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Evaluating behavioural change in transport – a case study of individualised marketing in South Perth, Western Australia

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Abstract

Demand management is a key component of the 'new realism' in transport, but relatively little attention has been paid to the evaluation of its effectiveness. In part this is due to a lack of (i) demonstrated cause/effect relationships (ie level of impact on travel behaviour) and (ii) evidence on the durability of those impacts. There is also, perhaps, a wariness of entering into an area dominated by paradigms that often equate 'more' with 'better' in evaluation of transport projects.

This paper presents takes the demonstrated results of a pilot project in South Perth, Western Australia, and applies socio-economic evaluation principles to derive robust evaluation results that demonstrate the value of demand management. It does so in terms that are similar to those used for investment in roads and demonstrates socio-economic returns that greatly exceed those from the majority of road-building projects. In the process, some interesting insights are gained into the valuation of travel time, congestion and health/fitness benefits.

Sensitivity analysis is used to demonstrate that even on 'worst case' (low benefit/high cost) scenarios, the benefits exceed the costs by a factor of three. Under the 'best case' (high benefit/low cost) scenario, the return is an order of magnitude higher.

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Introduction

Strategic Asset Management (SAM) is a means of achieving the most cost-effective use of resources in both transport and many other areas of economic activity. SAM requires that alternatives to 'build' solutions to capacity constraints, as well as investment in additional capacity, are investigated and evaluated on a comparable basis.

These alternatives include:

- Getting more out of existing asset capacity (for example through traffic management or intelligent transport systems); and
- managing demand to influence its level and distribution.

The methodology of evaluation has often not kept up with the requirements of strategic asset management, most specifically because the linkages between SAM and outcomes have not been clearly-enough defined or well-enough quantified. In addition, evaluation methodologies, in practice if not always in theory, often assume that 'more is better'.

This paper reports an application of conventional evaluation methodology to the results of a pilot individualised marketing project in South Perth, Western Australia

Individualised Marketing for Travel Demand Management

The traditional approach to changing community behaviour, especially in the health promotion area, is social marketing (Andreasen (1995, p7). However, Brög (1998) argues traditional social marketing focussed on target audiences is not appropriate to change travel behaviour on the basis that:

- people's travel decisions are based as much on their environment as their attributes.
- people's misperceptions of cycling and public transport are best improved through direct experience of the modes
- people need help to identify which trips can be used by alternative modes which is different for each household and each household member

Application in South Perth, WA (James and Brög, 1998)

To test the validity of individualised marketing in Perth, a rigorous measurement program was applied. The first project was a pilot with a small random sample. The project had three distinct stages:

- a survey of existing behaviour;
- implementation of the individualised marketing program;
- measurement of behaviour after the program – immediately and one year later.

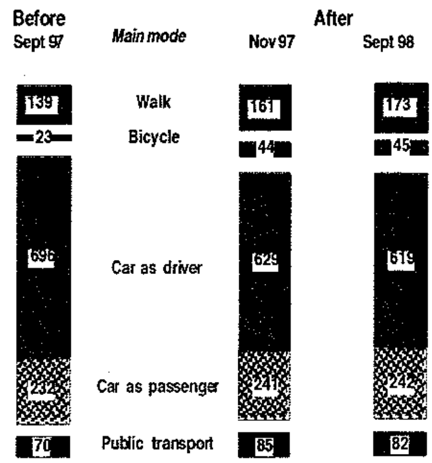
Results

Measured behaviour change, in terms of mode share of trips, is shown in Figure 1. Results also included:

- reduction –
  - from 79% to 75% of cars used each day,
  - from 3.3 to 2.9 trips per car per day,
  - of 14% in car-kilometres;
- increased use of local shops and services;
- 2 kilometres less travel per person per day, but 4 minutes additional travel time;
- changed modes for all types of trips.

Figure 1 Travel Behaviour Change

Trips per Person per Year



To ensure that observed effects could be confidently attributed to individualised marketing, the pilot project was carried out with no media publicity or associated initiatives. A broader-scale program of individualised marketing would be reinforced through the media and community groups, increasing its effectiveness.

