Cycling Demonstration Towns
Development of Benefit-Cost Ratios

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Department for Transport

Executive summary

In 2005, Cycling England launched a Cycling Demonstration Town programme to invest in measures to stimulate increased levels of cycling through combinations of physical infrastructure, promotion and other smart measures. The first phase of the programme ended in March 2009. The towns selected as Cycling Demonstration Towns were Aylesbury, Brighton and Hove, Darlington, Derby, Exeter and Lancaster with Morecambe.

This analysis builds upon the recently published monitoring reports which found that on average cycling rates increased by 27% in the Cycling Demonstration Towns and that the health benefits (from reduced mortality) were worth around £2.50 for every £1 spent. In particular this paper attempts to produce a Benefit-Cost Ratio (BCR) of the programme consistent with the analytical approach used by DfT to appraise business cases. This approach provides an assessment of the impact of the Cycling Demonstration Towns on a range of objectives such as congestion relief and improved journey ambience.

Whilst the Cycling Demonstration Towns were subject to extensive monitoring, data was not collected from the sites with the purpose of producing a BCR of the programme. Therefore, it has been necessary to make a number of assumptions about the impact of the programme on key transport objectives to produce a BCR. Inevitably, this approach is not as robust as an analysis based on direct monitoring of outcomes but our judgement is that it provides a representative assessment of the relative size of different impacts.

Including a wider range of impacts in addition to reduced mortality does increase the BCR although none of the individual objectives considered (congestion, amenity, absenteeism or cycling casualties) were as large as the benefits of reduced mortality. Depending on how changes in cycling casualties were treated the BCR increased from 2.5 to 2.6-3.5 when assessed over a 10 year period. This is possibly conservative given the level of capital infrastructure delivered in the Cycling Demonstration Towns. The BCR range increases to 4.7-6.1 if the benefits could be sustained for 30 years assuming some on-going investment in behavioural change programmes and training[1].

The most significant additional benefits were decongestion and journey ambience, although the estimate of the latter is very uncertain given the number of untested assumptions used. Our analysis revealed mixed evidence about the impact on cycling casualties – the range in the BCR mainly reflects the range of possible outcomes given by alternative analysis of the accident data.

Whilst this analysis provides some useful insights on the likely impact of packages of measures to increase cycling, it also shows that the overall value of these types of schemes is sensitive to assumptions which have yet to be tested. In particular, the overall BCR is very sensitive to whether increases in cycling are permanent or fall back to pre-programme levels over time. Steps are being taken in the next phase of the Cycling Demonstration Towns programme to generate more robust data for the purpose of generating BCRs.

Finally, whilst it has been possible to extend the analysis of Cycling Demonstration Towns to cover a wider range of impacts it is clear that some important benefits may have been missed. It has not been possible to value the benefits of increased cycling amongst children (either directly or though any increased propensity to cycle in later life). Nor has it been possible to value reductions in morbidity from increased cycling. These impacts could be significant and may outweigh the non-morbidity impacts considered here.

This is on-going work with Cycling England and we seek to refine and update the conclusions as more data becomes available.

Approach and caveats

As part of the monitoring of the Cycling Demonstration Towns, Cycling England estimated the benefits of increased cycling as a result of reduced mortality. They found that these health benefits were about £2.50 for every £1 spent. This analysis extends the assessment of the impact of increased cycling in the Cycling Demonstration Towns to cover:

- Reduced absenteeism
- Decongestion impacts
- Changes in the number of accidents amongst cyclists

1. The on-going costs are assumed at half the annual expenditure observed during the Cycling Demonstration Towns programme.

- Benefits to cyclists from better facilities

It is important to note from the outset that the monitoring data from the Cycling Demonstration Towns was not collected with the purpose of estimating these impacts. Therefore, in most cases we have had to forecast or project these additional impacts based on changes in the number of people cycling. The methodology for estimating the change in the number of cyclists in each town is described in Cavill et al (2009)[2]. The percentage of respondents to surveys performed in each of the towns doing 'any' cycling in 2006 was calculated and subtracted from the percentage doing 'any' cycling in 2009. The difference between these two percentages was multiplied by the adult population of each town to provide an estimate of total new adult cyclists.

