practice, namely:

- a schools scenario where congestion and safety concerns arise from traffic generated by a number of schools in close proximity
- a corridor scenario where traffic congestion is growing but the public transport services are already heavily loaded
- a greenfield development site involving a mixture of residential, retail and commercial activities.

While development of this framework is an important step, there is much to be learned from the evolving experience with TDM evaluations in Australia, New Zealand and elsewhere around the world. At a local level, the repository for data and reference information, developed as part this project, can play a very valuable role in that context.

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1 INTRODUCTION

Interest in travel demand management has grown throughout the world as transport authorities seek to employ a range of solutions to improve transport efficiency while reducing the negative impacts associated with the growing use of the motor vehicle. Austroads has been active in the development of Travel Demand Management (TDM) in Australia and was responsible for commissioning work in the early 1990s to study road demand management and determine 'the principles on which management of demand for use of the road network in major cities could be based and identify specific measures to reduce congestion' (Wayte, 1991; Austroads, 1991). *Travel Demand Management Guidelines* were subsequently published (Austroads, 1995) and more recently evolved into a resource book on TDM (Austroads, 2002). While these, and many other references, provide insight into the range of TDM measures available, less attention has been focussed on the evaluation of TDM measures to support either more informed decisions about their implementation or more insightful understanding of the impacts of measures which have been implemented. Consequently Austroads commissioned this study into the evaluation of TDM measures with a particular emphasis on non-pricing measures.

The purpose of this project is to establish a nationally consistent approach to evaluating the effectiveness of TDM measures. This will provide a basis for more informed choices between non-infrastructure and infrastructure solutions, a better understanding of how and when to use TDM measures and it will enable TDM investment decisions to be considered and integrated with other investment choices. It will also help to identify the benefits of TDM measures to public transport, cycling and walking and the extent to which the measures contribute to promoting more sustainable forms of transport.

The framework explicitly builds on the *National Guidelines for Transport Systems Management in Australia* (Australian Transport Council, 2006) and reflects elements of Land Transport New Zealand's funding allocation process (Land Transport NZ, 2005). While the final terminology adopted more closely mirrors the Australian national guidelines there is still consistency with the general approach adopted in New Zealand. In this way the framework has relevance to all Austroads constituencies. The Australian national guidelines make use of an Appraisal Summary Table which also forms a key part of the *New Approach to Appraisal in the UK* (UK Department of Transport, 2005). The framework presented here has evolved from an appraisal framework for proposed actions in a TDM Action Plan (Ker, 2003). That framework drew on the concept of the Appraisal Summary Table. By building on that foundation with enhancements that closely mirror the National Guidelines, the proposed framework presented here is in harmony with the National Guidelines. It therefore provides an excellent basis for evaluating demand management measures alongside traditional supply side measures which are the primary focus of the National Guidelines.

The framework presented in this report has been refined in response to feedback received from practitioners throughout Australia and New Zealand. That feedback has influenced not only the detail of the framework but also the title of the final report. Since the framework draws a distinction between appraisal and evaluation, it was regarded as important to have the title reflect that breadth rather than implying a narrower focus purely on evaluation. As noted above, the emphasis of this project is on non-pricing TDM measures. However, it became apparent as the project progressed, and through the feedback received at the workshops, that the framework which was developed is not inherently limited to non-pricing measures and has the capacity to see broader application not only to pricing measures but also to complementary infrastructure and land use initiatives.

The structure of this report is as follows. The evaluation framework is presented in Section 2. Next the process for selecting candidate TDM options (Section 3) and an explicit short-listing appraisal methodology (Section 4) are described. The subsequent stage of Rapid Appraisal is then considered (Section 5) prior to dealing with evaluation (Section 6). Section 7 introduces three scenarios used to illustrate the application of the framework. Finally the conclusions of this study are highlighted (Section 8).

2 A FRAMEWORK FOR APPRAISAL AND EVALUATION OF TDM MEASURES

There are many examples in the TDM and evaluation literature where different terms are used to refer to the same concept. The terminology used here mirrors that in the *National Guidelines for Transport Systems Management (TSM)* (ATC, 2006), specifically:

- appraisal is the process of determining the impacts and overall merit of a proposed alternative, including presentation of the relevant information for consideration by the decision maker
- assessment is a generic term referring to quantitative and qualitative analysis of data to produce information to aid decision making
- evaluation is the specific process of reviewing the outcomes and performance of an initiative after it has been implemented.

These definitions clarify that appraisal is undertaken on a range of alternatives in order to make a decision on which one to implement. Following implementation, evaluation examines the actual outcomes against the desired outcomes and seeks to establish the outcomes which are attributable to the initiative which has been implemented.

Figure 2.1 summarises the overall framework for selection and evaluation of TDM measures. This process is framed by two key inputs – the objectives and stakeholder consultation. The objectives play a key role as inputs to a number of components of the process. Stakeholder consultation can be viewed as a continuous part of the process, whether it is conducted formally or informally, as the process proceeds.

The evaluation framework has three central components (shown shaded in Figure 2.1):

- short-list Appraisal
- rapid Appraisal
- evaluation.

Note that each of these components is guided by the underlying objectives.

While a broad range of candidate TDM measures could be considered, it is desirable from an efficiency point of view, to target a smaller set of candidate options for appraisal. For this task a selection toolkit has been developed which encompasses a Selection Checklist and a TDM measure Selection table. That selection toolkit is outlined in the following section and is designed to assist in identifying a candidate set of TDM measures or packages of measures which are relevant to the particular problem context.

In addition to identifying a range of TDM options it is necessary to specify the base case since the benefit cost analysis conducted as part of Rapid Appraisal is based on a comparison between a base case and a project case. As noted in the Australian National Guidelines for TSM, the base case is rarely a do-nothing option, rather it is a no policy change reference point which reflects 'whatever would be done in the absence of significant additional investment or business-as-usual' (ATC, 2006).

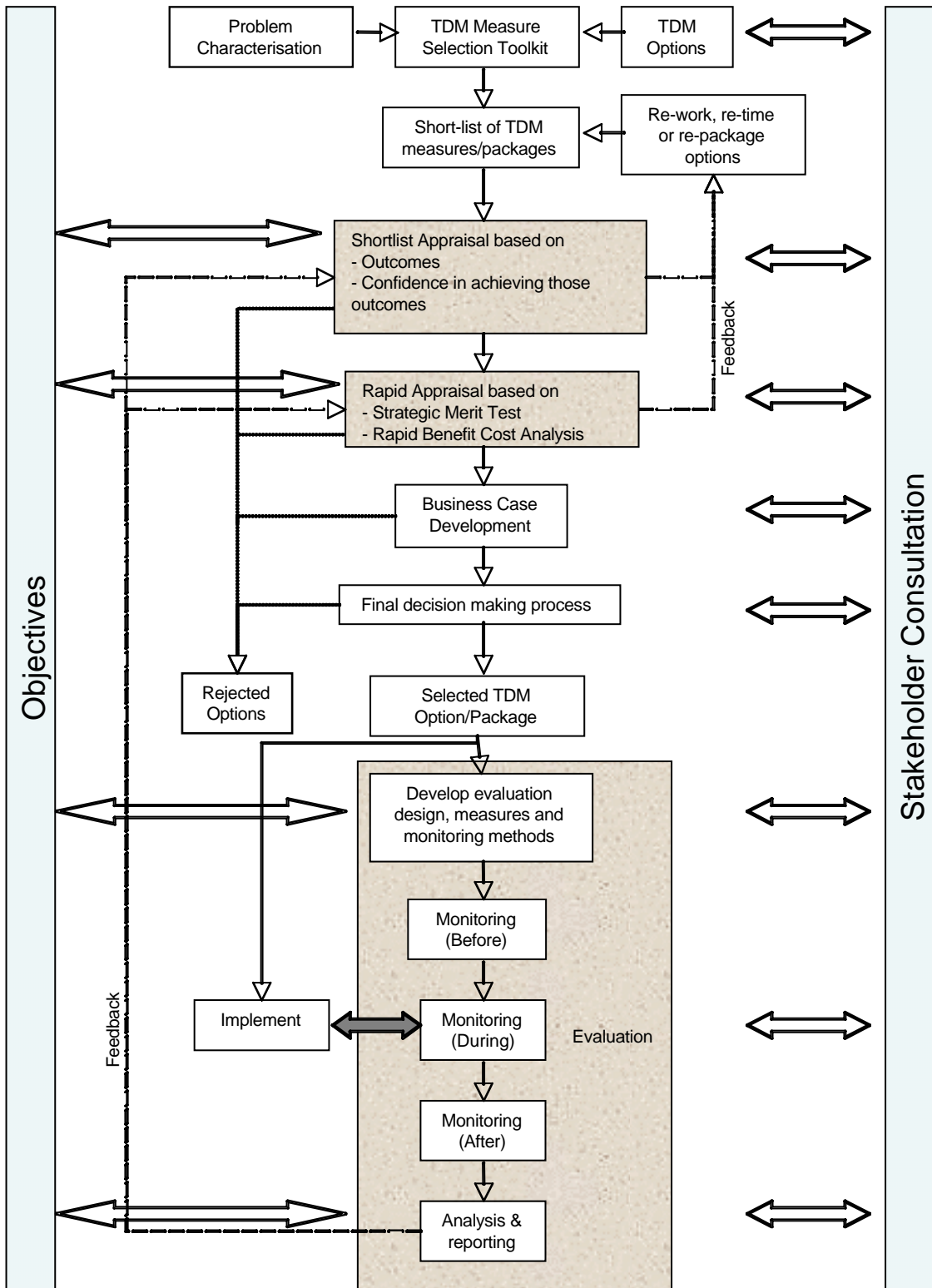


Figure 2.1: Overall appraisal and evaluation framework

Appraisal is not a single step in the process but can be likened to a two stage sieve. The first coarser sieve (Short-list Appraisal) is intended to identify options which are unlikely to survive the more detailed appraisal stage which follows. The second stage sieve (Rapid Appraisal) prunes the list of candidates so that the strongest would proceed to the development of a business case as a basis for a final decision to implement. Rapid Appraisal is based on a Strategic Merit Test and Rapid benefit cost analysis (BCA).

Candidate TDM options are first assessed using a Short-list Appraisal process which is based on an assessment of the anticipated outcomes and the confidence of achieving those outcomes. The Short-list Appraisal process relies on scoring the alternative against a range of criteria. The scores on the 'outcomes' and 'confidence' dimensions then provide a basis for identifying options/packages worthy of subsequent more detailed appraisal and business case development. Appraisal is often an iterative process where options may be refined on the basis of the understanding developed through the process of conducting the appraisal. The iterative nature of that process is reflected in the feedback links shown towards the top of Figure 2.1.

