ATKINS
AECOM

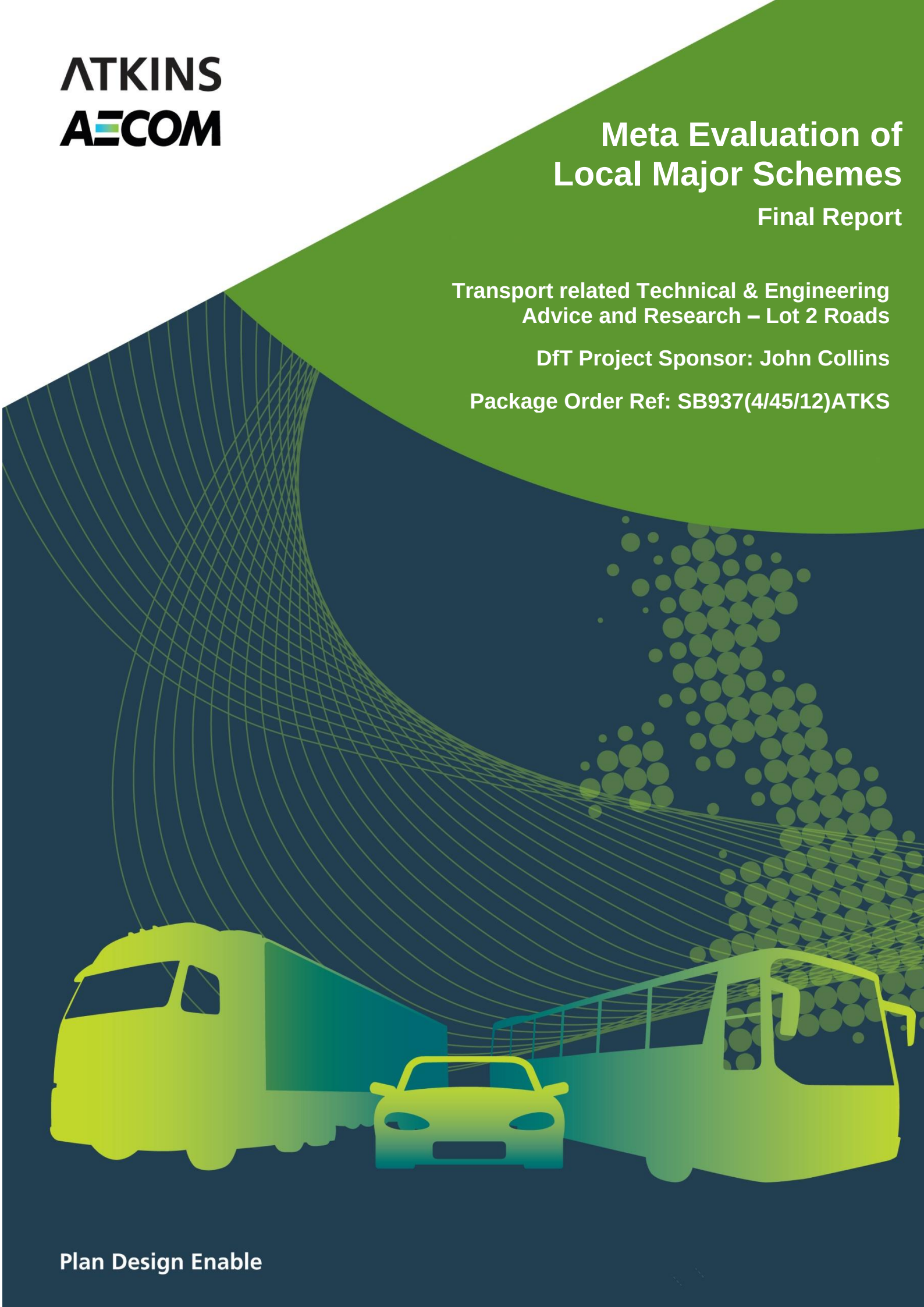
Meta Evaluation of Local Major Schemes

Final Report

Transport related Technical & Engineering Advice and Research – Lot 2 Roads

DfT Project Sponsor: John Collins

Package Order Ref: SB937(4/45/12)ATKS



Plan Design Enable

Meta Evaluation of Local Major Schemes

Final Report

Highways Agency/DfT
Framework for Transport Related Technical and Engineering Advice and Research Lot 2

Task Ref: SB937 (4/45/12) ATKS

DfT Project Sponsor: John Collins

Submitted by:

Atkins Limited

Notice

Document History

Revision	Purpose Description	Originated	Checked	Reviewed	Authorised	Date
1	Draft Report	NW/RR/DD	GO/RR	NDM	NDM	14/03/14
2	Final Report	NW/RR/DD	GO/RR	NDM	PR	25/03/14
3	Final Report – Incorporating Additional DfT Comments	NW/RR/DD	GO/RR	NDM	PR	01/04/14
5	Final Report – Removal of Cambridge Guided Busway from cost analysis	NW/RR/DD	GO/RR	NDM	PR	02/04/14
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7	Final Report – Final changes following local authority comments	NW/RR/DD	GO/RR	NDM	PR	12/05/14
8	Final Report – Correction to Fig 7	NW/RR/DD	GO/RR	NDM	PR	10/07/14

Contents

Section Page

Appendices

Appendices are contained in a separate document as follows:

- **Appendix A** – Programme and Cost Data;
- **Appendix B** – Scheme Templates;
- **Appendix C** – Review of Data Quality (by scheme);
- **Appendix D** – Review of Data Quality (by attribute); and
- **Appendix E** – Scheme Promoter Questionnaire

Executive Summary

The National Audit Office (NAO) report on Local Authority Major Schemes[1] highlighted the importance of evaluation for ensuring transparent and accountable decision making. Since that time the Department for Transport (DfT) has taken a number of steps to improve monitoring and evaluation, and in the context of Local Major Schemes has released further monitoring and evaluation guidance[2] with the aim of ensuring as consistent and proportionate a process as possible. It will be some time before Local Major Scheme evaluation results are available that have used to most recent guidance measuring a consistent set of metrics, however the DfT would like to share any lessons that are available from evaluations that have been recently completed and submitted to the DfT.

In November 2013, therefore, the DfT commissioned Atkins and AECOM to undertake a 'Meta Analysis of Local Major Scheme (LMS) Evaluations'. The commission draws upon evidence contained in 23 monitoring and evaluation reports prepared for schemes implemented between 2007 and 2012.

A meta analysis was not possible due to the limitations of the data, which is perhaps unsurprising given that less of an emphasis was placed on evaluation by the DfT during that period. To enable the best use of the data available a meta evaluation has therefore been undertaken which is supplemented with additional evidence obtained through dialogue with the scheme promoters.

Main findings

Delivery to Cost and Programme

- Schemes are delivered 23 months later than forecast at Programme Entry Stage. This slippage reduces to an average of 5 months at Full Approval Stage.
- The causes of programme delays vary by scheme. Interaction with third parties (particularly delays caused in dealing with statutory undertakers) is the most commonly reported cause of programme slippage.
- Scheme costs are, on average, 52% higher than forecast at Programme Entry Stage. Greater certainty exists at Full Approval Stage, with only a 4% average increase in scheme costs from that stage. These figures are broadly in line with the current DfT guidance on optimism bias assumptions for use in the appraisal of schemes at different stages of a project lifecycle.
- The main reason cited by scheme promoters for cost change was delay in the scheme approval process and general programme slippage resulting in increased prices due to inflation.
- Cost and programme forecasting certainty improves significantly between Programme Entry Stage and Full Approval Stage. This would imply that scheme promoters should be actively encouraged to develop their 'Management Business Cases' at the earliest possible opportunity to help mitigate against programme and cost over-runs. If undertaken at the scheme prioritisation stage, this also gives the added benefit of ensuring the right schemes are taken forward for delivery.

Objectives and first order outcomes

- From the evidence provided, LMS have evidently been successful in delivering a range of short term objectives, particularly focused on reducing congestion and improving journey times.
- Public transport schemes have also been shown to deliver objectives of reliability, punctuality and service quality, albeit for a small number of schemes.

Other findings

- Little evidence was presented in evaluation reports to demonstrate the delivery of longer term objectives such as economic, environmental and social impacts.
- Few scheme evaluations (3 out 23) reported updated outturn Benefit-Cost Ratios.
- There was a general lack of evidence presented on mode choice with the majority of schemes presenting scheme specific data.

[1] Review of Local Authority Major Capital Transport Schemes, National Audit Office (2011)
[2] Monitoring and Evaluation Framework for Local Authority Major Schemes, DfT (2012)

- Reduced congestion and improved network performance were often used to infer improvements in air quality and to a lesser extent, noise. Minimal use was made of actual environment monitoring data.
- Few scheme evaluations compared forecast impacts with actual impacts thus restricting the opportunity to fully understand the reasons for any variance.

Lessons for future evaluations

The evaluation standard for LMS implemented was highly varied. This has limited the opportunity to identify constructive lessons for promoters of future LMS. The key lessons identified are as follows:

- A requirement to present baseline, target and outturn data for each outcome being evaluated would enhance the quality of future post opening evaluations.
- The observed counterfactual scenario generally used the observed pre scheme data collected as part of the Business Case preparation. No attempt was made to consider an updated counterfactual situation.
- There was limited evidence of data triangulation in scheme evaluations, through which to draw more robust and meaningful conclusions. There was an over reliance on single datasets, often consisting of single data points for each of the before and after periods.
- There was limited evidence from end users, with the exception of selected public transport schemes. Although it is recognised that undertaking end-user research for highways schemes is often prohibitive on cost grounds, understanding cause and effect of observed behaviour change would significantly enhance the quality of scheme outcome attribution in the post opening evaluation.
- There was poor evidence of intervention logic, resulting in assumed changes and linkages being reported, which could not be evidenced by data. The use of logic mapping and the more common adoption of combined methods incorporating elements of theory-based techniques will help to address this issue.

1. Introduction

1.1 Study Purpose

The recently published Monitoring and Evaluation Framework for Local Authority Major Schemes[3] highlighted the Department for Transport's (DfT) intention to periodically publish meta analysis findings. In November 2013, the DfT commissioned Atkins and AECOM through the DfT T-TEAR Framework to undertake a 'Meta Analysis of Local Major Scheme (LMS) Evaluations'. The commission draws upon monitoring and evaluation reports prepared for schemes implemented between 2007 and 2012.

