Post Opening Project Evaluation

Meta-analysis : Economic Impacts

February 2009

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1. Introduction

Overview

1.1 The Highways Agency (HA) is responsible for improving the strategic highway network by delivering schemes within the programme of Major Schemes (MS). Prior to construction, these schemes are subject to a detailed appraisal based on NATA principles that consider how the scheme is forecast to perform against the following five over-arching transport objectives:

- Economy;
- Safety;
- Environment;
- Accessibility; and
- Integration.

1.2 Typically the decision whether not to proceed with a scheme is based on the balance of costs and benefits as often summarised in the form of an Appraisal Summary Table (AST). These costs and benefits typically fall into two categories:

- **Non monetised benefits/costs:** Relate to those impacts which can not be easily quantified in monetary terms. Examples include: heritage and water impacts;
- **Monetised impacts:** These relate to impacts against which a monetary value can be placed, specific examples include impacts on journey times, accident impacts and impacts on vehicle operating costs.

1.3 As a government agency, the HA has duty to demonstrate good value for money by continuing to invest in those schemes that offer best value for money. In order to achieve such a duty, the HA uses the Post Opening Project Evaluation (POPE) programme to evaluate all schemes following opening to ascertain whether such impacts have been realised. The Agency further uses POPE to identify lessons that can be learnt about the appraisal process and how methods can be used to enhance decision making.

The POPE Meta-Report

1.4 POPE began in late 2001 and was implemented to evaluate all schemes within the Targeted Programme of Improvements (TPI), now replaced by the **Programme of Major Schemes.** For each scheme, an individual report is prepared which details all of the predicted impacts and assesses whether these impacts have occurred.

1.5 As well as the reporting of all impacts in individual reports, the POPE process is designed to provide an information base to help improve the appraisal methods currently used in England, and this is undertaken by considering the combined impacts from all of the individual evaluations in the form of a m**eta-Report**. A meta-evaluation is therefore one which seeks to learn lessons from a number of evaluations so that general themes and trends can be determined. In summary, the meta-Report brings together all POPE schemes to identify common themes in the data. It examines the relationship between scheme predicted and outturn benefits and impacts, across all the NATA appraisal objectives.

1.6 For the 2008 meta-analysis, the main report has been developed from a number of theme **'daughter documents'**, namely a detailed assessment of five key areas so that key findings,

lessons learnt and recommendations can be made in the areas of most concern to the HA. The five key areas are:

- Traffic Impacts;
- Economy;
- Safety;
- Environment; and
- Accessibility/Integration and Consultation.

1.7 The main objectives of the meta-Report are threefold, and are:

- To identify differences between targeted (predicted) and outturn benefits and impacts;
- To interpret these differences using evidence-based methods; and
- To provide feedback on lessons to be learnt.

1.8 The Highways Agency will use the outcomes from the meta-Report to inform its decision-making and appraisal methods.

Background to Economic Evaluation

1.9 This report is the 'daughter document' on the economic impacts and presents the assessment of the monetised impacts of the schemes in terms of:

- Economy Benefits: comprise time savings for road users as a result of the scheme; and
- Safety Benefits: these are the monetised benefits that accrue from accident savings.

1.10 This section then considers the predicted and outturn scheme cost estimates. It then combines these with the assessment of scheme benefits to derive overall economic indicators (Net Present Value and Benefit Cost Ratio) in order to compare the predicted and outturn values.

1.11 After discussion with the Highways Agency TAME (Traffic Appraisal, Modelling and Economics) section, a series of questions have been agreed between all parties that this report should seek to answer. These are:-

- How accurate are the agency's estimates of scheme benefits?
- How accurate are the agency's estimates of scheme costs?
- Does POPE confirm schemes as having positive economic outturns?

1.12 This report specifically looks to address these issues and derive a series of conclusions and recommendations for the HA and Department for Transport (DfT) to consider as part of any revisions to the appraisal process.

The Schemes

1.13 For the evaluation of economic impacts, this report considers all schemes on the Highways Agency's Major Schemes (MS) Programme and draws information from **37** schemes.

1.14 It is mandatory within the POPE process to undertake evaluations One Year After (OYA) and Five Years After (FYA) the scheme has opened. However, as the POPE process only started in 2001, and evaluated schemes that opened in mid 2002 onwards, there are very few schemes in the Five Years After stage where the evaluations and approval have been completed, hence, the majority of the conclusions drawn have been from the One Year After stage.

1.15 **Table 1.1** outlines the sample of schemes, identified by evaluation period and by category and **Figure 1.1** lists the names of these schemes by geographical distribution.

1.16 This table shows that we have included two Five Years After evaluations. These schemes are the A34 Newbury Bypass and A46 Norton Lenchwick improvement scheme, and have been included as although they were not part of the TPI, it was considered that as economic information was still available, and they could be evaluated.

1.17 The schemes have been categorised into three groups:

- **Bypass schemes**
- **Junction improvement schemes**; and
- **Online widening schemes**.

Table 1.1 – Scheme Sample

	Bypass Schemes	Junction Improvement Schemes	Online Widening Schemes	Total
One Year After (OYA)	19	6	10	**35**
Five Years After (FYA)	2	0	0	**2**
Total	21	6	9	**37**

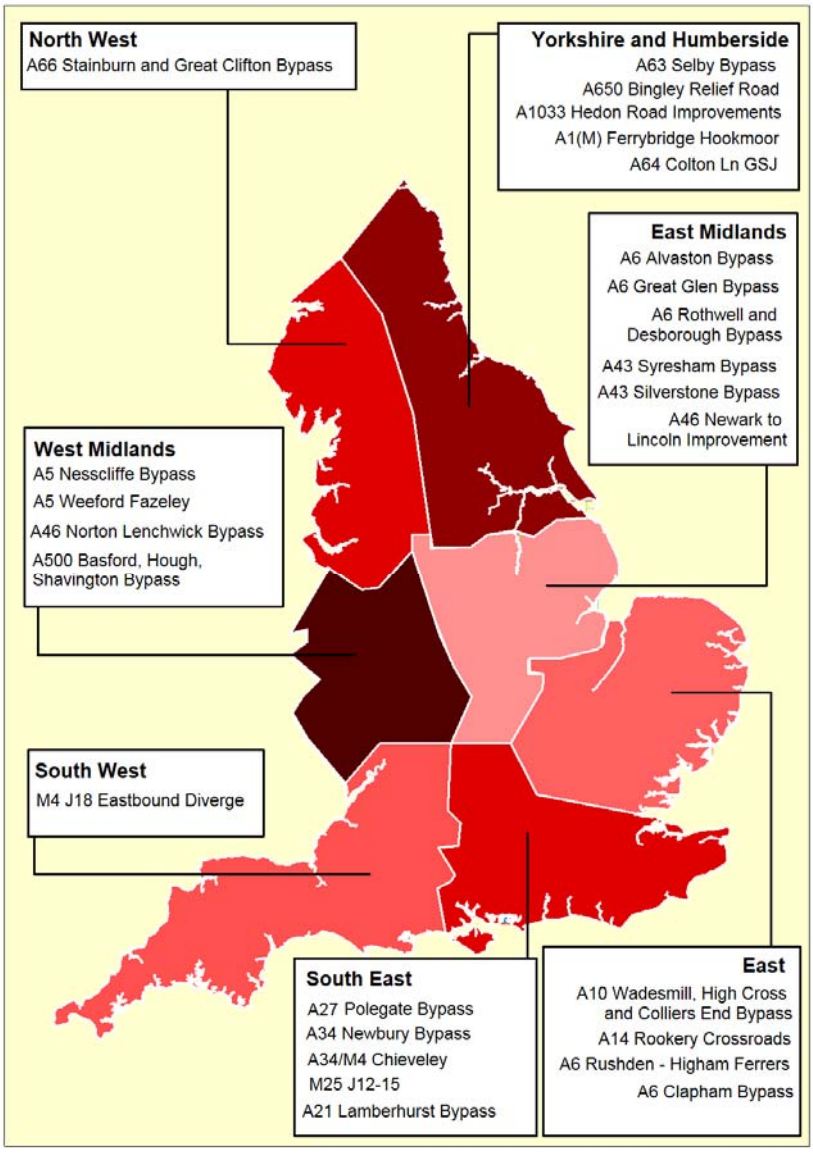


Figure 1.1 – Location of Schemes

Data Sources and Availability

Scheme Cost Data – Predicted and Outturn

1.18 Major schemes have normally been subject to several revisions of economic appraisal, especially those first appraised on the early 1990s. For the POPE evaluation process, predicted scheme cost data has been taken from the most recent economic forecast published prior to the start of scheme construction.

1.19 Outturn scheme cost data for most of the schemes included in this meta-analysis has been obtained from the scheme's project sponsor. In one case, where the scheme Project Manager was unable to supply the costs a figure published in Hansard was used. Since 2008, outturn costs have been obtained from the HA's Regional Finance Managers.

Scheme Benefit Data – Predicted and Outturn

1.20 The predicted economic benefits of the schemes has been taken from the scheme appraisal process where all the benefits are calculated and presented in order to justify the construction of each scheme. The aim is to use as consistent data as possible but these appraisals were carried

out using different major scheme guidance and over a long time span so that the content and techniques used vary. In many cases the economic information that is used in POPE is incomplete and various techniques have to be used to calculate benefits using limited base information.

1.21 Outturn benefits for the schemes are reforecast over the same appraisal period as the original predictions (30 or 60 years). These figures are calculated for POPE based on the use of observed 'one year after' data to calculate a reforecast of the benefits now expected over the appraisal period. This reforecast is termed the 'outturn benefit'.

Difficulties in Comparing Monetised Costs and Benefits

Differing Present Value Years

1.22 In appraisals a standard present year is used to allow comparisons between schemes. Monetary values are factored to the standard present year by changing the price base and by a process known as 'discounting'. The analysis presented on the individual major schemes encompasses a range of present value years and discount rates. Those used in the analysis comprise of:

- 1988 present value year with 8 percent discount rate;
- 1988 present value year with 6 percent discount rate;
- 1994 present value year with 6 percent discount rate;
- 1998 present value year with 6 percent discount rate; and
- 2002 present value year with 3.5 percent discount rate.

1.23 For each major scheme the post-opening assessment has been undertaken using the same present value year as used in the original assessment. This ensures that each major scheme report is internally consistent. However, when aggregations or comparisons are made across schemes of differing present value year two points must be borne in mind:

- The only indicator that is directly comparable between schemes of differing present value years is the benefit to cost ratio (BCR). All other indicators such as the Present Value of Benefits (PVB), Present Value of Costs (PVC) and Net Present Value (NPV) should only be directly compared with some degree of caution; and
- The later the present value year of a scheme, the greater the weight that the scheme will contribute to the overall total. Thus a scheme evaluated to a 1998 present value year has a higher value than an identical scheme evaluated to a 1988 present value year and would tend to distort any comparisons that are made between schemes.

Differing Opening Years

1.24 A crucial element when comparing schemes is that of the scheme opening year. For the majority of the evaluated reports, the actual scheme opening year is later than the predicted scheme opening year at the time of the traffic and economic appraisal. The meta-report uses the original forecasts but the delay in scheme opening into other years introduces the potential for variation because of time sensitive factors like cost inflation and traffic growth, hence the outturn benefits are invariably based on a slightly different 30-year or 60-year assessment period than the one used for the appraisal.

Differing Basis of Cost Estimates

1.25 A further crucial element of the assessment of scheme cost estimates has been the consistency and availability of information on outturn scheme costs. Throughout most of the period when the POPE process has been undertaken, the only available source of information on scheme cost estimates has been that provided by the scheme Project Managers within the Agency. While on some schemes the quality of information has been good, on other schemes the availability of

information has been poor. In addition, there appears to be a lack of consistency between the scheme cost estimates; for example, it is not always apparent whether an outturn scheme cost includes elements such as non-recoverable VAT, preparation, or supervision as reporting requirements have changed over time. Therefore, the information on PVC should be treated with some caution.

1.26 As of 2008, outturn costs for major schemes are supplied for POPE use by the Regional Finance Managers. This is supplied in 'as spent' values and therefore can be converted in to a common price base enabling comparison with the forecast cost and for the calculation of the Benefit to Cost Ratio. This has improved the reliability of the cost estimate significantly.

Availability of Data

1.27 In comparing the predicted and outturn economic evaluation of major schemes, a limiting factor is the availability of the original data files on which the economic evaluation was based. These files are predominantly COBA input files, although it is usually possible to re-create a COBA input file from the corresponding output file. **Table 1.2**Error! Reference source not found. provides a summary of the data available for the major schemes that have been considered in this report. Around half of the original COBA data files are available (16 out of 30 schemes).