It is essential that consideration be given to the design of the evaluation prior to implementation. The design of the evaluation includes specification of the measures to be used to assess whether the objectives have been achieved and the monitoring methods to be employed to collect the necessary data. Monitoring needs to be conducted before, during and after implementation. This ensures that appropriate data are collected to enable an informed decision to be made about the impact of the TDM measure. It is also critical for data to be collected prior to implementation so that measures can be compared 'before' and 'after' the TDM measure is implemented. The underlying objectives are an important input to the establishment of the evaluation measures and monitoring system and they also provide the basis on which the performance of the initiative is judged. The data collected before, during and after implementation are subsequently analysed and provide the basis for preparing a final evaluation report. The insight gained from evaluation can be fed back to the appraisal stage for future projects. The depository developed as part of this project provides a mechanism for archiving and sharing the results of TDM evaluations.

Key concepts which this framework seeks to emphasise are that:

- the process is driven by the underlying objectives – they govern the selection of appropriate measures and the ultimate assessment of the success of the measures which are implemented
- stakeholder consultation should be an integral part of the whole process
- appraisal of options is often an iterative and multistage process where a broad range of options are refined, pruned and/or packaged as they are subjected to successively more detailed forms of appraisal in order to provide the foundation for a decision on which option to implement
- evaluation needs to be considered early to ensure that the appropriate data is collected in a timely fashion (specifically 'before' and 'after' implementation) to enable an informed assessment to be made of the success of the TDM measure(s).

Each step in the process is now considered separately in the sections which follow.

3 TDM MEASURE SELECTION TOOLKIT

An important first step in the overall framework is the selection of candidate TDM measures. There is a need to ensure that an appropriate range of TDM measures are considered. In this context 'appropriate' could be considered to mean measures which will not only address the underlying problem but do so in a way which is consistent with progressing the relevant objectives for the transport system. It would not be appropriate for the guidelines, or the evaluation framework, to describe in detail the nature of all potential TDM options. A variety of resources are available which provide insight into the range and character of TDM options (Austroads 1991, 1995, 2002; Litman, undated, Wayte, 1991).

Technically, for every project, the full range of TDM options could be subjected to appraisal. Rather than spend time assessing all possible TDM actions, a short-listing approach is used to prune the number of TDM measures which need to be considered. The selection toolkit has been developed to assist in identifying potentially 'appropriate' TDM measures. On the basis of a characterisation of the underlying problem, and the full range of candidate TDM measures, a Selection Checklist (Figure 3.1) and TDM Measure selection table (Table 3.1) are used to assist with the short-listing process.

The Selection Checklist (Figure 3.1) identifies the sequence of steps to be followed in selecting an appropriate TDM measure. Two versions of the checklist are shown: one with a strategic emphasis, where it is consideration of the underlying objectives which starts the process, and the other with a tactical emphasis, where an existing problem motivates the search for a TDM measure. The steps in the two versions are similar, the difference is primarily in the sequence of those steps. TDM measures can have a potentially valuable role to play in progressing strategic objectives such as reducing greenhouse gas emissions, improving levels of physical activity (to respond to concerns over obesity) or reducing fossil fuel consumption (to reduce vulnerability to changes in price or availability). Here most emphasis is placed on the steps in the tactical version since that is the one which is most likely to be applied in practice. The tactical version of the checklist indicates the first step is to develop an understanding of the problem which TDM measures are intended to solve. This can include identifying the geographic scale of the problem, for example, whether it relates to an individual building or group of buildings (e.g. an office park development), a location on the road network, a route on the road network or a corridor or region of an urban area. The location within the urban area (inner or outer suburbs) could also have a bearing on the characteristics of the problem and the availability of travel options. The underlying problem may be characterised in terms of the time period over which unsatisfactory performance is noticeable.

A distinction could be drawn here between a problem which primarily manifests itself during weekday peak periods as opposed to being associated with special events such as a festival or sporting match. Detailed consideration needs to be given to the relevant user groups since TDM measures, by their very nature, are aimed at modifying travel behaviour and so need to be developed with due regard to the underlying users' travel behaviour. It is useful to identify key user groups relevant to the problem along with factors motivating their travel and their sensitivity to various changes in the transport system. Consideration also needs to be given to the scope to change aspects of their travel behaviour such as the timing or frequency of trips, the destination, mode or choice of route taken for those trips. TDM measures may then be selected which would have greatest impact on the travel decisions which are the targets for change.

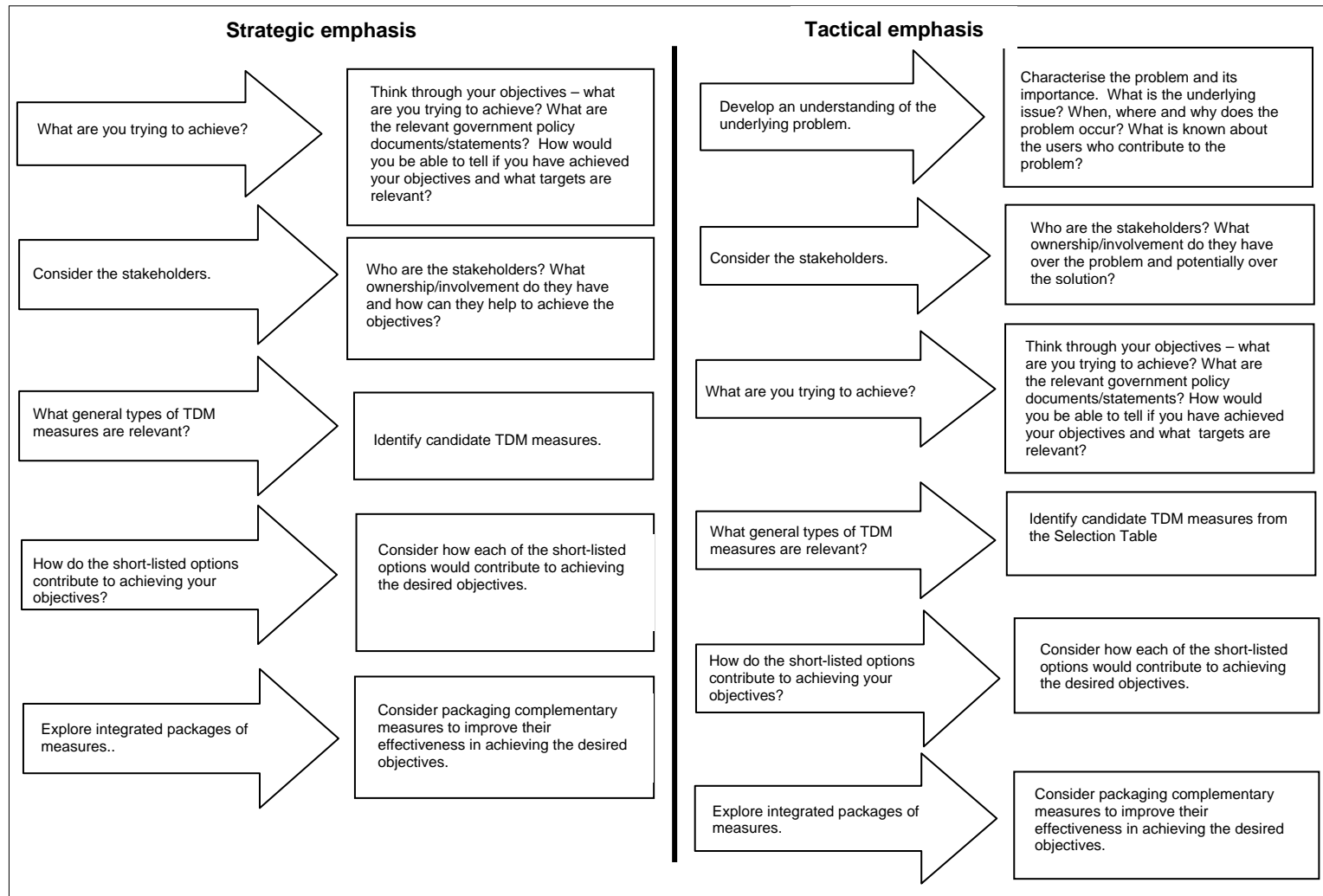


Figure 3.1: Strategic and tactical views of the selection checklist

Table 3.1: TDM measure selection table

		Where does the problem occur or where could a solution be targeted?					
		Individual building or site	Group of sites	Link	Route	Corridor	Area/Region
When does the problem occur?	Weekday peak	<ul style="list-style-type: none"> ▪ Parking provision and management ▪ Travel plan ▪ Multi-modal access guides ▪ Changing cost of car travel ▪ Raising travel/environmental awareness ▪ Improved ped and bike facilities ▪ Promoting walking and cycling for health ▪ Ride-sharing, carpooling or car-sharing ▪ Teleworking, teleconferencing ▪ Alternative hours ▪ Smart growth or transit oriented development ▪ Travel coordinator ▪ Events and challenges 	<ul style="list-style-type: none"> ▪ Parking provision and management ▪ Travel plan ▪ Multi-modal access guides ▪ Changing cost of car travel ▪ Raising travel/environmental awareness ▪ Improved ped and bike facilities ▪ Promoting walking and cycling for health ▪ Ride-sharing, carpooling or car-sharing ▪ Teleworking, teleconferencing ▪ Alternative hours ▪ Smart growth or transit oriented development ▪ Transportation management association ▪ Travel coordinator ▪ Events and challenges 	<ul style="list-style-type: none"> ▪ ATMS – signal priority, access metering, lane restrictions ▪ PT and HOV priority lanes ▪ Improved ped and bike facilities ▪ LATM/traffic calming 	<ul style="list-style-type: none"> ▪ ATMS ▪ ATIS ▪ Changing capacity ▪ PT and HOV priority lanes ▪ Improved ped and bike facilities ▪ LATM/traffic calming 	<ul style="list-style-type: none"> ▪ ATMS ▪ ATIS ▪ AUPS ▪ Changing capacity across routes ▪ PT and HOV priority lanes ▪ Improved ped and bike facilities ▪ LATM/traffic calming ▪ Community-based travel behaviour change program (e.g. TravelSmart) 	<ul style="list-style-type: none"> ▪ ATMS ▪ ATIS ▪ AUPS ▪ Physical restraint through area limitations (traffic cells/mazes, area licences) ▪ Parking provision or restraint, control and management ▪ Changing cost of car travel ▪ Vehicle registration and purchase taxes ▪ Campaigns to raise environmental awareness, reduce GHG or promote PT ▪ Community-based travel behaviour change program (e.g. TravelSmart) ▪ Raising environmental awareness ▪ Promoting walking and cycling for health ▪ Ride-sharing, carpooling or car-sharing ▪ Smart growth or transit oriented development
	Weekday off-peak or weekend	<ul style="list-style-type: none"> ▪ Parking control and mgt ▪ Travel plan ▪ Teleconferencing 	<ul style="list-style-type: none"> ▪ Parking control and mgt ▪ Travel plan ▪ LATM/traffic calming ▪ Changing cost of car travel ▪ Campaigns to reduce GHG or promote PT ▪ Transportation management association 	<ul style="list-style-type: none"> ▪ ATMS ▪ PT and HOV priority lanes 	<ul style="list-style-type: none"> ▪ ATMS ▪ ATIS 	<ul style="list-style-type: none"> ▪ ATMS ▪ ATIS 	<ul style="list-style-type: none"> ▪ As above
	Variable – linked to special event timing or seasonal factors	<ul style="list-style-type: none"> ▪ Public transport to special events ▪ Subscription buses or shuttle buses ▪ Alternative hours 	<ul style="list-style-type: none"> ▪ Public transport to special events ▪ Subscription buses or shuttle buses ▪ Alternative hours ▪ Transportation management association 	<ul style="list-style-type: none"> ▪ ATMS ▪ PT and HOV priority lanes 	<ul style="list-style-type: none"> ▪ ATMS ▪ ATIS ▪ Changing capacity ▪ PT and HOV priority lanes ▪ Improved ped and bike facilities 	<ul style="list-style-type: none"> ▪ ATMS ▪ ATIS ▪ AUPS ▪ PT and HOV priority lanes 	<ul style="list-style-type: none"> ▪ As above

