Guidance on the Appraisal of Walking and Cycling Schemes
TAG Unit 3.14.1

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1. Guidance on the Appraisal of Walking and Cycling Schemes

1.1. Introduction

1.1.1. This TAG Unit contains guidance on various aspects of the analysis of cycling and walking schemes. This guidance was written to help in certain aspects of the analysis of schemes aimed primarily at improving conditions for cyclists and walkers, such as the development of a cycle route. However, it can also be used where public transport or road schemes are likely to have a significant impact on cycling and walking trips. This Unit explains:

- Objectives and option appraisal
- The appraisal process
- The forecasting process
- Monitoring and evaluation

1.1.2. Three case studies are included in an appendix to demonstrate how the appraisal and forecasting processes have been applied in real situations.

1.1.3. In the case of schemes which are not aimed at cyclists and walkers but which are expected to have a significant impact on cycling and walking, it is not expected that a separate appraisal of the impacts on cyclists and walkers should be produced. In this case the cycling and walking impacts should be assessed with the help of this guidance and then integrated into the overall appraisal for the whole scheme. For instance, for major schemes (see *Major Scheme Appraisal in Local Transport Plans Detailed Guidance on Public Transport and Highway Schemes* (TAG Unit 1.4) with a significant cycling and walking element or a significant impact on cycling and walking the appraisal presented should combine the impacts associated with cycling and walking with the other impacts of the scheme (for instance by using the modified TEE table described below).

1.1.4. This Unit covers only part of the transport analysis process and assumes that many of the steps described in *The Overall Approach: The Steps in the Process (*TAG Unit 2.1) have already been carried out. In particular, it is important that a cycling and walking scheme emerges as an appropriate potential solution (or part of a solution) after a process which includes consideration of objectives, problems, opportunities and constraints. In other words a cycling and walking scheme should not be a starting point of the overall process, even though this Unit assumes that a particular cycling and walking scheme is being assessed.

1.1.5. This Unit follows the standard approach to appraisal guidance as explained in *The Appraisal Process* (TAG Unit 2.5). However, issues of particular importance to cycling and walking such as physical fitness benefits and journey ambience are more fully explained. This guidance includes advice on monetising some of the benefits of cycling and walking schemes. There is significant uncertainty around the use of such techniques and the valuations suggested in this document, which shall be expanded on. **These valuations should therefore be used with care and only for the purposes of sensitivity testing**.

1.1.6. It is therefore intended that this guidance is used to appraise walking and cycling schemes as an indicative measure of the effectiveness of one scheme against another. It should be appreciated, with the aid of this guidance, how sensitive the results are to different elements of the appraisal, such as forecasting assumptions or the monetised values of derived utility themselves. This knowledge can be just as important as the final BCR that falls out of the process. At this stage, this guidance is intended as a tool to facilitate the decision-making process in line with the comprehensive NATA approach where this is deemed of benefit to understanding the returns on investment.

1.1.7. Specific cycling and walking schemes are often relatively small schemes. It is accepted that the amount of effort devoted to the analysis of such schemes should either be proportional to the scale of the project or the scale of impact on cycling and walking modes.

1.1.8. It is anticipated that demand measures such as Smarter Choices schemes should be included in a full appraisal context, likely to require a demand model. This is advisable due to the relatively large scale impact achievable on mode choice as a result of these schemes and hence the change on motorised traffic may be significant enough to warrant a full model. The Department is currently researching the most appropriate method of incorporating Smarter Choices into the transport modelling process and a Guidance Unit is forthcoming.

1.1.9. This Guidance Unit, although focussed primarily on more locally-based interventions, identifies the key benefits that more mesoscopic demand measures will provide that are relatively unique to walking and cycling: namely health and ambience benefits.

1.1.10. There is a significant amount of published guidance on walking and cycling schemes in general. Useful lists of publications are provided by the Traffic Advisory Leaflets *Cycling Bibliography* (DfT, 2005a) and *Walking Bibliography* (DfT, 2005b).

1.2. Objectives and option appraisal

1.2.1. Scheme objectives need to be clearly set out. This TAG Unit will help to identify objectives to which cycling or walking schemes or alternative schemes provide the best solution. This will require a number of options to be developed and the appraisal process will help to prioritise the options.

1.3. The appraisal process

1.3.1. The overall appraisal process is explained in *The Appraisal Process* (TAG Unit 2.5) and is set within an overall approach which includes the identification and assessment of problems, the identification of options and the assessment of those options (schemes). Four 'strands' to the appraisal process are identified:

- An Appraisal Summary Table (see below)
- An assessment of the degree to which the local and regional objectives of the study would be achieved by the scheme
- An assessment of the extent to which the problems identified would be ameliorated by the scheme
- Supporting analyses of distribution and equity, affordability and financial sustainability, and practicality and public acceptability. The analysis of distribution and equity may be important for some cycling or walking schemes

1.3.2. The appraisal of cycling and walking schemes should take account of these four appraisal strands and should be presented in the same way as that for major schemes (*Major Schemes in Local Transport Plans* (TAG Unit 1.4)). However, the effort put in should be proportional to the scale or impacts of the scheme and many of the sections identified may not be applicable.

1.3.3. Appraisal of schemes will be relative to some “Without Intervention” or “core” case. For cycling and walking schemes this will simply be the situation without the scheme in most cases, but could include projections of modal splits against trends. Where the impacts on cycling and walking are being considered in the context of another major scheme it may be appropriate to include the major scheme in the core scenario in order to identify the incremental effects on cycling and walking.

1.3.4. It is important to mention here that scheme costs and benefits identified in appraisals should measured in net present values in the Department’s current appraisal base year prices (2002). This is to ensure that the change in the value of money over time is included by applying a discount rate of 3.5% per year up to thirty years ahead and 3% thereafter. The net present value is the summation of a discounted accumulated cost or benefit over the appraisal period. The discounting process is explained in *Cost Benefit Analysis* (TAG Unit 3.5.4).

1.3.5. The recommended appraisal period consistent with NATA advice throughout WebTAG is sixty years. Historically, this period was born out of highway appraisal, based on long road service lives and the fact that after this period, the discounting effect reduces any marginal benefits beyond this time to a negligible level. Clearly in the case of some walking and cycling schemes the life of the infrastructure or plan may not be of a sixty year length. In order to maintain a fair appraisal, one should therefore use an appraisal period of less than sixty years where the provision of benefits is reduced so much as to be deemed insignificant before this time has elapsed.

1.4. The Appraisal Summary Table

1.4.1. The Appraisal Summary Table (AST) is described in *The Appraisal Process* (TAG Unit 2.5). It provides the opportunity to summarise the potential benefits associated with the proposed scheme, including both quantitative and qualitative impacts. The AST is divided into five key objective categories; economy, safety, environment, accessibility and integration. These are further divided into a number of sub-objectives:

- **Environment** – noise, local air quality, greenhouse gases, landscape, townscape, biodiversity, heritage of historic resources, water environment, physical fitness, journey ambience
- **Safety** – accidents, security
- **Economy** – public accounts, transport economic efficiency, reliability, wider economic impacts
- **Accessibility** – option value, severance, access to the transport system
- **Integration** – transport interchange, land use policy, other government policies

1.4.2. The AST allows a consistent view to be taken concerning the impacts of a scheme. It is important that the standard approach is used when completing the AST (as described in *The Appraisal Process* (TAG Unit 2.5)), including the presentation of the impacts in the form specified. Consistency and standardisation makes it easier to compare one scheme with another. This kind of comparison is often needed when considering different ways of resolving a given problem or when allocating funds from limited budgets.

1.4.3. The following paragraphs outline how the objectives and sub-objectives could apply to cycling and walking.

Environment

1.4.4. The standard approach for completing the elements under the Environment objective is covered in *The Environment Objective* (TAG Unit 3.3).

1.4.5. Improvements in **Noise**, **Local Air Quality** and **Greenhouse Gases** will only occur if there is a reduction in motorised traffic relative to growth trends as a result of the scheme. If they are monetised the value of changes in Noise, Local Air Quality and Greenhouse Gases can be entered in the modified Analysis of Monetised Costs and Benefits Table (see below). This is only possible if robust estimates for the monetary value of these impacts is available and there is a large enough mode shift from motorised modes to make a significant difference to traffic levels.

1.4.6. For **Landscape**, **Townscape**, **Heritage of Historic Resources**, **Biodiversity** and **Water Environment** sub-objectives, cycling and walking schemes have the potential to have a beneficial effect if motorised traffic is reduced as a result. However, schemes may be detrimental where large numbers of extra users cause damage to the area (through erosion, litter, disruption of sensitive habitats etc.). Townscape may also be improved through improvements in the quality of the walking environment and public space.

1.4.7. **Physical Fitness**: This sub-objective relates to increased levels of personal physical activity. Cycling and walking schemes are likely to have a positive effect on physical fitness where new or extended trips are generated, either where these trips were formerly made by motorised means or where they were not previously made at all. For the individual, there is a 'curvilinear' dose-response relationship to the amount of physical activity and the benefits gained, meaning that benefits are greater at lower increases in activity, but that benefits continue to accrue at higher levels of activity.

1.4.8. Physical inactivity is a primary contributor to a broad range of chronic diseases such as coronary heart disease, stroke, diabetes and some cancers (Dept of Health 2004 'At Least Five a Week' A report from the Chief Medical Officer). Physical activity also has an important role to play in preventing weight gain and obesity and improving mental health.

1.4.9. The most detailed research on cycling activity shows that the relative risk of an active cyclist of all-cause mortality is 72% relative to the prevalence of mortality in the population as a whole, based on data from the Copenhagen heart study (Andersen et al, 2000). In this study, three hours of exercise per week was required in order to reduce the relative risk to this level. The health benefit entry in the AST should reflect the change in activity, and hence relative risk of all-cause mortality, based on the average distance and speed that individuals travel as a result of the scheme intervention. For cycling and walking schemes a monetary value will often be appropriate here, since this is a relatively important part of the scheme benefit. A unit cost saving of decreased mortality through increased activity may be derived using cost of death estimates. This is explained subsequently.

1.4.10. Physical Fitness is a new entry in the modified Analysis of Monetised Costs and Benefits Table. Guidance on how to calculate the value of this impact is given below in *Estimating the health benefits of new cycling and walking facilities*.

1.4.11. **Journey ambience**: This is defined in *The Environment Objective* (TAG Unit 3.3) and relates to three elements of the experience of travellers:

- Traveller care: the quality and cleanliness of facilities and information provided
- Travellers' views: the extent to which travellers can see the surrounding landscape and townscape
- Traveller stress: frustration, fear of potential accidents and route uncertainty

1.4.12. For cyclists and walkers some of these impacts may be very important, in particular, the fear of potential accidents. In the standard AST, this sub-objective is assessed qualitatively, which makes it difficult to emphasise its importance.