Table 1.2 – Summary of Available COBA Data

Scheme Type	Scheme	Original COBA Data
Bypass	A1(M) Ferrybridge - Hook Moor	No
	A10 Wadesmill to Colliers End Bypass	No
	A21 Lamberhurst Bypass	Yes
	A27Polegate Bypass	Yes
	A34 Newbury Bypass	Yes
	A41 Aston Clinton Bypass	Yes
	A43 Silverstone & Syresham Bypasses	Yes
	A46 Norton Lenchwick Bypass	Yes
	A5 Nesscliffe Bypass	Yes
	A5 Weeford - Fazeley Improvement	No
	A500 Basford, Hough, Shavington Bypass	No
	A6 Alvaston Bypass	No
	A6 Clapham Bypass	Later version
	A6 Great Glen Bypass	Yes
	A6 Rothwell - Desborough Bypass	Yes
	A6 Rushden - Higham Ferrers	Yes
	A63 Selby Bypass	No
	A650 Bingley Relief Road	No
	A66 Stainburn and Great Clifton Bypass	Yes
Junction	A1 Stannington GSJ	Yes

Scheme Type	Scheme	Original COBA Data
	A14 Rookery Crossroads GSJ	No
	A34 Chieveley/M4 Jct 13 Improvement	Yes
	A64 Colton Ln GSJ	No
Online	A1033 Hedon Road Improvements	Yes
	A11 Roudham Heath to Attleborough	No
	A2 Bean to Cobham Improvement Phase 1	No
	A2/M2 Cobham to Junction 4 Widening	No
	A46 Newark to Lincoln Improvement	Yes
	M25 J12-15 widening	No
	M4 J18 Eastbound Diverge	Yes

2. How Accurate are the Appraisal Estimates of Economic Benefits?

Introduction

2.1 The appraisal of a scheme against the Economy Objective involves cost-benefit analysis, where the benefits of a scheme are balanced against its costs to determine its value for money. For major schemes, this involves balancing the forecast costs against a forecast of the stream of benefits accruing over an appraisal period of 30 or, more recently, 60 years. The accuracy of the forecast of the benefits is critical to answering the question as to whether the scheme will be value for money.

2.2 This section uses the findings from the POPE evaluations to examine the accuracy of the forecast of economic benefits. POPE economic evaluation is based on using the observed outturn data to calculate a reforecast of the benefits now expected over the appraisal period. This reforecast is termed the 'outturn benefit'.

2.3 In assessing these schemes there is a need to make a judgement as to whether a scheme is performing as predicted. The simplest method of making this comparison is to determine whether the outturn benefits lies within a particular threshold of the predicted benefits. In this case a value of +/- 15% has been chosen, as used in the traffic meta-analysis which is generally in accordance with the guideline target values for model validation defined within DMRB Volume 12, and therefore maintains consistency with the daughter document on traffic impacts.

2.4 Economic forecasts for the schemes evaluated under POPE were prepared over a long period using different price bases and discounting rates, thus this meta-analysis of the benefits is concerned with the comparison of differences between predicted and outturn as percentages rather than absolute figures.

2.5 As outlined in the previous section, monetised benefits have been categorised into:

- Economy benefits : travel time benefits only; and
- Safety benefits.

2.6 Vehicle Operating Costs (VOC) are usually included in the appraisal of scheme economic benefits and are a standard output of COBA. However, VOC's have been excluded from the meta-analysis of economics because VOC's tend to be a very small proportion of the overall economy benefits compared to time savings, and also they are dependent on a number of key assumptions other than time and distance such as fuel price and other operating cost assumptions which are often changing, but are assessed using default values, hence for true outturn results, they have been excluded from all of the analyses.

2.7 The process of converting traffic model outputs into economic forecasts involves the use of various assumptions for factors such as traffic growth and values of time. The POPE approach is to use the same factors in the post-scheme evaluation as were used in the appraisal, even if they are inconsistent with current appraisal guidance. This means that accuracy of the predicted and outturn benefits of individual schemes can be assessed with confidence but that it is more difficult to compare two separate schemes, unless they happen to use the same version of COBA and assumptions within it.

2.8 This section also looks at whether travel time or safety is the main contributor to scheme benefits, i.e. how the predicted and outturn benefits are split between travel time and safety benefits.

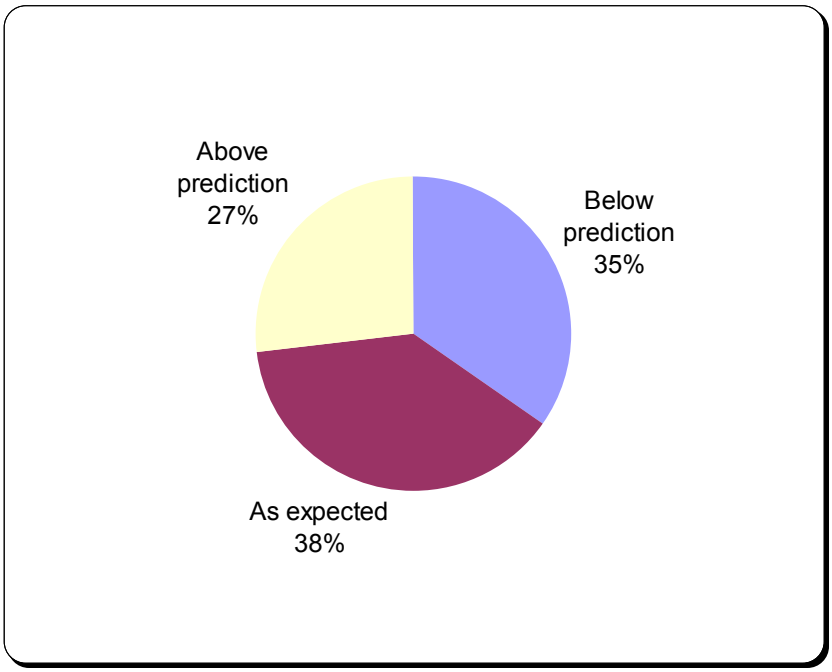
Travel Time Benefits

2.9 Within the full set of schemes, there are a total of 26 schemes with sufficient suitable data that have been included in this analysis. This includes 18 bypass schemes, 3 junction improvement schemes and 5 online widening schemes.

2.10 To provide a comparison of the predicted and outturn economy benefits it was necessary to calculate the time savings attributable to each scheme. This has been undertaken by using the observed traffic data to update the original economic assessment. It should be noted that the figures presented here are expressed in terms of the present value year in which the original assessment was undertaken.

2.11 **Table 2.1** presents a summary of the economy benefits for each scheme. The final column of the table provides a broad indication of the performance of each scheme with outturn values +/- 15% of the predicted values regarded as performing 'as expected'. The summary of the overall performance is shown as a pie chart in **Figure 2.1.**

Figure 2.1 – Performance of Outturn Travel Time Benefits compared to Predictions



2.12 The results shown in Table 2.1 show that, of the 26 schemes evaluated:

- 10 (38%) have outturn travel time benefits within 15% of those predicted;
- 7 schemes (27%) had outturn travel time benefits 15% higher than predicted; and
- 9 schemes (35%) had outturn travel time benefits 15% lower than predicted.

2.13 This balanced split suggests that there is no evidence of a particular bias towards under- or over-prediction. It can be seen that 62% of schemes have outturn benefits that are more than 15% different from their forecasts, but it also shows that two-thirds of schemes deliver similar to, or more than the benefits that were forecast.

2.14 These results have deteriorated slightly since the previous meta-analysis report in which only half of schemes had forecasts that were outside the 15% threshold, and where there were more schemes performing better than predicted than those that performed worse.

Table 2.1 – Summary of Monetised Travel Time Benefits

Scheme	Predicted Travel Time Benefits (£m)	Outturn Travel Time Benefits(£m)	% Difference	Performance
A1 Stannington GSJ	17.90	9.40	-48%	worse
A1(M) Ferrybridge - Hook Moor	300.00	124.90	-58%	worse
A10 Wadesmill to Colliers End Bypass	86.30	71.40	-17%	worse
A1033 Hedon Road Improvements	37.00	36.27	-2%	as expected
A2/M2 Cobham to Junction 4 Widening	70.92	99.93	41%	better
A21 Lamberhurst Bypass	18.75	20.55	10%	as expected
A27 Polegate Bypass	19.34	23.79	23%	better
A34 Newbury Bypass	369.20	411.45	11%	as expected
A34 Chieveley/M4 Jct 13 Impr.	130.22	60.20	-54%	worse
A41 Aston Clinton Bypass	28.50	29.17	2%	as expected
A43 Silverstone & Syresham Bypasses	23.59	52.75	124%	better
A46 Newark to Lincoln Improvement	52.39	38.62	-26%	worse
A46 Norton Lenchwick Bypass	19.20	21.40	12%	as expected
A5 Nesscliffe Bypass	6.51	5.93	-9%	as expected
A5 Weeford - Fazeley Impr.	7.90	14.90	89%	better
A6 Alvaston Bypass	18.10	47.80	164%	better
A6 Clapham Bypass	27.98	29.08	4%	as expected
A6 Great Glen Bypass	6.73	6.42	-5%	as expected
A6 Rothwell - Desborough Bypass	6.09	5.65	-7%	as expected
A6 Rushden - Higham Ferrers	16.52	45.54	176%	better
A63 Selby Bypass	177.00	100.00	-44%	Worse
A64 Colton Ln GSJ	9.31	7.18	-23%	Worse
A650 Bingley Relief Road	106.00	83.00	-22%	Worse
A66 Stainburn and Great Clifton Bypass	22.73	22.49	-1%	as expected
M25 J12-15 widening	151.00	192.00	27%	Better
M4 Jn 18 Eastbound Diverge	82.50	34.60	-58%	Worse

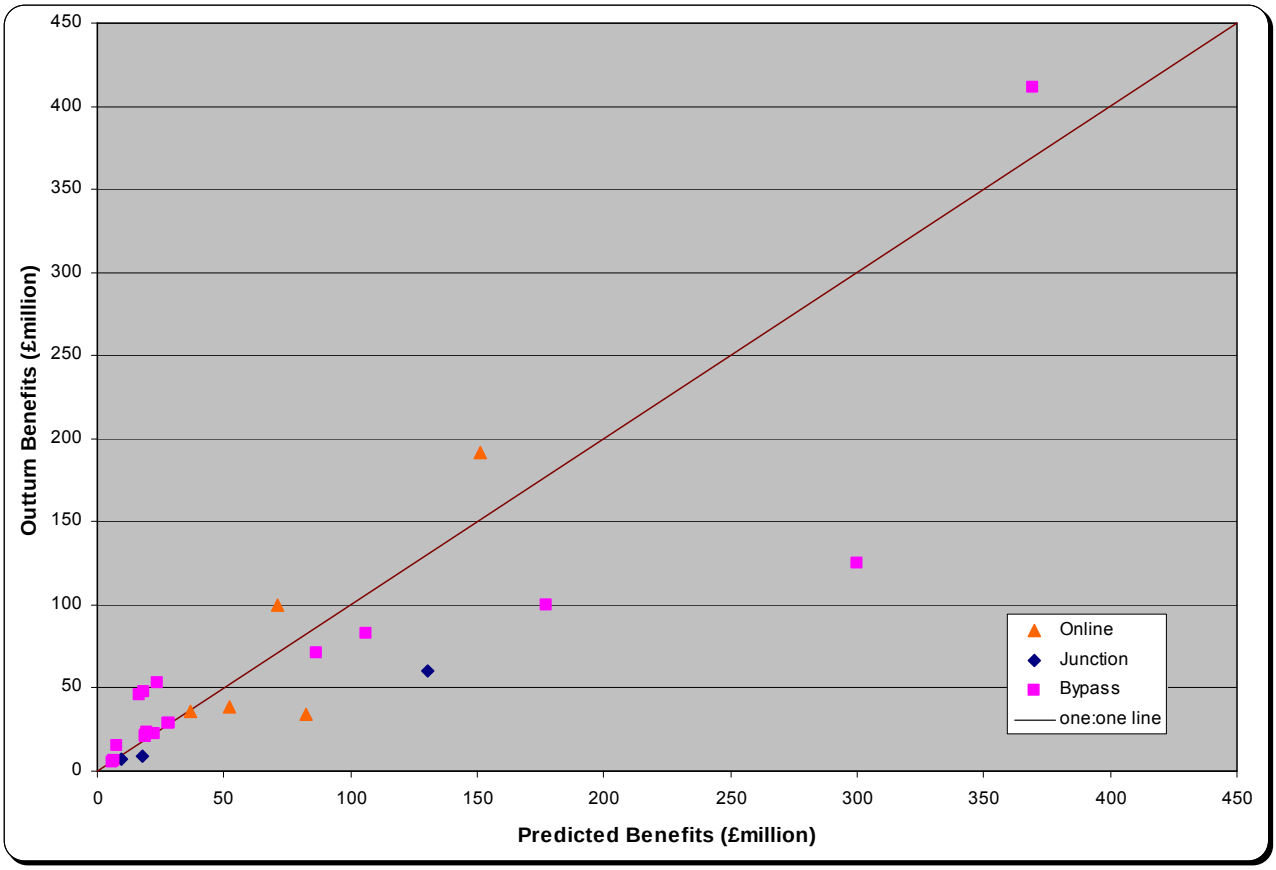
Table note: 'As expected' = outturn benefits are within +/- 15% of predicted

2.15 The travel time benefits of the schemes in Table 2.1 have not been summed or averaged because the schemes use different methods of appraisal, some benefits are forecast over a 30 year period and others over 60 years and they also use differing price bases and discount rates.