Evaluation Frameworks

The principal evaluation frameworks, each of which is useful in different contexts, are:

- Socio-economic - to guide the overall allocation of resources to achieve the most beneficial outcomes for society.
- Public sector finance - to assist in the assessment of the impacts of the program on public sector expenditure requirements.
- Private (User) - to demonstrate the value to the individual.

Each framework treats some impacts differently. For example:

- Transfer payments are not estimated in socio-economic evaluation since they are a cost to one group of those impacted and an equal benefit to others. Transfer payments are financial transactions only and do not represent a net use of resources.
- Public sector financial evaluation does include one part of a transfer payment (eg increased fare revenue) where it accrues to government
- Private (user) evaluation also includes include one part of a transfer payment (eg increased cost of public transport fares) where it accrues to the user.

The evaluation framework is outlined in Table 1 (Benefits), Table 2 (Costs) and Table 3 (Transfer Payments).

Table 1 Evaluation Framework for Individualised Marketing: Benefits

	Social	*Govt*	*User*	*Comment*
Private vehicle operating costs	✓	✗	✓	Valued as resource cost (11.3 cents/km - net of taxation) for 'social', but at market prices (17.2 cents/km) for 'user financial' (Bray & Tisato, 1997)
Public transport services: operating	✓	✓	✗	Only applies where additional services have to be run. In conventional economic analysis, operating costs are treated as 'benefits' (may be positive or negative)
Increased walking/cycling costs to user	✓	✗	✓	Costs are small except where new equipment is purchased. Cycling cost estimated at 2.75cents/km (authors' estimate). Walking cost not estimated.
Travel time	✓	✗	✗	Induced mode changes result in small initial increases in travel time, even after substitution of closer destinations. Road investment project evaluation in WA excludes the value of private/commuting
Improved health and fitness due to exercise (reduced mortality)	✓	(✓)	✗	Increased life expectancy (socio-economic - based on Hillman (1997)). Reduced health system costs (government - not quantified) Improved quality of life (user - not quantified)
User exposure to air pollutants	✓	(✓)	✗	Cyclists, pedestrians & bus passengers less exposed to exhaust pollutants than car users (ETA, 1997, p2). Not quantified
Air pollution	✓	(✓)	✗	Motor vehicle exhaust emissions reduced pro-rata with traffic volumes. Likely to be more than proportionate impact if traffic conditions improved.
Greenhouse gas emissions	✓	(✓)	✗	Motor vehicle greenhouse gas emissions reduced pro-rata with traffic volumes. Likely to be more than proportionate impact if traffic conditions improved. Values from Bray & Tisato (1997)
Road congestion	✓	✗	✗	Lower time and vehicle operating cost for <u>remaining</u> road users, both private and commercial. Values based on Luk et al (1994).
Road trauma (community) – related to car use	✓	✗	✗	Pro rata with change in motor vehicle traffic volumes. No estimates for non-hospitalised injuries or property-damage-only accidents.
Road trauma (users who change modes) – related to use of other (vulnerable) modes	✓	✗	✗	Increased exposure (amount of walk/cycle travel - calculated for cycle only). Reduced accident rates for walking and cycling with fewer motor vehicles. Historical trends in Perth show cyclist hospitalisations increase at one-third the rate of cycle usage in the presence of other cycle programs.
Traffic noise	✓	✗	✗	Pro rata with motor traffic volumes. Values from Bray & Tisato (1997).
Water Pollution	✓	✗	✗	Pro rata with motor traffic volumes. Values from Bray & Tisato (1997).
Conflicts on Walk/Cycle facilities	✓	✗	✗	Real, in centres and on busy shared paths, but not quantified. Not a significant issue in South Perth.
Improved security and safety in the community	✓	✗	✗	A demonstrable benefit through 'eyes on the street' and enhanced social interaction, but virtually impossible to quantify
Viability of local shops and businesses	✓	✗	✗	Benefits to existing customers, especially those who walk or cycle. Difficult to quantify, but nevertheless real.
Synergy with other marketing initiatives.	✓	✓	✗	Spin-off benefits for cycling, walking and public transport, through 'word-of-mouth'. Real, but not quantifiable.

