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the mode-shift benefit matrix

abstract

For many transport projects, the proposed costs are not huge, and there is no sense in spending more money on developing the the business case - the economic justification for the investment - than in implementing the scheme. This paper presents the mode-shift benefit matrix: a solution to the problem of how, cost-effectively, to calculate the economic value of the costs and benefits of a scheme that is designed to cause a modal shift.

This matrix will give a means of calculating the value to society of a unit shift between any two modes. This can fulfil a tactical and a strategic role. Tactically, it provides a simple calculation for the business case of a scheme or policy where total mode shift can be estimated using professional judgement and experience, and/or (for larger schemes) using forecasts from a validated multi-modal transport model. Strategically, it also provides indications to the top-level decision makers on what sort of modal shifts are desirable; it can inform a quantified, reasoned decision on the overall area-wide approach to demand management; and it can therefore contribute to the development of strategies for transport, land-use, health, and the environment.

Cost-benefit appraisals typically identify three elements of benefit to a scheme: those accruing to current users from the improvement to their journeys; those benefits accruing to new users; and the benefits to society of the modal shift from the previous mode. The mode-shift benefit matrix deals with monetary value of the latter two .

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editorial

Welcome to the second edition of the London Analytics Research Journal. In this edition we put down a marker to advance the sophistication of ready-reckoner business case tools. Traditional business-case procedures have systematically under-valued schemes designed to improve the public realm, by neglecting the externalities which are reduced by a modal shift to walking. By monetising these values where possible, the benefits can be captured within economic assessments.

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the mode-shift benefit matrix

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introduction

This paper was presented at the 2005 Money for Walking conference, organised by Living Streets and the Corporation for London.

This work grew from an initial project within Transport for London [TfL] to identify hierarchies of social benefit for different users of the streets. From there, it was a straightforward step to start quantifying the differences within the hierarchies, and to include the costs and benefits of tube travel where appropriate.

monetisation

The monetising of external costs is fraught with difficulties: in particular, the use of willingness-to-pay or willingness-to-accept-compensation for features for which the interviewees have no experience of paying at the point of use is contentious, and some have argued that it is entirely invalid. Where possible, in this project, Revealed Preference data has been used, incorporating observed real-world prices.

qualitative ranking of benefit

Most streets have multiple uses which compete for space; each use has various external costs for which no direct pricing mechanism exists. We can produce ordinal (and in some cases well-quantified) ranking of those impacts, thus creating hierarchies for different categories.

Within the hierarchies presented below, the direction of ordering has been selected on the principle of ranking highest that mode which contributes most to the objective underlying the hierarchy. Therefore, progress can be made on delivering each objective by transferring movement from a mode ranked low to a mode ranked higher, or by reducing the impact of those modes lowest on the list.

Note that the initial ordering within the hierarchies listed below has been made on the basis of best professional judgement.

Road Danger (rate of injury caused by each mode, ascending order):
Walk
Cycle
Tram
Bus
Taxi
Car

Financial Cost (to public sector, ascending order)
Walk, cycle
P2W
Car
Taxi
Tram
Bus

Land-take (width used to move people at a set rate, ascending order)
Walk
Tram
Cycle
P2W
Bus
Car
Taxi

Local pollutants (emitted per person-km, ascending order)
Walk, cycle, tram, electric or fuel-cell vehicle
Bus
Taxi
Car

Exposure to pollutants (per person-km, descending order)
Tram
Walk
Cycle
P2W
Taxi
Bus
Car

Greenhouse gases (CO2 per person-km, ascending order):
Walk
Cycle
Tram
P2W
Bus
Car
Taxi

Congestion (increase in delay to others, ascending order)
Walk, Cycle
P2W
Tram
Bus
Car
Taxi

Improvement to physical fitness (descending order)
Cycle
Walk
Tram
Busi
P2W
Car, Taxi

By quantifying and then monetising the relative values of modes within each category, we can calculate the differences in value between each pair of modes, and these values will populate the mode-shift benefit matrix. It is expected that the matrix entries will be symmetric in magnitude, but with signs inverted; e.g. (using the number generated in the following example, for illustration only), if the value of a single person shifting from car to cycle were calculated to be +46p/km, the value of a single person shifting from cycle to car would be -46p/km.

One of the results of this analysis is that it shows that a modal shift to walking from most other modes is of a net benefit to society. It becomes all the more important, therefore, for the future investment in significant programmes that will encourage modal shift to walking, that we identify just how much this is worth.

the unit of measurement

The values within the mode-shift benefit matrix can be calculated in various units, and the choice of units has a significant impact on the relative values.

In the short term, for some trip purposes such as commuting, both origin and destination of each journey, and thus total trip distance, will be fixed. In this case, for assessing short-term impacts, it is most useful to have the unit of measurement as **pence per km**.

For other trips, such as shopping or leisure, the destination may be flexible in the short-term; as it is for almost all trips, in the long-term. Therefore, in those cases where the primary target for mode shift is shopping or leisure, and in those cases where we are interested in the long-term costs and impacts, costs and benefits should be calculated on the basis of **pence per trip**.

In general, in developing the case for transport investment, it is the long term that decision-makers are interested in, and therefore the benefits-per-trip matrix is most relevant.

populating the matrix with data

A later paper will present the construction of the populated mode-shift benefit matrix. Accident data from 2000-2003 has been used, together with standard TfL figures for the values of different classes of injury (fatality, serious, slight). Standard TfL values of time are used for each mode. Operational costs are based on figures from 2000-2004. The operating costs for public transport are based on recent marginal costs, rather than average costs: that is to say, the figures represent the cost to TfL of the additional bus and tube passengers since 2000. Local pollution costs are, in the first stage of developing this tool, based on emissions of Sulphur Dioxide and Carbon Monoxide, as data for these is readily available .

future research

Congestion figures are based on crowding levels on the roads, and on TfL values of time and the additional delays observed when traffic flows increase. Public transport congestion is based on observed crowding figures from 2002-2004, and marginal costs derived from standard TfL values for crowding on the tube and buses.

money for walking

The project so far has shown that with sufficient access to current literature, a major contribution can be made to appraisal using this form of tool: it provides an easy-to-use ready-reckoner for assessing the value of a scheme that produces modal shift.

It also clearly shows that when schemes and policies promote a modal shift to walking from any motorised mode, there are significant benefits to society from that modal shift, and by clearly identifying the value of those benefits, we can build stronger cases for more money for walking.