The approach for each impact is summarised in table 1. In the case of reduced absenteeism and accidents more than one approach was tested.

The final set of assumptions required to produce a BCR cover the length of time over which the investment in Cycling Demonstration Towns will have an impact and the extent to which the impact of investment on the number of people cycling may decline over time. There is a high level of uncertainty regarding the longevity of increased cycling within the Cycling Demonstration Towns given that activities only commenced three to four years ago and the programme consisted of a mix of hard measures with long asset lives (e.g. cycle paths) and softer measures (e.g. education and marketing). Our central case assumption is that benefits accrue for 10 years and that there is no decay in the number of cyclists over this period. Furthermore, it is assumed that costs will only be incurred during the first three years. As discussed later in this note, these assumptions are based on judgement and have yet to be satisfactorily tested. Given the level of uncertainty about these assumptions we present a number of sensitivity tests in the results section.

A number of caveats should be considered when interpreting the results of this analysis. The confidence in the estimates of individual impacts is discussed in the results section.

- The estimate of benefits will be sensitive to the level of modal shift achieved by the investment targeted on the Cycling Demonstration Towns. It is possible that changes in cycling activity may have been influenced by schemes not funded under the Cycling Demonstration Towns programme. For example, Darlington was receiving additional funding during this period as part of the Sustainable Travel Towns programme. If the Sustainable Travel Towns programme increased cycling then the BCR will overestimate the impact of the Cycling Demonstration Towns. We have tested the impact of removing Darlington from the analysis and found that this has minimal impact on the overall BCR.
- Benefits have been calculated based on changes in the number of over-16s cycling only. A number of the Cycling Demonstration Towns targeted schools and there is some evidence that cycling rates amongst school-aged children did increase as a result. This could potentially deliver significant additional benefits particularly if changes in cycling behaviour last into adulthood. This would mean that the BCR is underestimated.
- This exercise has extended the assessment to cover all impacts discussed in the WebTAG unit on walking and cycling. However, there are a number of other potential impacts that cannot be captured using the existing evidence base. The most significant of these potential benefits is through reduced morbidity which may be equivalent in scale to mortality impacts. This would mean that the BCR is underestimated.
- Many of the impacts valued in this analysis have not been directly observed but estimated using the change in the level of cycling in the Cycling Demonstration Towns.

The analysis presented in this paper draws heavily on the monitoring study completed by Sustrans and partners and Cavill Associates on behalf of Cycling England, and an assessment of the value of health benefits associated with increased levels of cycling in the Cycling Demonstration Towns. This study was reviewed by DfT and is published on DfT website at **http://www.dft.gov.uk/pgr/regional/ltp/demotowns/**. This publication sets out the robustness of the data and analysis.

2. Cavill N, Cope A and Kennedy A (2009) 'Valuing increased cycling in the Cycling Demonstration Towns'. Report to Cycling England.

Table 1. Methodology applied in extending the estimation of value of impacts in the Cycling Demonstration Towns

Reduced absenteeism	Two approaches were tested using the finding from the USA[3] that physical activity programmes of at least 30 minutes a day, five days a week reduced sick absences by between 6% and 32% (the lower bound was applied for this study): • A threshold model in which only those employees who meet the requirement get any benefit. • A linear model in which the benefit is pro rated according to the amount of time spent cycling each week. The threshold model is consistent with DfT guidance (unit 3.14.1). The linear model is presented as an illustration although we have no evidence to support its use. In both cases benefits were assumed to accrue only to those in work. Benefits valued through lost productivity to the economy – proxied by salary and other on-costs (based on value of work time reported in webTAG 3.5.6).
Decongestion impacts	Forecast by assuming that a proportion of new cycling journeys which would have been made by car and applying a unit decongestion rate (taken from webTAG 3.9.5) to the car km abstracted from the highway network. The impacts valued include lower congestion, reduced infrastructure costs, fewer road accidents, improved air quality, lower noise levels, reduced CO_2 and reductions in indirect taxes.
Changes in number of accidents	Three approaches were tested for estimating changes in the number of reported accidents: • Estimated using the model in webTAG unit 3.14.1 which shows a 32% increase in cycling accidents resulting from a doubling of cyclists – applying this to the increase in cycling in Cycling Demonstration Towns gives a 5.8% increase in reported accidents. • Comparison of reported accident statistics (STATS19) reported in the Cycling Demonstration Towns before and after the intervention – statistical significance tests published in Cope et al (2009)[4] indicates that accident levels remained unchanged. • Comparison of changes in reported cycling accidents reported in the Cycling Demonstration Towns with matched[5] towns (STATS19) – this suggests that there were 12% more cycling accidents reported to the police as a result of a higher number of cyclists and that this difference is statistically significant. The average cost per cycling casualty (webTAG 3.4.1) was then applied to estimate total costs of accidents.
Amenity benefits to cyclists	High level assumptions made about the benefit per cyclist using new or improved cycling infrastructure and the proportion of new and existing cyclists that use this infrastructure.

