Economic Appraisal of local walking and cycling routes

Methodology

Generating figures for changes in usage

In each case the approach to the case studies involves the testing of a single scheme scenario against a 'base' case. Usual practise would be to conduct appraisals on a range of possible options, and to compare the outcomes, the concept being to use the appraisal system as a tool to assist decision-making by comparing different project options.

However, these examples compare the 'no-change' scenario against a 'with-intervention' scenario that is based on known measures and simple projections. Normally the forecasting techniques recommended elsewhere in the guidance would be used, but since real pre and post scheme data exists for these schemes, forecasting based on actual data is preferred.

For the case studies, four measures of the impact of an intervention are generated in order to appraise the project. The measures are:

- Cyclists and walkers
- New individuals cycling or walking
- Car kilometres saved
- Commuter trips generated

The base unit for the assessment is pedestrian and cyclist users per day. These are generated from estimated annual usage equivalent figures[1], which are in turn derived from the manual counts. An annualisation factor is applied to the user per day figures where appropriate to the calculation.

Each of these measures is generated for the 'no-change' scenario using data collected prior to the intervention, and assuming no notable growth during the appraisal period. The equivalent measures for the 'with-intervention' scenario are based on the same pre-intervention data, and data collected after the

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[1] Another technical document, available from Sustrans, describes the generation of estimated annual usage equivalents

intervention is completed. Projections of usage are based on informed estimates of usage growth levels throughout the appraisal period.

The link between the impact measures and the factors included in the appraisal are shown in table 1.

Table 1: Impact measures and the costs/benefits to which they relate

Impact measure	Monetised cost/benefit
Cycling and walking users	Journey ambience
New individuals cycling or walking	Physical fitness
Car kilometres saved	Travel time (decongestion) Accidents Fuel tax revenues
Commuter trips generated	Absenteeism

To measure the difference in usage levels attributable to a particular intervention, the number of users expected under the base scenario is subtracted from the forecast number of users under the 'with intervention' scenario.

The number of new individuals cycling or walking is calculated by taking the number of users expected during the current year, and subtracting from it the number of users expected in the previous year.

To generate a number of commuter trips attributable to an intervention, the proportion of route users reporting that they are making commuting trips is used. Data concerning trip type is collected through the route user surveys.

The number of car kilometres saved through an intervention is calculated by multiplying the projected number of cycling and walking users in the 'no-change' and 'with-intervention' scenarios by the average trip lengths (collected through the route user surveys), and subtracting the former from the latter. The proportion of users then reporting that they could have used a car but chose not to is taken as the proportion of the total trip mileage that can be described as car kilometres saved. This measurement is applied to each of the case studies in terms of the assessment of accident reduction, travel-time savings and fuel tax revenue costs.

It should be noted that the appraisal guidance states:

> “*there is significant uncertainty around the use of such techniques and the valuations suggested in this document. These valuations should therefore be used with care and only for the purposes of sensitivity testing*”.

In terms of technique, Sustrans acknowledges that the tool is not as widely tried and tested as appraisal techniques for other modes, but we see ourselves in the vanguard of this developing area. In terms of valuations, it is Sustrans’ belief that, in the majority of cases, the uncertainty relating to the magnitude of the values applied is reflected in the conservatism of the estimate.

Thirdly, although sensitivity testing concerns the relative impacts of a number of different scheme alternatives, these schemes are all now completed, and the appraisal is used not as a tool to aid decision making in scheme selection, but as a means of demonstrating the benefits of the programme.

Sustrans therefore considers this exercise to be a valid means of examining the benefits and costs of local walking and cycling projects whilst acknowledging the relevant caveats.

Measuring Differences Between the ‘no-change’ and ‘With Intervention’ Scenarios

Projected usage of routes in the ‘with intervention’ scenarios is based on data collected on the route either side of the period when the intervention was made. Growth rates for the periods up to 20 years after the intervention are based on growth rates immediately after the intervention. Growth rates to the end of the appraisal period are limited to 1% per annum in all cases. The rates used are shown in the table below.

In the ‘base’ scenario, 1% growth in usage per annum is assumed throughout the appraisal period. This assumption is based on the expectation that some background growth in levels of cycling and walking will occur in future years (despite the fact that this runs contrary to trends recorded in some government data sources).

A 60-year appraisal period is the standard period for transport economic appraisal exercises.