Note: (✓) Benefits to government accrue outside the transport sector and have not been estimated

Table 2 Evaluation Framework for Individualised Marketing: Costs

	Social	*Govt*	*User*	*Comment*
Individualised marketing	✓	✓	✗	Upfront Capital cost to undertake individualised marketing
Individualised marketing maintenance	✓	✓	✗	Not undertaken. Potentially reduces decay of all cost and benefits over time.
Public transport capacity: capital	✓	✓	✗	Additional demand might require additional buses for peak period. Subject to decay function, as buses can be used to meet other demand growth.

Table 3 Evaluation Framework: Transfer Payments

	Social	*Govt*	*User*	*Comment*
Car parking costs	✗	✗	✓	Unless car parking is congested, the savings to the user are offset by reduced income for the car park operator. Except where there is an impact on the parking supply – likely to be long term and hence low present value
Car parking revenue	✗	✗	✗	See 'car parking costs', above.
Public transp fare cost to user	✗	✗	✓	Cost to user. Also a financial benefit to public transport provider
Public transport fare revenue	✗	✓	✗	Benefit to public transport operator (part accrues to Transperth and part to private operators of bus services). Also a cost to user
Fares foregone during incentive period	✗	✓	✗	Should be zero if individualised marketing targeted and implemented effectively
Government tax revenue	✗	✓	✗	Assumed to be net zero. Alternative commodities are also taxed. Money returned to roads assumed to be offset by reduced road expenditure needs.

Issues in Valuing Costs and Benefits

The range of costs and benefits resulting from individualised marketing in relation to travel behaviour raise some fundamental questions about how these can best be incorporated into a single evaluation framework. These questions centre on the applicability of monetary values, especially for social and environmental impacts, and the derivation and application of implicit or explicit weighting schemes for various components.

The issues, themselves, are of greatest importance when the impacts of projects being compared vary significantly in both magnitude and direction. However, in this study, all the main indicators - social, economic and environmental - move in the same direction.

The Philosophy of Evaluation

The **costs** of undertaking individualised marketing are known from the pilot project. In respect of a wider-scale project, covering the whole of the South Perth municipality, unit costs would be likely to be lower than for the pilot project:

- set-up costs would be spread over a larger number of households/people; and
- project staff would become more practiced in applying the individualised marketing technique and more familiar with the area and its access/transport opportunities.

In respect of the **benefits**, the evaluation has adopted conservative values where clear values cannot be determined accurately (for example, by using average rather than marginal values for the cost of congestion)

Where there is uncertainty about the appropriate values to be used, sensitivity analysis has been applied, either in the form of a binary sensitivity (does the effect have a value or not? - eg the value of time) or as a range (eg twice or half the base rate of 'effectiveness decay').

Costs

Maintenance of Individualised Marketing

The behaviour change brought about through individualised marketing is a social, economic and environmental asset. Most assets require ongoing maintenance if they are to continue to deliver the benefits for which they were created

There is no experience with maintenance of individualised marketing, nor have techniques been developed specifically to address it. The evaluation adopts a conservative approach to durability of impacts rather than attempting to make an assessment of 'asset maintenance' requirements or the extent to which maintenance might increase the level of future benefits.

Public Transport Capacity

South Perth was chosen for the pilot project because, amongst other things, there was sufficient capacity in public transport services to carry additional public transport trips generated by individualised marketing. There was no additional cost (capital or operating) for provision of public transport services.

The existing spare capacity is likely to be sufficient to cater for the additional patronage from a municipality-wide application of individualised marketing, but this is dependent to some extent upon the timing and location of such trips. There is insufficient information from the pilot project to assess the extent of any additional public transport service increase that would be required, so for sensitivity purposes the evaluation adopts the following:

- ➢ The distribution through the day of additional public transport trips is the same as the pilot project, viz: one-third morning peak, one-third evening peak, one-third off-peak
- ➢ Only peak period trips would require additional vehicles
- ➢ All peak period trips would require additional vehicles
- ➢ Additional vehicles would be able to make two trips in the peak direction during each peak period. This is a function of South Perth's proximity to the major public transport destination (the Perth CBD) and would not necessarily apply elsewhere - for more distant suburbs, only one trip would be feasible in each peak period.

