Appendix E Assessment Tools For The Transport System

E.1 Direct Transport Costs Estimates

This tool provides a checklist for the calculation of direct transport costs. The total direct costs of a transport P/D project must be calculated in order to be included within a cost benefit analysis (CBA) framework. The costs themselves and their use in CBA are usually straightforward, given that their units are naturally financial. However, there is a need to be thorough in estimating all these direct cost changes. This tool provides an audit of these costs.

The users of the tool will be those involved in the evaluation procedure. However, there may be a need to obtain the direct operating cost estimates from transport providers. The tool is utilised by calculating all direct transport cost changes associated with the transport system under consideration.

The direct cost elements to be included, which are all monetary, and which could each be segregated in terms of variable costs and fixed costs, can be categorised as follows:

1. Construction Costs and Installation Costs: the total costs of building and installing the necessary infrastructure to support the pilot/demonstration. This would include the costs of computer hardware and software, and the professional time to bring them to operation;
2. Operating Costs: the ongoing costs of providing the transport pilot/demonstration. This will include day-to-day running costs (e.g. fuel, staff costs) as well as routine maintenance costs; and
3. Research and Development Costs: if the transport pilot/demonstration requires more than the mere installation of off-the-shelf infrastructure, there will be costs associated with research and development to bring the infrastructure to a full operational fit-for-purpose implementation.

Uncertainty in establishing the above costs elements:

- Allocation between construction/installation costs versus research and development costs
- Incorporation of unusual maintenance within operating costs
- Research and development costs are often difficult to estimate in advance

The transport costs are directly utilised within CBA or CEA. These can be aggregated on a total (total gross costs) or per capita basis (total cost per user) over a given time period (e.g. one year). They can also be utilised within the patronage equivalent tradeoffs described below.

In aggregating transport costs it is important to discount the costs over the lifespan of the project. This can be done as follows:

$$C_0 + \frac{C_1}{(1+r)} + \frac{C_2}{(1+r)^2} + \ldots\ldots + C_n \quad \frac{\quad}{(1+r)^n}$$

where C_0 = initial construction costs, $C_1 \ldots C_n$ = stream of costs over time span of project, r = rate of return.

E.2 Operational Indices

This tool develops indices of transport system operation. This is done by relating aspects of the operation of the transport system to various denominators. In so doing baseline measures of operational aspects of the transport system are derived, changes in which can be utilised within the evaluation.

To develop operational indices evaluators must obtain accurate measures of efficiency and effectiveness of operation. These will be obtained through surveys of infrastructure users (counts/interviews) and performance statistics pertaining to the infrastructure (performance data) and relating these to an appropriate denominator (e.g. time, sample size).

Inputs to the indices can be qualitative (ease of interchange) or quantitative (service frequency), though denominators are usually quantitative and relate to:

- Time
- Total population
- Sample population
- Space measures (e.g. m^2)
- Measures of capacity of transport system/sub-system
- Cost
- Other operational aspects

Uncertainty is usually reflected in estimates of the transport system aspect under consideration.

Indices can be easily utilised in multicriteria analysis (MCA) and goal achievement matrix (GAM) analysis, but are less likely to be incorporated into CBA. In MCA the indices can be used within discrete multicriteria methods where tradeoffs are possible or not in order to determine the preferred option. With regard to GAM the indices can be related directly to the goals of the evaluation. Thus objectives of increasing service frequency can be directly measured by operational indices relating service frequency over time.

These tools are easily understood because they establish basic ratios for directly measurable aspects of transport system operations. They can thus be very powerful for informing non-technical decision-makers (e.g. politicians). The potential to develop many indices is a strength but also undermines their use because they require a very broad evaluation framework, strong prioritisation and both accepted and rigorous measurement to provide for transparent and compatible evaluation.

Examples of operational indices are as follows:

$$\frac{\text{Frequency of enhanced bus service on route A}}{\text{Frequency of enhanced bus service on route B}} = \textit{Frequency Index}$$

$$\frac{\text{Ease of interchange}}{\text{Sample Population}} = \textit{Ease of Interchange Index}$$

E.3 Capacity Indices

This tool develops indices of transport system capacity. This is done by relating aspects of the capacity of the transport system to various denominators. In so doing baseline measures of capacity aspects of the transport system are derived, changes in which can be used in the evaluation.