Table 2: Measures of usage and growth rates applied for each scheme

	Case study 1 (Hartlepool)	Case study 2 (Bootle)	Case study 3 (Sussex)
Average daily use pre-intervention	Cyclists 62 Pedestrians 804	Cyclists 56 Pedestrians 187	Cyclists 30 Pedestrians 17
Average daily use post-intervention	Cyclists 87 Pedestrians 1095	Cyclists 76 Pedestrians 359	Cyclists 88 Pedestrians 190
Change in usage in 'no-change' scenario	Cyclists +1% Pedestrians +1%	Cyclists +1% Pedestrians +1%	Cyclists +1% Pedestrians +1%
Growth in use at point of intervention	Cyclists +40% Pedestrians +36%	Cyclists +36% Pedestrians +92%	Cyclists +193% Pedestrians +1018%
Annual growth 2005-11	Cyclists +5% Pedestrians +5%	Cyclists +5% Pedestrians +5%	Cyclists +5% Pedestrians +20%
Annual growth 2012-20	Cyclists +1% Pedestrians +1%	Cyclists +3% Pedestrians +3%	Cyclists +5% Pedestrians +10%
Annual growth 2021-63	Cyclists +1% Pedestrians +1%	Cyclists +1% Pedestrians +1%	Cyclists +1% Pedestrians +1%
Appraisal period	60 years	60 years	60 years

Implementing the Appraisal Process on the three Case Studies

Expressions for user type split, average trip length, trip purpose split, and reported modal shift are generated locally from the survey data collected on site. The combination of user numbers, growth rates and trip profiling form the basis for the calculation of total trips, numbers of new users, car kilometres saved, and numbers of commuter trips. Each of these is required for the generation of the monetised values for the items listed below. In each case the calculated value is the net present value over the 60-year appraisal period at a 3.5% discount rate.

It should be noted that none of the areas involved in the appraisal contain any special allowance for impact on children. Each scheme is assessed on the basis of no distinction being made between use being made by adults and children.

Physical fitness: This exercise incorporates a variety of data to produce an estimate of the likely impacts of an intervention in health terms. The stages are:

- The number of deaths from three principal causes (coronary heart disease, stroke and colon cancer), the proportion attributed to a lack of physical activity, and the proportion avoidable by increased physical activity are used to generate a figure for preventable deaths

- Population figures are used to generate a figure representing the ratio of preventable deaths per population

- The product of the number of preventable deaths per person and the unit cost per death value is calculated as the unit value per additional cyclist or pedestrian

- The proportion of deaths that are preventable is calculated by multiplying the total number of annual deaths by the proportion allocated to physical inactivity and then multiplying this figure by the proportion of deaths that could be avoided with 30 minutes a day of walking. The value assigned is £122.93 per new route user. The value assigned per new user is counted in every subsequent year of the project appraisal period from the point of first impact.

This benefit would more correctly be referred to as 'physical activity' or 'public health benefit'. The expression used is that which appears on the DfT's Appraisal Summary Table.

Absenteeism: An assumption is made that a traffic-free route will lead to reduced absenteeism through improved levels of physical activity experienced by those commuters cycling and walking to work. An average daily employer cost is used. Average annual absenteeism rates per person are multiplied by the expected reduction rate through increased cycling and walking, based on a precedent from a US study (6%), and the number of days saved per person per annum is thus calculated. The employer cost saving of the reduction is calculated. A factor reflecting the proportion of all route users affected is generated based on the proportion of route users commuting, and the proportion of commuters reporting that they are new users and that the route has helped them to increase their levels of regular physical activity (derived from route user surveys). A value for the reduction in absenteeism, £8.30, assignable to each commuter user of a route is generated.

Journey Ambience: Journey ambience is calculated on the basis of a 'safety-insecurity' value, as derived from a study by Hopkinson and Wardman (1996). It is based on the assignment of a value to each individual trip carried by the intervention. The data in the case studies uses a separate assessment of the journey ambience value for cyclists and pedestrians, although the same value for each is applied: £0.91 per trip. In each case the rule of a half is used where new users are concerned to account for the issues around the realisation of generalised cost. The number of users projected daily on the route in question is multiplied by an annualisation factor. The annualisation factor used is 220 to reflect the number of working days in a year. Weekend day use is therefore not included.

Accidents: An increase in use of a walking and cycling route can imply an increase in the number of accidents if the calculation is based solely on the rate of accidents per trip. However, basing the assessment on the reduction in the number of accidents brought about by reduced car use can present a more positive reflection of the impact of a route in terms of accidents. This approach is used for the case studies. The incidence of killed, seriously injured and slightly injured car drivers and passengers is expressed in terms of accidents per million vehicle kilometres (2003 figures are used).

Table 3: Relative incidence of accidents by severity

Severity	Incidences (2003)	Billion car kms (2003)	Million car kms per incident
Killed	1,769		222.2
Seriously injured	15,522	393	25.3
Slightly injured	171,051		2.3

The figures calculated for the reduced number of car kilometres as a consequence of route development are used in these case studies, and the values assigned to each category of injury are applied as required. The effect of this (if a reduction in car usage is an outcome of a project) is a reduction in accidents, and consequently the assignment of a positive value to the project appraisal.