Through a systematic review of LMS evaluation reports prepared to date, the DfT is keen to draw out lessons learnt that will help:

- Better understand the extent to which the expected impacts of the LMSs have materialised;
- Identify key learning points to assist scheme promoters and their delivery partners respond to their devolved scheme prioritisation and local delivery responsibilities; and
- Inform ongoing development of its Monitoring and Evaluation Framework for Local Authority Major Schemes published in September 2012.

Further to the above commission objectives, the DfT has a number of more specific research interests that form the basis of the analysis presented in this report. These are summarised in **Table 1**.

Table 1. Summary of DfT Evaluation Areas of Interest for Local Major Schemes (LMS)

Delivery	Impacts and Outcomes	Lessons Learnt for Appraisal, Evaluation and Delivery
• Are LMS delivered on time? (if not, why not?) • Are LMS delivered on budget? (if not, why not?) • Do LMS delivery value for money?	• How well do schemes deliver their stated outcomes? • What are the main benefits of LMS (does this vary by scheme type/context?) • How do LMS impact on traveller experience? • Is there evidence LMS impact on modal choice? • How do LMS impact on the environment? • How do LMS impact on the local economy? • How do LMS impact on local bus operations? • How well have the impacts of LMS been forecast?	• What are the reasons for differences between forecast and out-turn? • What lessons can be learnt to improve LMS evaluation? • What key learning points should be communicated to future LMS promoters?

[3] Monitoring and Evaluation Framework for Local Authority Major Schemes, DfT (2012)

1.2 Important Definitions

The HM Treasury Magenta Book (April 2011)[2] provides useful background context to meta analysis and evaluation methods and their relevance to evaluation of government policy and infrastructure interventions.

In its simplest form, **meta analysis** refers to the process of analysing quantitative data aggregated from individual evaluation reports. Statistical techniques are then used to quantify the average or combined effect interventions can have on particular impacts and outcomes. The validity of results from meta analysis relies heavily on how data is collected, presented and analysed at the individual scheme level. Where the aforementioned is consistent across individual schemes, the potential for effective and meaningful meta analysis is higher. Where scheme data is collected using varying methods and levels of quality, its overall statistical robustness will be poor and consequently results and conclusions are likely to be misleading.

Although very similar in its underlying principals, **meta evaluation** offers a more flexible means of meta study in that it does not rely purely on the use of aggregated meta data. It allows for the synthesis of results of individual evaluations using both 'formal and informal' methods, to estimate the average or cumulative effect of transport interventions against a set of defined objectives, outcomes or impacts. By way of example, meta evaluation offers the scope to use less formal methods of data interrogation such as focus groups, questionnaires or a simple review of evidence. Collectively these methods can then be used to identify key learning outcomes.

For reasons discussed later in this document, a meta evaluation approach underpins the analysis presented in this report.

1.3 Document Structure

The remainder of this document is structured as follows:

- **Overview of Study Approach (Section 2):** Sets out a summary of the overall process and methodology followed in this study;
- **Data Quality Review (Section 3):** Contains a review of the data accessible from the evaluation reports and the extent to which it is fit for use in Meta Evaluation**;**
- **Meta Evaluation of Cost and Programme Forecast Accuracy (Section 4):** Summarises the extent to which schemes are delivered on cost and programme. Where accessible, additional explanation of reasons for these variances is also provided;
- **Meta Evaluation of LMS Impacts and Outcomes (Section 5):** Summarises the outcome and impact evidence available from evaluation and monitoring reports provided to the DfT; and
- **Conclusions and Lessons Learnt (Section 6):** This section provides a summary of the evaluation headline findings and more specifically sets out relevant lessons learnt that may be of wider interest to promoters of future LMS.

A separate document of supporting appendices also accompanies this report.

[2]HM Treasury, The Magenta Book, Guidance for Evaluation (April 2011).

2. Overview of Study Approach

2.1 Introduction

This section sets out a short overview of the methodological approach to this study. The analysis presented in subsequent chapters of this report was conducted in three key stages:

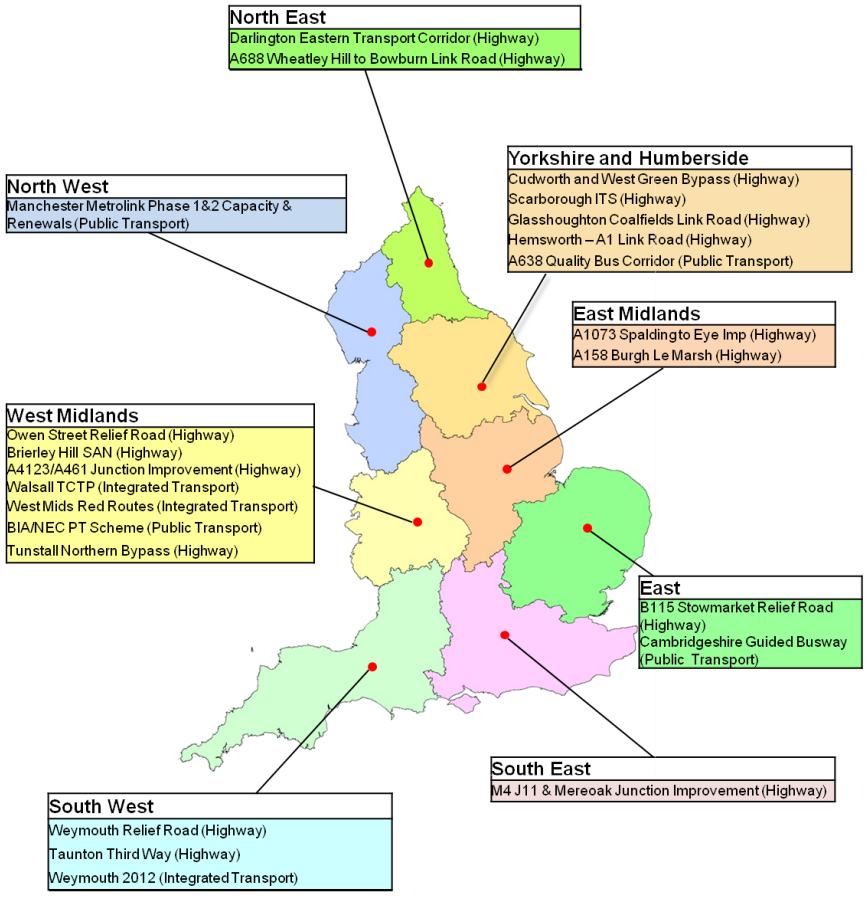
- Desktop review of data quality to enable meta analysis;
- Distribution of stakeholder feedback surveys; and
- Desktop meta evaluation of scheme evaluation and monitoring reports.

2.2 Overview of Data Sources

Two primary datasets were provided to the study team for review, these are summarised as follows:

- Cost and programme data was provided for 28 transport schemes implemented between 2007 and 2012. These are tabulated in **Appendix A**; and
- 23 evaluation and monitoring reports provided by scheme promoters. The geography and typology (highway, public transport and integrated transport) for all of the 23 schemes are summarised in **Figure 1**.

Figure 1 – Scheme Locations



Evaluation reports for five schemes were not provided in time for inclusion in this project, these schemes are listed below:

- Greater Bristol Bus Network (Public Transport Scheme);
- A631 West Bawtry Road Improvement (Highway Scheme);
- Kirklees- Strengthening and Maintenance Work (Highway Scheme);
- North Middlesborough Accessibility (Highway); and
- Poole Bridge Regeneration – Core Scheme Element (Integrated Transport).

Given the absence of detailed information for the above schemes, a total sample population of 23 schemes has been assumed for this study.

Supplementary surveys were also undertaken with scheme promoters. These are described in more detail in Section 2.4.

2.3 Desktop Review of Data Quality

The extent to which useful conclusions can be drawn from meta analysis is highly dependent on the overall quality of the data. According to Dekkers et al (2013)[3], meta data must fulfil a number of key characteristics for it to be fit for use in meta analysis (**Table 2**).

Table 2. Attributes of Good Meta Data

Criteria	Attribute
Accuracy	The measures used to assess a particular impact/outcome are relevant.
Availability	All of the required data is readily available now.
Completeness	The evaluation documentation contains all of the data needed to answer the research question.
Conformance	The analysis has been completed to the necessary standard and it is correct. There is an adequate balance of qualitative and quantitative evidence provided in the reports
Consistency	The data set lends itself to like for like comparisons between different schemes in the overall sample.
Credibility	The data is supplied from robust sources.
Processability	The data supplied is process-able i.e. the data can be easily aggregated and handled in the meta analysis phase.
Relevance	The data provided across evaluation reports is relevant to the DfT's core evaluation priorities (**Table 1).**
Timeliness	The evaluation timing is correct and relevant to the likely research questions being posed in the analysis.

A review of the data available in the evaluation and monitoring reports was undertaken to:

[3] *"Provision of Services for the publication, access and re-use of Open Public Data across the European Union, through existing open data portals."* (Contract No. 30 – CE0530965/00-17) 2013. Makx Dekkers, Nikolaos, Loutas, Michiel De Kevzer and Stijin Goedertier (PWC).

- Briefly set out a general overview of the attributes of good meta data and thus set the scene for how the overall quality of data used in the meta evaluation; and
- Highlight the extent to which the evaluation data made available to the DfT satisfies the attributes necessary for reliable meta analysis.

Within the context of best practice guidelines, an overarching assessment of the quality of data and its relative utility for further analysis in meta evaluation was undertaken. The detailed review of the data available is presented in **Section 3** is informed by the evidence in the supporting appendices:

- **Appendix A:** Scheme programme and cost data;
- **Appendix B:** Scheme pro-formas used to capture key evidence from scheme evaluations on a consistent basis;
- **Appendix C:** A general summary of the relative strengths of evidence for each of the key research questions (by scheme).
- **Appendix D:** A general summary of the relative strengths of evidence for each of the key research questions (by attribute).
- **Appendix E:** Scheme Promoter Questionnaire.

2.4 Stakeholder Feedback Surveys

The above review of monitoring and evaluation reports showed that scheme programme and cost data best matched the attributes for good meta data described in **Table 2**. In absence of detailed reasons for cost and programme variances in scheme evaluation reports, further stakeholder engagement was deemed an appropriate means by which to explore the primary reasons for cost and programme variances.