Acronyms used above: ATMS (Advanced Traffic Management Systems) includes signal priority and linking, access metering, lane restrictions to encourage high occupancy vehicles, PT and/or freight vehicles and discourage low occupancy vehicles; ATIS (Advanced Traveller Information Systems) involves information provision to influence departure time, mode or route choices; AUPS (Advanced User Payment Systems) includes integrated payment and smart charging across modes and/or with parking and tolls along with broader pricing initiatives such as congestion pricing; PT = Public Transport; HOV = High Occupancy Vehicle Lane; LATM = Local Area Traffic Management; GHG = Greenhouse Gas

Stakeholder analysis may also provide valuable insight at this time. This includes identifying the relevant stakeholders and their level of involvement in, or ownership of, the underlying problems. Stakeholders can play a valuable role in helping to generate options as well as giving feedback on a range of options. It is also worth considering their potential role in assisting with the implementation of solutions. Many TDM measures rely on active engagement by key stakeholders and there may be opportunities to build that involvement at an early stage.

An important next step is to consider relevant objectives and the extent to which it is possible to measure how a particular initiative progresses those objectives. This is very relevant to the ultimate development of an evaluation design which follows later in the process. Relevant targets may be sourced from government policy documents or statements and assessed for appropriateness in the context of the problem at hand. Targets need not always be framed in terms of an increase in say mode use since arresting a decline in use of a particular mode may be worthy achievement.

On the basis of the appreciation of the underlying problem, and who it concerns, candidate TDM measures can then be identified. To assist in this task, a selection table has been developed to highlight the range of measures which are likely to be relevant in particular situations. That selection table is shown in Table 3.1. The rows in the table correspond to the time period over which the problem is apparent while the columns relate to the location where the problem occurs or where a solution could be targeted. This table provides a basis for identifying a range of TDM measures which may be worthy of consideration in a particular context.

Depending on the temporal and spatial attributes of a particular problem, it may be necessary to consider more than one cell in Table 3.1 when identifying potential TDM measures. The dividing lines in the table are dashed to highlight that there are no rigid boundaries on the cells in the table. When seeking TDM measures to deploy in a strategic setting, entire rows or columns may need to be considered to identify appropriate candidates. To illustrate the application of the table in a tactical context, consider an example where a problem may relate to a particular corridor. In addition to considering the TDM measures listed in the 'Corridor' column in the table, there may also be scope to consider measures targeted on the 'Areas' at either end of the corridor, that is, considering a column to the right of where the problem occurs. Likewise, options to the left may also be relevant. In the corridor context, individual sites or groups of sites within, or at either end of the corridor, could be targeted with the measures in the left hand side columns of the table.

The options which are considered will depend on the particular problem context and will depend on whether an individual option is feasible in that setting. There is no problem with expanding the range of options to be considered in the subsequent appraisal stage. The only thing which a practitioner needs to keep in mind is that as the range of options expands, more time will be required for the appraisal phase which follows.

The final step in the short-listing checklist is to consider integrated strategies or measures. This could be a combination of different TDM measures or through combinations of TDM and more traditional supply side measures including infrastructure and land use planning. The traditional supply side measures include capacity expansion through either physical construction or application of advanced technology in the case of Intelligent Transport Systems (ITS). Options may be refined and packages developed by considering how effective they are likely to be in achieving the desired objectives. When exploring the potential for integrated strategies or measures there may be merit in considering 'packages' of the following types:

- 'Push' and 'Pull' measures such as a combination of disincentives to discourage status quo travel choices and incentives to encourage new travel behaviour: for example, changes to parking availability for single occupant vehicles and increased availability of premium location carpool parking implemented at the same time as High Occupancy Vehicle (HOV) lanes are introduced in a corridor.
- Information strategies to reinforce new or improved travel options: for example, multi-modal access guides or broader community-based travel behaviour change programs (e.g. dialogue marketing initiatives such as TravelSmart Community or Household programs) delivered at the same time that pedestrian and bicycle facilities are improved, when enhancements are made to public transport services or a new ride-sharing, carpooling or car-sharing scheme is introduced; development of an Advanced Traveller Information System (ATIS) to provide information on travel times by car in conventional versus HOV lanes.
- Activity changes to reduce the impact of 'Push' measures: Such as encouragement of teleworking or alternative (work) hour arrangements along with changes in parking provision.

4 SHORT-LIST APPRAISAL

The short-listed set of TDM measures are next subjected to a Short-list Appraisal process as illustrated in Figure 4.1. Short-list Appraisal focuses on two key dimensions: Outcomes and Confidence (that those outcomes can be achieved). The confidence dimension reflects a similar consideration which is imbedded in the Land Transport NZ's funding allocation process (Land Transport NZ, 2005). The assessment of both the 'outcomes' and the 'confidence' is achieved by scoring each TDM option against a range of criteria. The National TSM Guidelines (ATC, 2006) explicitly recognise the subjectivity associated with assigning the scores or ratings. While a project team could internally undertake the scoring for Short-list Appraisal, the subsequent Rapid Appraisal stage would usually involve scoring by government agency staff assessing proposals for funding. This issue is addressed further in Section 5.

Multiple outcomes are considered in the Short-list Appraisal by including a range of criteria covering two broad categories:

- TDM effectiveness, i.e. how effective is the measure in managing demand
- economic, environmental and social impacts.

Figure 4.1 highlights that the mean scores on the 'outcome' and 'confidence' dimensions feed into a category analysis to identify options which show sufficient promise to proceed to the Rapid Appraisal step. Section 5 examines the Rapid Appraisal process in greater detail. Short-list Appraisal involves outcome and confidence assessment, as described in Section 4.1, and the selection of options for further appraisal, described in Section 4.2.

4.1 Outcome and Confidence Assessment

Outcome assessment focuses on two areas: TDM effectiveness and impacts. In each area, a series of assessment criteria can be established and a rating or score assigned against each criteria.

Table 4.1 lists example assessment criteria for the TDM Effectiveness dimension while Table 4.2 highlights nine criteria for assessing the 'Impacts' dimension. In addition to scoring the outcomes, an assessment is also made of the confidence in achieving those outcomes. Again a range of criteria are established for this dimension as summarised in Table 4.3. These should be regarded as illustrative rather than prescriptive or comprehensive criteria for the Short-list Appraisal. In New Zealand the funding allocation process (Land Transport NZ, 2005) includes explicit objectives which can be incorporated through appropriate choice of criteria for the rating process. Following the appraisal of actions in a TDM Action Plan undertaken by Ker (2003), a scale from 0 to 3 is suggested including half point ratings (0.5, 1.5 and 2.5). This provides a seven point assessment scale. There will always be an element of subjectivity in assigning scores on each of the criteria. Rather than attempting to score each option in an absolute sense, the aim is to ensure a degree of consistency in the ratings assigned to alternative TDM measures. The emphasis at this stage is on relativities across the measures rather than absolutes for any one measure. The subsequent Rapid Appraisal step has a stronger 'absolute' dimension to the assessment particularly in terms of the benefit cost analysis. In the Short-list Appraisal, the first of criteria under the economic impact category refers to the ratio of benefits to costs. The National Guidelines for TSM (ATC, 2006) suggest that a BCA be undertaken as part of Rapid Appraisal although they recognise that, based on the experience of Australian jurisdictions, the error margin could be expected to be $\pm 40\%$. At the Short-list Appraisal stage, a rating of the anticipated BCA result would provide the foundation for the appraisal. The one to three scale for this criteria could be regarded as a '1=low', '2=medium', '3=high' scale.