To develop capacity indices project evaluators must obtain accurate measures of physical aspects of the transport system and changes in these aspects. These will be obtained through audits of transport infrastructure (e.g. link/network capacity) and physical context of the system (e.g. population within certain distances of transport nodes). These may be publicly available or may require primary data collection. These are then related to an appropriate denominator.

Inputs to the indices are predominantly quantitative (e.g. link / junction / network capacity, area covered by traffic management infrastructure etc.). Denominators are usually quantitative and relate to:

- Time
- Total population
- Space measures (e.g. m^2)
- Measures of capacity of transport system/sub-system
- Cost

Uncertainty is usually reflected in estimates of the transport system aspect under consideration.

Indices can be easily utilised in multicriteria analysis (MCA) and goal achievement matrix (GAM) analysis, but are less likely to be incorporated into CBA. In MCA the indices can be used within discrete multicriteria methods where tradeoffs are possible or not in order to determine the preferred option. With regard to GAM the indices can be related directly to the goals of the evaluation. Thus objectives of increasing the area included within mobility management strategies can be directly measured by capacity indices relating area transport management changes over time.

These tools are easily understood because they establish basic ratios for directly measurable aspects of transport system operations. They can thus be very powerful for informing non-technical decision-makers (e.g. politicians). The potential to develop many indices is a strength but also undermines their use because they require a very broad evaluation framework, strong prioritisation and both accepted and rigorous measurement to provide for transparent and compatible evaluation.

Examples of capacity indices are as follows:

$$\frac{\text{Maximum aircraft movements achieved after new control system}}{\text{Maximum aircraft movements achieved after new control system}} = \textit{Airport capacity Index}$$

$$\frac{\text{Number of buses fitted with AVL system}}{\text{Number of buses}} = \textit{AVL capacity Index}$$

E.4 User[1] Indices

This tool develops indices of transport system user perceptions and use. This is done by relating aspects of use of the transport system to various denominators.

In so doing baseline measures of user perceptions and use of the transport system are derived, changes in which can be utilised within the evaluation.

To develop user indices, evaluators must obtain accurate measures of user aspects of the transport system, and changes in these aspects. These can include:

- Current use (e.g. mode/frequency/trip length/route/occupancy)
- Potential use (e.g. potential mode/frequency/trip length/route/occupancy)
- Current perceptions (e.g. cleanliness of service/reliability)
- Potential perceptions (e.g. changed perceptions of cleanliness of service/reliability)

Inputs to the indices are both quantitative and qualitative. Quantitative and qualitative data can be input from observations, surveys and models of current behaviour, and from surveys and models regarding potential behaviour. Denominators can also be qualitative and quantitative and relate to:

- Time
- Total population
- Total sample
- Space/spatial measures (e.g. route changes)
- Measures of transport use
- Cost

Uncertainty is usually reflected in estimates of the transport system aspect under consideration (e.g. standard errors regarding sample size).

Indices can be easily utilised in multicriteria analysis (MCA) and goal achievement matrix (GAM) analysis, but are less likely to be incorporated into CBA. In MCA the indices can be used within discrete multicriteria methods where tradeoffs are possible or not in order to determine the preferred option. With regard to GAM the indices can be related directly to the goals of the evaluation. Thus, objectives of increasing acceptance of new forms of travel information can be directly measured by user indices relating to awareness of new information systems amongst a sample of users.

These tools are easily understood due to their establishing basic ratios for directly measurable aspects of transport system use/perceptions and potential use/perceptions. They can thus be very powerful for informing non-technical decision-makers (e.g. politicians). The potential to develop many indices is a strength but also undermines their use: they require a very broad evaluation framework, strong prioritisation and accepted and rigorous measurement to provide for transparent and compatible evaluation.

[1] Users can include both current and potential users of the transport system.

Examples of transport system use indices are as follows:

Number of trips with a changed route = *Route Change Index*
Total journeys

Perceived reliability of freight delivery times = *Delivery Reliability Index*
Total survey sample

E.5 Patronage[2] Equivalent Tradeoffs (Utilising Demand Elasticity Estimates)

This tool calculates the overall changes in patronage necessary within the transport system for pilot/demonstration project investment to be financially justified. This can relate to:

- Patronage increases: for example the extra passengers which must be generated on public transport to pay for a public transport investment (trip generation);
- Patronage decreases: for example the reduction in (usually car based) travel in pursuit of sustainability goals to justify the pilot/demonstration project (trip degeneration).