1.4.13. Perceived safety or the fear of potential accidents is often mentioned by cyclists and potential cyclists as a major barrier to cycling (or cycling more). In addition, some, high quality cycle and pedestrian facilities may enhance a travellers' views of the surrounding landscape and townscape. This impact is separate from the security sub-objective which is concerned with changes in levels of personal security and vulnerability to crime associated with schemes. This impact is also different from accidents, in that it covers fear of potential accidents rather than the costs of an actual accident occurring. Journey Ambience is also an entry in the modified Analysis of Monetised Costs and Benefits Table. Guidance on how to calculate the value of this impact is given in *Estimating the journey ambience impacts of new cycling and walking facilities* below.

Safety

1.4.14. The standard approach for completing the elements under the Safety objective is covered in *The Safety Objective* (TAG Unit 3.4).

1.4.15. **Accidents**: Predicting the change in the number of accidents as a result of a cycling and walking scheme can be challenging, especially when this is combined with changes in the levels of use. For the AST the change in the number of accidents should be quantified and valued, using the procedure suggested in *The Safety Objective* (TAG Unit 3.4). This suggests generating forecasts of accident reduction benefits using the methods contained in the COBA manual (DMRB Volume 13, Section 1) which incorporates established parameters for the number of accidents per million vehicle-kms on different types of road, but does not include accident rates for cycling or walking. For walking and cycling schemes therefore, estimates of the accident rates on the infrastructure in both the "core" ("without scheme") case as well as with the intervention will be needed as well as changes in the levels of walking and cycling.

1.4.16. If there is a significant reduction in motorised vehicle-kms, then the resulting reduction in accidents can be calculated using the methods contained in the COBA manual. "Accidents" is also an entry in the modified Analysis of Monetised Costs and Benefits Table (see below). There is also evidence that increases in walking and cycling may not lead to a simple linear increase in accidents, assuming constant motorised traffic levels in the case of on-road schemes. Particularly with high relative levels of cycling, further increases in use are at worst likely to lead to lower levels of extra injuries than would be anticipated by linear relationship and may well result in lower absolute levels of injuries. Guidance on how to calculate the change in the number of accidents is given in *Estimating the impact on accidents of new cycling and walking facilities* below.

1.4.17. **Security:** This sub-objective refers to the overall change in security features. These include some aspects of any cycling and walking facilities installed as well as changes in the levels of surveillance (formal and informal). Security levels of some cycling and walking infrastructure may be improved by increased levels of use.

1.4.18. **Economy:** The standard approach for completing the elements of the AST under the Economy objective is covered in *The Economy Objective* (TAG Unit 3.5).

1.4.19. **Public Accounts**: This is assessed using the Public Accounts Table. This should be filled in for cycling and walking schemes in the same way as for other schemes, though some of the entries may not be applicable (see *The Public Accounts Sub-objective* (TAG Unit 3.5.1)). Public Accounts is also an entry in the modified Analysis of Monetised Costs and Benefits Table (see below).

1.4.20. **Transport Economic Efficiency: Business Users & Transport Providers**: This is assessed using the modified Transport Economic Efficiency (TEE) Table (see below). This should be filled in for cycling and walking schemes in the same way as for other schemes, though some of the entries may not be applicable (see *The Transport Economic Efficiency Sub-Objectives (*TAG Unit 3.5.2)). Standard values of time should be used for cyclists and walkers (See *Values of Time and Vehicle Operating Costs,* (TAG Unit 3.5.6)). Note that there are unlikely to be any benefits for bus and coach and rail users and that there will only be vehicle operating cost and travel time savings if there is a reduction in motorised traffic. The concept of marginal economic cost of vehicles indicates that fewer cars on the road will reduce the externalities associated with them (ie the MEC) and provide economic benefit where alternatives are used. 'Business Users and Providers' is also an entry in the modified Analysis of Monetised Costs and Benefits Table (see below).

1.4.21. **Transport Economic Efficiency: Consumers**: This is assessed using the modified TEE Table (see below). 'Consumer Users' is also an entry in the modified Analysis of Monetised Costs and Benefits Table (see below).

1.4.22. **Reliability**: This sub-objective refers to the schemes impact on journey time reliability. The reliability of journey times is unlikely to be changed for cyclists and walkers since they are known to enjoy reasonably reliable journey times anyway. If journeys are switched from motorised modes there may be an increase in journey time reliability for those who switch. This might be particularly important for connections to public transport. For the AST the level of reliability should be quantified and valued, if there is likely to be a significant shift from motorised modes to cycling and walking, using the procedure suggested in *The Reliability Sub-Objective* (TAG Unit 3.5.7). The "stress" method can be used for the assessment of changes in reliability for road traffic. Reliability is also an entry in the modified Analysis of Monetised Costs and Benefits Table (see below).

1.4.23. **Wider Economic Impacts**: Cycling and walking schemes have the potential to have impacts on the local economy where tourism or retail is increased (usually through an increase in footfall, encouraging visitors to spend). They might also increase access to employment. For consistency with standard appraisal practice, these impacts should only be included under this sub-objective if it leads to a change in the number of residents of a regeneration area in employment. If this is the case the standard guidance should be followed (see *The Wider Economic Impacts Sub-Objective* (TAG Unit 3.5.8)) which includes the completion of an Employment Impact Report (EIR).

Accessibility

1.4.24. The standard approach for completing the elements of the AST under the Accessibility objective is covered in *The Accessibility Objective* (TAG Unit 3.6).

1.4.25. **Access to the public transport system**: Cycling and walking schemes may increase access to public transport through the provision of high quality facilities, or routes that are linked to public transport services. This is especially important for low income groups, people without cars, children, young people and older people.

1.4.26. **Option Values**: This sub-objective concerns the value that travellers may place upon a travel option that is available to them, but which they do not regularly use. The provision of safe and appealing walking and cycling infrastructure will provide a greater number of options available to people who do not walk and cycle along the route, although they remain on alternative modes. Therefore a new walking or cycling facility might be valued simply because it exists as an option. There is a risk of double counting as it is difficult to separate willingness to pay for the use from willingness to pay for the existence of an option. Ideally the option value should be evaluated, although in practice this is problematic, especially given the limited volume of research on this issue. Standard guidance recommends a qualitative assessment except in particular specific circumstances; see *The Option Values Sub-Objective*

(TAG Unit 3.6.1). 'Option Values' is also an entry in the modified Analysis of Monetised Costs and Benefits Table (see below).

1.4.27. **Severance**: Cycling and walking schemes may positively affect severance by reducing barriers to opportunities or destinations. This may include indirect routes, lack of provision, safety concerns or information. A modal shift to walking and cycling may reduce traffic volumes and thus further reduce severance

Integration

1.4.28. The standard approach for completing the elements of the AST under the Integration objective is covered in *The Integration Objective* (TAG Unit 3.7).

1.4.29. **Transport Interchange**: Where access to, and parking at, public transport is improved through cycling and walking facility implementation or improvements, interchange, and use of public transport, may increase.

1.4.30. **Land-Use Policy**: This sub-objective concerns the extent to which the scheme is integrated with land use proposals and policies and with proposals and policies concerning transport (all modes). Cycling and walking schemes may be particularly relevant for local plans (as opposed to regional or national) such as Local Plans/Local Development Frameworks and Unitary Development Plans.

1.4.31. **Other Government Policies**: Cycling and walking schemes have the potential to positively affect a number of other Government Policies. These include Health and Physical activity (eg PSA childhood obesity targets), injury reduction, access to health services and reductions in health inequalities (DH), environment, sustaining rural communities (DEFRA), access to education and skills (DfES), access to employment (DWP, DTI), reducing social exclusion (DfT), and land use, planning and sustainable communities (ODPM). Particular attention should be paid to the local application of Government policies, such as whether the scheme helps a local employer to encourage more people to walk or cycle to work.

1.5. The Modified Analysis of Monetised Costs and Benefits Table

1.5.1. For the purposes of cycling and walking schemes a modified version of the Monetised Costs and Benefits Table should be used (Table 1). The only difference between this version and the one given in *The Public Accounts Sub-objective* (TAG Unit 3.5.1) is the addition of a line for Physical Fitness in order to allow the monetised benefits of this impact to be presented alongside other impacts. For cycling and walking schemes journey ambience and physical fitness are both likely to be more important impacts than they are for other schemes. Indicative values are given which can be used as a sensitivity test of the likely worth of benefits. These are presented in Section 1.9.

Table 1 Modified Analysis of Monetised Costs and Benefits Table

Noise		
Local Air Quality		
Greenhouse Gases		
Journey Ambience		
Accidents		
Physical Fitness		
Consumer Users		
Business Users and Providers		
Reliability		
Option Values		
Present Value of Benefits (see notes) (PVB)		
Public Accounts		
Present Value of Costs (see notes) (PVC)		
OVERALL IMPACTS		
Net Present Value (NPV)		*NPV=PVB-PVC*
Benefit to Cost Ratio (BCR)		*BCR=PVB/PVC*

Note: This table includes costs and benefits which are regularly or occasionally presented in monetised form in transport appraisals, together with some where monetisation is in prospect. There may also be other significant costs and benefits, some of which cannot be presented in monetised form. Where this is the case, the analysis presented above does NOT provide a good measure of value for money and should not be used as the sole basis for decisions.

1.6. The Modified Transport Economic Efficiency Table

1.6.1. The difference between the version given as Table 2 and the one shown in *The Economy Objective* (TAG Unit 3.5) is the addition of a column to allow the benefits to cyclists and walkers to be separately identified.

1.6.2. The standard guidance for filling in the TEE table given in *The Transport Economic Efficiency Sub- Objective* (TAG Unit 3.5.2) should be followed.

1.6.3. The TEE benefits of a cycling and walking scheme for motorised users are likely to be small unless a significant mode shift leading to improved travel conditions for the remaining motorised users is anticipated. Where this is the case, a marginal external cost (MEC) based approach may be used to estimate the monetary benefits to the economy and the environment of a reduced level of motor vehicles related to the scheme. The Department for Transport's National Transport Model (NTM) has been used to calculate the marginal external costs of car traffic. A spreadsheet Marginal External Costs of Car Use (within TAG Unit 3.13.2) gives the marginal external costs for cars by area type, road type and congestion band for the base year and a specified future year. The use of these results to estimate decongestion benefits is described in *MSA: Decongestion Benefits* (TAG Unit 3.9.5) and in *Guidance on Rail Appraisal: External Costs of Car Use* (TAG Unit 3.13.2).

1.6.4. Benefits for cyclists and walkers rely on significant reductions in vehicle operating costs and/or travel time. This will be the case where a scheme provides a significant short cut for cyclists and/or walkers (such as a cycle bridge across a major obstacle).