2.16 A value of standard deviation of the percentage difference between the predicted and outturn relative to the mean percentage difference has been calculated. The standard deviation indicates how a set of data clusters around its mean, i.e. it shows how far on average the predicted benefits are away from the outturn benefits. For this analysis, the standard deviation is expressed as a percentage difference compared to the mean percentage difference to allow for a comparison between different data sets.

2.17 **Figure 2.2** shows the distribution of schemes according to their predicted and outturn travel time benefits, broken down further into scheme types (bypass, junction improvement and online widening) and compared to a one-to-one line.

Figure 2.2 – Predicted vs. Outturn Travel Time Benefits



2.18 The key points shown in the above graph are:

- Based on the data shown here, there is a slight bias toward over-prediction of benefits.
- There is a significant difference between the accuracy of predictions for the different scheme types. Bypass scheme have a much larger % variation of outturn benefits from the predictions while On-line and Junction improvement predictions have been much more accurate

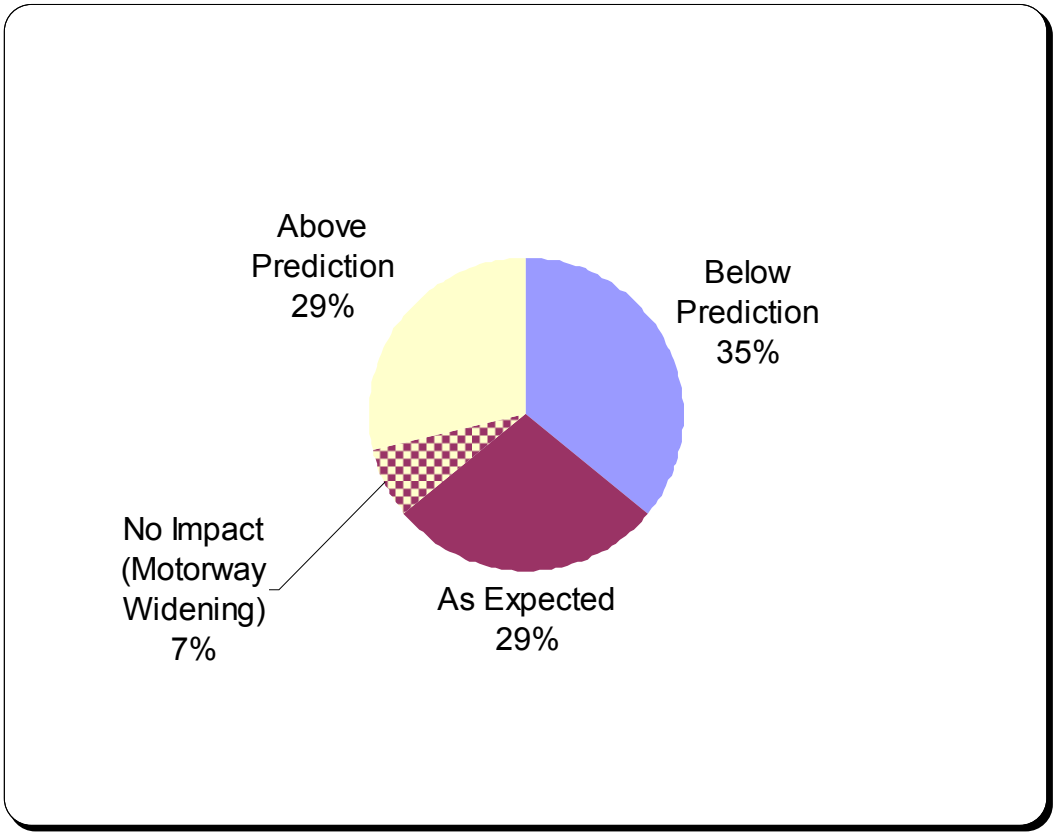
Safety Benefits

2.19 Within the full set of schemes, there are a total of 28 schemes that have been included in this analysis, on the basis of having adequate forecasting and outturn data available. This includes 18 bypass schemes 3 junction improvement schemes and 7 online widening schemes. The daughter document on safety presents a full analysis of effects of the Major Schemes on road safety and this impact feeds through to the scheme economic evaluation.

2.20 **Table 2.2** details the predicted and outturn safety benefits calculated by the POPE evaluation by scheme and **Figure 2.3** summarises the overall performance. As for the travel time benefits, the outturn figures are essentially reforecasts based on observed data from the first year post-opening. However, while trends in traffic flows and speeds can normally be identified easily within the post opening period, it is normal for a longer period to pass before safety trends

become clear. Thus the outturn One Year After safety benefits of the schemes shown here should be considered as less robust than the outturn travel time benefits.

Figure 2.3 – Performance of Outturn Safety Benefits Compared to Predictions



2.21 The results shown in Figure 2.3 show that, of the 28 schemes evaluated, roughly a third have been evaluated as showing a safety outturn as predicted (within 15%). Of the remaining 18, 10 schemes show below predicted benefits and 8 have benefits above the predicted amount.

2.22 As discussed in the Safety meta-analysis, the motorway widening schemes evaluated so far under POPE, were predicted to have no safety benefits. The POPE evaluation of the two motorway schemes included in the table below showed no clear safety trend. Thus, they have been evaluated as having no outturn safety benefit.

2.23 The correct approach for widening schemes would be to adopt observed accident rates for the Do Minimum scenario, and default COBA rates for the Do Something, hence it is possible to predict safety benefits for widening schemes, however for all motorway widening schemes looked at by Atkins, all assumed no safety benefits on the scheme itself or on the wider network.

Table 2.2 – Summary of Monetised Safety Benefits

Scheme	Predicted Safety Benefits (£m)	Outturn Safety Benefits (£m)	% Difference	Performance
A1 Stannington GSJ	7.90	2.00	-75%	worse
A1(M) Ferrybridge - Hook Moor	39.00	35.02	-10%	worse
A10 Wadesmill to Colliers End Bypass	20.20	23.10	14%	as expected
A1033 Hedon Road Improvements	2.27	2.98	31%	better
A11 Roudham Heath to Attleborough	25.90	28.00	8%	as expected
A2 Bean to Cobham Improvement Ph1	5.00	21.30	77%	better
A2/M2 Cobham to Junction 4 Widening	0.88	0.87	-2%	as expected
A21 Lamberhurst Bypass	10.00	14.00	40%	better
A27 Polegate Bypass	3.51	-1.56	-144%	worse
A34 Newbury Bypass	36.00	17.25	-52%	worse
A34 Chieveley/M4 J13 Improvement	2.67	6.07	127%	better
A41 Aston Clinton Bypass	3.73	2.88	-23%	worse
A43 Silverstone and Syresham Bypasses	18.82	10.50	-44%	worse
A46 Newark to Lincoln Improvement	20.05	22.21	11%	as expected
A46 Norton Lenchwick Bypass	5.40	4.60	-15%	as expected
A5 Nesscliffe Bypass	4.99	6.60	32%	better
A5 Weeford - Fazeley Improvement	7.70	14.60	90%	better
A6 Alvaston Bypass	8.70	3.20	-63%	worse
A6 Clapham Bypass	10.22	11.09	9%	as expected
A6 Great Glen Bypass	5.60	6.25	12%	as expected
A6 Rothwell - Desborough Bypass	1.90	-3.22	-270%	worse
A6 Rushden - Higham Ferrers	4.93	14.36	191%	better
A63 Selby Bypass[1]	1.01	61.60	5999%	better
A64 Colton Ln GSJ	0.60	0.33	-45%	worse
A650 Bingley Relief Road	29.00	11.00	-62%	worse
A66 Stainburn and Great Clifton Bypass	9.10	5.05	-45%	worse
M25 J12-15 widening	0.00	0.00		no benefit for motorway
M4 Junction 18 Eastbound Diverge[2]	0.00	0.00		no benefit for motorway

Table note: 'As expected' = outturn benefits are within +/- 15% of predicted

[1] Monetised safety benefit for this bypass was forecast to be relatively low for a bypass type scheme. This was due to the forecast of a slightly increased risk of fatalities from head-on collisions on the single carriageway bypass. Clearly the one year evaluation cannot adequately assess this.
[2] Despite its title, this scheme is primarily a motorway climbing lane.

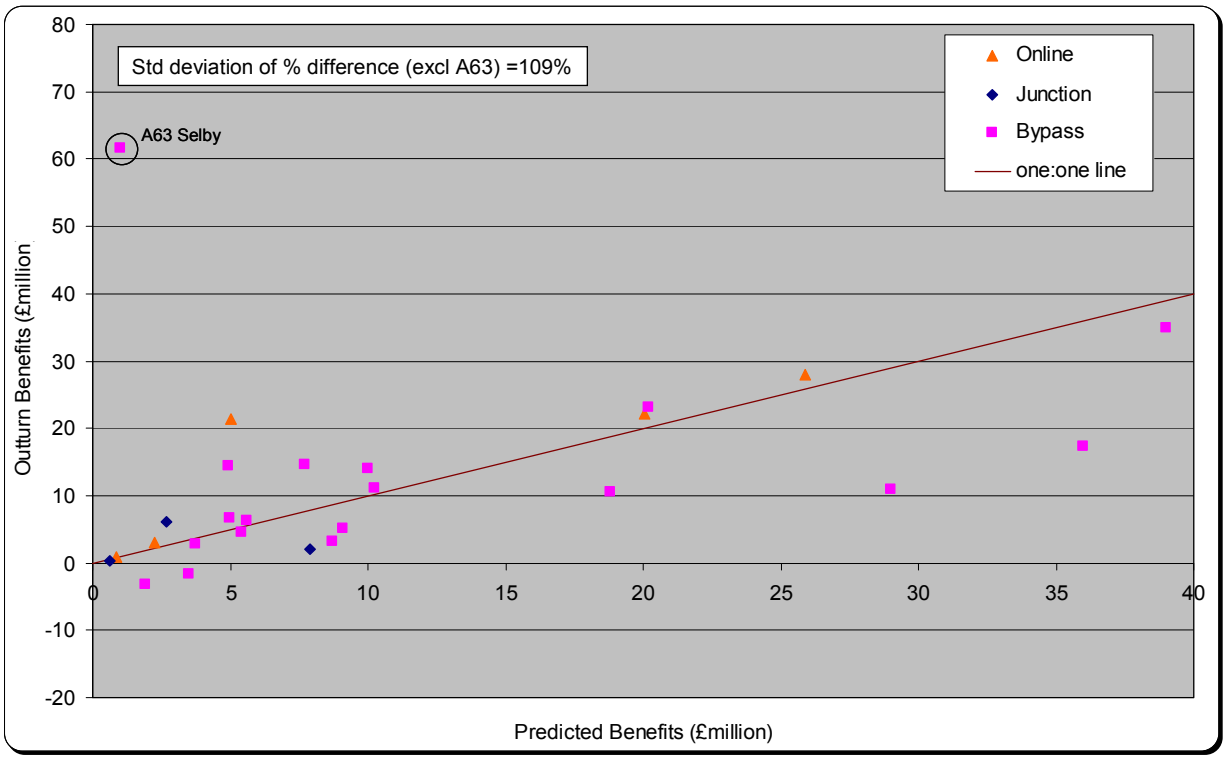
2.24 The safety monetary benefits of the schemes in Table 2.2 have not been summed or averaged because the schemes use different methods of appraisal, some benefits are forecast over a 30 year period and others over 60 years and they also use differing price bases and discount rates.