3. World Health Organisation (2003), Health and development through physical activity and sport.
4. Cope A, Muller L and Kennedy A (2009) ‘Cycling Demonstration Towns Monitoring Project Report 2006 to 2009: Appendix’.
5. Each of the Cycling Demonstration Towns sites was matched with a local authority considered most similar, using the National Statistics 2001 Area Classification. The matched towns were: Bournemouth, West Berkshire, Stockton-on-Tees, Bolton, York and Canterbury.

Results

The result of the exercise to extend the analysis of impacts of Cycling Demonstration Towns to other potential impacts is presented below. This is presented as a range to reflect the different approaches available for estimating accident and absenteeism benefits.

Table 2. Benefits and Costs of Cycling Demonstration Towns

Impact	Estimate of benefits and costs over 10 year period (£m, 2007 prices and values)
Reduced mortality	Benefit of £45 million
Decongestion	Benefit of £7 million
Reduced absenteeism	Benefit of £1-3 million
Amenity	Benefit of £9 million
Accidents	Disbenefit of £0-£15 million
TOTAL BENEFITS	**£47-64 million**
Costs	£18 million
Benefit-Cost Ratio	2.6 – 3.5

The analysis indicates that the improvement in the health of new users from reduced mortality is the single most significant benefit of the programme accounting for between 70% and 96% of net benefits. This is consistent with the results of other case studies (e.g. as reported in webTAG 3.14.1) although towards the higher end of the range.

The next largest impact is the disbenefit of increased accidents amongst cyclists which is estimated to cost up to £15 million although there is uncertainty about whether the programme increased the total number of cycling casualties. The £15 million cost is based on a comparison of changes in the number of reported cycling accidents in the Cycling Demonstration Towns against changes in the matched towns. This analysis suggests that the number of reported cycling accidents across the Cycling Demonstration Towns were around 12% higher than it would have been had they followed trends in these areas[6]. Comparisons of reported accident numbers within towns before and after implementation of the programme suggest that the number of reported accidents within the towns has remained stable[7]. Therefore, we have presented these disbenefits as a range and we will seek to update this in light of any further analysis of the figures e.g. to test whether expenditure on safety measures were higher in the matched towns.

Amenity benefits are estimated at £9 million but are subject to a very high level of uncertainty. The standard approach to valuing the benefits of improved infrastructure is based on estimating the number of cyclists and walkers making use of it. The monitoring data collected for the Cycling Demonstration Towns was insufficient to allow this to be done and we were unable to find any other evidence on typical usage rates for new pieces of cycling infrastructure at an area level. Given that the primary purpose of this work is to give an indication of the likely impact of cycling schemes of this kind we had to make some assumptions about the proportion of cyclists using new cycling infrastructure and the value these cyclists got from this. For the purposes of providing an indicative figure we assumed that 40% of trips made by new cyclists utilised new infrastructure – the equivalent rate for existing cyclists was 20% (we assumed that the rate for new cyclists was higher as they are more likely to require new cycle paths etc to encourage them to cycle). We also assumed that each cyclist using the new infrastructure would get a benefit of 10p per trip – which is equivalent to cycling for around three minutes on a new off-road cycle path. Our judgement is that this is likely to be conservative.

6. This varies significantly from site to site – e.g. this analysis suggests that there was a statistically significant fall in cycle casualties in Lancaster.
7. These results are not necessarily contradictory as the total number of cyclists killed or injured in England has fallen possibly as a result of reduced cycling levels.