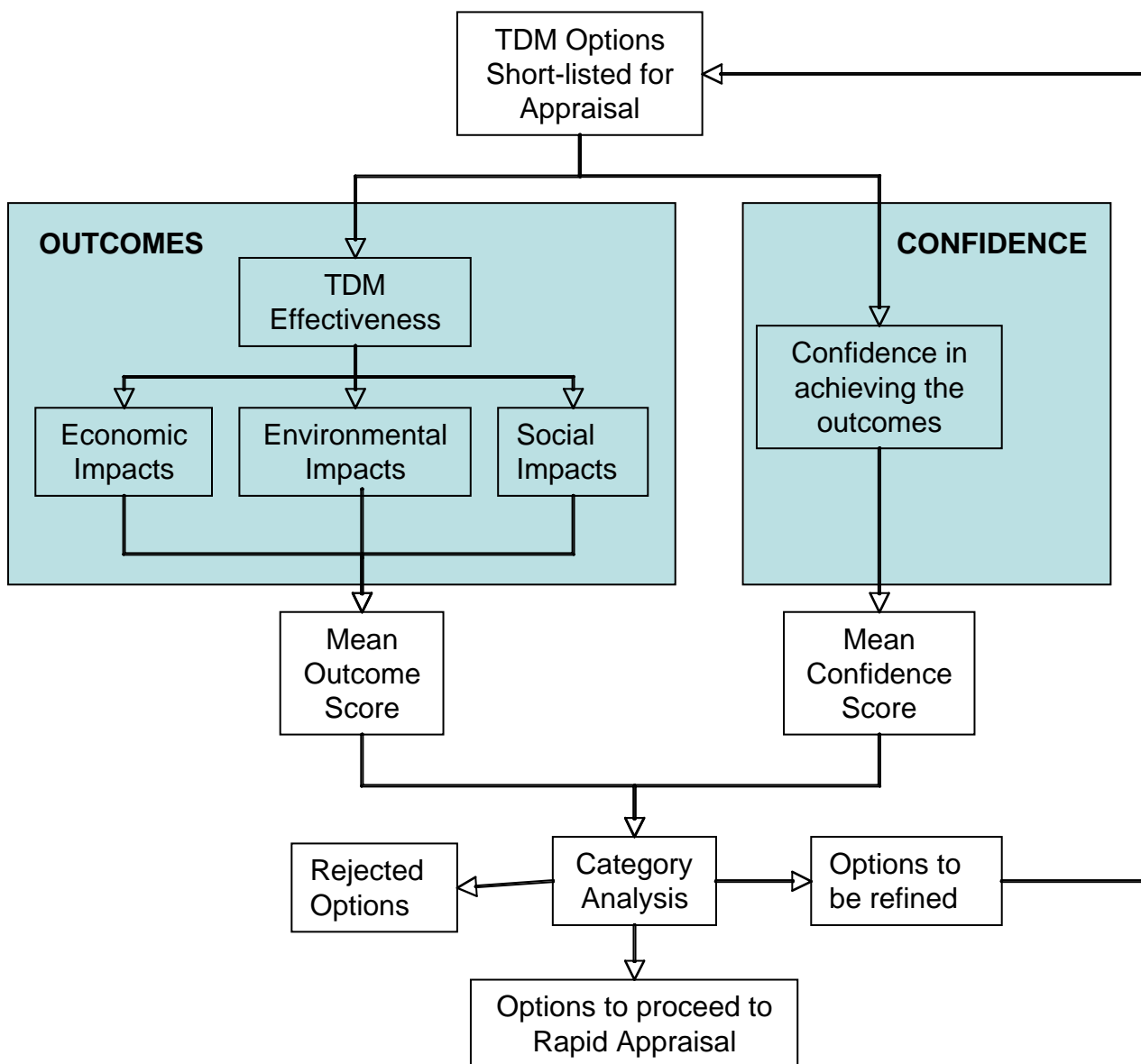


Figure 4.1: Short-list Appraisal of options

Table 4.1: TDM effectiveness criteria

Criterion	Interpretation/assessment/comment
TDM effectiveness: How effective is the measure in managing demand?	
<ul style="list-style-type: none"> ▪ Increased use/share of public transport 	Does the measure promote, raise awareness or enhance use of public transport?
<ul style="list-style-type: none"> ▪ Increased use/share of walking and cycling 	Does the measure promote, raise awareness or enhance use of walking/cycling?
<ul style="list-style-type: none"> ▪ Reduced reliance on car travel 	Extent of impact on single-occupant car travel (in the context of commuting) or 'serve-passenger' trips (in the context of school-based travel)
<ul style="list-style-type: none"> ▪ Optimise use of existing infrastructure 	Extent to which the impact is on times/areas of peak demand (high score for reduced car use could be low, or even negative on this criterion where a lack of spare capacity on public transport could undermine mode shift) Targeted and targetable actions (e.g. through choice of locations) would score more highly
<ul style="list-style-type: none"> ▪ Synergy with existing strategies 	Effectiveness of the measure, or other complementary initiatives, is likely to be enhanced, where it is aligned with established transport and/or land use strategies

Table 4.2: Impact criteria

Economic impacts	Interpretation/assessment/comment
<ul style="list-style-type: none"> ▪ What is the scale of the economic impact/benefit relative to the cost? 	<ul style="list-style-type: none"> ▪ What is the scale of impact related to the cost? What is the likely range of the benefit-cost ratio?
<ul style="list-style-type: none"> ▪ Reduce costs of travel to the community 	<ul style="list-style-type: none"> ▪ To what extent does the measure have an impact on critical aspects of the transport system and usage (e.g. congestion)? ▪ A focus on reducing peak-period arterial trips by road would increase rating, but to a smaller extent if change is only to encourage public transport where there is no spare capacity
<ul style="list-style-type: none"> ▪ Improve price signals in the market place 	<ul style="list-style-type: none"> ▪ Includes improved perceptions of existing pricing signals and broader understanding of overall 'costs' of individual travel decisions ▪ Changes from fixed to variable costs for pricing would be a desirable step
Environmental impacts	Criteria
<ul style="list-style-type: none"> ▪ Improve air quality 	<ul style="list-style-type: none"> ▪ Regionally, proportional to changes in car use, with allowance for short journeys (cold start conditions for higher proportion of total journey) ▪ Locally, lower impact/concentration of pollution in suburban areas ▪ Disproportionate local impact (mainly peak period) arterial road journeys
<ul style="list-style-type: none"> ▪ Reduce greenhouse gas emissions 	<ul style="list-style-type: none"> ▪ Regionally, proportionate to change in car use, with allowance for short journeys (cold-starts)
<ul style="list-style-type: none"> ▪ Reduce noise pollution 	<ul style="list-style-type: none"> ▪ Focus on times and areas of high car use. Rating would be higher where the target is peak period commuting on arterial roads and lower for more dispersed (in time and space) impacts
Social impacts	Criteria
<ul style="list-style-type: none"> ▪ Improve equity of access to employment or other activity opportunities 	<ul style="list-style-type: none"> ▪ Rating proportional to the impact on alternatives to the car, representing improved perception or greater use of lower cost modes
<ul style="list-style-type: none"> ▪ Increase health and well being 	<ul style="list-style-type: none"> ▪ Rating generally in line with increase in walk/cycle use, less so for public transport and also related to impact on air pollution ▪ Health and fitness benefits from active transport (walking, cycling and accessing public transport) depend on the existing fitness levels of those who change with people who are inactive or sedentary reaping a higher benefit. Physical activity can also be accumulated over the day e.g. walking for short distances to/from public transport will deliver a benefit where it contributes to accumulating at least 30 mins of physical activity each day for adults and at least 60 mins of moderate to vigorous activity for children and young people. ▪ Disproportionate local air pollution impact for (mainly peak period) arterial road journeys
<ul style="list-style-type: none"> ▪ Increase public safety and security 	<ul style="list-style-type: none"> ▪ Related to increased people activity ('eyes on the street'), particularly walking and cycling and at public transport stops/stations and reduction in car use (net road trauma reduction). Children, women and the elderly benefit particularly from a safer environment. ▪ May depend on area of impact with UK research indicating children are up to four times more likely to be injured in a traffic crash in poor socio-economic areas.

Table 4.3: Confidence criteria

Criterion	Interpretation/assessment/comment
<ul style="list-style-type: none"> ▪ Certainty of an ongoing outcome 	<ul style="list-style-type: none"> ▪ To what extent are the benefits 'guaranteed' versus uncertain? How good is the evidence that the program will achieve the effect?
<ul style="list-style-type: none"> ▪ Time frame for benefit realisation 	<ul style="list-style-type: none"> ▪ How soon will the benefits be realised? Short-term (0-2 years) 3pts; medium-term (2-5 years) 2pts; long-term (more than 5 years) 1pt.
<ul style="list-style-type: none"> ▪ Durability of the impacts 	<ul style="list-style-type: none"> ▪ Are the impacts durable without continued resourcing of the intervention?
<ul style="list-style-type: none"> ▪ Degree of social acceptability 	<ul style="list-style-type: none"> ▪ What is the ease with which the intervention can be implemented given the extent to which the intervention will be acceptable to the community?
<ul style="list-style-type: none"> ▪ Feasibility 	<ul style="list-style-type: none"> ▪ To what degree are the necessary skills, expertise and other resources available?
<ul style="list-style-type: none"> ▪ Robustness 	<ul style="list-style-type: none"> ▪ How robust is the measure? How sensitive are the outcomes to key assumptions about the broad environment (exogenous factors) or internal aspects of the option? Will the measure still deliver benefits across a range of potential future scenarios?
<ul style="list-style-type: none"> ▪ Flexibility 	<ul style="list-style-type: none"> ▪ Can the delivery be modified to accommodate changed needs?

4.2 Selecting Options for More Detailed Appraisal

Interpreting the results of the Short-list Appraisal provides a basis for selecting options to proceed to the more detailed stage of Rapid Appraisal. Examination of the scores on the different dimensions provides insight into the strengths, weaknesses and degree of confidence in different options.

To facilitate the identification of options likely to be worthy of further more detailed assessment, it is useful to consider each option's mean score on the Outcomes and Confidence scales. Figure 4.2 shows how a plot of the mean Outcome and Confidence scores can be used to identify categories of options which:

- may be worthy of further, more detailed appraisal (Category I)
- need to be re-worked, packaged or re-timed (Category II)
- perform poorly in terms of both Outcomes and Confidence and should therefore be rejected (Category III).

The phrase 're-timed' used in the context of Category II measures, refers to options which may be capable of delivering solid outcomes but would be unlikely to attract community support for implementation. It may be that through greater stakeholder engagement and education, those options may attract a different level of support at a later point in time. Options which rate highly on the Confidence scale could be used as a 'point of entry' in establishing a TDM initiative. Subsequent emphasis could then be on building the Outcomes dimension through complementary measures.

The discussion here implies that it is the raw average scores that are used to identify candidates for Rapid Appraisal. Scope exists to weight the various criteria if that is regarded as appropriate when seeking to select options to undergo the next stage of appraisal. This is analogous to the Adjusted BCA described in the National TSM Guidelines (ATC, 2006).

The key point here is that the appraisal can be regarded as part of an iterative process of option refinement. The insight provided by appraisal, through the feedback loop shown in Figure 2.1, can lead to improvements or re-packaging of the TDM options under consideration. Examination of criteria which scored poorly may help to identify opportunities to improve either the outcomes or confidence through re-design or refinement of the measure.