Table 2 Economic Efficiency of the Transport System (TEE) (modified)

Consumers	**ALL MODES**		**ROAD**		**BUS & COACH**	**RAIL**		**OTHER**
User benefits	**TOTAL**		**Private Cars and LGVs**		**Passengers**	**Passengers**		**Cyclists and Walkers**
Travel time								
Vehicle operating costs								
User charges								
During Construction & Maintenance								
NET CONSUMER BENEFITS		*(1)*						
Business								
User benefits			**Goods Vehicles**	**Business Cars & LGVs**	**Passengers**	**Freight**	**Passengers**	
Travel time								
Vehicle operating costs								
User charges								
During Construction & Maintenance								
Subtotal		*(2)*						
Private sector provider impacts						**Freight**	**Passengers**	
Revenue								
Operating costs								
Investment costs								
Grant/subsidy								
Subtotal		*(3)*						
Other business impacts								
Developer contributions		*(4)*						
NET BUSINESS IMPACT		*(6) = (2) + (3) + (4)*						
TOTAL								
Present Value of Transport Economic Efficiency Benefits		*(7) = (1) + (6)*						

Notes: Benefits appear as positive numbers, while costs appear as negative numbers.
All entries are discounted present values, in 2002 prices and values

1.7. Estimating the demand for new cycling and walking facilities

Introduction

1.7.1. *Modelling* (TAG Unit 3.1) provides detailed guidance on modelling and how it might be used to estimate future demand for transport facilities. Where cycling and walking schemes form part of a larger set of transport proposals, demand models or spatially aggregate models of the types described in that Unit may be appropriate.

1.7.2. Schemes may be promoted separately from other transport investment proposals and in these circumstances different modelling approaches may be required.

1.7.3. This section summarises three possible approaches to the estimation of demand for new cycling and walking facilities. It is of crucial importance to forecast demand of walk and cycle use as accurately as possible in order to produce a successful appraisal. It is also of importance to estimate the resulting change in use of other modes in order to fully appreciate the impact of a scheme. The best way of forecasting walk and cycle use is through modelling where the scope of schemes is appropriate. The methods in this section outline how walk and cycle may be forecast outside of a formal model and should also bear in mind the potential impact on the use of other modes.

Comparative study

1.7.4. The least complex and hence least costly approach to estimating future levels of walking and cycling is by making comparisons with other schemes similar to the one being proposed. Larger scheme proposals are likely to have greater demand changes and afford better potential for comparison with other existing schemes. Examples could include river crossings or the creation of other significant links in a network that reduce time and distance, or comprehensive urban centre networks that significantly change the balance between motor traffic and walking and cycling generalised costs.

1.7.5. The difficulty with this method is the many other transport system and socio-economic differences and changes that may exist between the two study areas. Forecasting and benefits evaluation form only part of the decision making process and, depending on other policy aspirations, there may be sufficient confidence in an approach based on comparative study.

1.7.6. *Encouraging walking and cycling: Success Stories* (DfT, 2004a) provides some useful starting points and some indication of potential levels of change for a variety of schemes that have achieved positive outcomes throughout Great Britain. Other sources of data may come through monitoring after a similar scheme has been implemented in the local area. The availability of this data is limited, although monitoring is an area that is receiving greater attention and should be encouraged in order to increase the number of case studies available and hence improve forecasts in future appraisals.

Estimating from disaggregate mode choice models

1.7.7. A general introduction to the use of bespoke and other mode choice models is in *Mode Choice Models: Bespoke and Transferred* (TAG Unit 3.11.3).

1.7.8. Wardman, Tight and Page (2007) derived a model to forecast the impacts of improvements in the attractiveness of cycling for the journey to work for distances of 7.5 miles or less. The full version of this model gives an expression for the forecast market share for cycling given changes in the utility of the different modes.

1.7.9. The example below of the model only applies to changes in the generalised costs of cycling. As such it implies that the utility of all modes except cycling remain unchanged. However, it is fairly straightforward to extend the logit model to include changes in the generalised costs of other modes following the advice given in *Mode Choice Models: Bespoke and Transferred* (TAG Unit 3.11.3). Given the assumption of no changes in the costs of other modes the logit model used simplifies to:

$$P_y^f = \frac{P_y^b e^{\Delta U_y}}{P_y^b e^{\Delta U_y} + (1 - P_y^b)}$$

Where:

ΔU is the change in utility of the cycling mode

P_y^b is the proportion of those choosing to cycle out of the maximum of those where it is a viable option, without any intervention

P_y^f is the proportion of those choosing to cycle out of the maximum of those where it is a viable option, with intervention

1.7.10. This formula applies to the non-captive population, i.e. those who would consider cycle mode as an option. In reality, not all travellers own or would consider owning a bicycle and a significant proportion of people will never select cycling as a viable transport option. The model here should therefore not be applied to the whole population. Where one wishes to derive the mode share of cycling out of all travellers, one should divide by the maximum proportion of those that could cycle. The survey used to derive this model found that in this case 60% of commuters (the purpose being tested) would never consider using a bicycle. Therefore the result of the formula only applies to the 40% who might. To give a figure for total mode share, one simply multiplies this result through by 40%.

1.7.11. The changes in utility are calculated using the coefficients shown in Table 3. These are empirically-based coefficients of utility derived from the study. The population that this change applies to is the number of people who commute short journeys (7.5 miles or less) who could enjoy the benefit provided. Only those coefficients relevant to changes in cycle conditions are shown. Thus, if a cycle facility is introduced which allows cyclists to spend ten minutes of travel time on a segregated cycle track rather than on a road with no facilities, this will result in a change in utility (for cycling) equal to the difference in the utilities of the different types of facility, multiplied by the amount of time. Thus:

$$\Delta U = t(c_w - c_n)$$

Where:

ΔU is the change in utility of the cycling mode

t is the travel time

c_w is the coefficient of utility on routes with facilities (ie the do something, with-intervention case)

c_n is the coefficient of utility on routes with no facilities (ie do nothing, without-intervention case)

Table 3 Utility of changes to cycle facilities (Source: Wardman et al, 2007)

Change	Interpretation	Coefficient
Change in time on off-road cycle track	Minutes	-0.033
Change in time on segregated on-road cycle lane	Minutes	-0.036
Change in time on non-segregated on-road cycle lane	Minutes	-0.055
Change in time on no facilities	Minutes	-0.115
Outdoor parking facilities	present/not present	0.291
Indoor cycle parking	present/not present	0.499
Shower/changing facilities plus indoor cycle parking	present/not present	0.699
Payment to cycle	one way payment in pence	0.013

1.7.12. To reiterate, the coefficients represent utility or disutility derived from various facilities. The most favourable cycling conditions are assumed to be on an off road cycle track (-0.033 'utils' per minute). This is negative because cycling for a minute still produces a disutility. We would like to not have to travel at all to reach our destination, so time spent travelling yields a negative utility. This, however, is favourable when compared to a road with no facilities, which has a higher coefficient of disutility (-0.115 'utils' per minute).

1.7.13. Using the coefficients supplied in Table 3, the change in utility from ten minutes use of a road with no facilities to a segregated cycle track is therefore 0.82 (= 10 * (0.115 - 0.033)). Note that zero overall change in travel time is assumed.

1.7.14. If the base proportion of the population who cycle is 2% out of all travellers and we assume that a maximum of 40% would cycle, we derive P_y^b as 5% (0.05). The model predicts that the proportion of this population cycling after the change will be 10.7% of the total mode share. This is calculated as follows:

$$0.107 = 0.05 * \exp(0.82) / (0.05 * \exp(0.82) + (1 - 0.05))$$

To calculate the total mode share of cycling, should we need to, we can multiply by 40% to get a value of 4.3% of the whole population.

1.7.15. Note that the impact of a wide variety of different changes can be calculated but that these results should only be regarded as very approximate in general application. This is pending further research in the field and the potential derivation of coefficients for other purposes or the development of a more sophisticated model. Note also that the model only applies to short journeys, only one journey purpose (commuting) and in the case of changes in facilities, only to those who could make use of any change.

1.7.16. In theory, the use of such models could be extended to cover walking but research in this area is problematical. People do not regard walking as a mode of transport in quite the same way as driving, using a bus or even cycling so studying their reaction to changes in the walking environment is difficult.

Sketch Plan methods

1.7.17. *Modelling* (TAG Unit 3.1) provides guidance on nationally available data sets. Sources that may be useful include Census journey to work trip matrices, journey to work distances and Department for Transport TEMPRO forecasts of trip ends by mode (including cycling and walking), journey mileage, car ownership and population and workforce planning data. TEMPRO modal split figures only reflect demographic factors and increasing car ownership. Local models will take account of changes in the generalised cost of travel by each mode and other impacts of rising incomes and local policy action to influence travellers' "taste" for different modes.

1.7.18. Changes to levels of walking and cycling as evidenced or forecast from these data sources may be approximately estimated by rule-of-thumb calculations. Care needs to be taken in the assessment of the extent to which a scheme might influence trip making. Forecasts of future trips are the primary indicator of the effectiveness of a scheme. Since walking and cycling schemes are on a comparatively small scale, the cost-benefit appraisals are highly sensitive to the quality of these forecasts. It is therefore important to produce a considered and robust set of forecasts. It is also useful to note that optimism bias (at the appropriate rate) should also be included in the scheme costs and needs to be apportioned to the private sector or public sector as appropriate.

1.7.19. Popularity of walking and cycling may also vary from place to place with the acceptability of those modes in those areas, as well as their attractiveness. For example, local walk and cycle initiatives may change the overall attractiveness of these modes without consideration of individual infrastructural schemes. At any rate, background growth in walking and cycling is required so that the change in demand brought on by a scheme may be compared to the reference case scenario that will experience the background growth.

1.7.20. To emphasise this point, it is crucial that the without scheme case is representative and includes the impacts of other schemes that may affect the mode share of walk and cycle modes. For example, the introduction of pedestrian areas in a town centre, or a central congestion charging system. The methods above remain valid for forecasts over and above the reference case. It should be recognised that inaccuracies in the base growth forecasts may cause the cost-benefit ratios of the appraised schemes to be inconsistent with those in other areas.

1.7.21. An approximate elasticity estimate of the change in demand for cycling in a district based on a change in the proportion of route that has facilities for cycle traffic (cycle lanes, bus lanes and traffic free route) is +0.05. This has been derived from models of the variation in cycle use at ward level (specifically a revision of the models used in Parkin, 2004). As an example, a district might have 2,000 trips by bicycle per day with a total road length of 500 kilometres and an existing length of cycle facilities in the district of 50 kilometres. A scheme is proposed to create a new off-carriageway cycle route of 10 kilometres in length. The new cycle facilities increase the proportion of cycle facilities by 20% (from 10% to 12%). The expected increase in cycle trip numbers would be 1%, or 20 trips per day. It should be noted that this is a useful, albeit approximate method for predicting the increase in demand for cycling and the results may differ somewhat from the more multifaceted approach described when estimating from disaggregate mode choice models.

Other considerations

1.7.22. Forecasting does not usually distinguish between children and adults. In respect of particularly cycling and also the journey to school, especially given the disproportionate numbers of children killed and injured on the roads, it may be appropriate to explicitly consider the different responses that children may make to schemes.

1.7.23. Catchments for new public transport modes are based around distances from public transport nodes and sometimes the topography of the catchments is also considered. Where there is a proposal for a significant walking or cycling route, for example a traffic-free route along a previously inaccessible green corridor, it may be appropriate to consider analogous techniques.

1.7.24. The choice for walking and cycling is more likely than for other modes to be influenced by the journey purpose because this affects, for example, the amount of luggage that needs to be carried and the type of clothing that it is appropriate to wear. It may be appropriate to consider modelling techniques that explicitly account for journey end activity.