A short questionnaire **(Appendix E)** was distributed to 23 scheme promoters to:

- Elicit the views of scheme promoters regarding the reasons for differences between major scheme programme and cost variances;
- Better understand at what stage in the project lifecycle these variances occur and their main causes;
- Identify best practice and lessons learnt relating to management of programme/cost variances throughout a project; and
- Record the extent to which schemes have resulted in intended/unintended impacts.

A total of 20 responses were received and contained varied levels of detail (**Table 3**).

Table 3- Responses Received

Scheme	Response Received	Scheme	Response Received
A158 Burgh Le Marsh Bypass	✓	Walsall TCTP	✓
B1115 Stowmarket Relief Road	✓	Weymouth Transport Package for 2012 games	✓
A4123/A461 Burnt Tree	✓	A628 Cudworth and West Green Bypass	✓
Cambridgeshire Guided Busway	✓	A638 Quality Bus Corridor	✓
Darlington Eastern Transport Corridor	×	BIA NEC Public Transport Scheme	✓
M4 J11 and Mereoak Improvement	×	Brierley Hill SAN	✓
Owen Street Relief Road	✓	Weymouth Relief Road	✓
A1073 Spalding to Eye	✓	Taunton Third Way Major Scheme	✓
A688 Wheatley Hill to Bowburn Link	×	Glasshoughton Coalfields Link Road	✓
Metrolink Track Renewal and Blockade	✓	Hemsworth - A1 Link Road	✓
Scarborough Integrated Transport Scheme	✓	West Midlands Red Routes - Package 1	✓
Tunstall Northern Bypass	✓		

Additional evidence provided by scheme promoters has been used to inform and validate the analysis presented in **Section 4**.

2.5 Desktop Meta Evaluation

Recognising the varied data quality (**Section 3**), the meta evaluation presented in **Sections 4** and **5** of this report has focussed on the following:

- A review of the returned stakeholder questionnaires to facilitate a more detailed explanation of cost and programme variances than can currently be gleaned from the evaluation reports alone;
- Preparing a succinct summary of the evidence available to answer the DfT's research priorities set out in **Table 1 (Section 1).** Although the analysis supporting the responses to each of these questions will be variable, it will provide the DfT and scheme promoters with an early view of the relative successes/shortcomings of the LMS programme.

3. Data Quality Review

3.1 Introduction

This section explores in detail the extent to which the data provided by scheme promoters to date satisfies the data qualities described in **Section 2**

3.2 Review of LMS Evaluation Evidence

3.2.1 Overview

Table 4 provides a summary of the main attributes of the data available from the monitoring and evaluation evidence currently available to the DfT. This is followed by a more detailed consideration of the general suitability of data in answering each of the DfT's key evaluation priorities.

Table 4 - Summary of LMS Evaluation Reporting Quality

Data Attribute	Summary of LMS Evaluation and Monitoring Report Data – Key Attributes

Accuracy	• Appropriate and consistent scheme cost and programme metrics (forecast and out-turn) are available for all 28 schemes implemented to date.
	• Where reported, the metrics used to demonstrate short term outcomes have been relevant. Illustrative examples include:
	  ◦ Reported changes in AADT to demonstrate traffic impacts;
	  ◦ Comparison of measured pre and post opening journey times and variance to demonstrate congestion improvements;
	  ◦ Comparison of observed Personal Injury Accidents (PIAs) numbers/rates to demonstrate scheme impact on safety indicators; and
	  ◦ Isolated use of patronage data to demonstrate modal shift changes.
	• In the limited instances where they are reported, longer term outcomes associated with modal shift, local bus operations and impacts on the economy are predominantly qualitative and inconsistently evidenced.
	• Rarely have any metrics/narrative been presented to explain reasons for differences between forecast and out-turn outcomes and impacts.
	• Little or no narrative has been provided on lessons learnt for the future.

Availability	• Scheme cost and programme information has been provided for all schemes. • The detailed traffic and environment (air quality) data supporting the high level findings presented in the evaluation are not contained in the evaluation reports and would need to be sought from scheme promoters. • Detailed Personal Injury Accident data is more readily available - the main reports tend to contain evidence of annual accident numbers. • The majority of the evaluations report on one year after opening impacts. This undermines the capacity to report on longer term environmental and economic impacts. • A quantitative value for money assessment has been undertaken for only 3 schemes and additional data would need to be collected to undertake this level of evaluation for the other schemes. • Forecast impacts are not provided for the majority of schemes and hence it is unclear whether forecast and out-turn impacts have been consistently prepared.
Completeness	• A majority of information necessary to determine whether schemes have been delivered on time and budget is available for all schemes. • Explanation of variances is absent in most cases. • Traffic (journey times and traffic flows) and safety impacts are presented in over half of the reports – although the consistency of evaluation approach is questionable. • Reporting of scheme outcomes relating to environmental, economic impacts and modal shift impacts only present (mainly qualitative findings) are poorly supported by quantitative data. • Forecasts scheme impacts have not been provided for the majority of schemes. This severely limits the possibilities for an evaluation of forecast vs. outturn scheme impacts.
Conformance	• Quantitative evidence is presented for the comparisons of forecast and outturn scheme cost and programme – subject to some checks this seems fit for purpose. • Scheme impacts such as traffic flows, journey times, safety and air quality have been evaluated using quantitative data. • For impacts such as local economic impacts, modal shift, accessibility, traveller experience and local bus operations are predominantly evaluated using qualitative evidence only. • Further interrogation of the technical methods used is needed to determine whether traffic/journey time data is comparable between schemes and sufficiently robust.

Consistency	• Cost and programme data has been supplied in a consistent manner which facilitates like for like comparisons across schemes. • Scheme impacts such as journey times and traffic flows are presented in a variety of ways. This makes like for like comparisons across a number of schemes difficult for example: number of corridors over which routes have been measured, differences in units of traffic used e.g. ADT/AWT). • Different air quality indicators are used across schemes depending on the data collection methods available for each scheme. • Safety impacts are presented more consistently, however, the majority of evaluations only present one year of post opening data which is often not sufficient to draw firm conclusions. • Outturn Benefit Cost Ratio (BCR) has rarely been presented – estimating a BCR using the data available is not feasible without significant extra work. • In the rare instances where impacts such as accessibility, local economy, modal shift, local bus operations and traveller experience are reported, assessments predominantly rely upon qualitative evidence. This limits the potential for like for like comparisons across the overall data set.
Credibility	• Not assessed in full. • Further interrogation of the technical methods used is needed to determine whether traffic/journey time data is comparable between schemes and sufficiently robust.
Processability	• Cost and programme data is the most consistent across all schemes and can be processed more readily. • Most of the data presented in the majority of evaluation reports in relation to scheme impacts would require in a significant level of standardisation. This would have associated cost and time implications.
Relevance	• The cost and programme data supplied are relevant to the DfT evaluation questions. • Traffic, journey time and safety impacts presented in over half of the evaluation reports are relevant to the DfT evaluation question surrounding benefits of LMS. However, many evaluations do not consider these impacts in sufficient detail to draw firm conclusions or facilitate like for like comparisons between schemes. • Other scheme outcomes such as accessibility, local economy impacts, modal choice, bus operations and traveller experience are generally not evaluated, or consist of a qualitative statement only.
Timeliness	• 20 of the 23 evaluations present evaluation findings based on evidence gathered in the first year after opening. • For scheme costs, it is likely that the majority of outturn costs would have been incurred within the first year of opening. • One year after opening is sufficient to understand the emerging scheme impacts in relation to traffic flows, journey times, and accessibility impacts. • The evaluation of safety and environment (particularly air quality) is less robust at the one year after opening stage due to the limited post opening data available to inform whether a scheme has been successful. • Local economic impacts and the impact of schemes on modal shift and local bus operations are also unlikely to have fully materialised in the first year after opening and hence evaluation of these impacts is highly questionable. Causal chains are also difficult to prove with these indicators.

3.2.2 To what extent are LMSs delivered to Programme?

Suitable programme metrics (forecast and out-turn) have been defined for all 28 schemes implemented to date. Project milestone dates achieved have been collected and have been recorded at consistent stages in the project lifecycle (Programme Entry; Full Approval and Out-turn). The raw data is in the main readily available and complete, although additional information was required from scheme promoters to ensure robust explanation of any variations from programme (only four schemes have provided any evidence regarding reasons for programme variance in their evaluation reports). As the data has been collected centrally by DfT it is assumed that reported dates are conformant and accurate. Given that all schemes have been open in excess of 12 months, the timing of such analysis is deemed appropriate.

3.2.3 Are LMSs delivered to cost and can variances be explained?

Suitable scheme cost metrics (forecast and out-turn) are defined for all 28 schemes implemented to date. Cost data has been collected and has been recorded at consistent project milestones (Programme Entry; Full Approval and Outturn) and thus lend themselves to programme level analysis. Costs have also usefully been split by key funding partner (DfT, Scheme Promoter, third party). The raw data is readily available, although additional information regarding explanation of

variations from programme was required from scheme promoters. In most cases, little or no evidence of reasons for cost over-runs or under spends has been given in the scheme evaluation reports. Given that all schemes have been open in excess of 12 months, the timing of this analysis seems reasonable.

3.2.4 What are the main benefits of LMS and how well do they deliver their stated objectives?

Meta analysis and evaluation provides a useful means by which the DfT and scheme promoters can demonstrate evidence of a scheme's outcomes and impacts. A majority of schemes provided a sufficient synopsis of scheme objectives. In the few cases where quantitative metrics were used to assess the degree of success in meeting primary objectives, they were relevant. Specific examples include:

- Comparison of measured pre and post opening journey times or variance to demonstrate congestion improvements;
- Comparison of observed Personal Injury Accidents (PIAs) numbers/rates to demonstrate scheme impact on safety;
- In the limited instances where they are reported longer term outcomes associated with modal shift, local bus operations and impacts on the economy are predominantly qualitative or inconsistent across the sample.

Whilst a majority of reports generally provide written narrative around whether they have met their main objectives, this is rarely backed up by a strong quantitative evidence base. There are significant inconsistencies in the standard and depth of evaluation reporting. Key trends include: a general dependency on the use of qualitative evidence to demonstrate a schemes successes; limited or no comparison of forecast and out-turn impacts; and limited documentation of technical assumptions to support evaluation outcomes relating to scheme objectives.