Benefits

Travel Time

Travel time-related items have been separately treated because of uncertainty about the real value of small increments of time. In the specific context of this project, travel time had the potential to dwarf other impacts when valued conventionally, on the basis of a four minute per person per day increase in travel time.

The direct first-year impacts on the individual, other than travel time, are set out in Table 4. The conventionally-derived value of time savings for road project evaluation is $7.33/hour. Using this value, the loss to individuals due to increased travel time of 4 minutes per person per day would be A$4.73 million in the first year. However, if this were the true value, users would not have changed their behaviour. For the observed behaviour change to have occurred either:

Table 4 Private (User) Benefits ($/year)

Impact	*Value*
Private vehicle operating costs	-A$3.53m
Public transport fares	+A$0.62m
Cycling costs	+A$0.05m
Walking costs	not estimated
Health & fitness (mortality)	-A$0.58m
Perceived cycle/walk injury risk	+A$0.90m
TOTAL	-$2.54m

- the behavioural value of time is much less in this case than has conventionally been assumed; or
- there are benefits to the individual over and above those that have been quantified here.

Either the value of time has to be factored down by at least 46% (to a maximum of $3.94/hour) or there are unquantified benefits of value equivalent to at least 86% of those currently quantified. The impact on the overall (net) level of benefits and the expression of socio-economic benefits relative to costs is the same whichever basis is used, since both affect the same part of any expression and only that part.

The base case for this evaluation is a zero value of time, with sensitivity testing at $3.94 per person hour, but it should be recognised that this may reflect unestimated benefits as much as the real value of travel time.

Congestion

The major component of congestion cost is travel time, both private and commercial. Commercial travel time is generally accepted as having a definable value, at least in aggregate, because of the competitive nature of commercial enterprise. However, there is some evidence to suggest that the same issue arises at the margin as for private travel time.

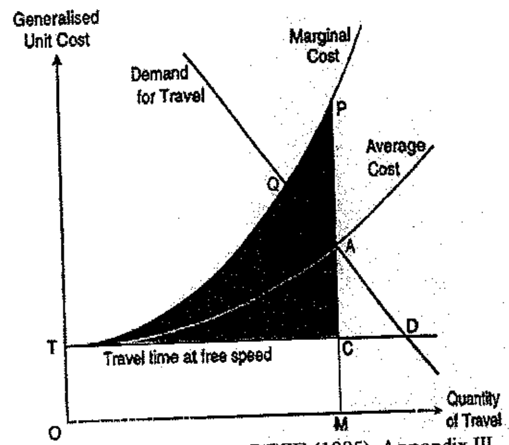
Rather than delve into the complexities of valuing commercial travel time, this evaluation treats all travel time alike, with a base case of zero unit value for congestion reduction. A value for sensitivity testing is derived below.

Average versus Marginal Values

Congestion has a number of defining characteristics (Figure 2):

- marginal cost always exceeds average cost; the cost imposed by one more car exceeds the cost experienced by each car already on the road;
- marginal cost increases with traffic volume - each extra car imposes successively higher costs; and
- most congestion costs (66% in Melbourne, across the whole road network (BTCE, 1995, p31)) imposed by the marginal vehicle are imposed on other road users.

Figure 2 Characteristics of Congestion Delay Cost



Source: BTCE (1995), Appendix III

Method of estimation

Luk et al (1994) estimated the cost of congestion in Perth to be $368 million in 1992 prices (equivalent to $410 million in 1997 prices). This is not a useful value in its own right, as a state of zero congestion cannot be achieved in practice, either through expanding capacity or economically-efficient pricing, neither of which is costless. However, this global estimate can provide a basis for deriving a unit cost of congestion for use in this evaluation.

If we assume that:

- all congestion cost is incurred during the morning and evening peak periods (ie that there is effectively no congestion off-peak); and
- motor vehicle traffic during the day (35.8 million vehicle kilometres/day; 36.9 passenger car equivalent kilometres/day) is distributed:
  - 15% morning peak
  - 15% evening peak

- 35% inter-peak
- 35% off-peak (BTCE, 1996, Table III.1)

then the <u>average</u> congestion cost per peak period passenger car kilometre is 12.33 cents.