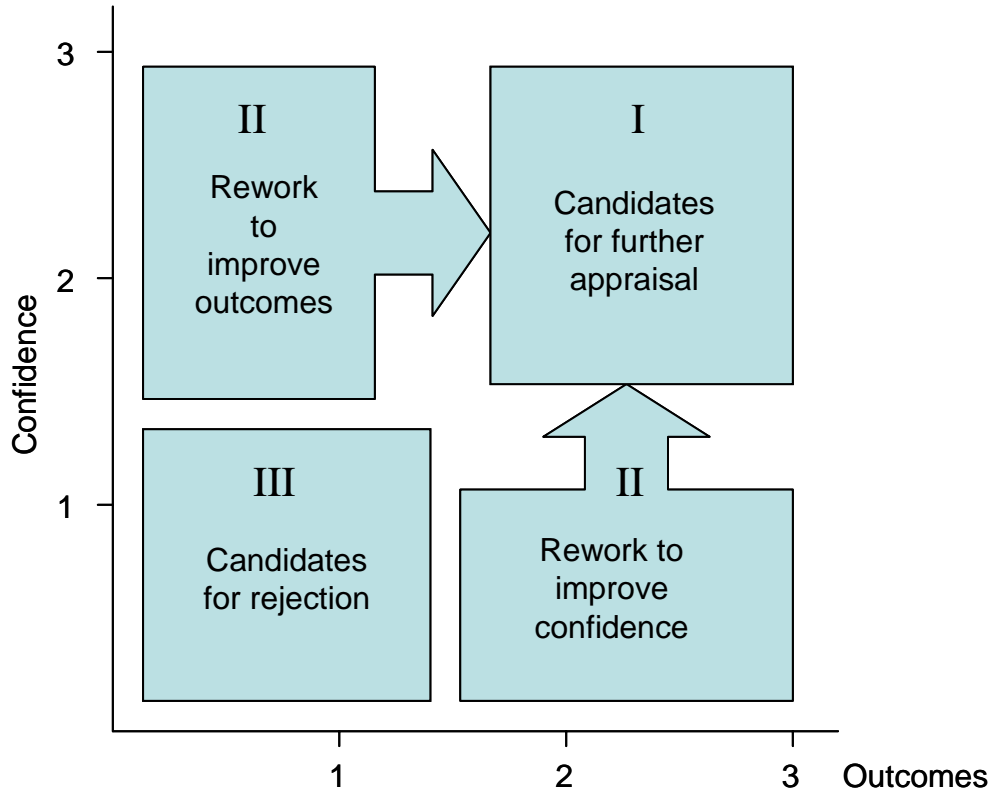


Figure 4.2: Classification of options following Short-list Appraisal

5 RAPID APPRAISAL

The National Guidelines for TSM in Australia (ATC, 2006) provide detailed guidance on conducting Rapid Appraisal. While those guidelines were originally developed for appraisal and evaluation of infrastructure or supply side projects, they also have application in the context of TDM evaluation.

Rapid Appraisal can be considered to comprise two elements: Strategic Merit Test (SMT) and Rapid BCA. The SMT examines the strategic fit of the option with relevant plans/strategies and transport system objectives. Rapid BCA is a 'broad-brush' quantitative assessment. The National Guidelines also note that an adjusted BCA approach, essentially a hybrid of BCA and multi-criteria analysis, can be employed. The National Guidelines note that based on the experience of Australian jurisdictions, the error margin on the Rapid BCA could be expected to be $\pm 40\%$. The expectation is that for rapid BCA, estimates would be less precise with costs and benefits that are small or difficult to estimate omitted altogether. The detailed appraisal stage which follows Rapid Appraisal in the National Guidelines, focuses on a detailed BCA, and requires a greater commitment of time and resources in order to refine the benefit estimates. The Guidelines distinguish between small and large scale projects with small scale ones exempted from the requirements of a detailed BCA. While noting that jurisdictions may have their own views on what constitutes a small-scale project, the guidelines propose an upper limit on investment cost of \$10 million as signifying a small scale project. On this basis TDM projects may not require detailed BCA.

As explained in the National Guidelines, the heart of the SMT is an assessment of how the objectives of a project align with the objectives of the government as spelt out in strategy documents relevant to the project. This is summarised in an Objective Impact Tableau which is similar to the Appraisal Summary Table in the UK system (UK Department of Transport, 2005). Specific objectives need to be nominated along with identification of the source documents for those objectives. The National Guidelines suggest that the achievement of each objective be rated on a seven point scale which could be interpreted on a numerical scale from -3 to +3 as follows:

- -3 (large negative): Major negative impacts with serious long-term and possible irreversible effects leading to serious damage, degradation of the physical, economic or social environment.
- -2 (moderate negative): Moderate negative impact. Impacts may be short medium or long term and most likely respond to management strategies.
- -1 (slight negative): Minimal negative impact. Possibly short term, able to be managed or mitigated, and does not cause substantial detrimental effects. May be confined to a small area.
- 0 (neutral): No discernible or predicted positive or negative impacts.
- +1 (slight positive): Minimal positive impact, possibly only lasting over the short term. May be confined to limited areas.
- +2 (moderate positive): Moderate positive impact, possibly of short, medium or long term duration. Positive outcome may be in terms of opportunities and outcomes of enhancement or improvement.
- +3 (large positive): Major positive impacts resulting from substantial and long term improvements or enhancements to the existing environment.

The National Guidelines provide example templates for summarising the results of the SMT. Importantly, there is explicit recognition of the subjectivity associated with assigning the scores or ratings. As noted in the National Guidelines:

While project proponents are free to assign their own ratings, the final ratings used for project appraisal should be assigned by the government agency assessing the proposal. Government officials can look across the range of project proposals submitted to ensure the ratings are right in relative terms. Project proponents are in a position to compare only the projects and options which they themselves submit (ATC, 2006, Vol 3, pp. 17)

Unfortunately there has been less experience with the application of BCA to TDM measures. This is an area where there is much to be gained from sharing initial experience with the application of this evaluation methodology. It is also important to keep in mind that an error margin of $\pm 40\%$ could be expected in the Rapid BCA of TDM options. Consideration could be given to quantifying and valuing benefits arising from TDM measures such as:

- travel time (savings or increases) for individuals or the network (congestion changes)
- vehicle operating costs
- fleet or staff cost or expenditures for public transport operations
- accident and road trauma costs
- health and fitness
- emissions and pollution costs (air, noise, greenhouse emissions).

The National Guidelines on TSM provide additional guidance on BCA for urban projects which may be of benefit in the context of applying BCA to TDM options. Other useful resources include a recent report discussing the evaluation of TravelSmart (the generic name for voluntary travel behaviour change initiatives) commissioned by the Victorian Department of Infrastructure (Maunsell Australia, 2006) along with the Land Transport NZ *Travel Behaviour Change Guidance Handbook* (Land Transport NZ, 2004) and the *Travel Behaviour Change Evaluation Procedures: Technical Report* (Maunsell Australia, 2004) which contain guidance on quantifying and valuing benefits for travel behaviour change programs. Litman (undated) also provides extensive discussion of the benefits and costs of TDM programs.

The SMT and the rapid BCA, along with any other supporting documentation, are then brought together in a single document referred to as a business case. This represents the formal presentation of the information about a project in a manner to aid decision-making. Following a decision on which TDM option, or package of measures, to implement there is a need to prepare for the evaluation in parallel with the implementation of the TDM measure. The following section provides guidance on conducting evaluation of measures.

6 EVALUATION

As noted in the National Guidelines on TSM (ATC, 2006), evaluation 'considers whether the desired transport system objectives were actually met. ... It also documents lessons learned'. This highlights the two important dimensions of evaluation: outcome evaluation and process evaluation. It is from outcome evaluation that an assessment can be made about the extent to which the objectives were achieved while process evaluation provides insight into how the delivery process for the project performed and what was learned that has implications for future projects. Output evaluation is also important to assess whether key outputs were delivered on time and on budget.

Evaluation is not an easy task whether undertaken in the context of infrastructure projects or TDM initiatives. It is essential that adequate time be allowed to rigorously plan the evaluation and for resources to be allocated to collect the required information in a timely manner. As noted in the overall framework shown in Figure 2.1, evaluation requires that monitoring be undertaken before, during and after implementation. That monitoring needs to be guided by the information needs of the evaluation. It is for this reason that the framework in Figure 2.1, highlights that evaluation measures and monitoring methods need to be established soon after a decision is made about which TDM measure or package of measures are to be implemented. Preparations need to be made early for the evaluation and an important part of those preparations is ensuring that adequate resources are available to undertake the evaluation. The resources required include time, money and staff. The budget required for evaluation will depend on the scale of the initiative/investment and also the stage in the development cycle of that initiative. One may distinguish between an initiative which is undergoing exploratory development versus a more mature TDM initiative. There may well be a different priority given to evaluation in each case as well as a difference in the balance between process, output and outcome evaluation. In Europe it is not uncommon for 10% of a TDM project's budget to be earmarked for monitoring and evaluation (MOST-MET, 2003). Not every project may be subject to evaluation if a broader program evaluation is undertaken.

6.1 Evaluation Levels

There are a range of levels on which an evaluation of a TDM measure could be undertaken. European practice (MOST-MET, 2003) identifies the following range of levels:

- **knowledge** of the existence of travel alternatives or service: do people know of the travel alternatives or service and which options or services are best known?
- **usage** of a travel service (e.g. carpooling service): what services are used and how often?
- **satisfaction** with travel services: are people satisfied with the travel services which are offered and how could they be improved to meet the needs of users?
- **acceptance** of travel options: since personal circumstances may stand against the objective advantages of the travel options which are proposed, there is scope to assess whether or not people accepted the proposed travel options.
- **experimental** individual travel behaviour: exploring whether or not people changed their individual travel behaviour to try a recommended travel alternative.
- **satisfaction** with travel option: are people satisfied with the tested alternative transport modes and how could they be improved to meet the needs of users?
- **permanent** individual travel behaviour: have people changed their travel behaviour and if so what travel choices changed (mode, departure time choice, destination choice, etc.)?

- **system impact:** aggregate changes in traffic flow, mode choice, emissions and energy consumption etc.

It is often the system level impacts which are likely to be of direct interest to assessing the extent to which an initiative helped to achieve the desired objectives. These are very relevant in the context of outcome evaluation. The other levels are however important in helping to understand the factors which have contributed to the outcomes which have been achieved. As noted in the framework in Figure 2.1, the overall objectives directly influence the choice of monitoring measures. Particularly at the system impact level, there is a need to identify measures which specifically relate to the objectives which were established at the appraisal stage of the project. There are obvious benefits in being able to draw on routinely collected data (such as traffic counts) but some system impacts such as health related impacts on asthma and obesity can require measuring more than vehicle kilometres travelled and emissions.

6.2 Evaluation Measures

For each level of evaluation identified in the previous section it is possible to identify potential indicators and methodologies for collecting the data. These are summarised in Table 6.1.

Table 6.1: Evaluation indicators and methodology

Evaluation level	Possible indicators	Possible methodology
Knowledge of a travel alternative or service	Number or % of people with knowledge of travel alternatives or services	Personal interviews, questionnaires
Usage of a travel service	Number of individuals contacted	Counts, personal interviews, questionnaires
Satisfaction with travel services	User satisfaction rating, assessment of staff knowledge and service level	Personal interviews, questionnaires
Acceptance of travel options	Number of suggestions followed/not followed, user satisfaction rating	Personal interviews, questionnaires
Experimental individual travel behaviour	Comparison of before and after experimental travel behaviour	Personal interviews, questionnaires
Satisfaction with travel option	Quality of the travel option as experienced versus as promised	Personal interviews, questionnaires
Permanent individual travel behaviour	Comparison of before and after travel behaviour	Personal interviews, questionnaires
System impact	Comparison of before and after system wide indicators, e.g. ridership, mode share, VKT, noise levels, emissions levels	Measurements, counts, ticket validations, surveys, projections

Source: Based on MOST-MET (2003)

It is clear from Table 6.1 that for many potential evaluation levels, direct data collection from users, through some form of survey, is needed to collect the necessary information. At the level of system wide impact there is scope to use automatic data collection equipment, e.g. traffic counts, public transport ticket sales or validations, to gain the necessary insight.