Fourteen schemes have shown some quantification of the opening year traffic volume, journey time and safety outcomes. However, this was not in a form conducive to immediate use in a meta analysis (variance in technical approach adopted between schemes). Strong evidence of the scheme's impact on the local environment, economy and safety objectives is also lacking – assessments of such longer term impacts are likely to be more relevant five years after scheme opening.

Unless followed up with substantial additional information from scheme promoters regarding evaluation methodologies and assumptions – the current dataset is not yet sufficiently consistent or complete to support detailed quantitative meta analysis. Even in areas where data offers a greater degree of consistency and is comparable between schemes (traffic impacts, journey times), ensuring that the data is sufficiently consistent and complete is unlikely to be achievable within the timeframes of this commission. Filling data gaps, standardising technical approaches and understanding scheme context are primary examples of key constraints to meta analysis in this instance.

3.2.5 How do LMS Impact on Traveller Experience?

As reported above, the current data set does little to satisfy the data attributes needed to answer this question robustly. The dataset is largely incomplete, lacks consistency and comparability and offers little overall scope for lessons learnt.

Whilst there is evidence that shows LMSs have contributed positively to enhanced traveller experience, this evidence is implied through improved journey times and journey time reliability (private and public transport) and safer transport networks inferring an enhanced user experience.

Only three schemes included user feedback surveys as a means of identifying changes in traveller experience. Whilst some limited analysis for these schemes would be feasible, it is likely to offer limited statistical value or robust lessons learnt.

3.2.6 Is there evidence of LMS Impact on modal choice and local bus operations?

The current dataset does little to satisfy the data attributes needed to answer this question robustly. The dataset is largely incomplete, lacks consistency and comparability and offers little overall scope for lessons learnt. With regards impact on bus operations there is no documented evidence capturing the impact on local fares and competition. The timing of evaluation of such impacts is also questionable given that demonstrative model shift patterns usually emerge over a period of years rather than immediately after scheme opening.

Seven schemes provided partial evidence on scheme modal shift impacts, with only one scheme (Manchester Metrolink Track Renewals) providing a comprehensive modal shift analysis. The remainder focus on non-motorised user activity rather than changes in bus patronage. None of the schemes with partial analysis included any comparison between forecast and out-turn modal shift impacts.

To undertake statistically robust quantitative meta analysis of modal shift impacts, all schemes would need to be considered for re-evaluation to ensure a like for like and complete analysis.

3.2.7 How do LMS impact on the local economy?

Attributing short term changes in local economic conditions to specific transport interventions is extremely difficult to achieve. This is particularly the case when only one year's worth of impact is being assessed. Unless unlocking a specific employment site or regeneration area, then attributing outcomes and impacts can be masked by other factors such as wider local economic trends, other non-transport initiatives focussing on employment and industry. This challenge is clearly evident through the observed deficiency of reporting presented in LMS evaluations.

For the reasons cited above, it is recommended that no further detailed impact evaluation on wider economic impacts is progressed.

3.2.8 How do LMS impact on the environment?

None of the evaluation reports provide conclusive quantitative or qualitative evidence regarding impacts on the environment. Furthermore, no narrative was provided around the emerging effectiveness of environmental mitigation measures. Nine schemes did undertake an analysis of local air quality data to seek out local air quality impacts. However, none of the findings were conclusive one year after opening. Over half of the scheme reports reviewed made no reference to environmental impacts.

3.2.9 How well have the impacts of LMS been forecast and what are the reasons for variance?

Most schemes demonstrate no comparison between forecast and out-turn impacts. In the rare instances where comparisons have been made, they typically focus on shorter term outcomes such as traffic, journey time or safety impacts.

A meta analysis is not recommended given the complexities of ensuring consistent measurement of scheme impacts across the programme. Progressing with such an approach relies on all impacts being collected and compared in the same way and as such significant data gaps would need to be filled and potentially re-work undertaken. Embarking on such an approach would also carry significant cost and programme implications. Assuming scheme promoters could retrospectively provide detail of forecasting data, some general commentary could be provided to

capture whether or forecasts were correct in predicting the general direction of impact (positive, adverse and neutral).

Further dialogue with stakeholders could be undertaken to capture further evidence of unexpected outcomes, but there is a risk that further engagement would not add to the evidence base already provided in the evaluation reports.

3.2.10 Do LMS deliver value for money?

The current dataset does little to satisfy the data attributes needed to answer this question robustly. Fundamentally the dataset associated with the derivation of BCR is largely non-existent and only three schemes in the sample provide a full re-assessment of the Benefit Cost Ratio (BCR). Sixteen schemes did not demonstrate any evidence (monetised or non-monetised) of scheme value for money.

In order to assess the VfM of a scheme in BCR terms, a full evaluation of scheme cost and benefits for all schemes would be required. Whilst anecdotal evidence is available to suggest schemes do offer value for money, this is mainly qualitative in nature and as such is unsuitable for detailed meta analysis.

3.3 Other Sampling Considerations

3.3.1 Scheme Geography

The geography and typology (highway, public transport and integrated transport) for all of the 23 schemes are summarised previously in **Figure 1**.

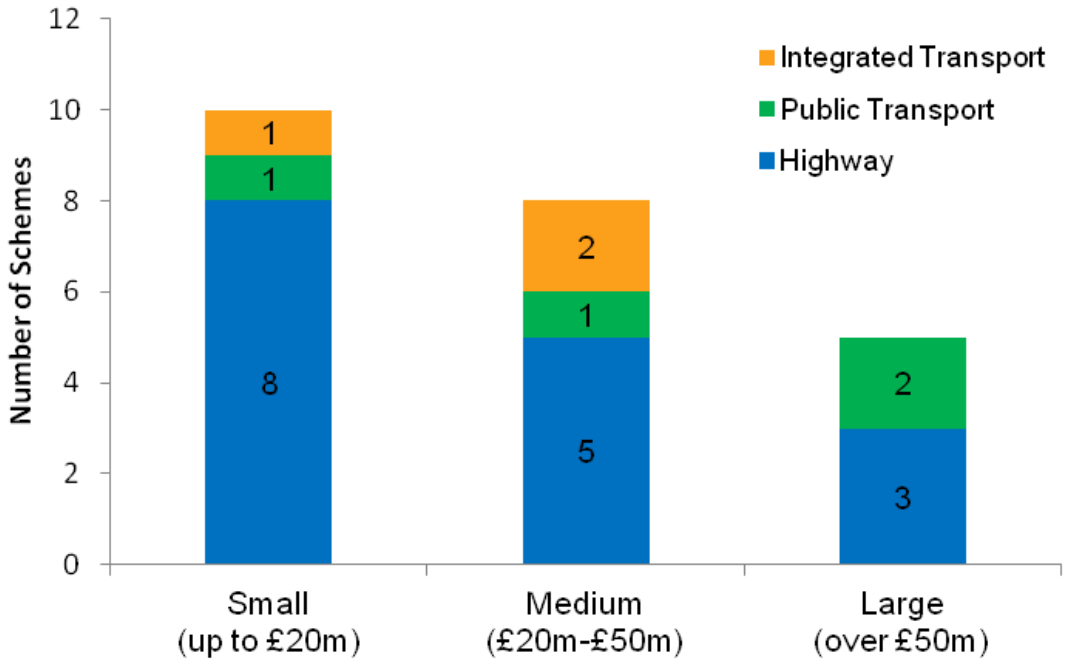
For the 23 schemes where evaluation and monitoring reports have been provided, the geographic spread of schemes is relatively even. There does however seem to be a slight over-representation of schemes implemented in the Midlands (26%).

3.3.2 Scheme Typology and Value

Figure 2 presents an overview of schemes classified by outturn cost and scheme type[4] . Two thirds (16) of the schemes are classified as highway interventions, a majority of which are valued at less than £20m. Large elements of the integrated transport schemes (3) consist of highway improvement works aimed at improving the public transport offering in the area (e.g. bus priority measures). There are only 4 wholly public transport schemes in the sample. Whilst this breakdown simply reflects the typology of transport schemes implemented by local authorities between 2007 and 2012, it does mean that more statistically robust opportunities for detailed study lie with highway schemes.

[4] Integrated Transport Schemes include a range of highway, public transport and sustainable mode interventions.

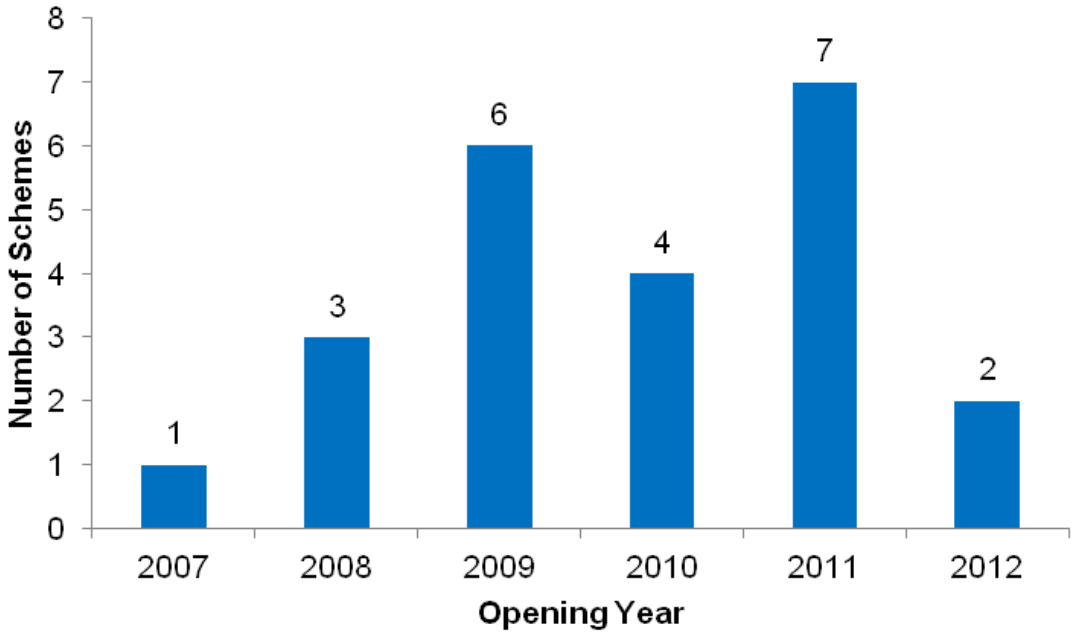
Figure 2 – Summary of Scheme Type and Outturn Cost



3.3.3 Scheme Chronology

Figure 3 shows that all 23 schemes opened between 2007 and 2012, with the majority opening between 2009 and 2011. Given that a majority of the schemes opened in 2009 or later, the opportunities to re-engage with scheme promoters regarding evaluation/scheme detail are enhanced as some institutional knowledge is likely to be still present.