2.25 Five Years After results for safety benefits should provide more reliable findings. The safety meta-analysis report shows that the preliminary results of the numbers of accidents saved over the early years gives some evidence that predictions get more accurate over time. As the data presented in this economy report is based only on published reports, no data from those studies that are still progressing through the POPE process has been used and hence only two schemes with five year evaluations are included. Of these, the A34 Newbury shows below forecast safety benefits which can probably be explained by the extra traffic in the corridor and the other scheme is close to the expected safety benefit.

2.26 The comparison between the forecast and outturn savings are illustrated graphically in Figure 2.4 The key points regarding safety benefits are:

- Safety benefits show much wider variance between the predicted and outturn values than travel time benefits do. This is indicated by the much larger standard deviation compared to the time benefits;
- Comparing the predicted and outturn results with the 1:1 line shown on the graph indicates that based on all schemes excluding the A63 Selby scheme, low safety benefit forecasts often performed better than expected but schemes with higher benefit forecasts were evaluated to have outturn safety benefits either as expected or substantially below forecast;
- 22% of Bypass schemes had outturn benefits within ±15%, compared to 38% of Junction improvement / online Widening schemes, suggesting bypass schemes are predicted less accurately; and
- Bypass schemes are often predicted to have higher safety benefits than other scheme types. This evaluation has shown that the accuracy of the Bypass scheme predictions is no better than other scheme types.

Figure 2.4 – Predicted vs. Outturn Safety Benefits



What are the Main Contributors to Inaccuracies in Forecasting?

2.27 **Table 2.3** shows how the predicted and outturn benefits are split between travel time and safety benefits. Each scheme has a different split between these two types of benefit, and this is determined by the scheme objectives and actual impacts. Error! Reference source not found. **Table 2.4** shows the average split between the benefits arising from travel time and from safety impacts.

2.28 Note that as detailed in the Introduction chapter, economic data for different schemes is based in differing present value years and with differing discount rates, hence figures presented in this table are not comparable across different schemes hence cannot be totalled or averaged here.

Table 2.3 – Summary of Combined Benefits

Scheme	Predicted Benefits PVB			Outturn Benefits PVB		
	Travel	Safety	Total	Travel	Safety	Total
A1 Stannington GSJ	69%	31%	100%	83%	17%	100%
A1(M) Ferrybridge - Hook Moor	88%	12%	100%	78%	22%	100%
A10 Wadesmill to Colliers End Bypass	81%	19%	100%	76%	24%	100%
A1033 Hedon Road Improvements	94%	6%	100%	92%	8%	100%
A2/M2 Cobham to Junction 4 Widening	99%	1%	100%	99%	1%	100%
A21 Lamberhurst Bypass	65%	35%	100%	60%	40%	100%
A27Polegate Bypass	85%	15%	100%	107%	-7%	100%
A34 Newbury Bypass	91%	9%	100%	96%	4%	100%
A34 Chieveley/M4 Jct 13 Impr.	98%	2%	100%	91%	9%	100%
A41 Aston Clinton Bypass	88%	12%	100%	91%	9%	100%
A43 Silverstone and Syresham Bypasses	56%	44%	100%	83%	17%	100%
A46 Newark to Lincoln Improvement	72%	28%	100%	64%	36%	100%
A46 Norton Lenchwick Bypass	78%	22%	100%	82%	18%	100%
A5 Nesscliffe Bypass	57%	43%	100%	47%	53%	100%
A5 Weeford - Fazeley Impr.	51%	49%	100%	51%	49%	100%
A6 Alvaston Bypass	67%	33%	100%	94%	6%	100%
A6 Clapham Bypass	73%	27%	100%	72%	28%	100%
A6 Great Glen Bypass	55%	45%	100%	51%	49%	100%
A6 Rothwell - Desborough Bypass	76%	24%	100%	232%	-132%	100%
A6 Rushden - Higham Ferrers	77%	23%	100%	76%	24%	100%
A63 Selby Bypass	99%	1%	100%	62%	38%	100%

Scheme	Predicted Benefits PVB			Outturn Benefits PVB		
	Travel	Safety	Total	Travel	Safety	Total
A64 Colton Ln GSJ	94%	6%	100%	96%	4%	100%
A650 Bingley Relief Road	78%	22%	100%	88%	12%	100%
A66 Stainburn and Great Clifton Bypass	71%	29%	100%	82%	18%	100%
M25 J12-15 widening	100%			100%		
M4 Junction 18 Eastbound Diverge	100%			100%		

Table 2.4 – Average Benefit Split by Scheme Type

Scheme type	Predicted Benefits PVB (£m)		Outturn Benefits PVB (£m)	
	Travel Time	Accidents	Travel Time	Accidents
Bypass	74%	26%	85%	15%
Junction improvement	87%	13%	90%	10%
Online widening (excluding M'way widening)	88%	12%	85%	15%
All	78%	22%	85%	15%

2.29 The results shown in Tables 2.3 and 2.4 show that:-

- Overall, the average predicted split of benefits was 78% from travel time savings and 22% from accident savings;
- The average split of the outturn benefits is 85% from travel time savings and 15% from accident savings;
- Bypass schemes were forecast to derive an average of 26% of their benefits from safety impacts. This was much higher than for other types of schemes. However the POPE evaluations show that based on the observations from the opening year, that on average bypass benefits are only 15% derived from safety, which is similar to the other scheme types;
- However, the safety daughter document points out that where five years of accidents are considered rather than one year, the outturn savings more closely reflect the predicted levels of savings; and
- Despite this caveat, it can be concluded that travel time benefits are more important in the outturn scenario than predicted forecasts.

2.30 It should be noted that the average figures presented in Table 2.4 hide the wide variation within individual schemes. The forecasts of travel time benefits as a proportion of the total predicted benefits range from 51 - 100%.

Key Findings

- Outturn benefits are within 15% of predicted benefits for 10 (38%) of the 28 schemes;
- 7 (27%) of the 28 schemes had outturn travel time benefits better than predicted, i.e. more than 15% better;
- 9 (35%) of the 28 schemes had outturn travel time benefits worse than predicted, i.e. more than 15% worse predicted;
- There is no obvious bias towards over- or under-predictions of travel time benefits;
- There is some variation in the accuracy of benefit prediction between the different types of scheme. Bypass schemes tend to have a wider variation from the expected benefits than the other scheme types while on-line and junction schemes appear to have more accurate predictions of scheme benefits;
- The Safety meta-analysis report shows that the predicted savings of accident numbers in the opening year show poor correlation with the outturn savings for many schemes. A variety of reasons were presented to explain this. This is also reflected in the weak correlation between predicted and outturn safety benefits based on One Year After data. There is some indication in the safety meta-analysis of the Five Years After data that the accident saving predictions become more accurate over time and hence it is expected that the safety benefits may also become more accurate over time;
- Outturn One Year After safety benefits of the schemes should be considered as less robust than the outturn travel time benefits. This finding could be considered to be as expected as it is normal for a longer period to pass before safety trends become clear. Of the 28 schemes evaluated 8 (29%) schemes have outturn safety benefits as predicted;
- The motorway widening schemes that have been evaluated have not assumed any accident benefits after widening in their appraisal, neither on the widened route itself nor on the wider network;
- Travel time benefits account for the large majority of monetary benefit, 85%, while accidents provide, on average, 15%. The predicted split gave slightly less emphasis to travel time savings of 78%.

3. Scheme Costs

Introduction

3.1 This section uses the findings from the POPE evaluations to examine the accuracy of the forecast of scheme costs compared to the outturn cost. This includes the accuracy of:

- scheme cost forecasting; and
- cost forecasting by scheme type.

3.2 POPE records scheme cost information as it is a fundamental element of calculating value for money. Where available, the scheme reports give an indication of sources of cost escalation, inaccurate forecasting etc. However, it is important to note that the POPE process is not mandated to investigate the reasons for the differences between predicted and outturn cost as Major Projects already undertakes this on a scheme by scheme basis.

3.3 The scheme cost analysis in this section is based on 26 schemes, comprising 16 bypasses, 4 junctions and 6 online widenings. These are the schemes for which it was possible to obtain a forecast cost and outturn cost.

Data source consistency

3.4 As noted earlier, a crucial element of the assessment of scheme cost estimates has been the consistency and availability of information on outturn major scheme costs. This issue is discussed in greater depth in Section 1 but it is important to re-iterate that the information on scheme costs has to be treated with some caution due to a lack of consistency in the interpretation of scheme costs between different schemes.

3.5 This is a recognised problem, but more recently, reliable outturn cost data for major schemes is supplied for POPE use by the Regional Finance Managers.

Accuracy of Scheme Cost Forecasting

3.6 Table 3.1 shows how accurate the cost estimates have been. The performance column assesses whether the scheme costs were better, i.e. lower than predicted, worse than predicted or as expected, i.e. within +/-15%.

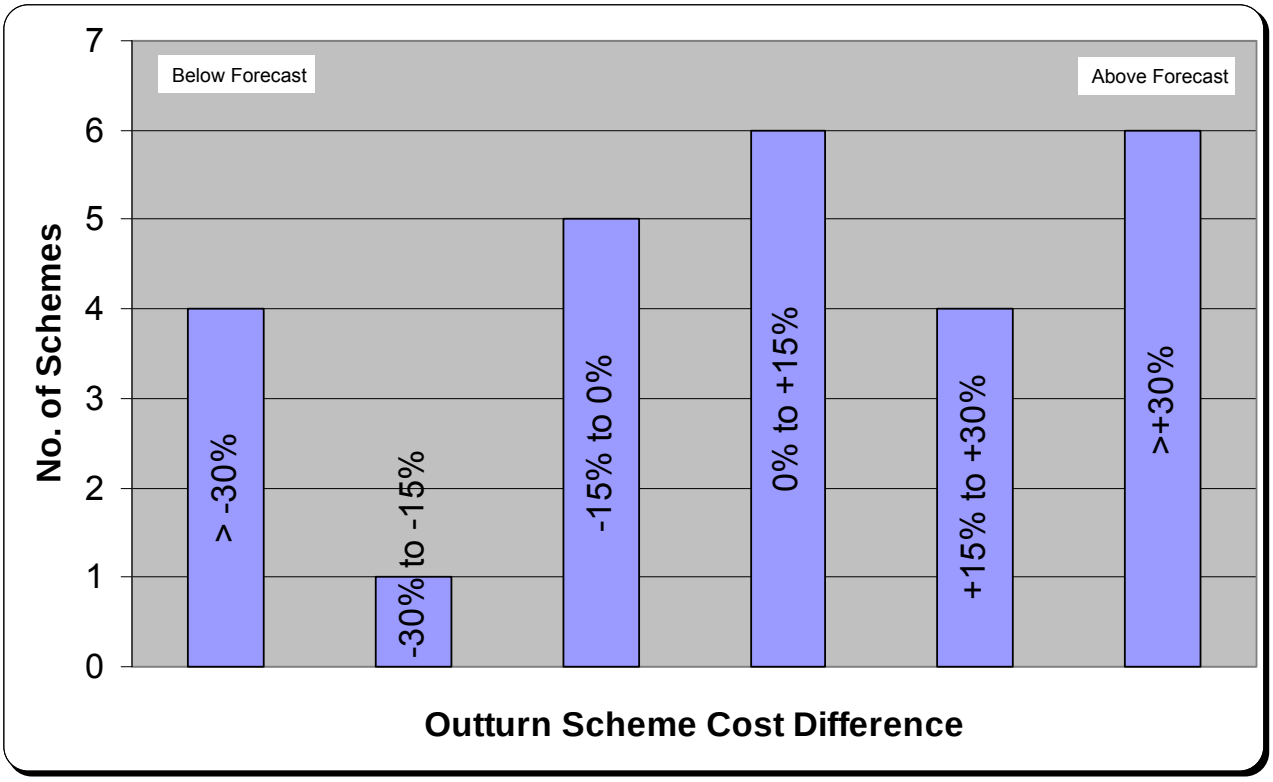
Table 3.1 – Summary of Scheme Costs

Scheme	Predicted Scheme Costs (PVC £m)	Outturn Scheme Costs (PVC £m)	% Difference	Performance
A1 Stannington GSJ	4.05	4.33	7%	As Expected
A1(M) Ferrybridge - Hook Moor	181.90	165.90	-9%	As Expected
A10 Wadesmill to Colliers End Bypass	20.30	40.70	100%	Worse
A1033 Hedon Road Improvements	19.98	18.97	-5%	As Expected
A14 Rookery Crossroads GSJ	10.18	14.32	41%	Worse
A2 Bean to Cobham Improvement Ph1	8.43	9.40	12%	As Expected
A2/M2 Cobham to Junction 4 Widening	74.64	46.38	-38%	Better
A21 Lamberhurst Bypass	11.60	16.50	42%	Worse
A27 Polegate Bypass	9.67	6.58	-32%	Better
A34 Newbury Bypass	74.90	104.50	40%	Worse
A34 Chieveley/M4 Jct 13 Improvement	27.40	31.70	16%	Worse
A41 Aston Clinton Bypass	13.34	21.83	64%	Worse
A43 Silverstone and Syresham Bypasses	13.57	11.79	-13%	As Expected
A46 Newark to Lincoln Improvement	28.77	25.91	-10%	As Expected
A5 Nesscliffe Bypass	7.68	3.53	-54%	Better
A5 Weeford - Fazeley Improvement	26.00	31.50	21%	Worse
A6 Alvaston Bypass	7.61	7.73	2%	As Expected
A6 Clapham Bypass	30.90	26.70	-14%	As Expected
A6 Great Glen Bypass	8.06	5.04	-37%	Better
A6 Rothwell - Desborough Bypass	10.50	13.00	24%	Worse
A6 Rushden - Higham Ferrers	10.46	12.83	23%	Worse
A63 Selby Bypass	36.00	57.10	59%	Worse
A64 Colton Ln GSJ	10.37	10.56	2%	As Expected
A650 Bingley Relief Road	57.00	59.00	4%	As Expected
M25 J12-15 widening	57.00	62.00	9%	As Expected
M4 Junction 18 Eastbound Diverge	11.00	8.20	-25%	Better