Decongestion benefits are estimated at £7 million over ten years. This is based on the average value of reducing congestion (including environmental and accident benefits) across all urban A roads (excluding major conurbations) in England. It is possible that the roads in the Cycling Demonstration Towns have greater or lesser congestion but we have found no data from the monitoring study which would allow us to test this. The estimate uses car occupancy data from travel behaviour surveys performed in Darlington[8] and Lancaster[9] but uses assumptions about average trip length and the proportion of cycling journeys that were previously made by car[10]. These assumptions have generally been informed by national data sets (e.g. NTS) although limited cross-checks with local data suggest that they are representative of the Cycling Demonstration Towns.

Employers in the Cycling Demonstration Towns are estimated to benefit by around £1-3 million over 10 years as a result of reduced absenteeism. Whilst there is some uncertainty as to whether threshold effects apply (i.e. whether employees need to cycle for 36 minutes for five days a week to obtain any reduction in sickness rates) the overall scale of benefits is small compared to other impacts.

Data on the costs incurred in Cycling Demonstration Towns is contained in a separate Cycling England report[11]. These are summarised in the table below. 80% of the costs were capital, mainly relating to the provision of routes and infrastructure. The raw cost data was adjusted to present the figures in the market unit of account. This involved removing VAT (assumed to apply to all costs apart from salaries in the absence of more detailed records) and uplifting all costs by the market cost adjustment factor (20.9%). For the purposes of discounting the costs were assumed to be evenly spread over three years.

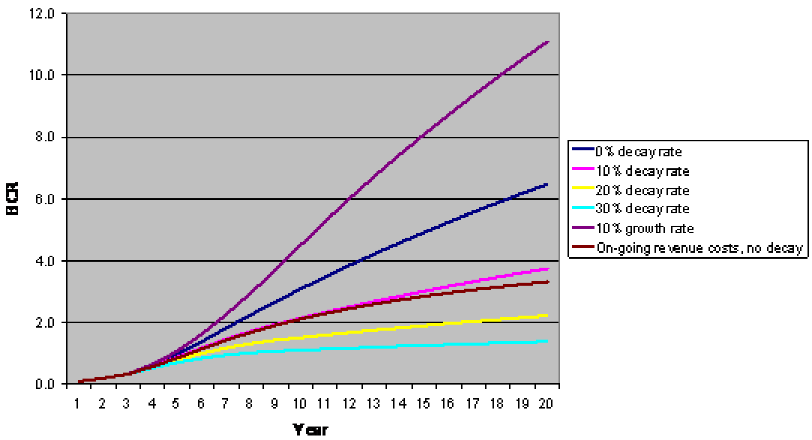
Table 3. Breakdown of costs in Cycling Demonstration Towns (outturn prices)

	Capital	Revenue
Infrastructure – routes and general	£13.4m	£0.3m
Enabling cycling	NIL	£0.2m
Schools	£0.9m	£0.5m
Workplace and Universities	£0.02m	£0.2m
Travel awareness	NIL	£1.0m
Travel information	NIL	£0.8m
Salaries	NIL	£1.4m
Total	**£14.3m**	**£4.4m**

As discussed above, the overall BCR is sensitive to assumptions about the longevity of increases in cycling within the demonstration towns. The chart below shows the impact of changing assumptions about the length of any impact and the decay rate – the rate at which increases in cycling fall over time. The case presented in table 2 is that there is no decay and cycling rates remain at post-implementation levels for 10 years before dropping back to pre-programme levels.

8. SocialData and Sustrans (2009) ‘Darlington – Sustainable Travel Demonstration Town. Travel behaviour research. Final evaluation report for Darlington Borough Council’.
9. SocialData and Sustrans (2008) ‘TravelSmart in Lancashire. Final report on the Individualised Travel Marketing Campaigns in Preston, South Ribble and Lancaster (2006-07)’.
10. It is assumed that this is proportional to the current modal share of car for journeys less than two miles (source: NTS, 2007/08).
11. ‘How to make your town a cycling town: a compilation of practitioners’ experience from the Cycling Demonstration Towns programme’ (2010).