A congestion cost of 12.33 cents per car-km in the peaks is a conservative estimate, because:

- the <u>marginal</u> cost of congestion (ie the cost saved when traffic is removed from the roads at congested times) must be higher than the average cost;
- the marginal cost of congestion will increase over time, as traffic increases faster than road capacity; and
- traffic volume relative to road capacity is higher in inner areas, such as South Perth.

Health and Fitness

Substituting more active modes of transport (cycling and even public transport which involves walking to and from bus stops) for car driving improves the health and fitness of people who make that change. This has been well-documented (eg Roberts, et al (1996)) and estimates made of the magnitude of some of the impacts, but not generally within a framework suitable for adoption in socio-economic evaluation

There has, however, been useful quantification of increased life expectancy due to cycling activity. Hillman (1997) has estimated that, in the United Kingdom, for every life year lost as a result of increased cycling (bearing in mind that cycling has a higher accident rate than motorised modes), 20 life years are gained through improved health and fitness. Assuming that the same relativity is appropriate in Australia, the 20:1 ratio can be applied to the fatality component (4%) of the road trauma resulting from increased cycle use.

Because this effect might be less significant in Western Australia than in the United Kingdom (for example, because of the greater range of outdoor recreation opportunities feasible for most of the year), sensitivity testing incorporates a zero value. Given that some such effect is almost certain to occur (ie people who get more moderate exercise are likely to live longer and have fewer ailments), this sensitivity assumption is highly conservative.

User Exposure to Air Pollutants

Despite the natural, and sometimes visibly-expressed, aversion of cyclists and pedestrians to travelling in heavy traffic, research has established that car-occupants absorb much higher levels of exhaust pollution than cyclists, walkers or bus passengers. (ETA, 1997)

In any given road environment, non-car users are exposed to several times less air pollution than car drivers or passengers. In this exercise, this effect is likely to have been reinforced by the substitution of local for more distant destinations for some trips, which are hence more likely to be on local streets rather than arterial roads.

Changes in user exposure to air pollution have not been quantified or valued in this evaluation, but it is important to acknowledge that such changes are a positive benefit <u>not</u> a negative impact on those who now choose to walk, cycle or catch public transport

Road Trauma

Road trauma impacts of changes in travel behaviour have two principal components:

- a reduction in road trauma involving motor vehicles; and
- an increase in road trauma involving cyclists.

For the reduction in road trauma involving motor vehicles, the 'central' evaluation uses average fatality/hospitalisation rates over the five years 1992-1996. Minor injury and property-damage-only accidents have not been included in the evaluation as data on these is inadequate, particularly for cycle accidents.

In the case of cycling, there is evidence that increases in cycling activity are not matched by increases in cyclist injuries (Bike Ahead, 1996, p2). The long term evidence for Western Australia indicates that cycle trauma, as measured by hospital admissions, increases at around one-third of the increase in cycle usage. This proportion has been used as the 'central' case for evaluation. For sensitivity testing, the 'low benefit' case assumes that cycle trauma will increase in direct proportion to the increase in cycle use.

The accident rate for non-motorised modes would also reduce because of the lower volume of car traffic and, hence, fewer conflicts with motor vehicles – to the benefit of all users.

The WA Office of Road Safety reports estimates of road trauma costs as follows:

- Fatality: $778 000
- Hospitalisation: $138 000

These values are based on what are usually (misleadingly) called economic costs, which derive from an accounting approach and substantially underestimate the amount that individuals collectively are 'willing to pay' to reduce the risk of fatality, in particular. Values based on the more correct economic concept of 'willingness to pay' have not been included in the sensitivity analysis, as there is no censensus on the extent to which 'willingness to pay' exceeds 'economic cost' nor on the application of 'willingness to pay to injury (as distinct from fatality) risk

Durability of Impacts

The effectiveness of learning declines over time unless the message is continually reinforced. With individualised marketing to change travel behaviour, the experience of changed travel behaviour is itself an effective reinforcing mechanism, provided the quality of the experience does not deteriorate