3.7 Figure 3.1 shows the distribution of schemes by the accuracy of their cost estimates. Table 3.1 and Figure 3.1 show that:

- Of the 26 schemes, 11 schemes (42%), can be said to have had cost estimates of within 15% of the outturn figure;
- Almost as many schemes, 10 (38%), were over 30% higher or lower than forecast; and
- There is a small bias towards under-estimation of scheme costs, with 62% of schemes over spending compared with their original cost estimate.

Figure 3.1 – Summary of Scheme Costs



Accuracy of Cost Forecasts by Scheme Type

3.8 Figures 3.2 and 3.3 show predicted costs against outturn costs for different scheme types. The schemes that had the largest overspends are highlighted.

Figure 3.2 – Predicted and Outturn Bypass Scheme Costs

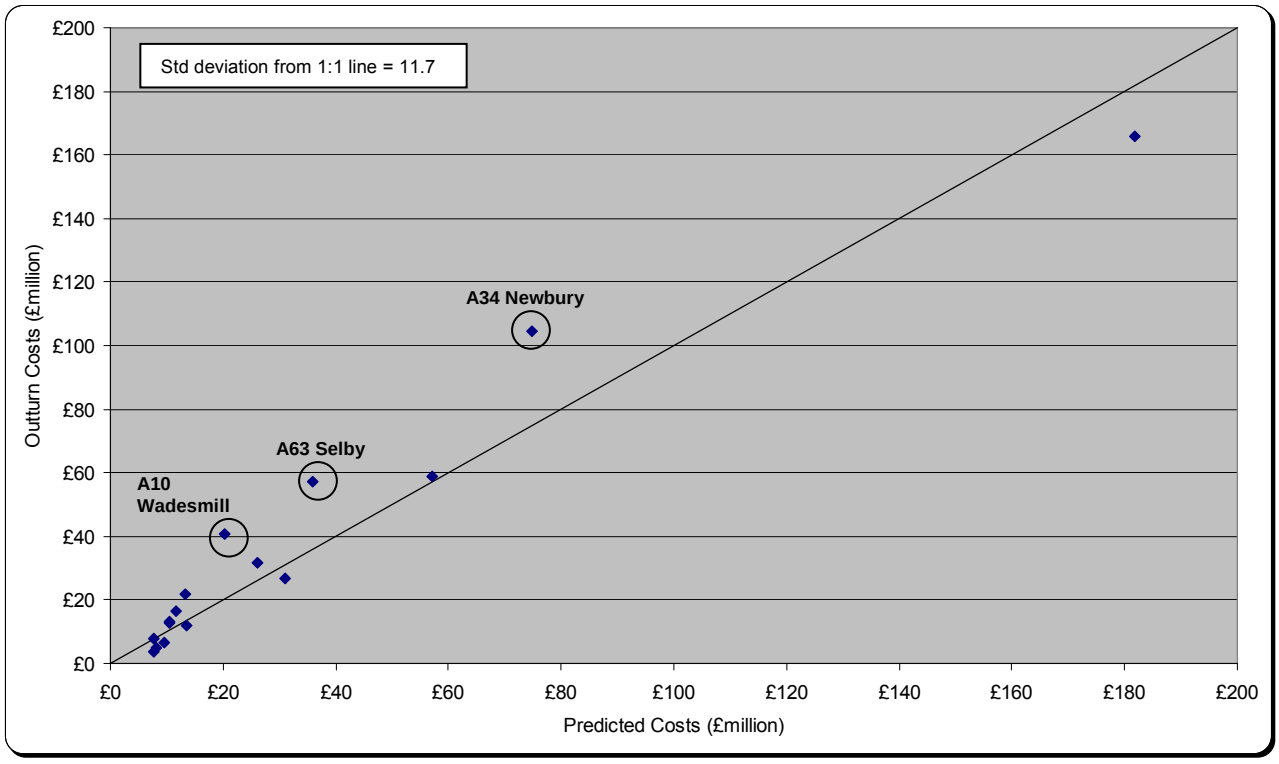
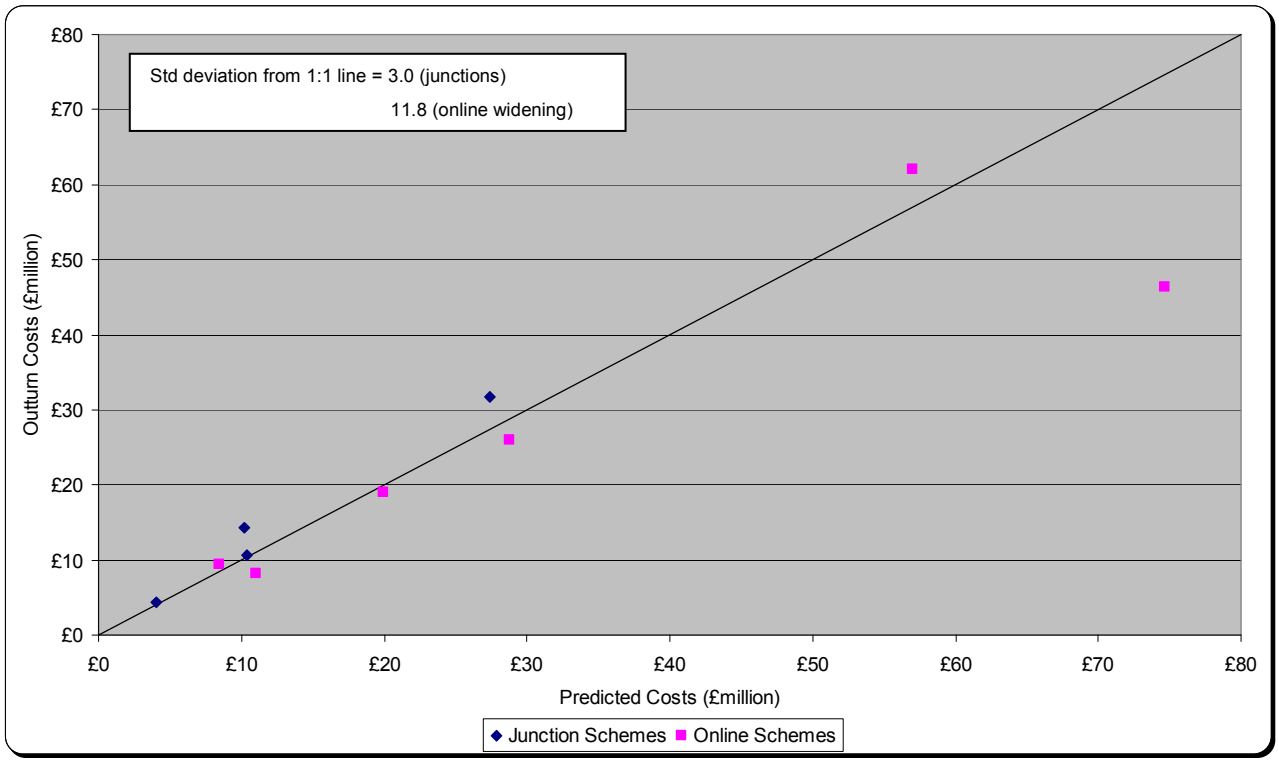


Figure 3.3 – Predicted and Outturn Junction Improvement and Online Widening Scheme Costs



3.9 The graphs and the calculations of the standard deviations from the one-to-one relationship between predicted and outturn cost show that:

- Bypass schemes and online widening schemes have the greatest variability from the predicted costs with the standard deviation of bypass schemes being almost £12m; and
- Junction schemes have more accurate scheme cost predictions with a standard deviation of just £3m.

3.10 The reasons for the increased variability for bypass and online widening schemes may be partly explained by the fact that they often include a large amount of offline works which mean that land purchase is a significant cost and land costs are known to have increased above other types of costs.

Key Findings

- Scheme costs have been difficult to obtain a consensus view on, but the recent change in sourcing of outturn costs has helped to overcome these problems
- 42% of schemes were within 15% of the estimate. It is difficult to know if this is a result of poor scheme cost estimates or poor scheme implementation, but the HA is carrying out more detailed analysis of this issue outside the POPE process
- There is a small bias towards overspend, the ratio of overspend:underspend is 11:7
- Where variances did occur, they tended to be quite large, 38% of schemes showed variations in outturn cost of greater than 30% either above or below the predicted cost: and
- Bypass and online widening schemes show the greatest variability in outturn costs, while junction improvement scheme estimates were the most likely to be accurate.

4. Do the Post Opening Evaluations Show Positive Economic Outturns?

Introduction

4.1 The Benefit to Cost Ratio (BCR) is one of the key economic indicators used by the DfT in the appraisal of the economic worth of transport schemes.

4.2 In the POPE process, an outturn BCR is calculated using the POPE calculation of the outturn benefits and the outturn scheme cost as obtained from the HA.

Comparison between Predicted and Outturn BCR

4.3 BCR is the most difficult aspect of scheme appraisal to predict accurately because it draws together all of the predictions used in the detailed appraisal into a single ratio. The BCR is a simple ratio between the PVB and the PVC and it is used to provide a standard indicator so that schemes can be compared against each other on a simple basis, even though this is still an indicative comparison as some schemes have been evaluated over 30 years and some 60 years, however in all cases, the comparison between forecast and outturn values are consistent. The complexity of economic scheme appraisal is encompassed within the calculations for benefits and costs. Therefore, the BCR is susceptible to a large number of potential errors in each monetary element of the scheme costs and benefits and the potential for inaccuracy is thus greater in the BCR than for the separate cost and benefit measurement in the previous sections of this report.

4.4 The BCRs quoted within this report are the ones reported before any adjustment by the DfT team to account for various impacts that are not monetised within the appraisal process.

4.5 The categories of value for money are:

- BCR <1 – Poor value for money;
- BCR between 1 and 1.5 – Low value for money;
- BCR between 1.5 and 2 – Medium value for money; and
- BCR >2 – High value for money.

4.6 These categories show that the BCR is the starting point for the Value for Money assessments, but non-monetised need to be examined to see if they would change the overall VfM rating. In practice these non-monetary impacts are usually small, in monetary terms, but they are significant in certain schemes and some funding decisions have been influenced by these factors in the past.

4.7 The overall average BCR across all schemes was predicted to be 2.9 while the outturn BCR has been slightly lower, 2.6, so the programme of schemes as a whole can be considered to be delivering a reasonably accurate prediction of the BCR. However, there are wide variations between schemes that make up this overall average.

4.8 Table 4.1 shows that there are quite wide variations between predicted and outturn BCR values on individual schemes but the particular mix of both positive and negative means that the average variation across all schemes is quite small. There are very few schemes where the outturn BCR is close to the predicted; only three schemes were within 15% of the predicted figure while four schemes were over 100% different.