1.7.25. Estimation of the demand for cycling and walking might also need to take into account the different types of user. For example, pedestrians could be characterised as “striders”, who are using walking to get somewhere and might be sensitive to changes in travel time or “strollers”, who might be less concerned about travelling efficiently but more sensitive to environmental factors (Heuman, 2005). DfT (2004b) suggests a number of different types of “design pedestrian types” and “design cyclist types”. These include commuters, utility cyclists and shopper/leisure walkers all of which might be expected to react differently to different interventions in the form of facilities.

Summary

1.7.26. Large scale modelling of cycling and walking may not be appropriate for the evaluation of benefits with sufficient accuracy for the purposes of scheme appraisal and decision making. Where it is appropriate, forecasting for cycling and walking may form part of an overall multi-modal model and *Modelling* (TAG Unit 3.1) is relevant. Where cycling and walking is an integral part of a strategy, for example the imposition of 20mph or lower speed restrictions in urban areas, coupled with a range of engineering changes to create a low-speed environment that is more appealing to pedestrians and cyclists, then the design of any models to be used should include appropriate representation of the alternatives to cycling and walking.

1.7.27. Irrespective of using more sophisticated modelling or comparative study techniques, it is important to produce forecasts that stand up to scrutiny to provide a valuable appraisal. Reliable forecasts of background growth levels are also important, factoring in local initiatives and schemes that may influence walk and cycle usage at the local level. Avoiding optimism bias is also crucial in providing fair and comparable appraisals.

1.8. Estimating the impact on accidents of new cycling and walking facilities

Introduction

1.8.1. The Safety objective requires the evaluation of the change in the number of accidents as a result of the scheme. This is calculated from changes in the levels of use of different types of infrastructure by different modes and the associated accident rates of these types of usage. An important consideration in the appraisal will be the type of scheme under consideration and how different schemes influence the safety of road users, as well as the existing safety conditions on the types of road or area to which a scheme is to be potentially applied.

1.8.2. For walking and cycling schemes, the information required is therefore:

- changes in amounts of walking, disaggregated by different types of facility
- changes in amounts of cycling, disaggregated by different types of facility
- changes in the amount of use of other vehicle types (if this is likely to occur)
- walk accident rates associated with different types of facility

- cycle accident rates associated with different types of facility
- accident rates for other vehicle types

1.8.3. Only the last of these is generally available in the COBA manual (DMRB Volume 13, Section 1). Guidance on how to calculate the changes in the amounts of walking and cycling (and therefore whether there are likely to be changes in the amount of use of other vehicle types) is given in *Estimating the demand for new cycling and walking facilities* above. This section therefore concentrates on the prediction of accident rates for different types of walking and cycling facility.

Possible methods

1.8.4. This is an area which is not well researched and provides significant challenges, given the variety of different facilities which could form part of a scheme and the amount of time needed to establish changes in the number of accidents which result from a scheme.

1.8.5. Possible methods for estimating accident rates could include comparative studies of the performance of existing similar schemes combined with expert judgement. In all cases, the detail of the design might be crucial, as there are clear differences in scale and sensitivity compared to schemes for motorised users. Clearly, the monitoring and evaluation of cycling and walking schemes is important in order to provide more robust input to the analysis of further schemes.

1.8.6. The introduction of an intervention may also demonstrate a large enough mode shift in the modelling to produce significant reductions in accidents associated with other modes. This will have the effect of increasing the value of a scheme where fewer traffic accidents occur. Where this is the case, such considerations must be included in the appraisal. Monitoring techniques such as stated preference surveys are useful in determining potential mode shift where walk and cycle users state that an alternative mode of transport was available to them.

Further considerations

1.8.7. There is good evidence to suggest that increasing levels of cycling does not result in an equivalent increase in the numbers of accidents involving cyclists (all other things being equal). Jacobsen (2003) used American and European data to create a power function model of the type:

$$I = aE^{b}$$

Where:
I = injury measure
E = measure of walking and cycling
a = a constant
b = a constant and was found to be approximately 0.4

1.8.8. This implies that a doubling of cycling would only lead to a 32% increase in the number of cycling accidents ($2^{0.4} = 1.32$) and that therefore the cyclist accident rate decreases. It seems intuitive that this model is applicable for cases above a certain critical mass of walkers and cyclists. For very small values, one should be careful in the application of this model as a close-to-linear increase in accidents per additional unit may well be more appropriate. The evidence base for this requires expanding through further research and monitoring.

1.8.9. Ideally one should incorporate the background changes to walk and cycle accident rates, which may indeed be decreasing over time. This may be due to increased bicycle safety, awareness and public information campaigns

1.8.10. Where facilities are being introduced which are expected to have a significant impact on the accident rate for cyclists and pedestrians, such mitigation is likely to have a more significant local impact than any increase in these modes.

Monetisation

1.8.11. Once the accident forecasts have been completed, one can then assign economic values to those accidents in order to derive the benefits or costs brought about by the intervention. Highway Economics Note 1 contains monetary values for accidents of different severity: fatal, serious and slight (DfT, 2004d).

1.8.12. Note that the cost of a fatality here includes incident costs and hence is slightly higher than the value of a life used in assessing the physical fitness benefits. It should also be noted that these accident costs should be uplifted over time in line with increases in real GDP per capita, somewhat offsetting the discounting process.

Summary

1.8.13. Comparative methods can be used to estimate the levels of accidents that might be expected following a scheme. There is good evidence that a general increase in cycling can lead to a decrease in the accident rate for cyclists all other things being equal. One this is achieved, monetary values may be applied.

1.9. Estimating the journey ambience impacts of new cycling and walking facilities

Introduction

1.9.1. Journey ambience is an important consideration in scheme appraisal for cyclists and walkers. It includes fear of potential accidents and therefore the majority of concerns about “safety” (eg segregated cycle tracks greatly improve journey ambience over cycling on a road with traffic). Journey ambience also includes infrastructure and environmental quality on a route. As an impact which is apparent to users, the journey ambience benefits should be subject to the “rule of a half” – that is the benefits for new cyclists/walkers should be divided by two. Current users of the route will experience the full benefit of any improvements to ambience.

Estimating the journey ambience impacts for cyclists

1.9.2. Assessing the impact on journey ambience of particular improvement schemes is a challenging issue, backed up with a relative handful of academic research. The application of monetary values to schemes is by nature approximate, especially when comparing different schemes or individual interventions with each other. The analyst should use judgment, or potentially a ‘sliding scale’ approach at evaluating the monetary impact on journey ambience depending on the perceived quality of an intervention, using published research figures as a guide to the potential maxima for an improvement. The analyst must ensure that when the benefits of schemes are compared against one another, consistent assumptions are made concerning journey ambience monetary benefits.

1.9.3. These various research studies are summarised to give the values in Table 4 below, for the relevant range of facilities covered in the studies. This gives an approximate monetary benefit of the introduction of cycling schemes and includes not only infrastructural changes, but facilities as well. These monetary values include all aspects of ambience, including environmental quality, comfort and convenience and perceived improvements to safety. The limitations of these values should be recognised, in that they apply to a specific study and hence a specific situation. The evidence will be expanded through further research.

Table 4 Summary of value of journey ambience benefit of different types of cycle facility relative to no facilities

Scheme type	**Value**	**Source**
Cycling schemes		
Off-road segregated cycle track	4.73p/min	Hopkinson & Wardman (1996)
On-road segregated cycle lane	2.01p/min	Hopkinson & Wardman (1996)
On-road non-segregated cycle lane	2p/min	Wardman et al (1997)
Wider lane	1.22p/min	Hopkinson & Wardman (1996)
Shared bus lane	0.52p/min	Hopkinson & Wardman (1996)
Secure cycle parking facilities	66p	Wardman et al (2005)
Changing and shower facilities	14p	Wardman et al (2005)

1.9.4. There is evidence to suggest that non cyclists value cycle facilities more highly than existing cyclists. It is suggested that the total journey ambience benefits for cyclists can be calculated by:

1. Estimating the total time that existing cyclists will make use of the new facilities

2. Multiplying this by a value for the benefits of the facility for existing cyclists (2002 £ per hour) from Table 4 which gives the total benefits for existing cyclists

3. Estimating the total time that new cyclists will make use of the new facilities

4. Multiplying this by a value for the benefits of the facility for new cyclists (2002 £ per hour) and halving to give the total benefits for new cyclists

5. Summing the two results

1.9.5. It is important that the above process should yield realistic results and where necessary reasonable assumptions may need to be introduced. For example, if a greenway of ten kilometres is constructed, it will be unreasonable to assume for that case that all cyclists will traverse the entire length of the scheme in light of the fact that there will be numerous exit points and different origins and destinations. The level of use in terms of the length of the infrastructure will vary from scheme to scheme. Ideally the modeller should assess the types of trip being made from major origin and destination points, as well as collecting some real world evidence to support these assumptions. A suitable alternative may be to use local or national figures of average journey length for walking and cycling trips, capping scheme use to this maximum value to avoid overestimation of ambience and other benefits. Indeed, this in itself assumes that building cycling or pedestrian infrastructure will not induce longer or shorter trips in the locality.

Estimating the journey ambience impacts for pedestrians

1.9.6. In general, very little work has been done to quantify and monetise the journey ambience benefits of walking schemes. Heuman (2005) supplies some values which were used in the evaluation of the Strategic Walk Network in London. These are given in Table 5.

Table 5 Values of different aspects of the pedestrian environment used in the evaluation of the London Strategic Walk Network

Scheme type	Value	Source
Walking schemes		
Street lighting	3.4p/km	Heuman (2005)
Crowding	1.7p/km	Heuman (2005)
Kerb level	2.4p/km	Heuman (2005)
Information panels	0.8p/km	Heuman (2005)
Pavement evenness	0.8p/km	Heuman (2005)
Directional signage	0.5p/km	Heuman (2005)
Benches	0.5p/km	Heuman (2005)

1.9.7. Studying the value of different aspects of the pedestrian environment is inherently difficult as walkers often do not regard their journey in a similar way to the users of other modes of transport. Figures such as those presented above should be treated with caution. Where comparisons are made with other schemes, consistent assumptions need to be made.

1.10. Estimating the health benefits of new cycling and walking facilities

1.10.1. This is the value of improvements in health as a result of increased physical activity due to a walking or cycling scheme. Specifically, this is the economic benefit arising through reduced rates of mortality through increased activity. There is an increasing amount of evidence (for example see Andersen et al., 2000) which suggests that this could be a potentially significant impact of an intervention which causes more people to become more physically active. Indeed, when this evidence is applied in an appraisal context, it has been observed that reduced mortality benefits do form a significant proportion of the benefits of a walking or cycling scheme and hence warrants thorough consideration.

1.10.2. The method for calculating this benefit is taken from the World Health Organisation project *Quantifying the health effects of cycling and walking* (2007) and it accompanying model, the Health Economic Assessment Tool for cycling (HEAT). It is likely to underestimate the health benefits of increased physical activity as it only evaluates the benefit as a result of decreased mortality and ignores benefits due to reduced morbidity or sickness. The latter is however covered in part by the benefits of reduced absenteeism (see below).