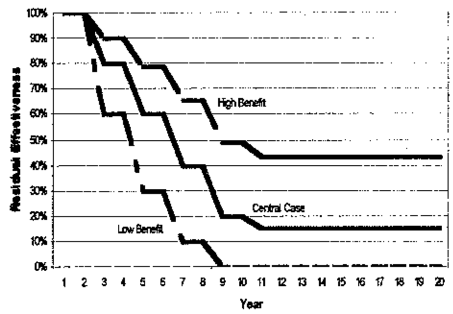
There is limited evidence on the durability of behaviour change However, a 12-month follow-up survey in South Perth, using both experimental and control groups has shown that the extent and form of travel behaviour change has been maintained (see Figure 1).

For sensitivity purposes, three effectiveness 'decay' rates were used (Figure 3):

- A 'base case', in which the residual effectiveness fell to 15% after 10 years;
- An 'optimistic' case, with half the progressive rate of decay; and
- A 'pessimistic' case, with twice the progressive rate of decay

A further assessment was made of changes in travel behaviour being self-reinforcing and maintained at their initial level.

Figure 3 Residual Effectiveness



Evaluation Specification

The evaluation was carried out for ranges of values set out in Table 5. The values are classified according to whether they are the 'best' estimates or form 'high benefit' (favouring the project) or 'low benefit' (disadvantaging the project) cases

'Central' Evaluation Results

Socio-Economic Evaluation

The principal socio-economic evaluation results for the 'central' evaluation are in Table 6. Even on the most conservative assumption in the central evaluation, an investment of $1.3 million in individualised marketing in South Perth would produce benefits of $16.8 million (present value) over 10 years, with a benefit-cost ratio of nearly 13:1

Including the anticipated benefits through mortality reduction increases the BCR to 15:1

The only substantial negative in the evaluation is the increased road trauma through walking and cycling, but this is more than offset by the reduction in car crash costs and the specific health and fitness benefits.

Table 5 Evaluation Scenarios

Parameter	*High Benefit*	*Central Value*	*Low Benefit*	*Source(s)*
Durability of Change	Decay = 0.5*Base	Reduce to 0.15 beyond Yr 10	Decay = 2*Base	See Section 4.4
Costs				
Individualised Marketing	$40.25	$40.25	$40.25	South Perth Pilot Project
Public Transport Capacity	No new buses	No new buses	New buses for peak (@$300 000)	Transperth
Benefits				
Car Operating Costs	17.2 c/km 11.3c/km net of tax	17.2 c/km 11.3c/km net of tax	17.2 c/km 11.3c/km net of tax	Bray & Tisato (1996)
Public Transport Operating	$2.20 per bus-km	$2.20 per bus-km	$2.20 per bus-km	Transperth
Cycling cost to user	2.75c/km	2.75c/km	2.75c/km	Own estimate
Travel Time	Zero	Zero	$3.94/hour	See 'Value of time'
Health & Fitness: mortality	20:1 life years	20:1 life years	Zero	Hillman (1997)
Air Pollution	3.6cents/km	2.0cents/km	0.6cents/km	Bray & Tisato (1996) Luk & Thoresen (1997)
Greenhouse Gas Emissions	2.9 cents/km	2.0 cents/km	1.0 cents/km	See 'Air Pollution'
Road Congestion	12.3 cents/peak-km	Zero	Zero	Based on Luk et al (1994)
Road Trauma (car use)	Average rate	Average rate	Average rate	See 'Road Trauma'
Road Trauma (cycle use)	One-third average	One-third average	Average rate	See 'Road Trauma'
Traffic Noise	0.5 cents/km	0.3 cents/km	0.1 cents/km	See 'Air Pollution'
Water Pollution	0.3 cents/km	0.15 cents/km	0.1 cents/km	See 'Air Pollution'
Transfer Payments				
Public Transport Fares	Average $1.28	Average $1.28	Average $1.28	Transperth

Financial Evaluation

The principal financial impact on government, other than the initial investment in individualised marketing, is through changes in the costs and revenues of public transport. These are outlined in Table 7.

For public transport, as a whole, the first-year rate of return is 48% and the cost of individualised marketing would be recovered in a little over two years. Over a 10-year evaluation period, the present value of benefits would be 2.24 times the initial investment.