4.9 There is little bias to BCR prediction. Of those schemes where a comparison can be made, 11 of the schemes have performed better than predicted while 13 have been worse.

Table 4.1 – Predicted and Outturn BCR

Scheme	Predicted	Outturn	%	Outturn Performance
A1 Stannington GSJ	6.4	2.6	-59%	Lower
A1(M) Ferrybridge - Hook Moor	1.8	1.0	-48%	Lower
A10 Wadesmill to Colliers End Bypass	5.2	2.3	-56%	Lower
A1033 Hedon Road Improvements	2.0	2.1	5%	Higher
A2/M2 Cobham to Junction 4 Widening	1.0	2.2	126%	Higher
A21 Lamberhurst Bypass	2.5	2.1	-16%	Lower
A27Polegate Bypass	2.4	3.4	43%	Higher
A34 Newbury Bypass	5.4	4.1	-24%	Lower
A34 Chieveley/M4 Jct 13 Impr.	4.9	2.1	-57%	Lower
A41 Aston Clinton Bypass	2.4	1.5	-39%	Lower
A43 Silverstone and Syresham Bypasses	3.1	5.4	72%	Higher
A46 Newark to Lincoln Improvement	2.5	2.3	-7%	Lower
A5 Nesscliffe Bypass	1.5	3.5	137%	Higher
A5 Weeford - Fazeley Impr.	0.6	0.9	56%	Higher
A6 Alvaston Bypass	3.5	6.6	87%	Higher
A6 Clapham Bypass	1.2	1.5	22%	Higher
A6 Great Glen Bypass	1.5	2.5	64%	Higher
A6 Rothwell - Desborough Bypass	0.8	0.2	-75%	Lower
A6 Rushden - Higham Ferrers	2.1	4.7	128%	Higher
A63 Selby Bypass	4.9	2.8	-43%	Lower
A64 Colton Ln GSJ	1.0	0.7	-26%	Lower
A650 Bingley Relief Road	2.4	1.6	-33%	Lower
Average	2.9	2.7	-6%	Lower

4.10 Figures 4.1 and 4.2 show how the BCR performance compares between different types of schemes. Figure 4.1 shows the distribution of predicted and outturn BCR for bypass schemes while Figure 4.2 shows it for online and junction improvements. Some of the schemes that had the largest variations in actual and forecast BCR are highlighted in the Figures.

Figure 4.1 – BCR Accuracy for Bypass Schemes

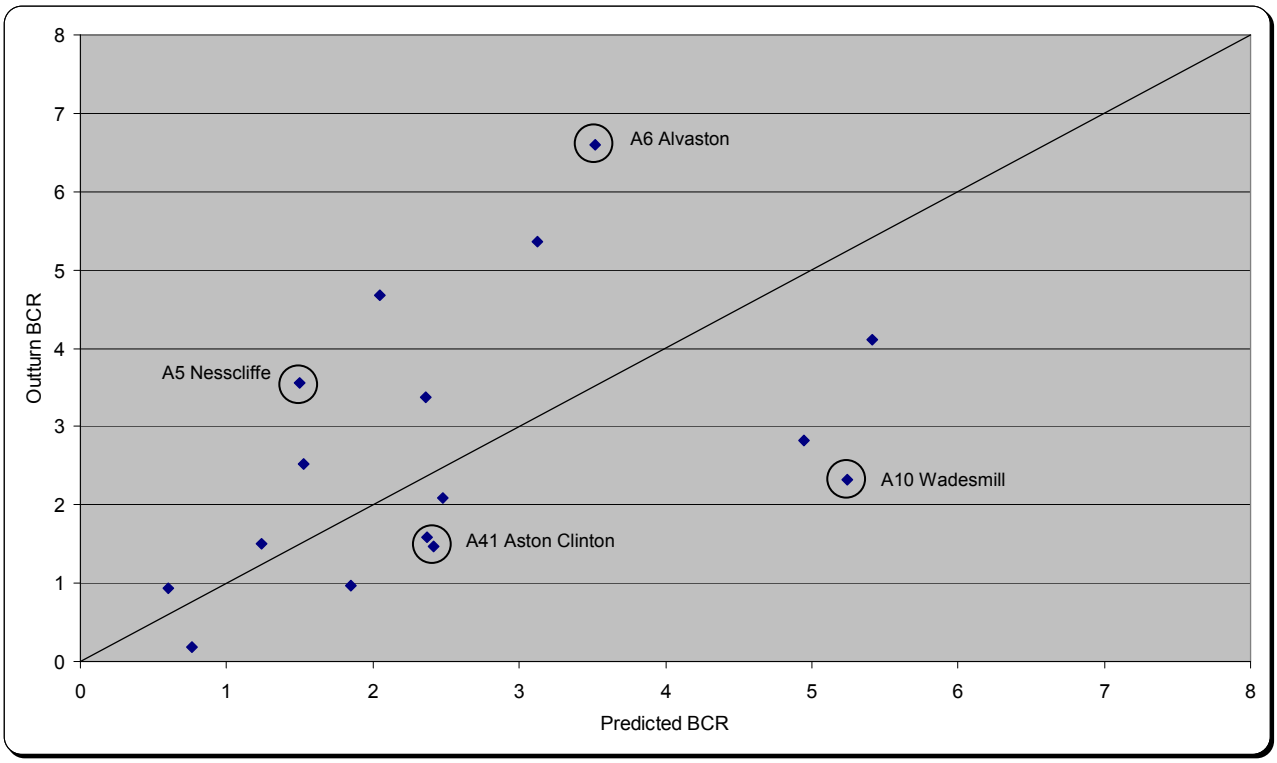
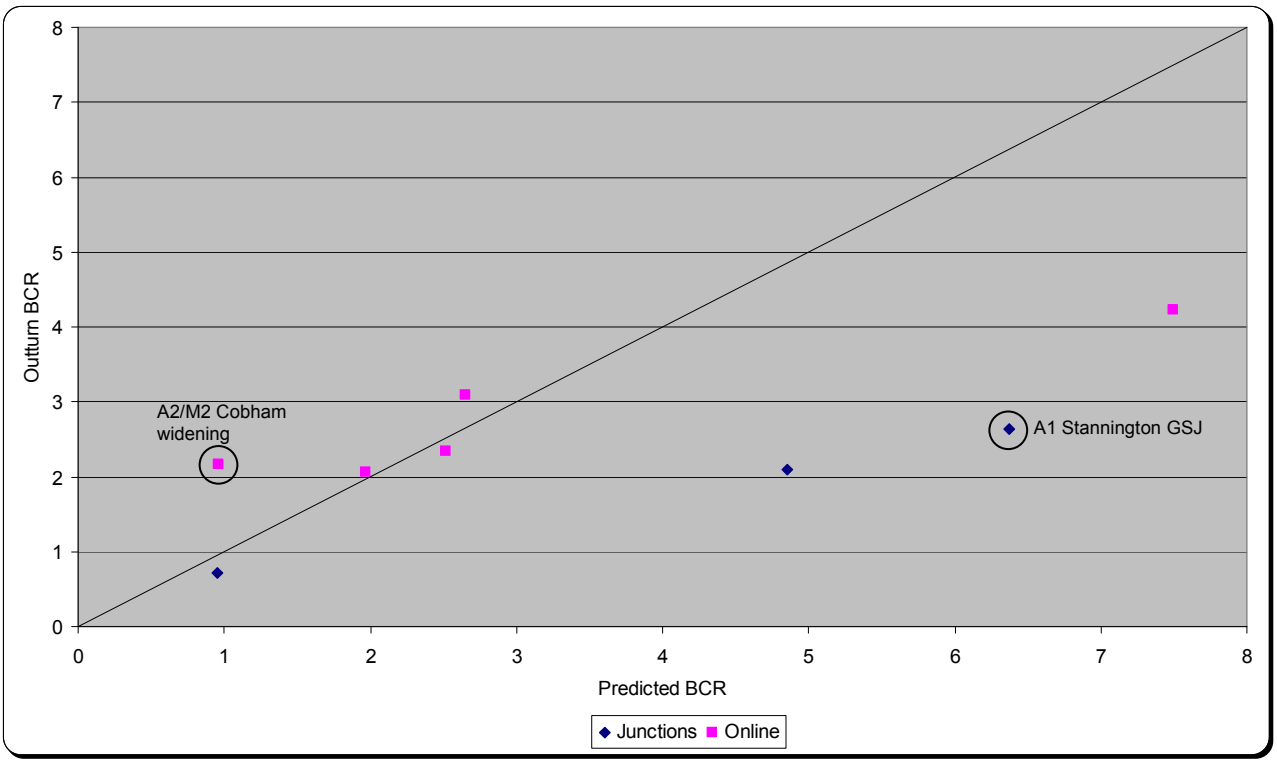


Figure 4.2 – BCR Accuracy for Junction Improvement and Online Widening Schemes



4.11 Bypass schemes show widely scattered BCRs, with 50% better and 50% worse than forecast, as shown by the symbols above and below the one-to-one line.

4.12 There are a lower proportion of junction and online widening schemes above the one-to-one line than for bypass schemes, which suggests they are more likely to deliver a BCR that is in line or

below the predicted ratio. The sample size for these schemes is quite low, involving only eight schemes, so as a result the confidence level of these conclusions has to be limited.

4.13 These results show that bypass schemes are more likely to deliver better than expected BCRs than the other types of major schemes.

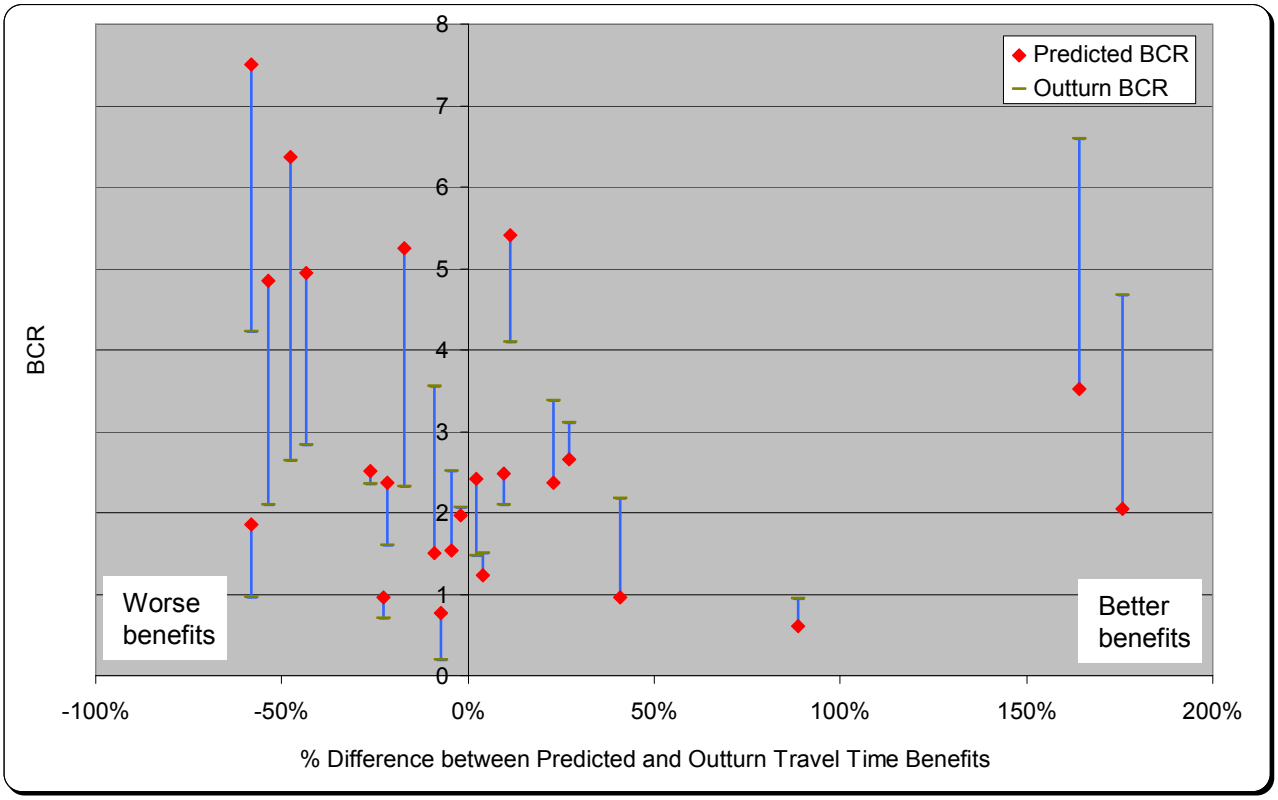
4.14 The measurements of the standard deviation (σ) of the outturn against predicted BCR from the one-to-one relationship of these three distributions gives an indication of how accurate the predictions are for the different scheme types. It does not take into account whether the outturn is an over or under prediction, just its overall accuracy. The bypass schemes and online widening schemes have a σ of 1.7 and 1.6 respectively, while the three junction schemes show more disparate results with a σ of 2.7. This suggests those junction schemes BCRs are more variable than the other scheme types. However, the sample sizes for online widening and junction schemes are quite small so care must be taken in attaching too much weight to these statistics.