The design of surveys is a specialist field in its own right with careful consideration needing to be given to how to sample respondents along with the design of the questionnaire. Sampling involves decisions about the size of sample required and the selection method to identify a target sample. The underlying variability in the behaviour being measured has a direct effect on the required sample size and the ability to detect a statistically significant change between the before and after periods. The reviews of recent Australian and New Zealand TravelSmart projects (voluntary travel behaviour change programs targeted in workplaces, schools or communities) provide valuable references on some of the finer points of survey design in the context of TDM evaluation (Australian Greenhouse Office, 2005; Land Transport NZ, 2004). Two European Union funded research projects provide useful examples of questionnaires relevant to TDM evaluation. The first titled MOST-MET (Mobility Management Strategies for the next Decade – Monitoring and Evaluation Toolkit) (MOST-MET 2003) focussed on the development of a monitoring and evaluation toolkit. The subsequent TAPESTRY (Transport Awareness Publicity and Education Supporting a Sustainable Transport Strategy in Europe) project involved assessing mobility management/TDM campaigns across Europe using the MOST-MET framework. TAPESTRY assessed 18 mobility management campaigns selected from across Europe which covered four types of campaigns (school based, public transport, cycling and walking). The project ‘demonstrated the importance of measuring changes in awareness and attitude, as well as changes in travel behaviour, particularly when it may not be realistic to expect changes in modal shift in the short term’ (Tyler and Cook, 2004). The references noted here provide examples of the questionnaires used in these studies and these can provide a useful starting point for developing questionnaires in other TDM evaluations.

As noted in the framework in Figure 2.1, measurements need to be taken ‘before’ and ‘after’ the implementation of the TDM measure. Ideally the changes between the ‘before’ and ‘after’ period would be attributable to the TDM measure. Small changes in behaviour may be difficult to observe and costly to measure because of the increased sample sizes needed to statistically confirm small changes. A key issue is to separate the changes resulting from the TDM project from changes resulting from ‘other’ factors as illustrated in Figure 6.1. Those other factors are referred to as ‘threats to validity’ and care needs to be taken to separate out their effects from the effects attributable to the TDM measure.

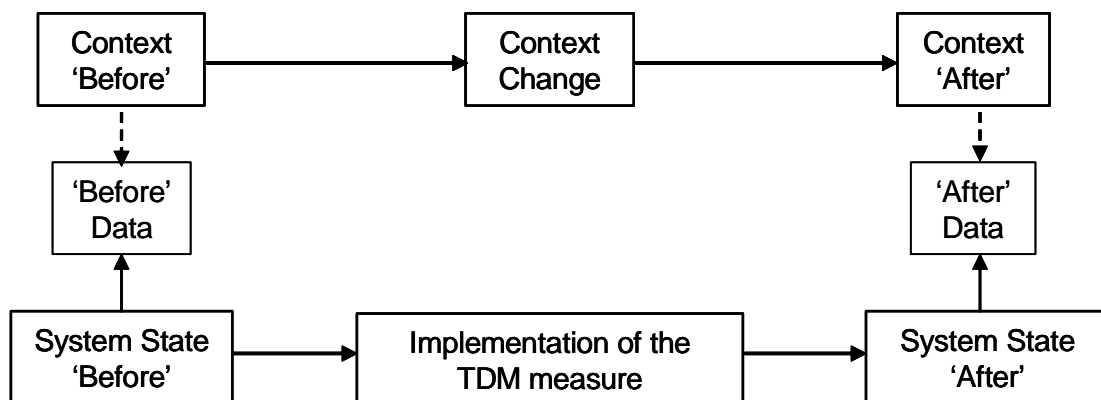


Figure 6.1: Impact of context change on before-after evaluation

It is easiest to illustrate the significance of threats to validity using a couple of practical examples. In one case, a high-occupancy lane could be installed along a major route. Data collected before and after the installation of the lane might confirm an increase in vehicle occupancy. However, it could be that other factors, such as an increase in petrol prices or reductions in availability of all-day parking are also impacting the extent of carpooling. In another case, traffic counts may be used to monitor the impacts of a package of TDM measures implemented in an office park setting. The traffic counts may indicate a dramatic reduction in traffic levels. However this could be due to the relocation of a major employer out of the office park which suppressed overall traffic levels.

Potential 'threats to validity' can be overcome by using a control group to compare to the group participating in the TDM initiative. In the case of the high occupancy lane mentioned earlier, vehicle occupancies could be monitored on other facilities where no high occupancy lane was installed. Trend analysis can also play a role although it may be necessary to watch for threats to validity such as changing demographics along a train line which might account for increased patronage rather than being due to the implementation of a TDM initiative. It may be possible to identify potential threats to validity at the stage that the evaluation is being designed and to account for those factors in the analysis through appropriate monitoring. As highlighted in Figure 2.1, this evaluation design would ideally be undertaken following selection of the TDM measure and in parallel with the planning for implementation. Again in the case of the high occupancy lane, by monitoring petrol prices and making an assumption about the elasticity of demand with respect to petrol price, it may be possible to estimate how much carpooling would be expected to increase because of the cost pressure alone.

There is much to be learned from the evolving experience with TDM evaluations in Australia, New Zealand and elsewhere around the world. At a local level, the repository for data and reference information, developed as part of this project (Pattinson, 2006), can play a very valuable role in that context.

7 EXAMPLES

This section sets out a series of examples illustrating the application of the framework. In each case the underlying problem is described and then the TDM Measure Selection Toolkit is used to identify candidate TDM measures. Those measures are then subjected to short-listing appraisal to identify a set of measures to proceed to the more detailed, Rapid Appraisal phase.

7.1 Sample Appraisal 1: Schools

7.1.1 *Problem Characterisation*

An inner city municipality is home to five primary and secondary schools located in close proximity which cater for a total of 4000 students. The common start and finish times of the schools creates challenges for students, parents, residents and other users of the transport system.

Initial consultation with the school principals, crossing supervisors and the local municipality has highlighted a variety of concerns:

- Students and their parents complain that the local traffic congestion makes them late for school.
- Road safety concerns have been raised because of the difficulties for children who are walking or riding to school. Pedestrian crossing supervisors have also reported cases of road rage where parents driving children to school have ignored parking signs and created tensions with other road users (including other parents at the schools).
- Residents complain about access problems they experience because of the local traffic congestion as well as noise and local air pollution.
- Spill-over effects are being experienced at the broader network level where high right turn volumes at some unsignalised intersections create congestion on the main roads. This not only affects private motor vehicles but is also impacting the reliability of public transport services on routes which serve the area. Ironically, students accessing the schools on public transport are also being impacted by the traffic congestion.

These problems are most pronounced in the morning peak period particularly in relation to the impacts on the broader network. In the afternoon peak the problems tend to be more localised in the immediate vicinity of the schools.

7.1.2 *Application of the TDM Measure Selection Toolkit*

Application of the selection checklist highlighted the following issues:

Understanding the underlying problem: appears to be related to the high mode share of serve passenger car trips to the schools. Anecdotal evidence from the school principals' suggests that between one third and a half of the trips to the school are home based. Enrolment data suggests that the catchments of each school do vary with the proportion of students living within 3 km of the school varying between 20 and 75%. Two of the schools are within walking distance of a railway station while the other three are within 100 m of a bus route and one of those bus routes connects with a railway station.

Stakeholders: School council/principals, local community represented by their local councillor(s) and the municipality, public transport operators. Of these the council and the schools have direct involvement in the problem and potentially can play a key role in the solution.

Objectives: The government has a policy to increase the share of trips on public transport and wishes to increase walking and cycling. Road safety is a major government priority. Congestion reduction itself is not identified as an objective in its own right except where traffic congestion is impacting on public transport services and therefore affecting ridership.

Candidate TDM measures: The problem characterisation suggests that the problem is primarily a 'weekday peak' problem. In terms of where the problem occurs the 'Group of sites' category is the best fit. Table 3.1 provides a basis for identifying a range of potential measures. Consultation with the key stakeholders (refer to the overall framework in Figure 2.1) would be an important part of developing a short-list of measures. Some of the measures may not be appropriate for a schools context or may have less application (e.g. telecommuting). In addition to the best fit box in Table 3.1, it is worth considering the columns on either side. No new measures are suggested by the 'Individual building or site' column but stepping up to the 'Link' column would suggest some additional measures. These include ATMS, PT/HOV priority lanes and LATM. In this case the following range of measures could be expected to fit the problem and would need confirmation through the consultation process:

- travel plan
- multimodal access guide
- school travel coordinator in local government
- raising travel/environmental awareness
- improved bike and ped facilities
- parking restraint, control or management
- carpooling
- alternative hours
- ATMS – lane restrictions with no right turn in peak hours
- PT priority lanes
- LATM in the vicinity of the schools to discourage through trips
- event days.

Contribution to objectives: the initial short-list of measures has the potential to contribute to the achievement of the objectives as outlined above.

Packaging: There is potential for packaging measures with events, access guides and parking restraint along with LATM and ATMS achieving a combination of push and pull measures. Cost could be a hurdle in relation to the ATMS option and installation of public transit priority lanes could also prove to be difficult or expensive.

7.1.3 Short-listing Appraisal

Each of the options identified using the Selection Toolkit would then be subjected to Short-listing Appraisal. That involves scoring each alternative on a one to three scale against a series of criteria covering the 'Outcomes' which could be expected for that alternative and the 'Confidence' that those outcomes could be achieved.

The results of Short-listing Appraisal can be presented in a variety of ways. Figure 7.1 illustrates the average scores for the options on the four outcome dimensions of TDM Effectiveness as well as economic, social and environmental impacts. When the scores are illustrated in this side-stacked bar graph the relative performance of the alternatives in each of those dimensions is highlighted as well as each options' combined performance on all the outcomes criteria.