Figure 3 – Number of Schemes in Sample by Year of Opening



3.3.4 Timing of Scheme Evaluations

The timing of the evaluation has an important bearing on whether the validity/robustness of the individual evaluation outcomes. As per the 2012 guidance on monitoring and evaluation issued by the DfT, the point at which different outcomes/impacts can be accurately evaluated varies significantly. For example whilst the impact of a new highway scheme might become evident within twelve months of opening, impacts on economic growth or safety are unlikely to emerge fully until a period of five years after opening.

Of the 23 schemes where evaluation reports were provided, they consisted of the following:

- During construction – 1 scheme[5];
- 6 months post opening – 1 scheme;
- One year after opening – 18 schemes; and
- Three years after opening – 3 schemes.

A majority of the scheme evaluations have been prepared within one year of the project opening date. This is an important consideration when assessing the relative robustness of the evaluation findings set out elsewhere in this report.

3.4 Summary Implications for Meta Analysis or Evaluation

The review of data presented above shows that the scope for robust meta 'analysis' as defined in **Section 1** is heavily constrained. With the exception of the detail available on cost and programme, there are substantial gaps in the overall meta dataset that would need to be filled before a robust meta analysis can be undertaken. The main obstacles to meta analysis are summarised as follows:

- Evaluation analysis is inconsistent across the programme and between research questions, this severely limits the scope for cross programme level analysis;
- Further evaluation is not at all feasible without significant additional engagement with scheme promoters and there is a risk that this would not add any more detail than that already provided in the evaluation reports;
- Adequate detail regarding technical assumptions used in evaluations is regularly missing, inconsistent or require further challenge such that immediate comparison between schemes is not appropriate without substantial additional work; and
- Most schemes have been evaluated just one year after opening, whilst this is sufficient for assessing shorter term impacts this is not the case for impacts on the local economy and the environment.

Such data inconsistencies make it only feasible to prepare qualitative statements about scheme outcomes and impacts at the programme level – supported in a minority of cases by quantitative data. Consequently these issues result in difficulties relating to the identification of useful learning points for both the DfT and future scheme promoters.

Due to the limitations of a meta analysis approach described above, a predominately meta evaluation approach was adopted. The findings of this evaluation are documented in the remaining sections of this report.

[5] This is the A1073 Spalding to Eye scheme evaluation which consisted of a 'during construction' stakeholder consultation exercise.

4. Meta Evaluation of Cost and Programme Forecast Accuracy

4.1 Introduction

The DfT are keen to understand to what extent LMSs have been delivered in accordance with **programme** and also to understand where variances have occurred and why. Such an understanding may be of value to promoters of future schemes in that it may help to identify areas which require mitigation against programme over-runs at an early stage of the project lifecycle.

Understanding **cost variances** and why they occur is also of immediate relevance to both the DfT and scheme promoters. Assuming common themes can be drawn, evaluation offers both parties the opportunity to learn lessons that may help to identify issues which require mitigation to ensure cost over-runs do not occur. Furthermore such lessons can also help promoters achieve greater cost certainty or identify scope for savings.

The remainder of this section is structured as follows:

- Evaluation Data Sources;
- Delivery to Programme; and
- Delivery to Cost.

4.2 Evaluation Data Sources

The evaluation of cost and programme impacts will draw upon the following sources:

4.2.1 Cost and Programme Data supplied by DfT

The DfT has provided forecast and outturn scheme cost and programme information for the 23 schemes implemented to date which are being considered in this study. This data is replicated in **Appendix A**. A brief summary of the information provided and any assumptions used is listed below:

- **Scheme cost data**
  - Total scheme costs have been presented for consistent stages in the project lifecycle (Programme Entry, Full Approval, Actual (outturn)).
  - Data for Programme Entry Costs has been derived from Conditional Approval or Full Approval submissions to Ministers.
  - Data for Full Approval Costs has been derived from Full Approval submissions to Ministers.
  - Data on actual scheme costs has been derived from the last Quarterly Monitoring Report received from the scheme promoter.
  - Costs have also been split by key funding partner (DfT, Scheme Promoter, third party).
  - In a small number of instances the reported costs differ from those contained in the evaluation reports. For consistency, the costs provided by the DfT have been used in this evaluation.
  - The information on actual costs for one scheme (Cambridgeshire Guided Busway) are not yet available to the DfT. For the purposes of the evaluation of scheme costs, Cambridge Guided Busway has been removed from the analysis.

- **Programme data**
  - Data for Full Approval Dates is derived from the Full Approval submission to Ministers.
  - Data on forecast start of works and scheme opening dates at Programme Entry Stage are derived from the electronic records available. These records tended not to include scheme opening dates.
  - Estimated construction start dates and opening dates have been provided for the Programme Entry Stage for only 8 schemes. With incomplete or no dates provided for 16 schemes due to the data not being readily available
  - Estimated construction start dates and opening dates have been provided for 22 out of the 23 schemes at Full Approval Stage.
  - Actual construction start dates and opening dates have been provided for all 23 schemes.

4.2.2 Questionnaire Responses

A short e-mail questionnaire survey of scheme promoters has been undertaken with the following key aims:

- Elicit the views of scheme promoters regarding the reasons for differences between major scheme programme and cost variances;
- Better understand at what stage in the project lifecycle these variances occur and their main causes; and
- Identify best practice and lessons learnt relating to management of programme/cost variances throughout a project.

Questionnaires were issued to 23 scheme promoters and responses were received from 20. However, it should be noted that the survey responses for five schemes were very limited, in particular those which were delivered on time and budget.

4.3 Delivery to Programme

This section draws upon the data presented above and addresses the following key questions.

- To what extent are LMS delivered on programme and at what stage do slippages occur?
- What were the main causes of programme slippage?
- How could programme slippage have been forecast and managed/mitigated and what lessons could be learnt for future scheme delivery?

4.3.1 To what extent are LMSs delivered on programme and at what stage do slippages occur?

The following key points can be made in relation to delivery against programme for all schemes with data available.

- The average change in forecast completion date between Programme Entry and Actual completion date is +23 months (sample: 8 schemes).
- The average change between forecast completion date at Full Approval and Actual completion date is +5 months (sample: 22 schemes).

The remainder of this section considers the programme data in relation to scheme type followed by scheme size.

Figure shows the changes in completion date by scheme type, key points to note are:

- Only 8 schemes had estimated completion dates at Programme Entry Stage;
- Unsurprisingly there is greater certainty of programme timescales at Full Approval Stage, compared to Programme Entry Stage. This reflects an increased understanding of programme risks and uncertainties in the latter stages of the project development lifecycle;
- The scatter graph illustrates that with the exception of one outlier (Cudworth and West Green Bypass), highway forecasting is broadly consistent with public transport schemes. Due to loss of institutional knowledge on a number of schemes, the reasons for the change in timescales are not fully understood; and
- From the four public transport schemes considered, there is a greater degree of overall programme uncertainty between Full Approval forecasts and actual completion dates. This is due to one scheme (Cambridgeshire Guided Busway) which was completed approximately 30 months later than planned due to a contractual dispute.

Figure 4 – Changes in completion date by scheme type

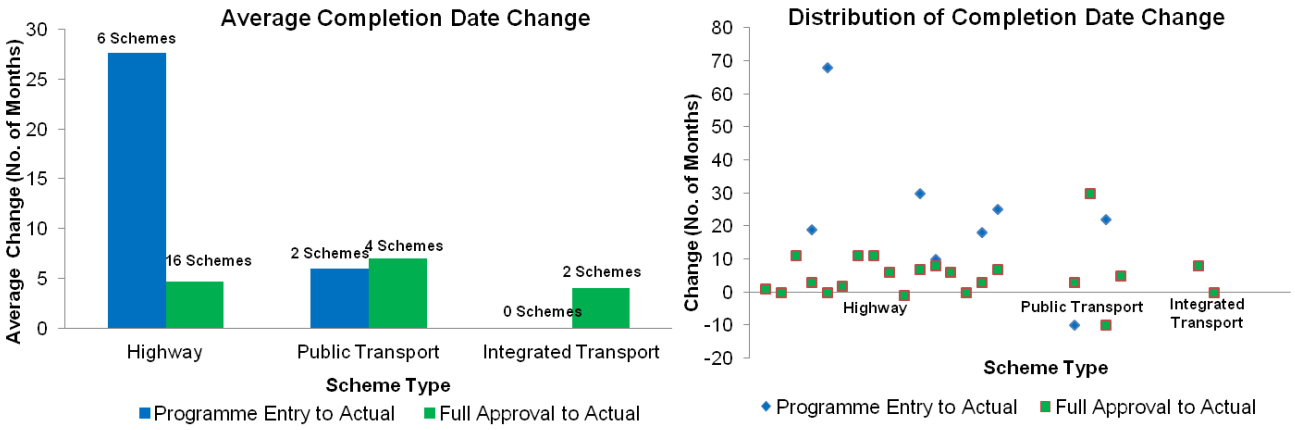


Figure 5 shows the changes in completion date by scheme size, key points to note are as follows:

- For smaller schemes, an indication of programme timescales has been achieved relatively accurately early in the project lifecycle;
- For large and medium projects, timescales are much less accurately forecast at the programme entry stage; and
- When the Cudworth and West Green Bypass is excluded from the analysis, the accuracy of forecasts at programme entry stage for medium sized schemes is much improved.