An alternative approach to addressing the benefits associated with accident reduction is to use a rate per 1,000 trips. The incidence of accidents per 1,000 trips is calculated separately for cyclists and pedestrians based on a simple formula involving the number of accidents per year and the UK population figure. The number of accidents per year on the current route in a ‘no-change’ scenario is calculated for the project period, and compared the number of accidents on the proposed routes. A reduction in the rate of accidents should be included to reflect the fact that increased levels of activity do not necessarily result in increased levels of accidents.

In each case, application of the accident related costs for the killed, seriously injured and slightly injured categories is the basis for the calculation of values for the appraisal.

Travel time benefits: There is a broad assumption that the impacts of modal change can only be realised on schemes were there is strong evidence of, or a reasonable basis for expectation of modal shift. In the case of the Links to Schools programme, there is considerable evidence that congestion is often concentrated around schools at the start and end of the day. The travel time benefits realised by users are therefore calculated for these schemes (they may not be calculated for many other cycling and walking schemes, where there is less emphasis on modal shift). The calculation is conducted on the basis of a decongestion value that is applied in relation to the reduction in car kilometres that is attributable to the intervention. Two values are available; either 7.0 pence per kilometre for off-peak surface transportation, or 23.0 pence per kilometre for peak time surface transportation costs. The lower value is applied in this case due to the suburban nature of many of the projects, despite the peak-period nature of much congestion around schools. The generated figure is therefore regarded as a conservative estimate.

Fuel tax revenues: The calculation of the value of fuel tax revenues is based on the reduction in car miles travelled, and the consequent reduction in the value of tax revenue on fuel sales realised by the government. The value used is 4.54 pence per kilometre.

Environment: No attempt is made to monetise noise, local air quality, and greenhouse gas savings, although in some of the case studies there is evidence that the contribution is notable, and future inclusion of this area is seen as desirable.

Project costs

The scheme investment costs (design and construction) and operating costs (maintenance) are required for the appraisal. The values used are the total costs of the schemes, rather than the value of the grant awarded by Sustrans through the programme.

The estimated cost of a scheme is increased by 15% to account for optimism bias, and a further 20.9% is added to adjust for total capital costs as market prices. It is questionable whether the optimism bias adjustment should be applied in these cases, as costs are known, rather than being based on estimates for proposed schemes. However, it is retained for the sake of completeness.

The cost of tax revenue losses due to reduced vehicle kilometres, and therefore reduced purchase of fuel, is also included in the total project costs. Derivation is described in section 1.35.

The net present value of all costs is the sum of the full capital cost and maintenance cost with the optimism bias and market price adjustment applied, and the tax revenue losses associated with the scheme. Optimism bias and market price adjustment are not applied to tax revenue costs.

Table 4: All costs associated with the three case study schemes

	Case study 1	Case study 2	Case study 3
DfT/Sustrans grant awarded	£131,000	£25,174	£125,000
Scheme capital cost (actual)	£231,000	£50,349	£327,708
Ongoing maintenance cost (npv)	£33,286	£17,461	£89,801
+15% optimism bias (scheme costs, npv)	£294,946	£76,024	£467,391
+20.9% market price adjustor (scheme costs, npv)	£356,590	£91,913	£565,076
Tax revenue loss costs (npv)	£73,704	£85,311	£560,938
Net present value of all costs	£430,294	£177,224	£1,126,014

'Scheme costs' excludes tax revenue losses

Summarising Scheme Impacts

The impact of each scheme can be presented in terms of:

- The present value of benefits relative to the present value of costs
- The difference between the present value of benefits relative and the present value of costs (net present value)
- The ratio of the present value of benefits relative to the present value of costs (benefit to cost ratio)

The various alternatives are illustrated in the in table 5.

Table 5: Benefits and costs associated with the schemes

	Case study 1	Case study 2	Case study 3
Present value of benefits	£12,601,051	£5,766,824	£16,782,954
Present value of costs	£430,294	£177,224	£1,126,014
Net present value	£12,170,757	£5,589,600	£15,656,940
Benefit to cost ratio	29.3	32.5	14.9

The impact of each of the schemes can be seen to be very considerable, both in terms of the net present value and the benfit:cost ratio. Ratios of this magnitude compare very favourably with other transport schemes. A recent list of road improvement and public transport schemes appraised and approved in principle or provisionally accepted by the DfT showed that none had a benefit to cost ratio in excess of 10 (LTT, November 2004).