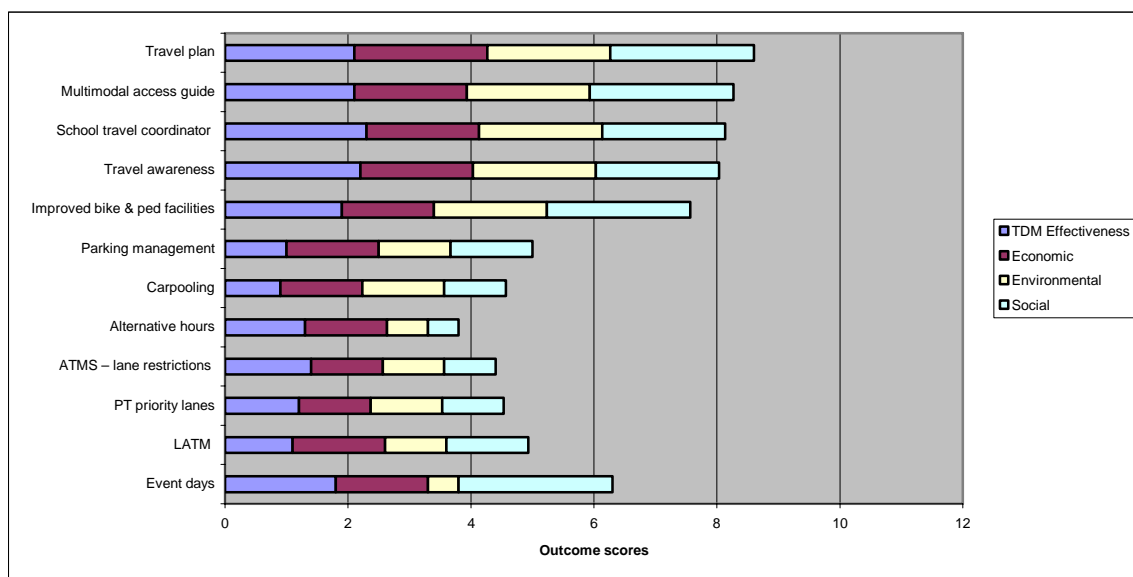


Figure 7.1: Outcomes scores for options in the Schools sample appraisal

The selection of options which could proceed to Rapid Appraisal is facilitated through a plot of the average scores on the 'Outcomes' and 'Confidence' dimensions as shown in Figure 7.2. Alternatives which perform well in terms of both outcomes and confidence are then candidates for taking onto Rapid Appraisal.

Candidates for Rapid Appraisal in this example include: event days, improved bike and ped facilities, travel awareness, school travel coordinator, multimodal access guide and a travel plan

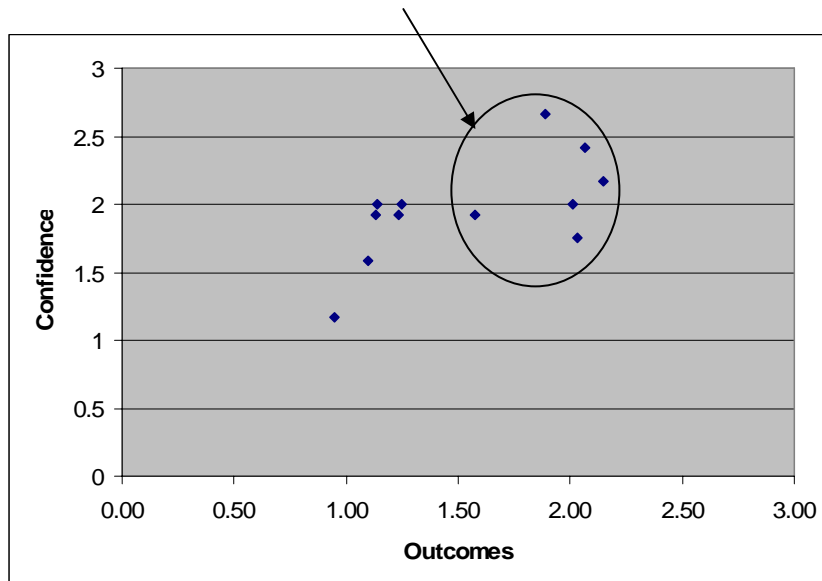


Figure 7.2: Use of category analysis plot to identify candidates for Rapid Appraisal (Schools)

7.2 Sample Appraisal 2: Corridor

7.2.1 Problem Characterisation

A southern corridor feeding into a major urban area is experiencing transport access problems as a result of heavy peak period, CBD-bound loads on the radial train line and corresponding traffic congestion on parallel road routes. The traffic congestion manifests itself by way of higher travel times in the peak and also noticeable day-to-day variability in travel times as minor incidents or fluctuations in demand result in deterioration in the level of service. The rail corridor serves Dandenong, an outer suburban municipality and a string of activity centres near intermediate railway stations.

7.2.2 Application of the TDM Measure Selection Toolkit

Application of the selection checklist highlighted the following issues:

- Understanding the underlying problem: There is evidence of total peak period demand exceeding the capacity of both the road and rail networks. While the proportion of people choosing to drive is a problem, there appears little scope to accommodate additional trips on the rail service since it is already heavily loaded.
- Stakeholders: The prime stakeholders are the residents/local communities represented by their local councillor(s) along the corridor, the businesses along the corridor and at either end, the road authority and public transport operators. Of these the residents and business have direct involvement in the problem and potentially can play a key role in the solution.
- Objectives: The government has a policy to increase the share of trips on public transport and wishes to increase walking and cycling. Congestion reduction itself is not identified as an objective in its own right except where traffic congestion is impacting on public transport services and therefore affecting ridership.

Candidate TDM measures: The problem characterisation suggests that the problem is primarily a 'weekday peak' problem. In terms of where the problem occurs the 'Corridor' category appears the best fit. Table 3.1 provides a basis for identifying a range of potential measures. Consultation with the key stakeholders (as Figure 2.1) would be an important part of developing a short-list of measures. In addition to the best fit box in Table 3.1 it is worth considering other columns. For this study area there could be merit in considering initiatives targeted at one or more routes in the corridor or potentially a group of sites or sub-region of the study area. Some of the 'Area/Region' options such as changes in vehicle registration and purchase taxes would be difficult to implement on a sub-region basis. In the case of this corridor, the following range of measures could be expected to fit the problem and would need confirmation through the consultation process:

- Advanced Traffic Management System (ATMS)
- Advanced Traveller Information System (ATIS)
- Advanced User Payment System (AUPS)
- change capacity across routes
- PT and HOV priority lanes
- improved pedestrian and bike facilities
- parking provision or restraint, control and management
- changing cost of car travel
- campaigns to raise environmental awareness, reduce GHG or promote PT
- community-based travel behaviour change program
- promoting walking and cycling for health
- ride-sharing, carpooling or car-sharing
- smart growth or transit oriented development
- travel plan
- multi-modal access guides
- teleworking, teleconferencing
- alternative hours
- transportation management association.

Contribution to objectives: The initial short-list of measures has the potential to contribute to the achievement of the objectives as outlined above.

Packaging: There is the potential for packaging measures with parking restraint/pricing in conjunction with carpooling and initiatives to spread the peak (alternative hours, teleworking, etc.) achieving a push and pull effect to produce changes in the underlying demand pattern.

7.2.3 Short-listing Appraisal

The results of short-listing appraisal are summarised in Figure 7.3. Again the scores on the 'outcomes' and 'confidence' dimensions are used to identify candidate measures which could be subjected to Rapid Appraisal.

Candidates for Rapid Appraisal in this example include: Advanced User Payment System, PT and HOV priority lanes, Parking restraint and management, smart growth or transit oriented development

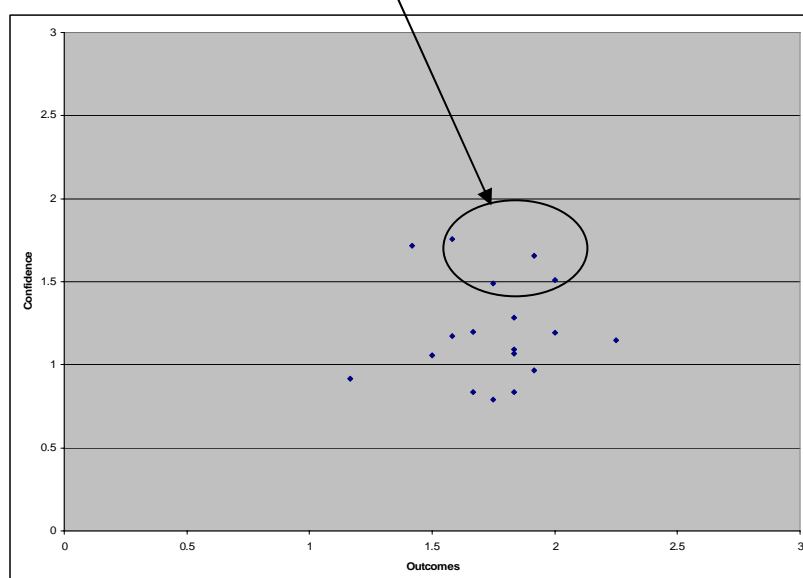


Figure 7.3: Identification of candidates for Rapid Appraisal (Corridor)

7.3 Sample Appraisal 3: Greenfield Site

7.3.1 Problem Characterisation

A greenfield site in a major growth corridor is to be developed into a major mixed use development comprising a regional centre with residential, commercial and retail development. The area will house about 2000 households with a major retail complex with supermarkets, department stores, speciality shops, cinemas and separate commercial office space. Four primary and two secondary schools will be built within the residential development areas. The town centre will also house municipal offices and a library. The area is to be served by a bus transit system, built round local feeder services and a high frequency express bus rapid transit service connecting nearby centres and radial suburban rail lines. The master plan includes upgrading the bus rapid transit service to a heavy rail link in approximately 15 years time. The development is located some 30 km from the metropolitan CBD, with a radial motorway approximately 5 km away. That motorway already experiences considerable peak period congestion which also spreads over many parts of the arterial road network. Given the nature of the homes likely to be built in the development with multi-car garage facilities it is likely that the area will attract families with average or higher than average car ownership.

In this case while the developer is in close consultation with the relevant state authorities, some of the candidate actions are beyond the scope that the developer can implement alone. The focus here is to be on measures over which the developer can take stewardship.