Figure 5 – Changes in completion date by scheme size

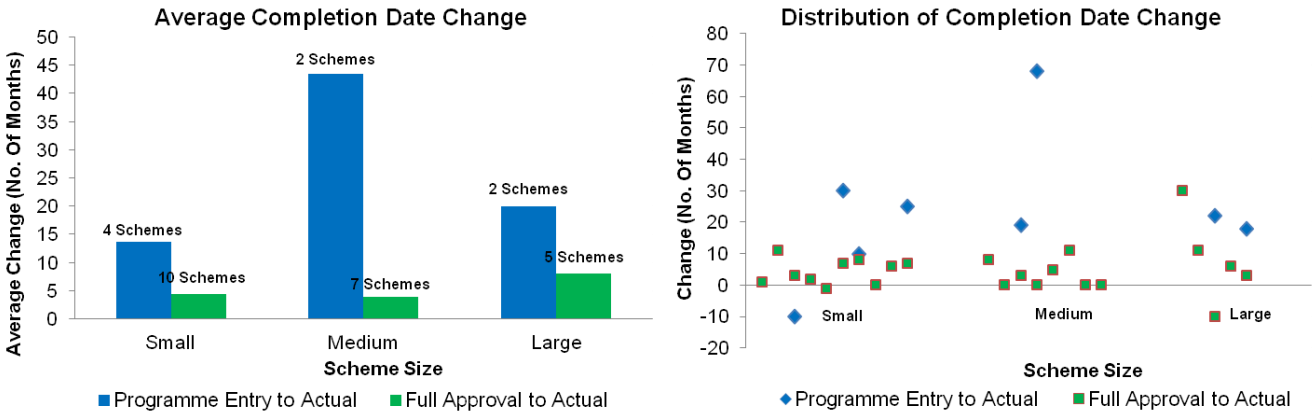


Table 6 presents a summary of changes in programme which have occurred at different stages in the project lifecycle.

Table 6 - Stages in the project lifecycle when programme slippage is likely to occur (by numbers of schemes)

	Programme Entry to Actual	Full Approval to Actual
No Data	15	1
Completion date moved forward	1	2
No change in completion date	0	4
Completion date moved backward by less than 3 months	0	2
Completion date moved backward by 3-6 months	0	6
Completion date moved backwards by > 6 months	7	8

As stated earlier, there is insufficient data available at Programme Entry Stage to draw firm conclusions regarding changes to programme for that stage. However, it can be noted that the forecast completion date slipped for 7 schemes (6 of which were greater than one year.).

Just 2 schemes opened in advance of the date scheduled within the Full Approval Stage Work Programme. 72% of the schemes opened later than the scheduled opening date at Full Approval Stage, although most were within one year of forecast.

4.3.2 What were the main causes of programme slippage?

The analysis undertaken above demonstrates that programme slippage is a regular occurrence across all scheme types and sizes. Scheme promoters identified a number of causes of programme slippage; these are themed as follows **(Table 7)**:

Table 7 – Main causes of programme slippage

Summary of Causes	Number of Schemes
Interaction with Third Parties – which includes delays due to work by statutory undertakers and Network Rail, availability of possessions on the railway, the incorporation of maintenance work into contract works to minimise overall disruption and the interaction of the scheme with other schemes being implemented.	**6**
Scheme objectors and the need to undertake additional consultation.	**2**
Delays due to poor weather conditions and unforeseen ground conditions.	**4**
Contractual issues – including disputes with the contractor and delays in purchasing land.	**4**
Design issues – the need to undertake additional design work.	**1**
Delays due to DfT approval process	**1**

It is noted that although the causes for programme delays vary by scheme, the interaction with third-parties, particularly statutory undertakers, is the most commonly given cause for programme slippage.

4.3.3 How could programme slippage have been forecast and managed/mitigated and what lessons could be learnt for future scheme delivery?

Scheme promoters identify a number of measures which could be applied to improve the forecasting of issues potentially causing programme slippage and to manage/mitigate these issues.

Potential issues could have been identified through the improved use of risk registers, improved investigation of ground conditions and by more comprehensive consultation with key stakeholders.

Issues causing programme slippage could have been managed or mitigated as follows (**Table 8**):

Table 8 – Mitigation of Programme Slippage

Mitigation of Programme Slippage	Number of Schemes
Better programming of construction works – to provide float in the programme for extended statutory undertakers work and to avoid and mitigate unsuitable weather conditions. Greater consideration could be taken of the impact of incorporating additional works on the programme.	**4**
Use of an alternative contract with closer scrutiny of risk allocation to the client.	**1**
Taking legal and planning advice and undertaking robust public consultation to minimise scheme objections.	**1**
Better vetting of sub-contractors to ensure financial stability to minimise the need to find alternative contractors mid-project.	**1**
Fully understanding the requirements of Network Rail at pre-tender stage and including in contract documents.	**1**
Partnership arrangement between design and operational staff and the private sector supply chain partners.	**1**
More thorough ground investigations.	**1**

When issues have arisen during the scheme construction, frequent meetings, negotiation and agreement of deadlines with the contractor and statutory undertakers have been used to minimise disruption to the programme.

4.4 Delivery to Cost

This section considers the following key questions:

- Are LMS delivered to cost and at what stage do slippages occur?
- What were the main reasons for cost changes between Programme Entry and Actual (completion)?
- What were the main reasons for cost changes between Full Approval and Actual?
- To what extent could cost variances have been foreseen and mitigated at an early stage?

4.4.1 Are LMSs delivered to cost and at what stage in the project lifecycle do slippages occur?

Figure 6 shows the changes in cost by scheme type.

Figure 6 – Changes in Cost by Scheme Type

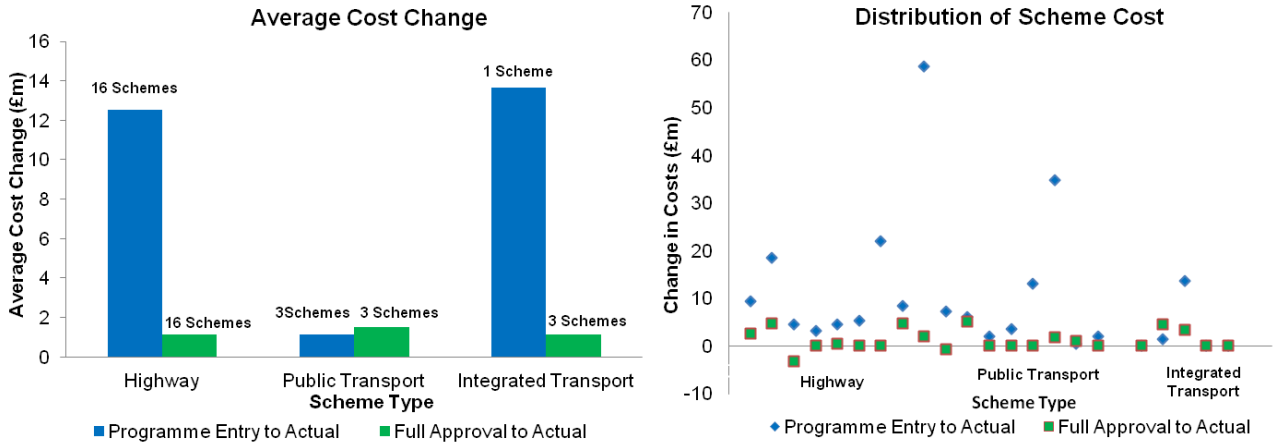


Figure 6 shows the following:

- The average cost change between Programme Entry and Actual is over £10m for all types of scheme. However, it should be noted that the distribution plot of the values for each scheme shows that this finding is skewed by a small number of schemes with large cost changes.
- For all but one of the 22 schemes the difference in cost between Full Approval Stage and the Actual cost were consistently small (or the same).
- The results clearly demonstrate that forecast scheme cost accuracy is more varied at Programme Entry Stage than Full Approval Stage.
- There is little evidence to suggest that there are significant differences between the different scheme types.

Figure 7 shows the changes in cost by scheme size

Figure 7– Changes in Cost by Scheme Size

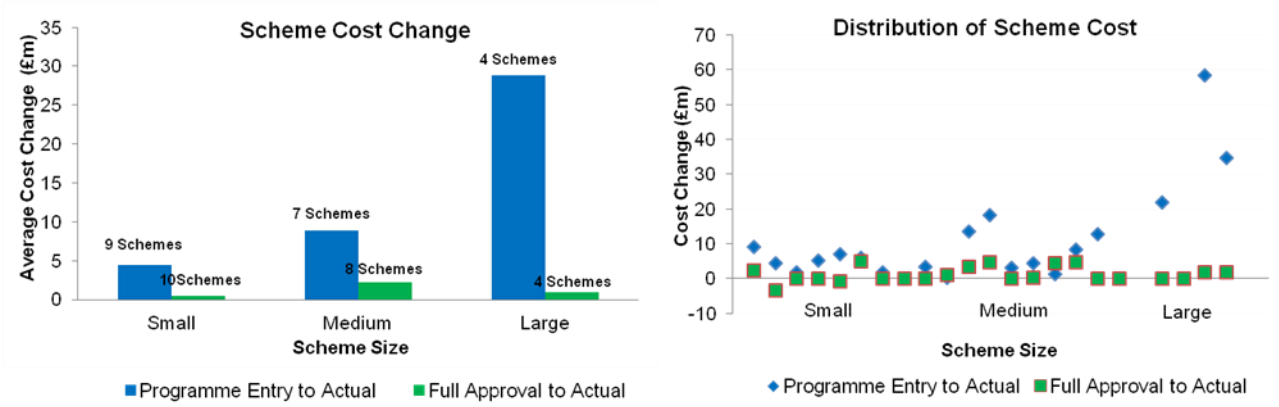


Figure 7 shows that:

- The average cost increase from Programme Entry stage is dependent on the size of the scheme, with smaller schemes exhibiting a smaller change in forecast cost.
- There is little difference between the average cost at Full Approval and the Actual cost for all scheme types. This is due to 9 schemes having Full Approval Costs and Actual costs which are identical. However, when looking at the distribution of individual costs, it is clear that there are a few schemes which showed a considerable change between these points.

Figure 8 below presents the change in scheme costs as a percentage. This shows that there is no clear pattern between the size and type of the scheme and the percentage cost change.