The combined net present value of the three schemes presented as case studies is £33,417,297. The total scheme costs are £1,733,532. The benefit to cost ratio is 20.3:1. The cost to the DfT/Sustrans total project fund is £281,174 and the combined scheme capital cost (without optimism bias and market price adjustment) is £581,349.

The combined scheme capital cost represents 33.5% of the present value of costs (without operating costs, optimism bias and market price adjustment). Assuming that this ratio is constant across the whole set of projects, the present value of costs on 146 schemes is £77,977,022. This is based on a £26,100,000 combined scheme capital cost. If the benefit to cost ratio is also constant across the projects, the present value of costs would be £1,582,933,000. This would represent a net present value of £1,504,956,000 for all 146 schemes completed during 2004/2005.

There is a considerable degree of variation between the three case studies in the way that the benefits are split across the key benefit categories. This variation is shown in table 6.

Table 6: All costs associated with the three case study schemes

	Case study 1	Case study 2	Case study 3
Congestion	0.92%	2.32%	5.24%
Journey ambience	59.34%	47.33%	28.22%
Physical fitness	37.14%	47.60%	62.45%
Absenteeism	2.10%	1.47%	0.95%
Accidents	0.51%	1.29%	3.15%

The most important benefit areas in each case are journey ambience and physical fitness. The data suggests that as much as half of the net present value of the routes may be 'realised' in terms of savings to health services. The impact of reduced congestion, reduced absenteeism, and reduced incidence of accidents all have a relatively minor role to play in economic terms. The principal determinants of the distribution of benefits are the number of new and existing users, the trip lengths, and propensity for modal shift.

As there is no allowance for the differential appraisal of child travel from adult travel in the appraisal process, there is no particular aspect of this exercise that distinguishes the benefits of walking and cycling routes that link schools to their communities from other traffic-free routes. If we are to assume a greater benefit value to children of accident reduction and physical fitness (and arguably absenteeism), and constant values for journey ambience, we might reasonably conclude that the calculations underestimate the value of benefits. Furthermore, the restriction of the physical fitness benefit value source to consideration of three causes of mortality only (coronary heart disease, stroke and colon cancer), suggests that this value is an underestimate. Both of these issues, and the failure to incorporate environmental benefits into the appraisal mechanism lead to the conclusion that the system used produces a conservative estimate of the value of benefits associated with the programme.

Formal reporting of economic appraisal

The overall impacts of each scheme are formally summarised in a series of four tables, each of which is described below. These tables are not appended to this report, but are available from Sustrans on request.

Public Accounts Table: In the local government funding section, a design and construction cost value, with optimism bias and capital cost as market prices adjustments, is inserted in the 'Revenue' box, and a maintenance cost value is inserted in the 'Operating cost' box. The capital cost of the project is inserted in the 'Investment cost' box. If the capital cost is part-funded by nongovernment grants, this should be reflected in the 'Developer and other contributions' box. The only circumstance where a cost to central government applies is for situations where the volume of modal shift is substantial, and there is a loss in 'Indirect tax revenues' due to reduced fuel sales. Also, where large modal shift is anticipated, a bus subsidy cost saving can be inserted as a negative value in the local government Grant/Subsidy payments cell. In each case values are inserted in the 'Other modes' column, and copied to the 'All modes' column. The net impacts on local and central government are combined and inserted in 'Total present value of costs (PVC)'.

Economic Efficiency of the Transport System: The consumer benefits that qualify for inclusion are 'Travel time' benefits. Salary cost savings through reduced absenteeism are recognised as a direct impact on businesses through cycling and walking schemes. The value of reduced absenteeism is inserted in the 'Reduced absenteeism' box as an 'other business' impact. In each case values are inserted in the 'Other modes' column for cyclists and walkers, and copied to the 'All modes' column. The 'Net consumer benefits' and the 'Net business impact' are combined as the 'Present value of transport economic efficiency benefit'.

Appraisal Summary Table: The 'qualitative impacts' cells contain a short description of how the project impacts on particular aspects of the environment, safety, economy, accessibility and integration. The 'quantitative impacts' cells contain only a description of the nature of the information entered as a value in the 'assessment' column, if applicable. The 'assessment' column may contain a value or a neutral/beneficial/detrimental typology of the effect of the project

Analysis of Monetised Costs and Benefits: Values for 'Journey ambience', 'Accidents', 'Consumer users' (where appropriate), 'Business users and providers', and 'Physical fitness' are added to the adapted Analysis of Monetised Costs and Benefits table. The sum of these values is entered as 'Present value of benefits (PVB)'. The value from the Public Accounts table is inserted in the relevant box and in the 'Present value of costs (PVC)' box. The 'Net Present Value' and the 'Benefit Cost Ratio' are calculated from the Present Value of Costs and the Present Value of Benefits.