This is achieved by estimating the increase in public transport use (increased patronage x fares/tolls) that would justify the investment and/or the reduction in use (non-user benefit) that would be necessary to justify the investment.

The tool is best used when a potential revenue stream is likely from the investment through trip generation on public transport or via road pricing or from parking facilities. It is of particular merit when private stakeholders are important stakeholders in the P/D project (e.g. public transport operators).

Inputs to the tool are quantitative. The following input data must be available or collected / derived:

- Current fares / costs incurred by travellers;
- Running and maintenance costs of pilot / demonstration or part thereof;
- Research and development costs of pilot / demonstration or part thereof;
- Total number of travellers using the transport system; and
- Their responsiveness to infrastructure changes

Uncertainty can be reflected in an analysis which provides a range of estimates of costs over various timescales and at various discount rates, and via the sample size utilised in estimating responsiveness to price changes.

These can be easily utilised within CBA as they directly relate monetary benefits to costs of P/D projects.

These tools are easily understood relating the potential trip generation both necessary and

[2] It is also possible to estimate the increases in charge that would have to be made to justify the investment. This is made possible through measuring the increases in fares that would be needed to cover the costs of the investment if patronage levels stayed the same. By estimating willingness to pay (see contingent valuation) the likelihood of the payment by consumers to cover this shortfall could be estimated. Patronage and fare equivalents could obviously combine within the evaluation.

possible to cover the costs of investment. The tool provides theoretical estimates of revenue before the pilot / demonstration is introduced using stated preferences of consumers. However, after the pilot / demonstration has been implemented revealed preference techniques can be used to estimate the real changes in revenue achieved by the pilot / demonstration.

An example of patronage equivalent tradeoffs is as follows:

An enhanced extension of a light rapid transit is introduced to a city. Using current average fares data and current patronage levels, the percentage increase in patronage needed to pay for the infrastructure and maintenance costs can be estimated. The potential to achieve these generation levels can be estimated via stated preference techniques with users.

E.6 Investment Performance Comparisons

This tool analyses which aspect of a pilot / demonstration project has performed best in comparisons to its indicators and / or overall project objectives. This tool enables comparison of performance to highlight comparative strengths and weaknesses of sub-elements of investment. This can be utilised to guide strategic decisions on future investment and also the overall performance of the project.

The tool is best used for internal comparison of sub-projects and their contribution towards overall project objectives. However, the tool can be used to provide a comparative data synthesis between competing projects. Ideally the tool is used at pre-implementation / ex-ante stages to inform the final configuration and investment decisions regarding the P/D project.

Inputs to the tool are usually qualitative and concern the actual / perceived contributions of investment towards project objectives. The following input data must be available or collected / derived:

- Data which reflects movement towards and indicators / objectives for separate investment areas: e.g.:

  Indicator: perceived usefulness;
  Investments/sub-projects: interactive journey planners; real time bus stop signs; roadside variable message signs; and
  Data: survey results asking potential users to rate usefulness on a 5 point scale.

Uncertainty can be reflected in standard errors and confidence limits applied to the survey.

These can be easily utilised within multicriteria analysis (MCA). Conjunctive models and dominance analysis can utilise the comparisons directly, and the results can also be utilised to set criteria targets for subsequent use in MCA techniques (e.g. regime analysis, concordance analysis).

These tools are easily understood and can graphically show comparative performance of investment against indicators and objectives. If common criteria/questions are contrasted the technique can generate numerous comparisons. This is also its weakness. There is a strong

need to establish the criteria to be contrasted in advance and establish the MCA framework into which they will be placed in advance.

An example of patronage equivalent tradeoffs is as follows:

In a trial of various information tools samples of residents are asked to rate the ease of use of the tools. The percentage of respondents rating the information tools as very easy, fairly easy and not easy are compared. This can show information tools that are performing weakly. These can be dropped from the trial, or indeed be the focus of renewed investment.