Figure 8 – Percentage Change in Cost by Scheme Type and Size

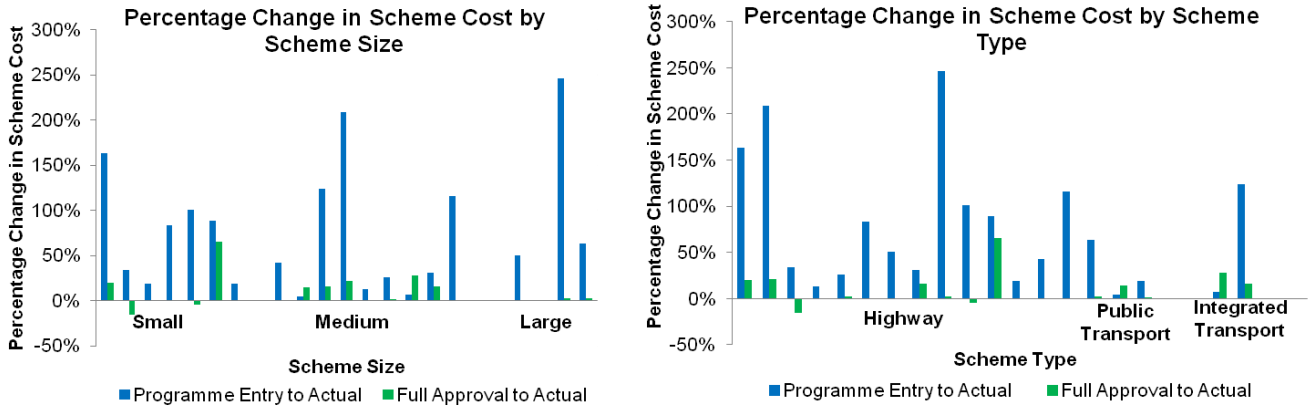


Table 9 presents a summary of changes in costs which have occurred at different stages in the project lifecycle.

Table 9 - Stages in the project lifecycle when cost variances are likely to occur (by numbers of schemes)

	Programme Entry to Actual	Full Approval to Actual
No Data	2	0
Decrease in costs	0	2
No change in cost	1	9
Increase in cost by > £0m and <= £1m	1	2
Increase in cost by > £1m and <= £5m	7	8
Increase in cost by > £5m and <= £10m	5	1
Increase in cost by > £10m	6	0

Between Programme Entry and Actual 19 schemes experienced a forecast cost increase. Conversely, there was a forecast cost decrease for only two schemes. The average increase in costs between Programme Entry and Actual is 52%.

The changes in costs between Full Approval and Actual are less distinct, with 9 schemes showing identical costs. It is probable that at Full Approval a number of schemes would have had 'fixed cost' type contracts and a known fixed cost at that stage. 11 schemes experienced an increase in scheme costs between Full Approval to Actual, with only three schemes showing a decrease. The average increase in costs between Full Approval and Actual for all schemes is +4%.

The following conclusions can be drawn from this section:

- The actual costs are on average 52% higher than the Programme Entry forecast for all schemes. DfT guidance on optimism bias to be used in appraisal at Programme Entry Stage suggests values ranging between 44 and 66 % for LMS type schemes.
- The average increase in costs between Full Approval and Actual costs is +4% for all schemes, which reflects the fact that many schemes report zero cost changes. DfT guidance on optimism bias at Full Approval Stage suggests a range of values between 3 and 6% for appraisal.

These findings are not surprising given the uncertainties surrounding schemes and their associated risks at Programme Entry Stage compared to the Full Approval Stage.

4.4.2 What were the main reasons for Cost Changes between Programme Entry and Full Approval?

The earlier analysis indicates that the highest change in costs occur between the Programme Entry and Full Approval Stages. The key reasons for cost changes at this stage, based on the scheme promoter survey, are as follows (**Table 10**):

Table 10 – Reasons for cost changes between Programme Entry and Full Approval

Reasons for cost change	Number of Schemes
Delays in the approval process and general programme slippage resulting in changes in prices due to inflation.	**6**
Additional costs during tendering process to obtain quality bids and the need to re-tender.	**1**
Additional costs due to public inquiries and legal issues.	**1**
Additional works required including geological and statutory undertaker issues.	**2**
Additional costs through developing Early Contractor Involvement, with the aim of reducing risk during delivery.	**2**
Scope change.	**2**
Changes to risk analysis.	**1**

4.4.3 What were the main reasons for Cost Changes between Full Approval and Scheme Completion?

There are a wide range of reasons for cost changes between Full Approval and scheme completion based on the survey responses from scheme promoters. The reasons provided are common to many construction projects and are shown in **Table 11**.

Table 11 – Reasons for cost changes between Full Approval and Actual

Reasons for cost change	Number of Schemes
Additional costs from statutory undertakers work.	**3**
Unforeseen ground conditions.	**1**
Poor weather conditions (e.g. extreme winter/wet summer) causing delays.	**2**
The need to comply with Network Rail (NR) requirements and additional NR possessions and works.	**3**
Legal costs for issues with stakeholders and contractor.	**3**
Late award.	**1**
Timing to coincide with routine maintenance.	**1**

4.4.4 To what extent could cost variances have been foreseen and mitigated at an early stage?

There is the general view among promoters that the cost changes could not have been foreseen as the extent of the delays or additional works could not have been predicted.

A number of promoters made design changes to minimise the potential additional costs. However, scheme constraints (e.g. potential to disrupt existing network) limited the ability to adjust the scheme and construction programme.

The majority of promoters do not consider how these cost variances could have been mitigated. However, ideas put forward (for a small number of schemes) include:

- Greater allowance for inflation in estimates;
- Greater time risk allowance;
- Better investigation and identification of statutory undertaker issues at an early stage; and
- The use of a full-time cost consultant.

5. Meta Evaluation of LMS Impacts and Outcomes

5.1 How well do LMS deliver stated objectives?

This evaluation question focuses on the achievement of stated objectives, rather than the specific benefits generated by LMS. To provide a structure to the analysis and reporting the evidence from the meta evaluation is presented by scheme type:

- Public transport schemes;
- Integrated Transport Packages; and
- Highways Improvements.

5.1.1 Public Transport Schemes

Four of the 23 schemes were defined as public transport, comprising the Cambridgeshire Guided Busway, Metrolink track renewal, A638 Quality Bus Corridor (QBC) and the Birmingham International Airport to NEC scheme. In terms of objectives, the four schemes were targeting improvements in journey times and reliability, service quality, passenger satisfaction and accessibility. Secondary impacts were identified as enhanced integration and reduced social exclusion, leading to enhanced employment. A summary of the main achievements reported across these schemes is presented in **Table 12** below.

Table 12 - Summary of Public Transport Objectives

Objectives	Scheme Achievements
Journey time and reliability	• A638 QBC saw improved journey time reliability of 57% in the AM peak but a 28% worsening in the PM peak. • The A638 generated improvements in absolute journey time of between 22-28% depending on time period and direction of travel. • The Cambridgeshire Guided Busway evaluation report focused on passenger survey results and did not report outturn service performance.
Service quality and satisfaction	• The Cambridgeshire and Metrolink services both generated improvements in passenger satisfaction results. • The A638 ex-post survey determined that 88% of passengers were satisfied with the quality of service (no baseline or target was reported).
Patronage Increase	• The Birmingham International Airport – NEC scheme fell below the 5% targeted increase in patronage for the whole network (baseline 2010-11 of ~300m). Indeed, patronage fell in 2012-13 to 276m. The contribution of the scheme to alleviating this decline was not assessed within the evaluation report. • Cambridgeshire Guided Busway was on track to achieve in excess of the targeted 2.5m passengers per year.
Congestion Reduction	• The Cambridgeshire Guided Busway identified a secondary impact of reducing congestion on the A14 by 8%. The year one post opening survey identified a 2% reduction in traffic flow on the A14, although no clear attribution or contextual analyses had been undertaken.

In summary, public transport LMS reported strong performance on impacts linked directly with scheme delivery, such as service quality, journey times and reliability. Little quantitative evidence

was provided to demonstrate contributions towards area-wide objectives such as social inclusion and modal shift. Anecdotal and stakeholder qualitative evidence was reported to support scheme impacts on improving connectivity, accessibility and integration. However, the sample of four schemes and the diverse nature of those schemes does not provide a sound basis for establishing robust conclusions regarding public transport scheme impacts.

5.1.2 Integrated Transport Schemes

Four of the 23 schemes were integrated transport packages; Walsall Town Centre, West Midlands Red Routes, Weymouth and Scarborough. The primary focus of schemes was to reduce traffic congestion and improve network resilience, making non-car modes more attractive; improved bus punctuality and journey time reliability were common objectives. Secondary outcomes targeted and resulting from reduced congestion included improved environmental conditions, reduced accidents and the removal of severance barriers to town centre accessibility. Third order outcomes or longer term impacts included facilitating town centre regeneration and promoting economic activity.

In respect of reducing congestion, the Scarborough scheme saw traffic reduce by between 15% and 76% on town centre routes, and an increase in Park and Ride patronage. Similarly, the Weymouth Transport Package reported a reducing in AADT of over 5,000 on two key routes into the town. However, neither scheme isolated the impacts of wider background changes in traffic movements, or robustly attributed observed changes to the scheme.

The West Midlands Red Routes (Package Two) achieved the following stated objectives:

- Reduced journey times for buses and other vehicles on all routes on certain days and time periods;
- Improved journey reliability for buses and cars on all routes on certain days and time periods;
- Improvements in bus punctuality on most routes;
- Increases in bus patronage have occurred on some services on all routes;
- Reductions in accidents (21-78% by route) and casualties (18-74% by route) on those routes where post scheme monitoring has been possible; and
- Improved levels of enforcement and compliance.

Little evidence was provided by other schemes regarding accident or environmental outcomes, primarily due to the majority of evaluation reports being prepared one year post opening. This was also the case for economic and regeneration impacts, with most schemes stating that such issues would be assessed in the five year post opening evaluation.