1.10.3. Further research will be undertaken on the relationship between fitness and health so the values derived from the method below should be taken to be indicative. It is worth bearing in mind that the potential morbidity benefits are likely to be relatively significant as well and may even compare at approximately the same level against the reduced mortality benefits. This uncertainty will also be addressed through ongoing research in the health profession.

1.10.4. The method involves calculating the number of preventable deaths per person taking up moderate physical exercise through walking or cycling. The modeller should make use of the Department for Transport's standard values for the statistical value of a life, giving a value to the benefits of changes in mortality as a result. As with the evaluation of accident benefits over the appraisal period, the value of a life will increase in line with real GDP growth per capita (i.e. where people are becoming more economically productive), largely offsetting the discounting effect that applies to other costs and benefits. See Highways Economic Note 1 for these values (DfT, 2004d).

1.10.5. The Copenhagen Centre for Prospective Population Studies found that individuals that cycle for three hours per week reduce their relative risk of all-cause mortality to 72% compared to those who do not commute by cycle (Andersen et al, 2000). For weekday trips, this accounts for 36 minutes per day. The modeller should assess the impact of a proposed scheme on journey distances and also on cycling speeds if it is considered that this will be affected significantly. From this, an average journey time may be estimated for new users. For more detailed information on the practical inference of changes to trip length at the local level resultant from a scheme, refer to Section 11.3.8 of the Design Manual for Roads and Bridges (DMRB).

1.10.6. From the average journey time, a relative risk of all-cause mortality specific to the average individual using the scheme may be calculated. This may be done by a linear interpolation between 0.72 and 1 if the average travel time per day is less than 36 minutes, taking into consideration the proportion of users that make return trips along the route. Linear extrapolation can be used where average walking and cycling times are expected to be greater than 36 minutes per day. Where it is assumed that speed is not a specific consideration (being relatively constant from one area to the next), we may simply use the distance as in the example below. For the period of the appraisal, the health benefits must be calculated each year and then discounted in the usual way.

Example:	
Calculate mean distance travelled per annum	
Mean distance travelled on route	4km
Mean speed on route	14kph
Proportion of users who make return trip	90%
Average days travelled on route per year	117
Mean distance travelled per year per cyclist = 4*(1+90%)*117	**823km**
Calculate relative risk for scheme study area	
Mean distance travelled per year per cyclist in Copenhagen study	1,620km
Relative risk (Copenhagen)	0.72
1 – Relative Risk (Copenhagen)	0.28
1 – Relative Risk (Scheme study area) = 823/1620*0.28	**0.14**
Calculate reduced mortality benefit	
Mean proportion of England and Wales population aged 15-64 who die each year from all causes (Source: ONS, 2007)	0.00235
Extra cyclists encouraged by scheme relative to “without intervention” case	100
Expected deaths in this population = 0.00205*100	0.235
Lives saved (in year x) = 0.205*0.14	0.033
Cost of life (Source: DfT, 2002 cost at 2002 prices) £1.215M	
Reduced mortality benefits (in year 2002) = 0.029*1.3M	**£38,000**

1.10.7. Note that if more accurate figures for mortality from physical inactivity are available from the locality concerned, these should be used but as local values may be highly variable there is a risk of bias. Any large deviations from the average should be noted and comparisons made with the average value.

1.10.8. There are several assumptions made in the currently recommended methodology that could be refined with further research, or further resources that are likely to not be appropriate for the scope of the appraisal. The following issues may be pertinent:

- There is no detailed evaluation that is specifically applicable to walking (although WHO plan to develop a walking-specific method also). It is intuitive that the relative risk reduction in all-cause mortality of walking is different to that of cycling for the same amount of time travelled. Walking generally should provide greater benefits to the average individual over the same distance travelled. However, the average cyclist travels further.

- No account is made for the economic disbenefits of obesity, especially in children. In a similar vein, no account is made for the costs of morbidity.

- A general assumption must be made concerning the impact of a shift to walk or cycle that in reality is an issue for the individual. For instance, an active individual already partaking in physical activities may derive little or no additional benefit from walking or cycling to reduce the chance of death by inactivity, or have a reduced relative risk through being partially active. There are some allowances made for this in the HEAT methodology, although without evidence at likely disproportionate cost, this is rather speculative and subject to a large degree of uncertainty.

- Similarly, it is accepted that there is a period where the health benefits will accrue over time until an individual is deemed “fully active” and to derive the full health benefits of their trip-making activities by active modes. Further research is required to better define this accrual period. Therefore, making the benefits instantaneous to new users will be an over-estimate, which the practitioner may address through estimating the accrual period (for example, five years as used in the case studies) and applying this in the appraisal calculations.

- Estimates should also be made of the proportion of new walkers or cyclists that use a scheme that have simply switched routes or are genuinely new users of active modes. Again, it is anticipated that there will be an accrual period here, but which will be a relatively short-term shift (five year accrual is used in the case studies). Once the scheme is established it could be assumed that the majority of new users do shift modes and hence may accrue health benefits. Where a significant short-term shift is expected to take place it should also be considered how this may affect the distance and speed of the new trips. For example, where a new cycle track overcomes the severance effect of a major highway, users of active modes may actually be travelling shorter distances due to the accessibility provided by the route and hence reducing the health benefits of current walkers and cyclists.

- The evaluation of benefits is only as good as the forecasts of usage that go in. The appraisal should consider inclusion of confidence bands or sensitivity tests around the assumed benefits.

1.10.9. It is assumed that the walking and cycling appraised is the derived demand from transport need rather than being undertaken specifically to gain the health benefits of physical exercise. The benefits outlined in this section should therefore not be subject to the ‘rule of a half’, which is consistent with the treatment of accident costs (See *The Safety Objective* (TAG Unit 3.4)).

1.11. Estimating the absenteeism benefits of new cycling and walking facilities

1.11.1. Reductions in short term absence from work can result from the improved levels of health of those who take up physical activity as a result of a walking or cycling intervention. These benefits can be monetised and entered into the appraisal as a value in the AST Table under the physical fitness heading though it should be noted that these are business benefits rather than consumer benefits. The method suggested here is that used in TfL (2004).

1.11.2. In the USA, physical activity programmes involving 30 minutes of exercise a day have been shown to reduce short-term sick leave by between 6% and 32% (WHO, 2003). In the UK the average absence of employees is 6.8 days, of which 95% is accounted for by short-term sick leave (CBI, 2003). Therefore, for each employee who takes up physical exercise for 30 minutes a day for 5 days a week as a result of a walking or cycling intervention, the annual benefit to employers is likely to be (on average) at least 0.4 days gross salary costs (6% of 95% of 6.8 days).

1.11.3. In order to calculate the benefits, this figure needs to be combined with the average gross salary costs and the number of affected working people. Average gross salary cost figures may be found in *Values of Time and Operating Costs* (Unit 3.5.6) with average hours worked. Market price values should be used, for consistency with other elements of the appraisal. This value should also increase over time to reflect increased wages and productivity in line with real GDP per capita.

1.11.4. The number of working people affected may be calculated from the number of new walking and cycling commuters who are expected to use the facility. These benefits should not be subject to the ‘rule of a half’ which is consistent with the treatment of other benefits from improved levels of health and accident costs.

1.12. Estimating the environmental benefits of new cycling and walking facilities

1.12.1. The benefits from a walk and cycling scheme for the environment objective are achieved through a reduction in motorised traffic and hence a reduction in the associated externalities. The assessment of disbenefits such as noise, air pollution and greenhouse gases are explained in *The Environment Objective* (TAG Unit 3.3). Other environmental factors such as the impact on landscape and biodiversity should also be considered.

1.12.2. The appraisal of walk and cycle schemes in terms of the impact on carbon emissions should be considered where sufficient mode shift away from car takes place. The appraisal process of carbon is explained in *The Greenhouse Gas Sub-Objective* (TAG Unit 3.3.5). Where the marginal external costs approach (see *MSA: Decongestion Benefits* (TAG Unit 3.9.5)) has been used to estimate decongestion benefits, this will provide global emissions benefits consistent with the decongestion benefits.

1.12.3. A walk and cycle scheme will have saved motor vehicle kilometres where there is a shift from private vehicles to either mode. This estimate is ascertained from the modelling process described previously. From this an appraisal of carbon can be included in the overall cost-benefit analysis. The following general information is required:

- Speeds on the route or on local roads where traffic is affected (to calculate fuel consumption)
- Forecasts of vehicle fuel efficiency over the appraisal period

- Type of vehicle affected (where possible, for use in fuel efficiency calculations)
- The marginal economic cost of carbon (MECC)

1.12.4. TAG Unit 3.3.5 gives a MECC value, in 2002 prices, of around £75 per tonne as a central estimate. This may vary considerably depending on precise micro-scale conditions. This approximates to an equivalent of around 3p per kilometre. As private vehicle kilometres saved may be determined over the appraisal period, an approximate monetary benefit due to reduced carbon emissions may also be determined. Where some schemes will have more accurate information on vehicle kilometre savings through use of a formal transport model, other schemes will rely on more approximate methods in deriving these values. Where this is the case it is recommended to use the Marginal External Costs worksheet, which provides costs per kilometre for various types of road. See *MSA: Decongestion Benefits* (TAG Unit 3.9.5) for further details.

1.13. Monitoring and Evaluation

1.13.1. Monitoring and evaluation of schemes that affect walking and cycling is an important element of the implementation of a scheme. They should be planned into the scheme to ensure that they take place in a timely manner and are carried out effectively. The planning of monitoring and evaluation will also help in clarifying the aims and objectives of any scheme.

1.13.2. The subsequent data made available will add to the slim evidence base that exists. This will be of great use when forecasting for subsequent schemes, especially if similar schemes are planned in the future and in light of the importance of sustainable transport options to health and the environment. In practice there are not enough well developed data for comparison where producing forecasts, especially in the area of user response data. Since post-scheme monitoring should be an important part of the implementation of a successful scheme, an estimate of the costs to do so should be included in the scheme costs.

1.13.3. At present detailed guidance on how to choose the appropriate methods of cycle volume collection (e.g. manual counts vs. counters), how to select sample sizes and locations, analysis and reporting is not available. Also information on the appropriate levels of resources and costs is not available. As an interim measure before such guidance becomes available, the following advice should be used as the basis for designing data collection programmes.

1.13.4. Monitoring of schemes is essential both before and after implementation. A set of ‘before scheme’ data is required in order to establish a without-intervention case against which to compare forecasts. This will hence form the appraisal. The purpose of collecting post-scheme evaluation data is to ensure that the impact of any scheme is identified in order to:

- Check whether the predictions made about a scheme were correct
- Determine whether a scheme was a success or not
- To analyse why it was effective (or otherwise)
- To identify what can be learned from the scheme
- To inform the analysis and appraisal of future schemes.

1.13.5. Evaluation can also be used as a method of publicising a scheme and making the lessons learned available to the wider transport planning community. Useful guidance on the evaluation of Road Safety Education Interventions is contained in

Guidelines for Evaluating Road Safety Education Interventions (DfT, 2004c) and much of this may be applicable to the evaluation of a walking or cycling scheme.