Relationship between Scheme Benefits and BCR

4.15 The variations between predicted and outturn BCR presented in the previous section are caused by multiple factors. The variation can be caused by higher or lower outturn scheme costs, by higher or lower outturn scheme benefits or by a combination of these two factors. Sometimes these variations work in opposite directions to cancel each other out.

4.16 Figure 4.3 shows the relationship between the accuracy of the predictions of traffic benefits and the outturn BCR. It shows how the outturn BCR changed in response to the outturn traffic benefits that the scheme delivered. In general, those schemes that delivered less than expected traffic benefits (those on the negative side of the Y axis) suffered a reduced BCR to varying degrees. Those that have accurate predictions saw little change in their outturn BCRs while those that achieved greater traffic benefits delivered better BCRs.

Figure 4.3 – Relationship between Difference between Predicted and Outturn Travel Time Benefits and the Predicted and Outturn BCR



Relationship between Scheme Costs and BCR

4.17 A similar analysis has been carried out into the relationship between changes in scheme costs and changes in BCR. Figures 4.4 to 4.6 show how the difference between predicted and outturn scheme costs has affected the outturn BCR for the different scheme types. It is clear that a small majority of schemes have suffered an increase in outturn scheme costs compared with predicted, 18 schemes had higher than expected scheme costs compared with 11 that were cheaper than predicted.

4.18 Some schemes experienced very large increases in BCR as a result of these cost savings, such as the A5 Nesscliffe Bypass. The A5 Nesscliffe is the only scheme to achieve an output BCR of greater than 2.0 after having a forecast of below 2.0. Other schemes were predicted to deliver a BCR of less than 2.0 and the outturn remained below this threshold. Schemes that have suffered large increases in scheme costs have seen consequential reductions in their outturn BCR, such as the A10 Wadesmill where scheme costs doubled and the BCR fell from 5.2 to 2.3.

4.19 Other schemes have experienced changes in their outturn BCR that do not appear to be related to a change in scheme cost, and there are also schemes that have experienced a change in cost that has had little or no effect on its BCR. This is because there has also been a change to the economic benefits achieved, i.e. both sides of the cost-benefit analysis have changed and the ratio between them has changed very little.

Figure 4.4 – Relationship between Accuracy of Scheme Costs and BCR – Bypass Schemes

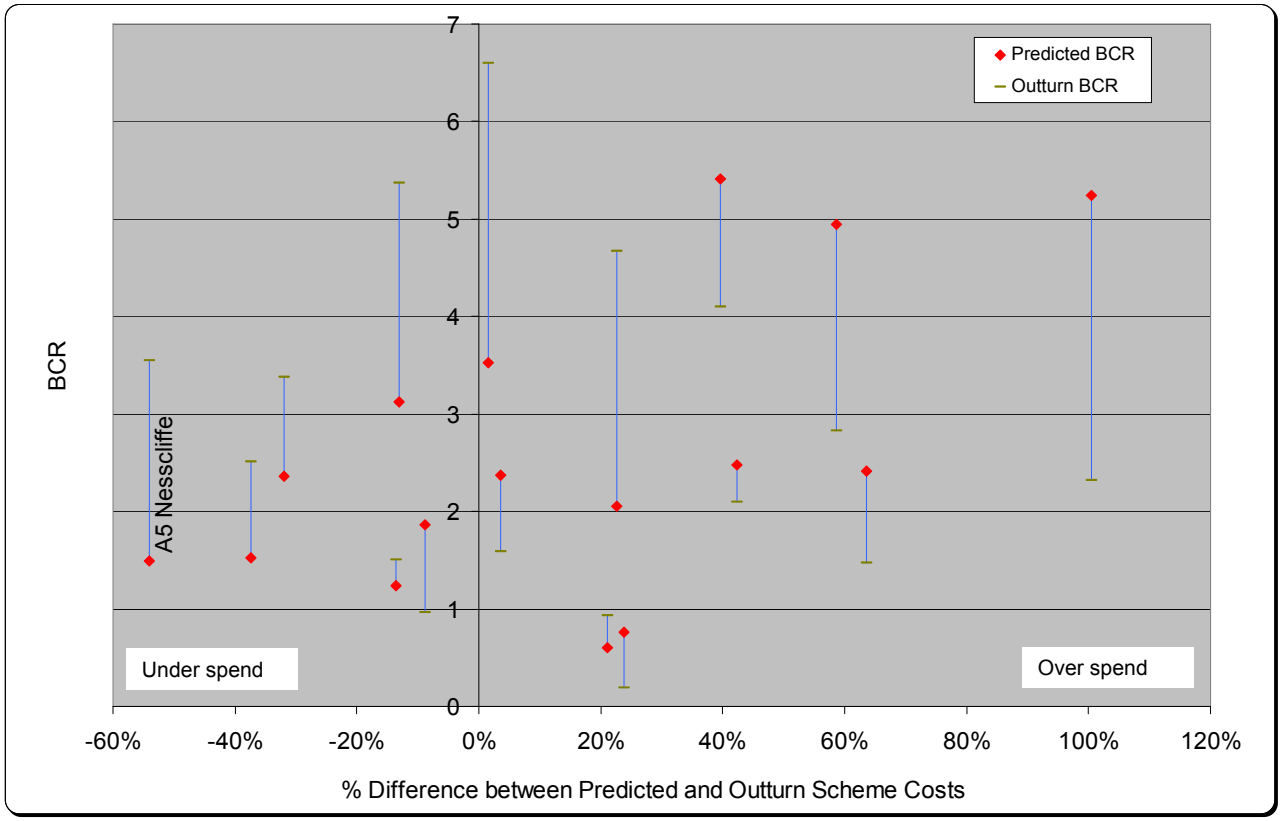
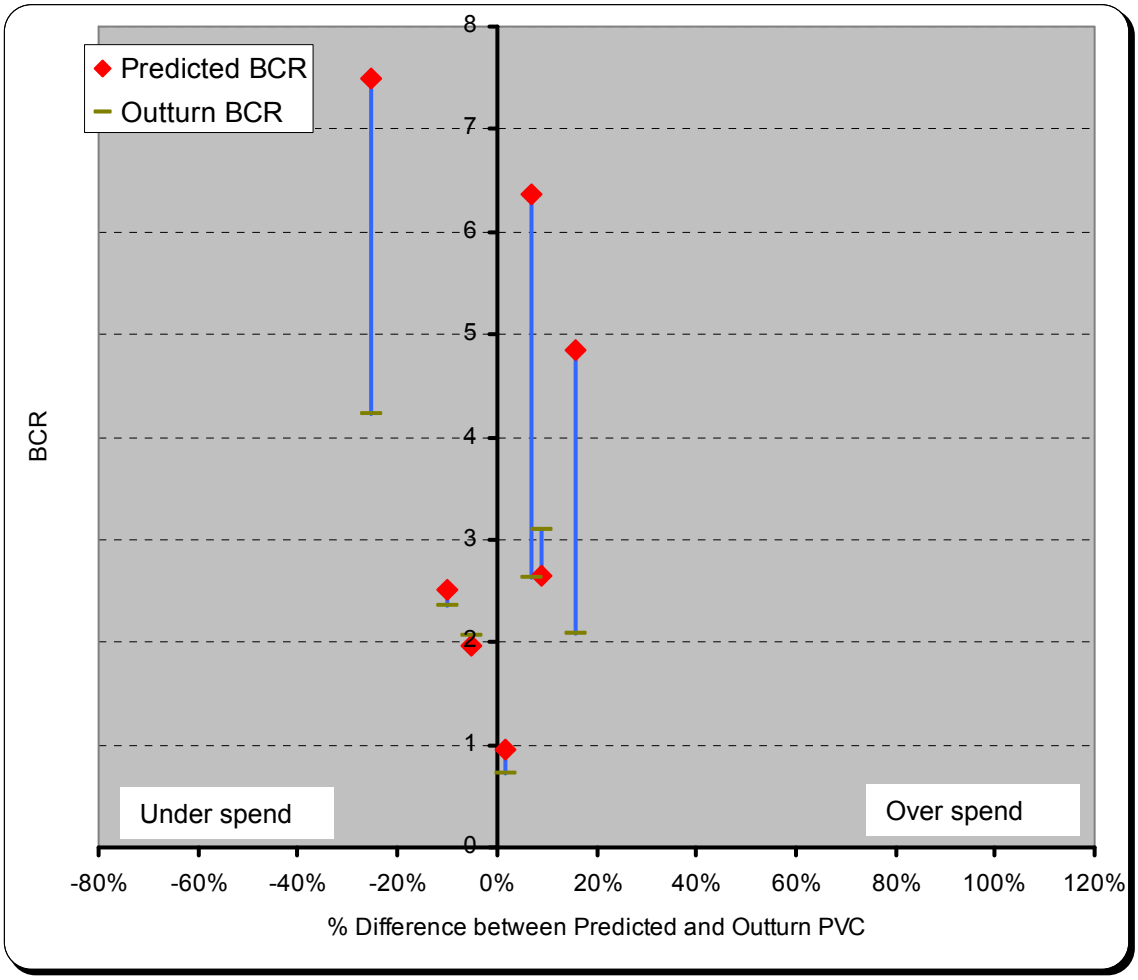


Figure 4.5 – Relationship between Accuracy of Scheme Costs and BCR – Online Widening and Junction Schemes



4.20 Figure 4.4 and 4.5 show how the different types of scheme have been affected by changes in scheme cost. Figure 4.4 shows that bypass schemes have shown large shifts in their BCR in response to variations in scheme cost. Online widening and junction schemes show large variations in response to scheme costs, but the sample size is small so it is difficult to draw firm conclusions. Online widening schemes show the smallest change in BCR and their forecasts are more likely to be accurate than those for other types of scheme.

Individual Scheme BCR Analysis

Case Studies of Schemes that have Experienced Significant Change in Their BCR

4.21 Certain schemes have delivered outturn BCRs that are significantly different from that forecast. This section analyses these schemes in some depth to explain why these variations have taken place to inform the debate on how to avoid or mitigate them from happening in the future. **Table 4.2** shows some examples of schemes that have had an outturn BCR that is significantly different to their forecast. It shows examples of schemes that have achieved both better and worse BCR's and there is some explanatory text about each scheme.

Table 4.2 – BCR for Schemes Showing a Major Change

Scheme	Predicted			Outturn		
	PVB (£m)	PVC (£m)	BCR	PVB (£m)	PVC (£m)	BCR
A6 Alvaston Bypass	26.80	7.61	3.5	51.00	7.73	6.6
A10 Wadesmill to Colliers End Bypass	106.50	20.30	5.2	94.50	40.70	2.3
A43 Silverstone and Syresham Bypasses	42.41	13.57	3.1	63.25	11.79	5.4
A1 Stannington GSJ	25.80	4.05	6.4	11.40	4.33	2.6

Schemes that have Experienced a Large BCR Variation

A6 Alvaston Bypass (Predicted BCR 3.5, Outturn BCR 6.6)

4.22 The Alvaston scheme experienced a large increase in outturn BCR and this was due to a doubling of outturn scheme benefits from £26.8m to £51m. Table 4.2**Error! Reference source not found.** shows that this increase in benefits was due to a very large increase in travel time savings, outturn accident benefits were actually less than half of those predicted.

A10 Wadesmill to Colliers End Bypass (Predicted BCR 5.2, Outturn BCR 2.3)

4.23 This scheme delivered a much lower than expected BCR, which was largely due to a doubling of outturn scheme costs from £20.3m to £40.7m. Economy benefits were slightly lower than predicted but still within 15%.

A43 Silverstone and Syresham Bypasses (Predicted BCR 3.1, Outturn BCR 5.4)

4.24 The Silverstone and Syresham Bypasses experienced a large increase in outturn BCR and this was due to a large increase in economy benefits from £42.41m to £63.25m and also a small reduction in outturn scheme costs. The higher than expected economy benefits were obtained through travel time savings that were more than double the forecast. Safety benefits were significantly lower than forecast.