BCR of Cycling Demonstration Towns - impact of alternative benefit decay rate assumptions



The chart shows that the BCR is sensitive to these assumptions. This can be shown by the impact of reducing the time over which benefits are included from 10 to seven years. Such a move would reduce benefits by around £22 million (0% decay). This is greater than the combined impact of including decongestion, absenteeism and amenity benefits in the analysis.

These sensitivity tests also show that with a fairly significant decay rate of 10% per annum (by year 10 the impact of the programme on cycling levels is around half that observed in year 3) the BCR is above two after 10 years.

Another way of considering the sensitivity of the BCR to assumptions about the appraisal period is to compare results over a 10-year and 20-year period. These are presented below.

Table 4. Comparison of BCR over 10 and 20 years

	BCR at 10 years	BCR at 20 years
10% growth in demand per annum	4.0-5.1	10.0-12.3
Zero growth in demand	2.7-3.5	5.8-7.2
10% per annum decay rate	1.9-2.5	3.4-4.2
On-going revenue costs, zero growth in demand	1.9-2.4	3.0-3.7
20% per annum decay rate	1.3-1.8	2.0-2.6
30% per annum decay rate	0.9-1.3	1.2-1.6

Given that a majority of the costs in the Cycling Demonstration Towns related to the provision of new infrastructure it is possible that the assumption used in the central case about the length of time over which benefits are experienced is too pessimistic. The chart and table above show how the BCR continues to increase if benefits are assumed to accrue over 20 years. However, as the Cycling Demonstration Towns included a number of softer measures (information and marketing campaigns) it is unlikely that the full impact will be maintained over 20 years without some further investment in these measures. An illustration of how the BCR might evolve if on-going revenue costs were included (maintained at rate experienced in the first 3 years of the Cycling Demonstration Towns) is provided above.

Extending this further – to 30 years – and assuming that higher cycling rates can be maintained with half the level of revenue support produces a BCR range of 4.7-6.1.

The figures presented above do not include any maintenance or renewal costs associated with the infrastructure delivered by the Cycling Demonstration Towns. It is likely that these activities will be wrapped up with more general maintenance of the highway and cycle paths. The absence of these costs in the analysis will mean that we overestimate the BCR although this effect is likely to be small in early years. However, as the appraisal period is increased the absence of these costs will have a larger impact and therefore the BCRs should be carefully considered alongside expected asset lives.

Implications for future research

This analysis confirms the results from the other case studies[12] which suggest that the health impacts are typically the largest single benefit of cycling schemes but that other impacts, particularly decongestion and amenity, can be significant. Including these other impacts may significantly increase the BCR and provide a stronger case for investment in cycling. However, this analysis has also demonstrated the difficulty in producing robust estimates of these wider impacts given the current state of knowledge and information collected through monitoring studies not specifically designed for the collection of data for use in economic appraisal. The sensitivity of the BCR to different assumptions would suggest that the priorities for further research are:

- To determine whether the increases in cycling rates from typical investments in soft and hard measures are experienced over the long term and to what extent their impact declines over time.
- To determine the benefits of increased cycling amongst children – both short-term (e.g. better health outcomes) and longer-term (e.g. higher prevalence of cycling when they become adults).
- To determine to what extent cycling reduces morbidity.

Whilst further research on these relationships are likely to take some time, the robustness of the economic evaluation of cycling programmes could be increased through the collection of more specific data as part of the monitoring programme. This would reduce the need to forecast or project impacts based on changes in the number of cyclists and/or national data. Priorities for the collection of monitoring data at other sites:

- Data on the number of new facilities provided (e.g. length of new cycle lanes completed, number of cycle racks, number of cycle crossing) and their use. It is likely that data on new facilities could have been collated for the Cycling Demonstration Towns but data on use was less readily available.
- Estimates of congestion on the local road network. Modal shift is unlikely to be large enough to directly measure changes in traffic but estimates of decongestion benefits could be significantly improved by using local data on marginal external congestion costs.

Many of the recommendations detailed above have already been incorporated into data collection in the 12 new cycling city and towns. This will provide robust data on the change in cycling, travel behaviour and physical activity. The evaluation will also collect information on facilities provided.

12. E.g. WebTAG unit 3.14.1 (DfT).