1.13.6. The advent of Smarter Choices Initiatives and the emerging Eco-towns also make monitoring and evaluation of vital importance. The data collected will assist in quantifying the demand shifts through the introduction of softer measures and the propensity for people to change modes having received better information to make more informed choices. There is an evident overlap with the needs of transport models to forecast these changes in demand effectively, requiring relatively large volumes of good quality data.

1.13.7. Table 6 details the potential monitoring requirements of cycling and walking schemes.

Table 6 Minimum Monitoring Requirements of Cycling and Walking Schemes

	Data to be collected
Prior to scheme implementation	• Number of cyclists/pedestrians per day • Utility/leisure split • Journey time • Origins and destinations
Scheme Details	• Length of scheme • Environmental improvements (landscaping, vegetation etc) • Safety/security improvements (lighting, CCTV etc) • Links with other schemes (part of a network, parking, resting places, crossings etc) • Information (signage)
Following scheme implementation	• Number of cyclists/pedestrians per day • Utility/leisure split • Mode shift (previous journey mode) • Previous journey route (if transferred) • Journey time • Origins and destinations

1.13.8. Methods of monitoring cycling include the following:

- National Travel Survey, National Traffic Census, National Population Census (National level)
- Automatic Traffic Counters (ATCs) (including pneumatic tube counters, piezoelectric counters and inductive loops)
- Manual Classified Counts (MCC)
- Cordon and Screenline Counts
- Destination Surveys
- Interview Surveys

1.13.9. Monitoring techniques that should be used for walking include:

- Origin/destination surveys
- Household surveys and travel diaries
- Manual counts

- Automatic count methods (including video imaging, infrared sensors, piezoelectric pressure mats).

1.13.10. Further information on each of these monitoring techniques, how to select survey sites an when to undertake surveys is provided in the *Traffic Advisory Leaflets Monitoring Local Cycle Use* (DETR, 1999) and *Monitoring Walking* (DETR, 2000).

1.14. Summary of walking and cycling scheme appraisal process

1.14.1. Figure 1 below shows the basic processes used to collect together the various cost and benefit elements for the appraisal of a walking and cycling scheme. This method was used to generate the case studies in the Appendix attached to this guidance.

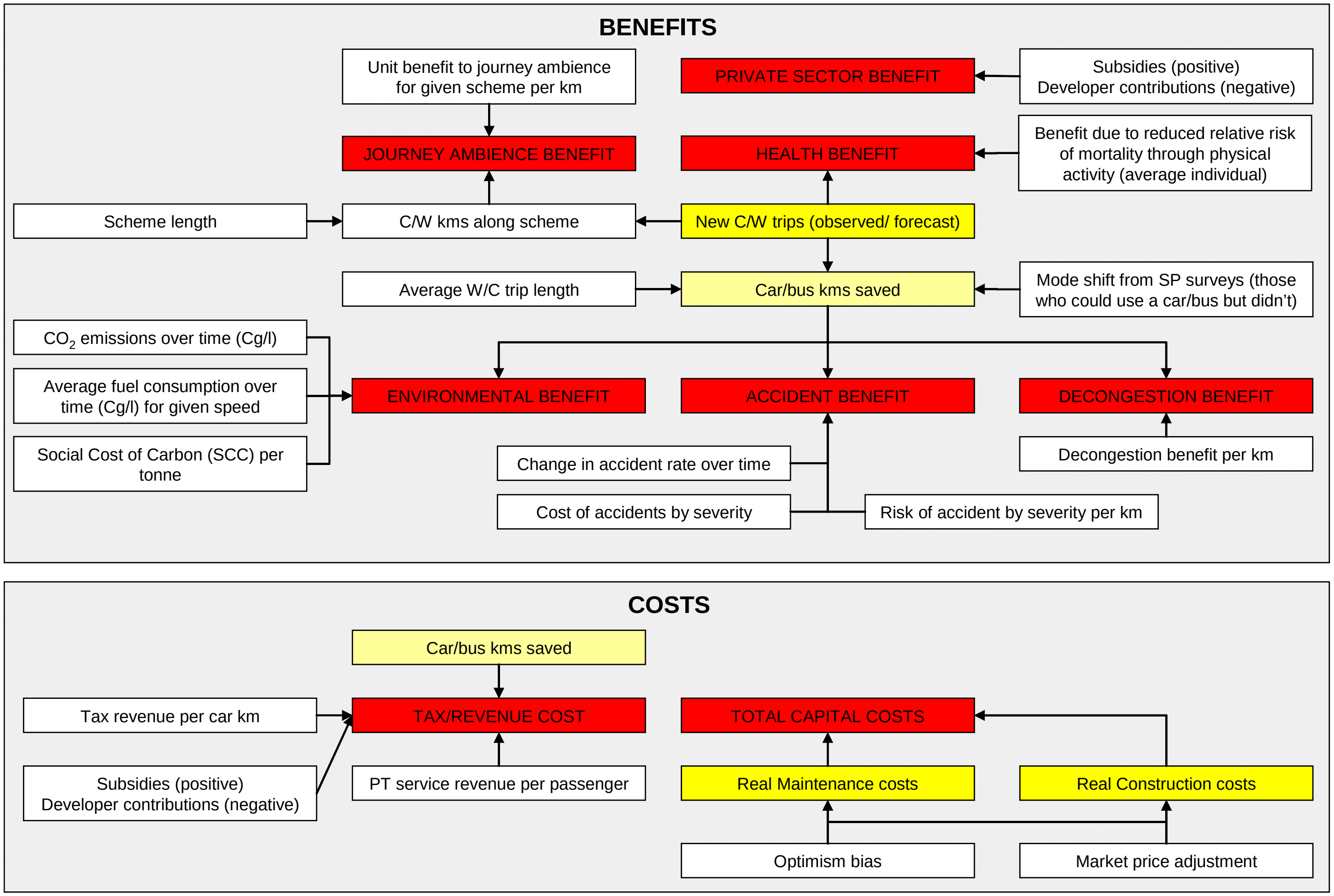

Figure 1 The basic process to derive a walk and cycle scheme cost benefit appraisal

2. Further Information

The following documents provide information that follows on directly from the key topics covered in this TAG Unit.

For information on:	See:	Link:
Appraisal background	*The Appraisal Process*	TAG Unit 2.5
Modelling	*Modelling*	TAG Unit 3.1
Appraisal	*Appraisal*	TAG Unit 3.2
Environment	*The Environment Objective*	TAG Unit 3.3
Safety	*The Safety Objective*	TAG Unit 3.4
Economy	*The Economy Objective*	TAG Unit 3.5
Accessibility	*The Accessibility Objective*	TAG Unit 3.6
Interchange	*The Interchange Objective*	TAG Unit 3.7

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4. Document Provenance

This TAG Unit became definitive guidance in April 2009.

January 2010: Table 5, and corresponding tables in Case Studies, corrected.

Technical queries and comments on this TAG Unit should be referred to:

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5. Appendix: Case Studies

5.1. The interventions

5.1.1. The guidance is applied to three case studies for illustrative purposes. The case studies represent a mixture of schemes:

- a short stretch of traffic-free route

- a longer stretch of traffic-free route with a particular commuter focus in Central London

- promotion of safety by introducing a toucan crossing on a busy route

5.1.2. The case studies should be read as proposed projects, although they are actually completed schemes. Usage forecasts are based on data collected pre-project and early in the post-implementation stages of the schemes. The forecasting methods recommended in the guidance are therefore not used. Assumptions of subsequent growth are made based on observations from similar schemes (although real world evidence of post-scheme walk and cycle growth is relatively sparse).

5.1.3. Each of the case studies appraises a set of scheme options against the without-intervention case. Most scheme interventions that are important to the appraisal will be directly measurable, such as length of the scheme, segregated cycle track versus on-road use, route usage before implementation and so on. Other factors that are more wrapped up with the journey ambience benefits may rely more on judgment as to improvements over existing quality (e.g. upgrading existing infrastructure, nominal cost of softer measures). It needs to be ensured when undertaking an appraisal that forecasts need a sound basis for development and need consistent and reasoned assumptions to allow comparison with alternatives.

5.1.4. In each case the approach to the case studies involves the testing of a single scheme scenario against a ‘core' case. Usual practice would be to conduct appraisals on a range of possible options and to compare the outcomes. However, these examples are provided for illustrative purposes of the process of generation, rather than for the decision-making process, hence the ‘single-scenario’ approach.

Case Study 1

5.1.5. The first appraisal case study considers a 1-kilometre length of ‘Greenway’ traffic-free route. The project consists of a series of upgrades to an existing route of modest quality, and carrying low levels of usage. It is assumed that an upgrade represents an improvement in journey ambience benefit of half of the full benefit from a no-facilities case. The capital cost of the project is £26,756. Usage data projections are based on pre-implementation surveys conducted in 2001 and post-project in 2004 - in both cases at a single point on the route. They show a considerable increase in usage following upgrade to the route surface quality and connectivity, albeit starting from a low base and moving to a state of modest usage.

Scheme monetary impact	**£ 2002**
Capital costs	£26,756
Maintenance costs per annum	£2,400
Journey ambience for cyclists: Off-road segregated cycle track (half of full benefit)	14p per unit
Journey ambience for walkers: Street lighting, reduced crowding, level kerbing, even paving, directional signage, benches (half of full benefit)	4.7p per unit
Scheme length	1km

Case Study 2

5.1.6. The second appraisal case study considers a canal towpath in London, which provides access to a major industrial business park area. The project consists of a series of upgrades to an existing route of modest quality and carrying relatively high levels of usage. Improving levels of commuter use is a particular point of reference. The route now consists of 6km of high quality route. The cost of the project was £139,130. User counts and surveys were conducted pre-project in 2002, and post-project in 2004, at four points on the route. They show a considerable increase in usage following upgrade to the route surface quality and connectivity.

Scheme monetary impact	**£ 2002**
Capital costs	£139,130
Maintenance costs per annum	£14,400
Journey ambience for cyclists: Off-road segregated cycle track (half of full benefit)	53p per unit
Journey ambience for walkers: Kerb level, information panels, pavement evenness, directional signage, benches (half of full benefit)	2.9p per unit
Scheme length	6km

Case Study 3

5.1.7. The third appraisal case study considers an example of usage at a new toucan crossing. The cost of the project is estimated at £60,870. Surveys and manual user counts were conducted pre-project in 2000 and post-project in 2003 at a point a short distance from the crossing on the traffic-free route served by the new crossing. They show a considerable increase in usage following scheme completion. A 20p journey ambience unit benefit is an estimate only.