7.3.2 Application of the TDM Measure Selection Toolkit

Application of the selection checklist highlighted the following issues:

- Understanding the underlying problem: The total peak period demand is likely to create problems with traffic congestion and high usage of parking facilities. Staff in the commercial and retail developments are likely to compete with customers/clients for parking where access is by private road based transport. Households moving into the area may come with expectations about vehicle use and accessibility.
- Stakeholders: The prime stakeholders are the residents/local communities, including their local councillor(s), schools, the businesses and retail store owners/lessors along with the local council, road authority and public transport operators. Of these the residents, schools and business have direct involvement in the problem while the public transport company(ies) will have an interest in the solution.
- Objectives: The government has a policy to increase the share of trips on public transport and wishes to increase walking and cycling. Road safety is a high priority particularly for pedestrians and cyclists. Congestion reduction itself is not identified as an objective in its own right except where traffic congestion is impacting on public transport services and therefore affecting ridership.
- Candidate TDM measures: The problem characterisation suggests that it is likely of an area/regional nature. While the weekday peak is likely to be part of the problem, there is also likely to be challenges in the off-peak, particularly when shoppers try to access areas where office workers have already taken parking spaces. Using the TDM Measure Selection table (Table 3.1), the column on the far right which identifies measures applicable to an area/region where the problem is either peak or off peak in nature provides a good starting point. In addition to attempting to identify measures relevant to the whole region, the other option is to consider measures targeted at individual buildings or sites, or groups of sites, within the development.

In the case of this area, the following range of measures could be expected to fit the problem:

- Advanced Traffic Management System (ATMS)
- Advanced Traveller Information System (ATIS)
- Advanced User Payment System (AUPS)
- physical restraint through area limitations (traffic cells/mazes, area licences)
- parking provision or restraint, control and management
- changing cost of car travel
- vehicle registration and purchase taxes
- campaigns to raise environmental awareness, reduce GHG or promote PT
- community-based travel behaviour change program
- raising environmental awareness
- promoting walking and cycling for health
- ride-sharing, carpooling or car-sharing
- smart growth or transit oriented development
- travel plans for individual buildings or groups of sites
- multi-modal access guides

- changing cost of car travel
- improved pedestrian and bike facilities
- promoting walking and cycling for health
- multi-modal access guides
- teleworking, teleconferencing
- alternative hours
- transportation management association.

As mentioned earlier, some of these candidate actions are beyond the scope that the developer can implement alone. The focus here is to be on measures over which the developer can take stewardship. Hence the ATMS, ATIS and AUPS options are regarded as inappropriate for further consideration here but could be explored as part of the consultation with the relevant state authorities. Likewise the developer is not able to influence vehicle registration and purchase taxes so that option is also regarded as inappropriate for further consideration.

7.3.3 Short-listing Appraisal

The results of Short-listing Appraisal can be presented in terms of a plot of the average scores on the 'outcome' and 'confidence' dimensions as shown in Figure 7.4. In this case a number of alternatives perform well on the Short-listing Appraisal. These options would then be subjected to Rapid Appraisal which involved the Strategic Merit Test and undertaking a Rapid Benefit-cost Analysis.

Candidates for Rapid Appraisal in this example include: parking restraint, control and mgt, changing cost of car travel, community-based travel behaviour change (TBC), promoting cycling and walking, travel plans, multi-modal access guides, improved bike and pedestrian facilities, event days, school travel coordinator

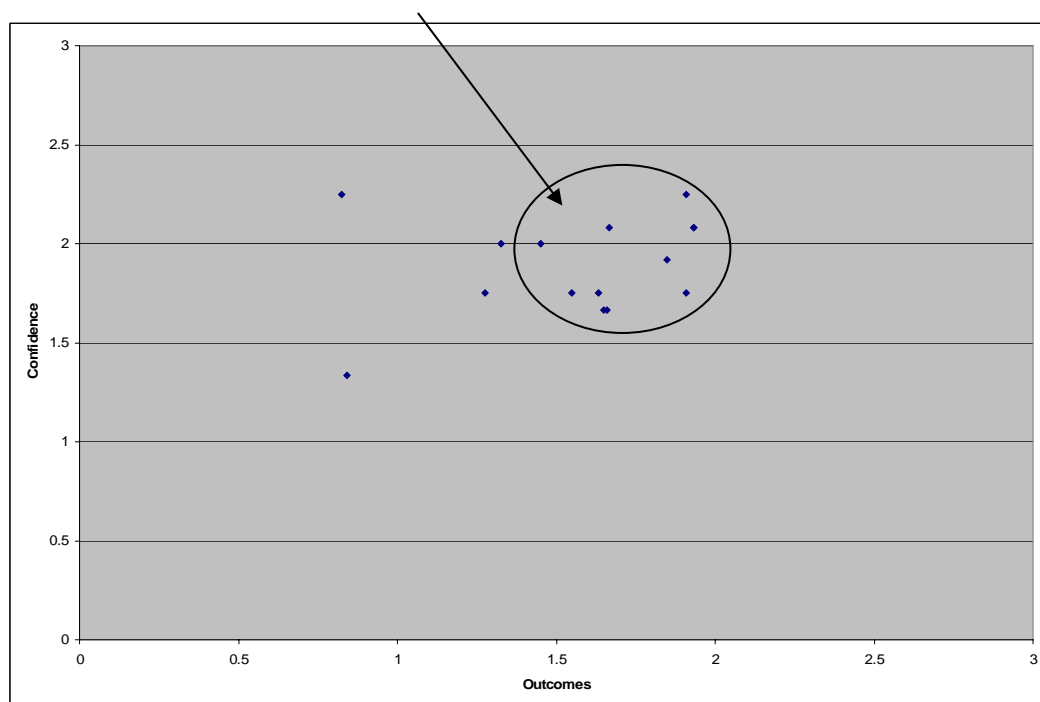


Figure 7.4: Identification of candidates for Rapid Appraisal (Greenfield Site)

8 CONCLUSIONS

This progress report has outlined a framework for the appraisal and evaluation of TDM measures. By building on the *National Guidelines for Transport Systems Management in Australia*, it provides a nationally consistent approach for appraisal and evaluation of TDM measures and will provide a basis for more informed choices between non-infrastructure and infrastructure solutions, a better understanding of how and when to use TDM measures and will also enable TDM investment decisions to be considered and integrated with other investment choices.

Ultimately the success of the evaluation will depend on:

- the extent to which the process is driven by the underlying objectives
- the extent to which stakeholders have been engaged through consultation conducted as an integral part of the whole process
- whether appropriate preparation and resources are being devoted to the design of the evaluation, and in particular to ensuring that the appropriate data is collected in a timely fashion (specifically 'before' and 'after' implementation) to enable an informed assessment to be made of the success of the TDM measure.

As noted in Section 6, evaluation is not an easy task and there is much to be learned from the evolving national and international experience with TDM evaluations. Effective sharing of evaluation experience is very important in that context and can be facilitated through ongoing provision of case study details to a repository for data and reference information.

REFERENCES

- Australian Greenhouse Office 2005, *Evaluation of 26 Australian TravelSmart Projects in the ACT, South Australia, Queensland, Victoria and Western Australia: 2001-2005*. Department of Environment and Heritage. 62 pp. <<http://www.travelsmart.gov.au/publications/evaluation-2005.html>> (accessed on 15 May 2006).
- Australian Transport Council 2006, *National Guidelines for Transport System Management in Australia*. 2nd Edition. <<http://www.atcouncil.gov.au/documents/index.aspx>> (accessed on 16 April 2007).
- Austrroads 1991, *Road demand management*, AP 9/91, Austrroads, Sydney.
- Austrroads 1995, *Travel demand management guidelines*, AP 117/95, Austrroads, Sydney.
- Austrroads 2002, *Travel demand management: a resource book*, AP-G67/01, Austrroads, Sydney.
- Ker, I 2003, 'Travel demand management action plan: appraisal of proposed actions', Contract Report RC5024, prepared for Department of Infrastructure, Victoria, ARRB Transport Research, Vermont South, Vic.
- Land Transport NZ 2004, *Land Transport New Zealand's Travel Behaviour Change Guidance Handbook*. <<http://www.landtransport.govt.nz/funding/travel-behaviour/guidance-handbook.pdf>> (accessed on 15 May 2006).
- Land Transport NZ 2005, *Land Transport New Zealand's funding allocation process*. <<http://www.landtransport.govt.nz>> (accessed on 15 May 2006).
- Litman, T n.d., *TDM Encyclopaedia*, <<http://www.vtpi.org/tdm>> (accessed on 20 March 2006).
- Maunsell Australia 2004, *Travel Behaviour Change Evaluation Procedures: Technical Report. Prepared for Transfund New Zealand*. 71 pp. <<http://www.atcouncil.gov.au/documents/index.landtransport.govt.nz/funding/travel-behaviour/technical-report.pdf>> (accessed on 15 May 2006).
- Maunsell Australia 2006, *TravelSmart III Evaluation Procedure Report* prepared for the Victorian Department of Infrastructure, 53pp. <<http://www.travelsmart.vic.gov.au/web4/tsmart.nsf/headingpagesdisplay/Research?opendocument&Expand=6.2&>> (accessed on 17 January 2007).
- MOST-MET 2003, *Monitoring and Evaluation Toolkit: A Guide for the Assessment of Mobility Management Approaches*. <<http://mo.st>> (accessed on 22 March 2006).
- Patinson, W 2006, *TDM evaluation repository – a progress report*, ARRB Group Report RC71857-4 for Austrroads, Sydney.
- Tyler, S & Cook, A 2004, *Measuring the effectiveness of campaigns: lessons for mobility management from the EU TAPESTRY project*, European Platform on Mobility Management (EPOMM), Brussels, viewed 8 May 2006, <<http://www.epommweb.org/ecommm2004/workshops/anglais/Tyler.pdf>>.
- UK Department of Transport 2005, *Transport Analysis Guidance*. <<http://www.webtag.org.uk>> (accessed on 14 March 2006).
- Wayte, A 1991, 'Austrroads: road demand management study: conclusions and findings', *Road Demand Management Seminar, 1991, Melbourne, Australia*, Austrroads, Sydney, pp.19-34.

INFORMATION RETRIEVAL

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Keywords:

Demand, traffic management, travel, transport planning, appraisal, evaluation, road cost, environment, car pooling, travel behaviour, environment, high-occupancy

Abstract:

An appraisal and evaluation framework has been developed which provides a nationally consistent approach to appraisal and evaluation of TDM measures. This framework will provide a basis for more informed choices between non-infrastructure and infrastructure solutions, a better understanding of how and when to use TDM measures and it will also enable TDM investment decisions to be considered and integrated with other investment choices. The framework is governed by two key inputs – the objectives and stakeholder consultation. A TDM Measure Selection Toolkit is outlined to guide the selection of a set of short-listed TDM measures which are then subjected to a two stage appraisal process (Short-list Appraisal and Rapid Appraisal). Short-list Appraisal is based on an assessment of the anticipated outcomes, and the confidence of achieving those outcomes and relies on scoring the alternative against a range of criteria. The scores on the 'outcomes' and 'confidence' dimensions then provide a basis for identifying options worthy of subsequent more detailed appraisal and business case development. Rapid Appraisal is based on a Strategic Merit Test and Rapid Benefit Cost Analysis. The final step of evaluation is the process of reviewing the outcomes and performance of an initiative after it has been implemented.