A1 Stannington GSJ (Predicted BCR 6.4, Outturn BCR 2.6)

4.25 This junction scheme produced a much lower than expected BCR, mainly because the economy benefits it provided were less than half of those predicted. The outturn scheme costs were close to the forecast costs. The travel time and accident reduction forecast were both significantly over-estimated and were not delivered by the scheme.

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Key Findings

- BCR is the most difficult economic indicator to predict prior to implementation and explain post-implementation because it is influenced by so many factors that can affect the ratio in opposite ways
- Overall, the schemes have achieved a slightly lower average BCR (2.6) than was predicted (2.9) but the accuracy of the overall BCR average prediction is good. The number of schemes that have achieved a higher than expected BCR (12) is the same as those with a lower one (12).
- The variations for individual schemes within this overall average are very large; a very small number of schemes have an outturn BCR that was close to predicted
- Bypass schemes are more likely to deliver a higher BCR than the other scheme types; and
- There are clear links between changes in scheme costs and benefits and the resulting BCR, but it difficult to demonstrate these relationships across the programme of schemes.

5. Conclusions and Recommendations

Overview

5.1 This section provides a summary of the conclusions and recommendations emerging from this daughter document of the meta-Report. The main areas of assessment for economic impact were determining:

- Any conclusions regarding data availability
- The accuracy of the estimates of benefits?
- The accuracy of the estimates of scheme costs?
- Whether the Post-Opening Evaluations show positive economic outturns?

5.2 The conclusions and recommendations outlined below are for the Highways Agency and Department for Transport to consider as part of any revisions to the appraisal and evaluation processes.

Data Availability

5.3 POPE is a process which began in 2001, originally to evaluate schemes in what was termed the Targeted Programme of Improvements (TPI), now termed the Major Schemes (MS) Programme.

5.4 These schemes opened from 2002 onwards; however, the appraisals or justification for these schemes were undertaken in the 1990s well before POPE started. Therefore the evaluation team were dependent on the original appraisal material and reports being available, but unfortunately this was not always the case.

Conclusions

- The POPE process has helped to archive all appraisal information and reports, so that they are available for the evaluation stage;
- This archive should include the main appraisal reports such as the final versions of the Data Collection Report, Local Model Validation Report and Forecasting and Economics Report, as well as any updated documents following the release of these reports; and
- The lack of clarity on the differences between Do Minimum and Do Something traffic volumes and journey times within the Forecasting and Economics Report and in the derivation of scheme costs has hindered the explanation of differences between predicted and outturn benefits, costs and the Benefit Cost Ratio.
- Frequently, the appraisal process is long and complicated and information about scheme design, scheme costs, AST's and other appraisal documents change throughout this process and it can be very difficult to establish what is the most up-to-date information to use in the POPE. The introduction of the Project Control Framework (PCF) is expected to assist in the standardisation of data in the future.
- All of the evaluations to date have been appraised through the use of COBA. More recent appraisals have used the DfT Program TUBA, which is a matrix-based approach, and hence will be more problematic in identifying benefits on particular links

How Accurate are the Estimates of Benefits?

5.5 This question required an analysis of predicted and outturn scheme benefits. The following conclusions can be made:-

Conclusions

- The forecasting of scheme benefits uses a large range of assumptions and techniques so the key to an informative evaluation is to ensure that the predicted and outturn figures are using a comparable base. This can be particularly difficult when the predictions are old and use out-of-date methodologies or when the predictions have little or no supporting information on how they have been derived.
- The forecasting of travel time benefits is not very accurate with only 38% of schemes within +/- 15% of the predicted benefits. However, there is no evidence of a systematic bias towards either under- or over-prediction.
- Scheme benefits are made up of travel time benefits and monetised accident benefits and each of these is subject to variation between the predicted and outturn figures. Travel time benefits largely outweigh accident benefits in most cases but there can be under-prediction for one of these categories and over-prediction for the other. So the variation can cancel itself out to make the overall prediction appear to be good, or it can be compounded if both variances are in the same direction. This is why looking at just the total effect can mask errors within the appraisal process.
- Variation in travel time benefits is caused by poor traffic flow forecasts from the traffic modelling. There are many reasons why this happens and these are explained in more detail in the Traffic Model Performance daughter document. The Traffic daughter document concludes that the main reasons why models produce inaccurate forecasts are; unexpected re-assignment of traffic on a strategic and a local level, inaccurate traffic growth assumptions, the effects of other road schemes on the model results and the effect of unexpected land use changes.
- The predictions of accident savings and, therefore, accident benefits, vary significantly from the outturn figures for a large proportion of schemes. This is not necessarily a criticism of the forecasting methodology but is more likely to be affected by the lack of long term data for the schemes. Accidents are infrequent and it is difficult to draw any conclusions after only one year of post-opening data, and hence, as the number of Five Years After reports increases the significance of the figures will increase. Inaccuracies in traffic flow forecasting have a knock-on effect on accident forecasts through the COBA model.
- Outturn travel time benefits account for the large majority of monetary benefit (85% compared to 15% for safety benefits), although caution should be taken as individual schemes are evaluated with differing present values.

How Accurate are the Estimates of Costs?

5.6 This question required an analysis of predicted and outturn scheme costs. The following conclusions can be made:-

Conclusions

- Scheme costs are particularly difficult to establish with any certainty because of the time differences between appraisal, construction and the POPE process and the way that the value of money changes over time. There is also some variation between predicted costs at scheme implementation and those costs that are used in the economic appraisal of the scheme. Scheme costs themselves also vary over time, if the detailed design or the risk register changes or if actual inflation is different to forecast so it is important to establish the costs at the most relevant point in time to provide a good comparison.
- It was difficult to obtain consistency in outturn scheme costs, however, the HA has introduced a new system for co-ordinating and publishing major scheme costs to overcome this problem of inconsistency.
- Cost estimates also have a relatively low level of accuracy, with 58% of schemes differing by more than 15% but are not strongly biased towards overspend or underspend. Research and analysis has been carried out through the Nichols Report and ongoing work is being carried out by the HA to improve the accuracy of scheme cost forecasting.

Do the Post-Opening Evaluations show Positive Economic Outturns?

5.7 Overall economic outturn takes all of the figures from the benefit and cost calculations and presents them as simple summaries of scheme benefits minus costs (Net Present Value) and the relationship between benefits and costs (Benefit Cost Ratio, BCR). These statistics are intended to provide a consistent base against which dissimilar schemes can be directly compared. By their nature these relatively simple figures incorporate a large volume of calculations and assumptions. Errors in the base predictions can cancel each other out to produce what looks like accurate predictions of BCR or NPV, or the errors can be compounded to produce a very inaccurate result.

5.8 Given the variability within the large number of factors that go to make up the Benefit to Cost Ratio the overall average outturn BCR is close to the predicted figure. However, there is a wide variability within the individual schemes that make up this average and this variability damages the confidence in the forecasting of future scheme BCRs. There is, however, no evidence of a systematic bias within BCR calculations towards under- or over-prediction.

Conclusions

- The programme as a whole is delivering BCRs in line with predictions but that the individual schemes show a high level of variability.
- Overall, the schemes have achieved a slightly lower average BCR (2.7) than was predicted (2.8) but the accuracy of the overall BCR average prediction is good.
- The number of schemes that have achieved a higher than expected BCR (12) is the same as those with a lower BCR (12).

- The variations for individual schemes within this overall average are very large; a small number of schemes have an outturn BCR that was close to predicted. Bypass schemes are more likely to deliver a higher BCR than the other scheme types
- There is little evidence of any systematic bias in the forecasting of scheme benefits and costs. The assessment of changes of BCRs suggests that although some are reduced compared to predicted, all are positive, and most still represent high value for money. There are no schemes that have been built that have subsequently proved to be poor value for money.
- There are three schemes where the outturn BCRs are below 1.0, but all had low predicted BCRs also, and were justified on non-economic reasons.

Recommendations

5.9 In light of the conclusions drawn on economic issues, we have identified a number of recommendations to be considered by the Highways Agency and the DfT.

Data Collection and POPE Issues

- POPE is heavily reliant on the accurate provision of data, often produced many years ago by people and consultants who are no longer involved. It is important therefore for the POPE consultant to obtain all relevant reports and files that have been used in the appraisal of schemes before opening. This is currently being undertaken as standard, and HA Project Managers and/or scheme consultants are encouraged to prepare such information for handover.
- Progress has been made in the recent guidance for major schemes and appraisals, which now includes a requirement for business cases to set out how the post-opening evaluation will be carried out, and hence the current guidance is supported and encouraged. Greater consistency of approach and information archiving will help to ensure that the POPE process can highlight real issues and trends rather than just anomalies caused by data collation issues.

Economic Assessment Issues

- Economic benefits from new schemes considered in this review of evaluation have been derived from Transport Models, hence accuracy of predicting scheme benefits is a function of the accuracy of traffic volume predictions. It is clear therefore that the recommendations outlined in the Traffic model performance daughter document on how the modelling process can be improved should be adopted, particularly:
  - Ensuring sufficiently wide network to encompass all likely traffic volume changes;
  - More consideration of local, re-assigned traffic;
  - Consideration of more robust background traffic growth;
  - Consideration of inclusion/exclusion of additional schemes; and
  - Consideration of likely land use change.
- For the small number of motorway widening schemes evaluated, the recommended approach of using observed accident rates in the Do Minimum and default COBA accident rates is not being applied and no accident benefits are being predicted. More recent

schemes may be applying this approach, but more adherence to this guidance is recommended.

- The use of TUBA to derive economic benefits for the scheme will be problematical for the POPE process as it will not be possible to derive benefits from specific links for comparison with outturn data. As such, there will be a requirement to consider the best approach for the evaluation of schemes which have used TUBA.
- Current guidance within WebTag outlines the recommended supporting analyses within scheme appraisal. One of these is **distribution and equity**, which recommends that the spatial distribution of benefits is clearly demonstrated, normally through the use of sectored areas, both local to the improvement and further afield. This approach is also fundamental for the evaluation of schemes and therefore adherence to this guidance is recommended. In order for evaluations to be possible for projects that have used TUBA in the economic appraisal, a sector area from a cordoned model demonstrating benefits on key links adjacent to the scheme (and where observed flows and times are available) is recommended to be adopted as standard.
- An improvement to the understanding of economic benefits would be the use of an Uncertainty Log for each scheme appraisal such that economic benefits are shown for more than one scenario so that the sensitivity of changing economic benefits is understood when key assumptions are changed. Again, this is current guidance, but this is not demonstrated in the evaluations currently undertaken, and would help with the understanding of the predicted benefits.
- The forecasting of accident benefits makes a contribution, albeit smaller than travel time, to the economic impact of schemes and the changes that are recommended in the Safety daughter document will help to improve the accuracy of these forecasts. This emphasised the importance of using a sufficiently wide and detailed area in the model for routes where strategic (and local) re-assignment is likely to be an issue.
- Accident forecasts are also subject to differences against outturn savings within the modelling process and will benefit from the recommendations set out in the Traffic model performance daughter document for improving the traffic flow forecasts.

Scheme Costs

- In terms of cost data, there are many types of scheme costs and sources, and this has led to confusion over comparing like-for-like comparisons. For comparison purposes, predicted costs should be derived from PCF stage 5 Final Business Case, and relevant Project Managers briefed as to this requirement.
- The introduction of the system of using Regional Finance Managers should provide a more robust estimate of outturn scheme costs but the HA needs to ensure that scheme costs are being interpreted consistently in the different regions.
- Analysis of the accuracy of scheme cost estimates is ongoing by the HA and this work will generate its own recommendations. It seems likely that the introduction of a more sophisticated cost estimation process in recent years, using techniques such as Quantified Risk Assessments, will improve the accuracy of cost estimates, but the results of this will take time to filter through to the POPE process.

Other Issues

- Obviously, non-monetised objectives are excluded from this sort of analysis because they do not contribute towards scheme economics, but are still a vital element of the appraisal process. The evaluation also does not fully consider other monetised benefits such as noise, wider economic benefits and carbon emissions, however appropriate methodologies for evaluation should be derived to take account of these to derive a more representative BCR.
- The introduction of monetary assessment of other objectives should continue to expand, particularly in issues such as journey reliability, local air quality, noise and wider economic benefits, to give more weight to the BCR comparisons that can be made.