Sensitivity Testing

The differences between the 'High Benefit' and 'Low Benefit' scenarios are of three types:

- the magnitude of impacts, for example road trauma for those who change modes;
- monetary values attached to specific impacts, eg travel time, noise and air pollution;
- durability of impacts over time.

Table 6. Socio-Economic Evaluation: 'Central' Results

Item	*Present Value*	
	10 Years	30 Years
Costs		
Cost of individualised marketing	$1,300,000	$1,300,000
Additional public transport capacity: capital	$0	$0
Benefits		
Private vehicle operating costs (net of tax)	$10,900,000	$12,611,000
Additional public transport services: operating	$0	$0
Walking/cycling costs to user	($232,000)	($269,000)
Travel time	$0	$0
Improved health and fitness due to exercise - reduced mortality	$2,713,000	$3,139,000
Air pollution costs to community	$1,929,000	$2,232,000
Greenhouse gas emissions	$1,929,000	$2,232,000
Road congestion	$0	$0
Road trauma (reduced car use)	$3,278,000	$3,793,000
Road trauma (increased cycle/walk use)	($1,406,000)	($1,626,000)
Traffic noise	$289,000	$335,000
Water Pollution	$145,000	$167,000
Net Present Value (NPV)	$15,533,000	$18,176,000
NPV (including health/fitness - mortality)	$18,246,000	$21,314,000
Benefit-Cost Ratio (BCR)	12.9	15.0
BCR (including health/fitness - mortality)	15.0	17.4

Note: Figures in brackets indicate disbenefits or increased costs

The 'High Benefit' scenario is a combination of all the individual 'high benefit' parameter values. Likewise, the 'Low Benefit' scenario is a combination of all the individual 'low benefit' parameter values. As such, both scenarios are extremes that define the boundaries of the possible whilst being unlikely conjunctions of optimistic or pessimistic projections.

Table 7 Financial Evaluation: 'Central' Results

Item	*Up-front*	*First Year*	*Present Value*	
			10 Years	30 Years
Cost of individualised marketing	$1,300,000		$1,300.000	$1.300,000
Additional public transport capacity: capital		$0	$0	$0
Additional public transport services: operating		$0	$0	$0
Public transport fare revenue: Transperth		$186,000	$875,000	$1,012,000
Public transport fare revenue: Private Operator		$434,000	$2,042.000	$2,362,000
First year rate of return: Transperth		14%		
First year rate of return: Public Transport		48%		
Farebox cost-recovery: Transperth			67%	78%
Farebox cost-recovery: Public Transport			224%	260%

Two additional sensitivity tests were carried out on specific parameter values, in conjunction with the 'Central' evaluation:

- Continued effectiveness maintained at initial levels in perpetuity – in other words, individualised marketing creates a fully sustainable change in behaviour; and
- Additional bus capacity required for half the trips changed from car to public transport.

Socio-Economic Sensitivity

Results from the socio-economic sensitivity testing are set out in Table 8. The key result from the sensitivity testing is that even in the worst-case scenario, *excluding the value of time*, benefits substantially exceed the costs - by a factor of nearly 4:1. Even at this level, the return from individualised marketing compares favourably with many public sector projects in transport.

Financial Sensitivity

Results of the socio-economic sensitivity testing are set out in Table 9. The key results are:

- Farebox cost recovery, for public transport as a whole, becomes less than one in the 'low benefit' case (82%), although it still compares favourably with the overall level of farebox cost recovery for public transport (24.2% for 1997/98 (Transport, 1998, p79)).
- Only in the very long term (30 years) high benefit case does Transperth, the WA Government's public transport authority for Perth fully recover the costs associated with individualised marketing. Even so, the rate of cost recovery under the high benefit scenario (83%-115%) is several times that from public transport generally (24.2%)
- The major financial benefit under current contracts accrues to the private operators of bus services in Perth, whether or not they make a financial contribution to the program