Scheme monetary impact	**£ 2002**
Capital costs	£60,870
Maintenance costs per annum	£2,000
Journey ambience for cyclists: Toucan crossing only	20p per unit
Journey ambience for walkers: Toucan crossing only	20p per unit
Scheme length	0km

5.2. Estimating demand for and impacts of cycling and walking schemes

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

Table 7 Indicators used in the economic appraisal of walking and cycling schemes

Indicator	**Used to appraise**
Cycling and walking users	Journey ambience
New individuals cycling or walking	Health (physical fitness) Journey ambience (rule of half)
Car kilometres saved	Accidents CO_2 emissions Fuel tax revenue Travel time (decongestion)
Commuter trips generated	Health (absenteeism)

5.2.2. In each case two scenarios are described. Firstly, a ‘core' scenario is generated, followed by a ‘with intervention’ scenario for which forecasts of demand and impact are used. Each of the case studies examined were able to be done is in isolation.

5.2.3. **The core scenario should include all schemes that potentially will impact on demand that will affect the individual scheme being appraised**. This is especially relevant in the case of evaluation where observed counts may be affected by other global considerations. The possibility of a potential impact of one scheme on another should be assessed where those two schemes are being compared, since they may not be isolated.

5.2.4. To generate the number of cycling and walking users generated by an intervention, the number of users expected under the core scenario is subtracted from the forecast number of users under the ‘with intervention’ scenario. Normally the forecasting techniques recommended elsewhere in this guidance would be used, but since real pre and post data scheme data exists for these schemes, forecasting based on actual data is preferred. These usage levels and growth rates may be transferable to other schemes with care.

5.2.5. The number of new individuals cycling or walking is calculated by subtracting the number of users expected in the previous year from the number of users expected during the current year. These case studies use an assumption that 90% of users of each route also make return trips along the same route, hence avoiding double counting in the estimation of individuals. New users to active modes (previous users of mechanised modes) are considered to accrue over five years, since it is assumed that the scheme may also attract existing walkers and cyclists from other, less attractive routes.

5.2.6. To generate a number of commuter trips attributable to an intervention, the proportion of route users reporting that they are making commuting trips is taken as the proportion of all trips that can be assigned to this category. A suitable expression of the relative level of commuter use will be required.

5.2.7. The number of car kilometres saved through an intervention is calculated by multiplying the projected number of cycling and walking users in the core and ‘with intervention’ scenarios by the average trip lengths, 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 kilometres 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. The relative importance on travel time and tax revenue will be proportional to the potential impact on mode shift. Therefore, this is only significant in case study 2, where there is a particular emphasis on commuter use and consequently the impact on mode shift that is anticipated.

5.3. Project costs

5.3.1. The scheme investment costs (design and construction) and operating costs (maintenance) are required for the appraisal. The estimated cost of a scheme have be adjusted by +15% to account for optimism bias (in practice, this varies with the level of development of the scheme - see *The Estimation and Treatment of Scheme Costs,* TAG Unit 3.5.9), and a further 20.9% should be added to adjust total capital costs and operating costs to market prices

Table 8 Capital costs of the case studies after inclusion of optimism bias and adjustment to market prices

	Case study 1	**Case study 2**	**Case study 3**
Scheme capital cost	£26,756	£139,130	£60,870
+15% optimism bias	£30,769	£160,000	£70,001
+20.9% market price adjustor	£37,200	£193,439	£84,631

5.4. Projected usage of routes associated with intervention

5.4.1. The usage figures for the 'with intervention' element of the case studies are based on data collected on site 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 around the initial period, decaying in a logarithmic fashion. Growth rates to the end of the appraisal period in 2061 are assumed to be zero. Where local schemes that aim to affect mode split are thought to indicate different rates of walk and cycle growth over this period they should be used in preference. The rates used are shown in Table 9.

5.4.2. The growth rates used in the case studies are based on similar rates of growth on other schemes and are relatively ad hoc. The actual method employed is logarithmic growth, halving the rate of growth for each two year period from four years after the introduction of the scheme, converging towards background growth levels of 1% to 2021. From here there is assumed a gradual convergence to zero growth.

5.4.3. The important issue is that the forecasting methods are relatively consistent so that they may be compared against one another. Significant uncertainty surrounds the longer term impacts of walk and cycle schemes on usage levels. This will improve with the advent of further research in this field and collection of evidence through continued monitoring.

Table 9 Growth in walk and cycle trips during the appraisal period						
Forecast years	**Case study 1**		**Case study 2**		**Case study 3**	
	Cycle	**Walk**	**Cycle**	**Walk**	**Cycle**	**Walk**
2002-2006	0.289	0.368	0.127	0.064	0.094	0.098
	Source: average user counts 2001-04		Source: average user counts 2002-04		Source: average user counts 2000-03	
2007-2008	0.150	0.189	0.119	0.031	0.052	0.054
2009-2010	0.080	0.099	0.064	0.020	0.031	0.032
2011-2012	0.045	0.055	0.037	0.015	0.020	0.021
2013-2014	0.027	0.032	0.024	0.013	0.015	0.015
2015-2016	0.019	0.021	0.017	0.011	0.013	0.013
2017-2018	0.014	0.016	0.013	0.011	0.011	0.011
2019-2020	0.012	0.013	0.012	0.010	0.011	0.011
2021-2061	Converges to zero growth		Converges to zero growth		Converges to zero growth	
Appraisal period	60 years		60 years		60 years	

5.4.4. The table below shows the usage in terms of numbers of cyclists and pedestrians associated with each scheme, based on the count data collected during the pre and post implementation phases. The user numbers at the start of the project are shown, plus the figures at the 10-year point. Also shown are the difference at the 10-year point in usage between the base case and with intervention scenario, the number of new users generated, the difference in the number of car kilometres saved, and the difference in the number of commuter trips. The 10-year data is used as a 'snapshot' example of the numbers generated over the 60-year appraisal period.

Table 10 Absolute growth after the first year and first ten years of the appraisal period for cyclists and pedestrians (based on observed counts and forecasts)						
	Case study 1		**Case study 2**		**Case study 3**	
	Cyclists	Peds	Cyclists	Peds	Cyclists	Peds
Year 1 figures (usage per day)						
Base	7	25	1,085	517	110	118
With intervention	7	25	1,085	517	110	118
Year 10 figures (usage per day)						
Base	8	27	1,187	565	120	129
With intervention	33	166	3,734	732	200	219
Usage difference	25	139	2,548	167	80	90
Difference in car kms saved	11	18	2,713	52	86	69
Difference in commuter trips	0	2	88	7	1	1

5.4.5. Figure 2 below shows a chart of the projected number of walkers and cyclists to use the scheme daily with and without the intervention. This is shown across the sixty year appraisal period. The assumption in these case studies is that demand flat-lines from 2021, converging to a zero growth assumption in both scenarios.

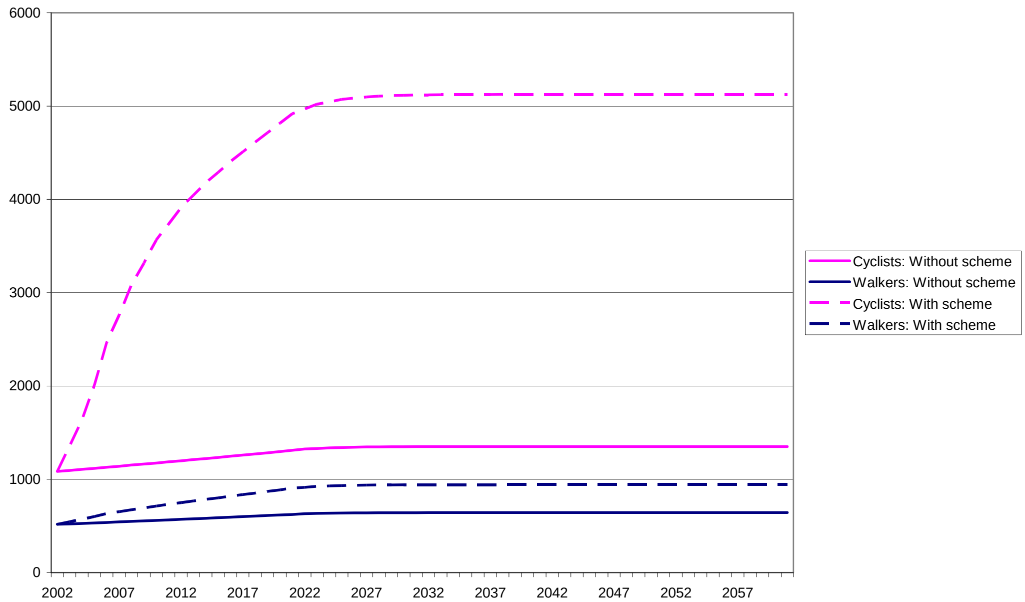

Figure 2 Usage forecasts of walking and cycling modes for case study 2

5.5. Calculating the costs and benefits associated with each scheme

5.5.1. 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.

Environment

5.5.2. In these example case studies, no attempt is made to monetise noise and local air quality. These issues are summarised in TAG Units 3.3.2 and 3.3.3 respectively; the latter being based on guidance in DMRB vol. 11. In some of the case studies there is evidence that the contribution is notable, and future inclusion of this area is seen as desirable. Greenhouse gas savings, specifically emissions of carbon dioxide, have been included in the case studies. Use of the marginal external costs (MEC) approach for calculating decongestion benefits would have generated benefit estimates for all of these impacts.

5.5.3. A basic appraisal of carbon has been achieved using fairly simple methods that take into account:

- The volume of car kilometres saved
- Estimated CO_2 emissions per kilometre based on fuel efficiency for an average vehicle over time and the average speeds on the highways affected by the scheme
- The marginal economic cost of carbon per unit

5.5.4. Car kilometres saved are calculated by determining out of the new users of a route, those that have the ability to use a car but did not. In these case studies, stated preference surveys were used. It is also assumed that the kilometres saved will be based on the average length of walk and cycle trips, rather than simply the length of the scheme, which may substantially under count or over count the savings. To convert daily savings to annual savings, a factor of 220 is applied, representing the average number of working days.

5.5.5. The marginal economic cost of carbon per kilometre has been calculated directly using the tables in *The Greenhouse Gases Sub-Objective* (TAG 3.3.5). Carbon emissions per litre of fuel burnt are projected to decrease, especially with the increased use of biofuel mixes from 2008. Fuel efficiency is projected to increase over time and combined with average speed gives the average volume of fuel burnt by kilometre, assuming a homogenous vehicle type. A significant reduction in motorised traffic will therefore lead to a benefit in reduced carbon emission, which is monetarised in the case study appraisals.

Physical fitness

5.5.6. 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 relative risk of death due to physical inactivity is recalculated for potential new walkers and cyclists along the scheme route. This is done by estimating the average length of new trips encouraged by active modes and interpolating the relative risk, with a maximum achievable relative risk of 0.72 for cyclists and 0.85 for walkers at 36 minutes per day (compared to inactive individuals). The walking value uses a working assumption based on research evidence that a similar dose of activity reduces the relative risk of CHD only to around 0.9.

- The calculated relative risk of death and the number of new walkers and cyclists are used to calculate a figure for the potential number of lives saved.

- The product of the number of potentially prevented deaths and the cost per death value per year is calculated and summed across the appraisal period. This may also be converted into a unit saving per additional cyclist or pedestrian for ease of calculation across the appraisal period.