Table 8 High and Low Benefit Results: Socio-Economic Evaluation

	High Benefit		*Low Benefit*	
	Present Value		Present Value	
Costs	10 Years	30 Years	10 Years	30 Years
Cost of individualised marketing	$1,300,000	$1,300,000	$1,300,000	$1,300,000
Additional public transport capacity: capital	$0	$0	$796,000	$758,000[(a)]
Benefits				
Private vehicle operating costs (net of tax)	$13,417,000	$18,640,000	$7,816,000	$7,816,000
Additional public transport services: operating	$0	$0	($460,000)	($460 000)
Walking/cycling costs to user	($286,000)	($397,000)	($166,600)	($167 000)
Travel time	$0	$0	($8,561, 000)	($8,561 000)
Improved health and fitness due to exercise - reduced mortality	$3,339,000	$4,639,000	$0	$0
Air pollution costs to community	$4,275,000	$5,938,000	$415 000	$415,000
Greenhouse gas emissions	$3,443,000	$4,784 000	$692 000	$692,000
Road congestion	$2,928,000	$4,068,000	$0	$0
Road trauma (reduced car use)	$4,036,000	$5,606,000	$2,351 000	$2,351,000
Road trauma (increased cycle/walk use)	($1,730,000)	($2,404,000)	($3,024,000)	($3,024,000)
Traffic noise	$594,000	$825 000	$69,000	$69,000
Water Pollution	$356,000	$495 000	$69 000	$69,000
Net Present Value (NPV)	$22,804,000	$32,188,000	$5,666 000	$5,704,000
(incl. health/fitness - mortality)	$26,144,000	$36,827,000	$5,666,000	$5,704,000
(incl health/fitness, congestion, time value)	$29,072,000	$40,895,000	($2,895,000)	($2,857 000)
Benefit-Cost Ratio (BCR)	18 5	25 8	3 7	3 8
(incl. health/fitness - mortality)	21 1	29 3	3 7	3 8
(incl. health/fitness, congestion, time value)	23.4	32.5	-0.4	-0.4

(a) A small amount of non-life-expired capital (buses) is freed up after year 10 in the 'low benefit' scenario

Table 9 High and Low Benefit Results: Financial Evaluation

Item	*High Benefit*		*Low Benefit*	
	10 Years	30 Years	10 Years	30 Years
Cost of individualised marketing	$1,300,000	$1,300,000	$1,300,000	$1,300 000
Additional public transport capacity: capital	$0	$0	$796,000	$767,000
Public transport services: operating (PV)	$0	$0	$460,000	$460,000
Fare revenue: Transperth (PV)	$1,077,000	$1,496,000	$627,000	$627,000
Fare revenue: Private Operator (PV)	$2,513,000	$3,491,000	$1,464,000	$1,464,000
Farebox cost-recovery: Transperth	83%	115%	25%	25%
Farebox cost-recovery: Public Transport	276%	384%	82%	83%
First year rate of return: Transperth	14%	14%	2%	2%
First year rate of return: Public Transport	48%	48%	16%	16%

Conclusions

Individualised marketing has been demonstrated to be an effective technique, in South Perth, for changing travel behaviour and delivers benefits that substantially exceed the direct and indirect costs.

Using methodology and values consistent with the evaluation of road projects, the socio-economic benefits of individualised marketing for South Perth exceed the costs by a factor of between 11:1 and 13:1, over 10 years, and 12.5:1 to 15:1 over 30 years. These benefit-cost ratios substantially exceed those of investment in metropolitan road infrastructure.

Sensitivity testing, to allow for uncertainties, indicates a range from just under 4:1 to 33:1 Despite the wide range of results from sensitivity testing, all values are substantially positive and compare favourably with transport investment generally.

The only qualification to this is with respect to the value attached to travel time. If small increments of travel time are given the maximum possible value consistent with the results of the pilot project, the estimate of overall socio-economic return becomes negative in the worst-case scenario, itself a combination of a large number of 'unfavourable' values.

Financial benefits through increased public transport fare revenue outweigh the costs, in all but the extreme 'low benefit' scenarios. The key factor in the 'low benefit' scenarios is any requirement to invest in additional public transport capacity and/or to operate additional services, although this is offset by accelerated reduction in effectiveness which more rapidly frees up buses for 'base load' public transport.

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