5.5.7. The relative risk value used in each case study assumes that the average trip length for new users is 1.5 kilometres for walkers and 3.9 kilometres for cyclists, travelling an average of 5kph and 20kph respectively (DMRB 11.8.3). 90% of route users make a return trip each day. It is also assumed that the benefit of using active modes accrues over a five year period, after which new cyclist or pedestrians achieve the full health benefit of their activities.

Absenteeism

5.5.8. The level of absenteeism from work is expected to decrease where more people walk or cycle as the means of travel to work for over 30 minutes per day. Moderate physical activity is seen to lead to a reduction in sick days taken from work and hence provides a benefit to the employer. This is not the same as the benefit of better health for the individual.

5.5.9. 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%) (WHO, 2003). The number of days saved per person per annum is thus calculated. The employer cost saving of the reduction is then 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 per day, assignable to each commuter user of a route is generated.

Journey Ambience

5.5.10. Journey ambience is calculated on the basis of a 'safety-insecurity' value, as derived from the research studies cited in Section 1.9. It is based on the assignment of a value to each individual trip carried by the intervention, therefore affecting existing users as well as new users. The data in the case studies uses a separate assessment of the journey ambience value for cyclists and pedestrians. 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.

5.5.11. The monetary benefits of journey ambience depend on the scheme being implemented. Section 5.1 details the main types of intervention from the research that have an estimated benefit.

5.5.12. For case studies 1 and 2, which are upgrades to existing facilities, a simple assumption is made that these would achieve additional benefits equivalent to half of the maximum benefits. Case study 3 appraises the construction of a Toucan crossing, which is a feature not known to have been researched in the literature, but does provide an increase in safety. This is assigned a benefit of 20 pence per use, being comparable to other monetarised ambience values.

5.5.13. 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. This gives the total ambience benefit for all walkers and cyclists for each year of the appraisal. It is assumed that the ambience of other modes is not affected.

Accidents

5.5.14. For the case studies, accidents are accounted for by calculating the number of accidents saved through reduction in motorised traffic where this is significant. This is suitable for case studies 1 and 2 where traffic free greenways are used and hence reduce traffic on nearby local roads. For case study 3 it is assumed that there will be no significant change in walk and cycle accidents as a result of increases in these modes. In reality there may be expected to be a reduction in accidents due to improved safety of crossing, although there is sufficient uncertainty here to estimate this with confidence without reference to similar scheme evaluations.

5.5.15. 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 11 Incidence of accidents by severity in Great Britain

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

5.5.16. The figures calculated for the reduced number of car kilometres as a consequence of route development are used in these case studies. The values assigned to each category of injury are applied as required from HEN 1 (DfT, 2004d). 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. Note that value of a life is slightly higher in accident appraisal than in health appraisal due to the associated incident costs associated with these casualties.

5.5.17. 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 'without-intervention' 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. This is especially relevant where the project being appraised is primarily aimed at increasing safety for walkers and cyclists. For example, construction of a major greenway may remove many cyclists from the roads entirely and hence reduce serious accidents substantially.

5.5.18. 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.

Impacts of modal change

5.5.19. 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. Case study two relates to a project that specifically targets commuter use and therefore can be expected to have a substantial impact on mode selection (indeed, evidence shows that this is the case). The other two case study schemes are expected to impact on modal choice, but the impacts are much less. Where it is justifiable to assume that a project will not affect mode split to a significant degree, it will simplify the appraisal to put these issues to one side. This will keep the appraisal complexity in proportion with the effort required.

Travel time benefits

5.5.20. The travel time benefits realised by users have been calculated on the basis of a decongestion value that is applied in relation to the reduction in car kilometres that is attributable to the intervention. Marginal external costs for cars vary widely according primarily to the type of road, the level of congestion (also affected by time of day) and the area type. Surface Transport Costs (1998) indicates two general values of 7.0 pence per kilometre for off-peak surface transportation and 23.0 pence per kilometre for peak time surface transportation costs. The peak period value reflects the fact that most of the benefits are realised by commuters during those peak periods. For the case studies an average all-day value of 15 pence is used. The Department has made available from the National Transport Model (NTM) information on marginal external costs suitable for use in these circumstances; see *MSA Decongestion Benefits* (TAG Unit 3.9.5).

Fuel tax revenues

5.5.21. 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 3 pence per kilometre.

5.6. Implementing the appraisal process on the case studies

Public Accounts Table

5.6.1. 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 'Investment costs' 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 non-government 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

5.6.2. 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 included with the benefits of physical fitness. 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

5.6.3. 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.

5.7. Analysis of Monetised Costs and Benefits

5.7.1. 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. The following table compares the values generated in the analysis for each of the three schemes.

Table 12 Cost and benefit accounting for the case studies

	Case study 1	**Case study 2**	**Case study 3**
Scheme capital cost (adjusted)	£37,200	£193,439	£84,631
Operating costs	£128,923	£773,537	£107,436
Developer contribution	-£17,971	-£296,439	
Bus Subsidy		£296,439	
Tax revenue (loss of)	£9,934	£944,413	£37,995
Public accounts PVC	**£158,086**	**£1,911,389**	**£230,061**
Consumer Users TEE (congestion)	£127,639	£12,072,535	£486,481
Greenhouse gases	£2,053	£194,308	£7,828
Physical fitness	£2,640,862	£38,544,772	£2,770,936
Journey ambience	£81,501	£15,700,934	£836,936
Accidents	£34,294	£3,239,936	£130,670
Business users (reduced absenteeism)	£39,285	£2,093,964	£34,628
Developer contribution	-£17,971	-£296,439	
Bus Subsidy		£296,439	
Present value of benefits	**£2,907,661**	**£71,846,450**	**£4,267,478**
Net present value	£2,749,575	£69,935,060	£4,037,417
Benefit to cost ratio	**18.4**	**37.6**	**18.5**

Comments on the case studies

5.7.2. Case study 1, upgrading of an existing greenway, has a cost-benefit ratio (CBR) of 1:18.4. This route previously had very low usage and the upgrade has led to large observed usage immediately after the scheme from the evaluation data. Over the sixty year appraisal period, cycle trips are forecast to increase by seven times and walk trips by ten times. The physical fitness benefits are the predominant gain through the scheme, accounting for 91% of the benefits, since the relative levels of growth are very high. This is evidence of a forecast mode shift to walk and cycle and hence increased levels of fitness.

5.7.3. Case study 2, also a greenway upgrade, is the most successful of the compared schemes, yielding a potential CBR of 1:37.6. The initial usage for this route was very high for schemes of this nature. Growth in the number of cyclists over the appraisal period is expected to be nearly five times the initial usage and the number of walkers is expected to almost double. Since there will be a large number of new route users, physical fitness benefits dominate, at £38.5 million (over half of all benefits). Journey ambience is also a significant benefit. This is due to the ‘existing’ users receiving increased journey ambience benefit as soon as the scheme is built and the walkers and cyclists increasing over the without-intervention case, which are numerous, will receive a potential benefit of £15.7 million for journey ambience (around a quarter of all benefits). Due to the relatively high mode shift associated with this scheme, removing a large number of cars from the road, the decongestion benefit also registers significantly in this case study, at around 17% of all benefits. This also increases the benefits gained through decreased absenteeism from work and decreased accidents facilitated by the scheme.

5.7.4. A significant caveat in this case study is that the scheme itself interacts with the London congestion charge zone. Therefore, forecast usage of walk and cycle modes may piggy-back on the mode shift expected from that major scheme. This case study has been undertaken as a methodological exercise using the same reference case ("without intervention") assumptions as the others. Clearly this emphasises the need to consider local factors and potential impacts from other schemes, especially where significant mode shift may have occurred. Although difficult, it should be attempted to untangle all of the potential impacts of other schemes in each locality so that a common realistic reference case for each scheme may be used. In the example of this case study, the reference case used may inform other schemes in the area on a comparative basis, but must be recognised as potentially biased when appraising schemes in other areas that will not benefit from the impact on mode shift brought by the congestion charge scheme.

5.7.5. Case study 3, the construction of a new toucan crossing on a major route to school, has a CBR of 1:18.5. Growth in cycle and walk modes are expected to increase by approximately two and a half times, both from moderate initial usage. This growth in users makes physical fitness dominant once again, with journey ambience and decongestion also significant. The journey ambience benefit is based on a one-off benefit of 20p to all users. It is worth noting that this case study to some degree may underestimate the perceived ambience benefit to, for example, parents placing a higher value on safety for their children accessing the school than an average user, although 20p is relatively arbitrary. Similarly, the toucan crossing is installed primarily with safety in mind over mode shift considerations. In this case it is in place to potentially protect a more vulnerable cross-section of people. Therefore accident savings may be underestimated here, based on reduction in car traffic as for the other case studies.

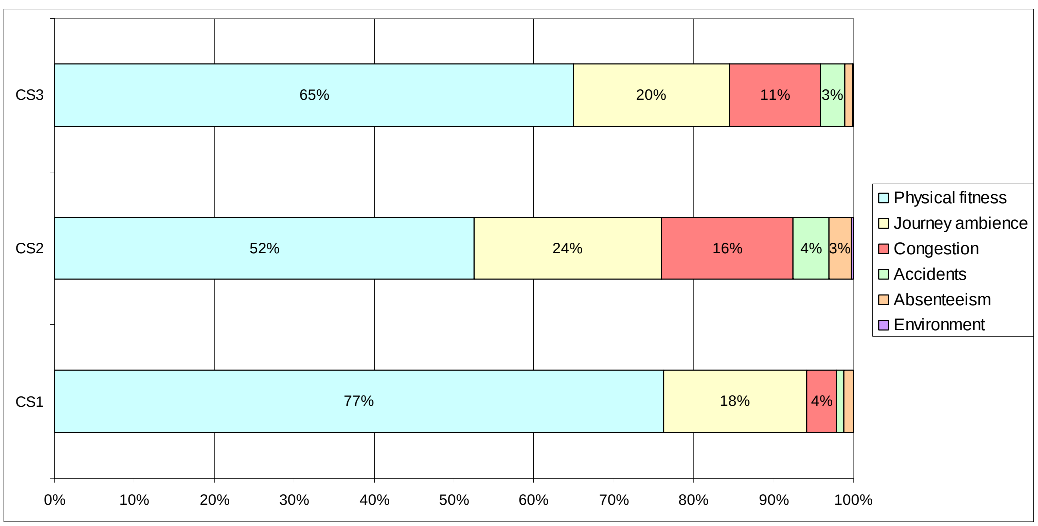

Figure 3 Proportion of benefits attributable to each sub-objective in each case study

5.7.6. It can be concluded from these case studies that the primary benefits gained from walk and cycle schemes in these appraisals are physical fitness and journey ambience benefits, with decongestion and other benefits becoming more significant as the absolute impact on mode shift increases. Physical fitness will dominate where there are sufficient levels of growth. Journey ambience remains significant, especially where initial levels of usage are high and where reasonable growth occurs. It is therefore important in the appraisal process to produce the best possible forecasts of growth and to ensure that physical fitness and journey ambience benefits are measured on a consistent basis.