5.1.3 Highway Schemes

Fifteen of the LMS were highways related, consisting of two main sub-categories:

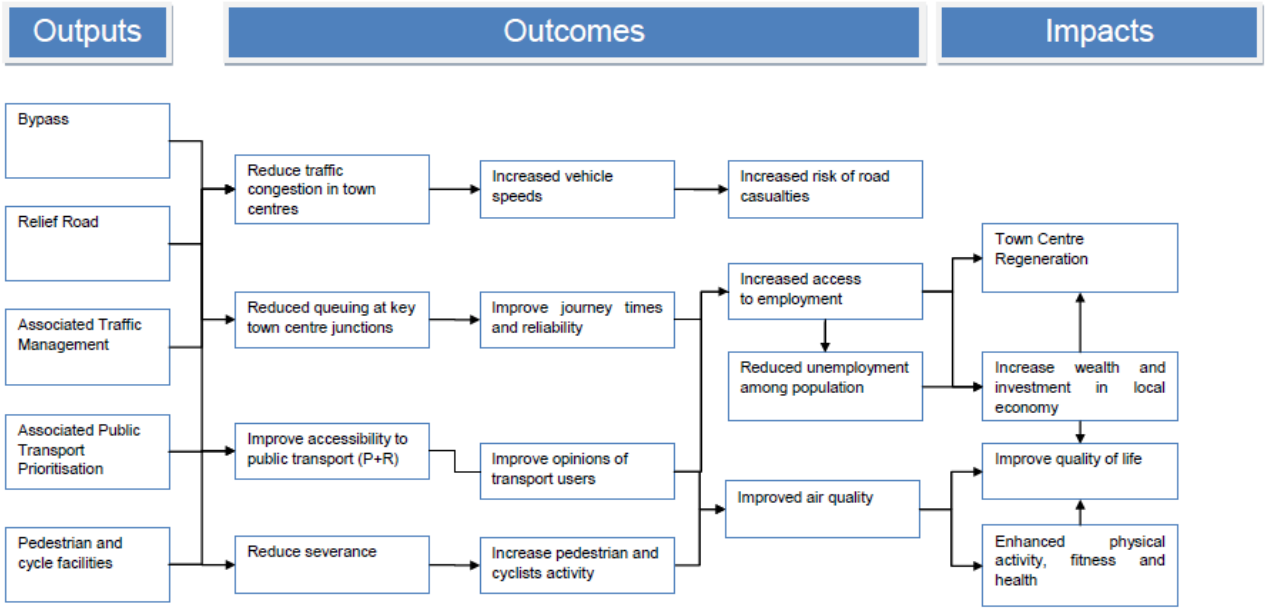
- 12 bypass or relief roads, providing alternative routes around congested towns and villages; and
- 3 junction improvement schemes.

The majority of bypass or relief road schemes reported the central objective of reducing traffic and associated congestion from towns and villages, with resulting improvements to public transport, walking and cycling accessibility. Subsequent and consequential outcomes were reported to be improvements in air quality and reduced accidents. Longer term impacts included town centre regeneration and improved quality of life for local residents.

An overarching (non-scheme specific) logic map for bypass/relief road schemes is presented in **Figure 9**. This has been prepared as part of this meta evaluation to highlight the common linkages

between first, second and third order outcomes, and subsequently impacts. This map is purely illustrative and for reference by scheme promoters and does not represent a detailed/comprehensive representation of bypass intervention logic.

Figure 9: Bypass/Relief Road Logic Map



Evidence was available from eight of the 12 bypass schemes to demonstrate changes in traffic flows, congestion and/or journey times in town centres (**Table 13**). The range of data presented was varied and very scheme specific, making any meta analysis impossible. **Table 13** therefore provides a summary of key reported outcomes in isolation from scheme context; it is also noteworthy that not all schemes presented absolute values for before and after implementation.

Evidence to demonstrate improvements in public transport reliability was sparse, with only two of the twelve schemes reporting changes. However, one of these schemes used improved traffic journey times on the new bypass road compared to the pre-scheme town centre road to assume a similar improvement in public transport reliability.

As per integrated transport packages, evidence was limited relating to accident, environment and regeneration objectives, with the majority of schemes stating that such issues would be evaluated as part of the year five post opening assessment.

Table 13: Summary of Traffic/Congestion and Journey Time Changes for Bypass Schemes

Scheme	Before Opening	After Opening
A628 Cudworth and West Green Bypass	10-15,000 AADT	5,300 AADT
Brierley Hill SAN	34% AM Peak and 43% PM peak reduction in traffic	
Owen Street Relief Road	3-4 minute journey time	2-4 minute journey time
Glasshoughton Coalfields Link Road	Reduced traffic on residential roads, 60% reduction in journey times to employment sites	
Hemsworth A1 Link Road	18% reduction in journey times, 60% improved reliability	
B115 Stowmarket Relief Road	550 vehicle flow AM Peak Hour	403 vehicle flow AM Peak Hour
Weymouth Relief Road	14% reduction of traffic on minor roads	
Tunstall Northern Bypass	5% - 24% reduction in traffic in town centre	

The three junction specific schemes targeted similar objectives, with improved journey times and bus reliability being prominent. Associated improvements in facilities and safety for cyclists and pedestrians were also a stated objective across all three schemes.

The A4123/A461 Burnt Tree junction improvement scheme reported a reduction in traffic of 12.6% in the AM Peak and 11% in the PM Peak. This reduction was reportedly due to the significant re-routing of traffic during scheme construction, with displaced traffic not having returned to previous routes. Background traffic volumes in the area reduced by 6% during the survey period. Journey times through the junction and alternative routes all reduced between survey periods, although no attribution analysis was presented.

The Taunton Third Way scheme also reported reduced traffic volumes, again identifying a fall in overall travel demand as the main cause. Higher than forecast reductions in journey times were achieved, 4.8% in the AM peak and 11% in the PM peak. The M4 Junction 11 Mereoak improvement scheme presented extensive and detailed evidence demonstrating improvements in traffic movement/flow, reduced queuing, and enhanced public transport, walking and cycling activity. Initial anecdotal evidence was presented to demonstrate progress towards longer term objectives of facilitating development and reducing accidents in the vicinity of the junction. This scheme was unique among the 23 assessed, as it focused on a major motorway junction improvement.

5.2 What are the Main Benefits of LMS (and how does this differ by scheme context/type)?

The main benefits of LMS were closely aligned with their stated objectives. Indeed, little evidence of unanticipated outcomes or impacts was presented. Rather than repeating the above section, a short summary of observed benefits by scheme type is present below.

5.2.1 Public Transport Schemes

As noted previously, the main benefits reported by the four public transport schemes centred on travel time reductions and improved service reliability/punctuality. This was commonly supported by increases in passenger satisfaction levels. Assumed scheme contributions to reducing traffic flows and congestion were presented, alongside also assumed but not evidenced increases in modal split for non-car modes. Patronage was commonly reported to have increased on bus services between before and after monitoring periods, but direct attribution to LMS was often lacking. The diverse characteristics of the four schemes does not support the drawing of commentary or conclusions on different impacts by scheme context or location. The four schemes performed different functions within very different geographical locations.

5.2.2 Integrated Transport Packages

The four integrated transport packages demonstrated a consistent benefit in reducing journey times and traffic flows in congested areas; assumed reductions in congestion were also commonly presented but not evidenced through queue length data. However, these benefits were very scheme and location specific, due to traffic re-routing differently than forecast, particularly in area wide schemes. Year one post opening evaluation reports also indicated initial improvements in air quality and accident levels, although the evidence was commonly linked directly to traffic flow analysis and modelling. Little evidence of wider economic or regeneration benefits was presented, primarily due to the short post-implementation period.

5.2.3 Highway Schemes

The fifteen highways schemes demonstrated clear evidence, although not consistently, of a contribution to reduced traffic flows and congestion. This was through the re-routing of through traffic and strategic movements away from residential centres, a process particularly apparent for bypass and relief road schemes. The context to such changes varied, with some scheme evaluations reporting a reduction in overall travel demand whilst others reported a net increase in

traffic; the economic recession influenced overarching travel demand for many schemes. Furthermore, little cross-modal analysis of travel demand was presented in highways focused schemes, removing the ability to demonstrate net area-wide benefits.

Evidence was presented to demonstrate highway scheme's contribution to improving journey times and accident levels on selected, and often strategic, routes. However, the short post implementation time period of analysis covered by many evaluation reports, resulted in accident data being indicative only. The contribution of schemes to wider economic objectives was also largely indicative. As a consequence of the relatively limited dataset generated across the schemes it has not been possible to consider variability by location and specific context.

5.3 Do LMS Deliver Value for Money?

The evaluation of scheme value for money should include the re-calculation of the Benefit-Cost Ratio (BCR), using outturn (observed) data. This includes the total scheme cost as reported to the DfT and measures of scheme benefit as observed through monitoring and survey activities. Of the 23 LMS assessed as part of the meta analysis, the following level of value for money assessment was identified as being feasible.

The three schemes that re-calculated BCRs generated lower outturn value for money compared with that forecast in the Business Case:

- **A628 Cudworth Bypass:** Forecast BCR at Full Approval of 3.13 against outturn BCR 3.05 (the original BCR was 3.58 at Programme Entry). The works were forecast at Full Approval to cost £21.261m, with actual outturn costs of £21.655m. Within the Transport Economic Efficiency table a statement was made that no revision to costs was required; this is not supported by the outturn cost data. The vast majority of monetised benefits were derived from journey time savings (£183m, representing 78%). However, these were calculated using a comparison of two alternative routes in the ex-post period, with no comparison of before and after data;
- **Walsall Town Centre Transport Package:** Forecast BCR 6.85 against an outturn BCR of 3.78. The scheme costs increased from £21.225m to £24.636m (16% increase) due to extended delivery periods, ground conditions and stats works. The Transport Economic Efficiency benefits were calculated using the forecast costs as the true outturn costs were not known at the time of one year post evaluation. Of the forecast benefits, journey time improvements were 53% of those forecast; it was reported that the economic recession had suppressed demand; and the ex-post surveys were undertaken one month post scheme completion resulting in regular traffic not re-routing from during-construction alternatives; and
- **Taunton Third Way:** Forecast BCR of 19.1 compared to an outturn BCR of 15. The vast majority of monetised benefits were derived from journey time improvements (93% of reported benefits). The scheme was delivered marginally under the Full Approval budget.

Twenty schemes did not demonstrate any quantitative evidence of the scheme outturn value for money; no re-calculation of the BCR was completed and no attempt had been made to determine a quantitative measure of value for money. Consideration was given to undertaking a meta evaluation, assessing whether schemes delivered at or under budget achieved their stated objectives. Although this would not equate to a quantitative assessment of benefits, conclusions could be drawn on the direction of change and implied benefit. Two schemes were delivered under the Full Approval forecast budget and six were delivered at budget. Of these, individual schemes reported improvements in journey times (and reliability), public transport reliability, accident rates, traffic flows and associated air quality. However, there was a high level of variability in benefits reported and inconsistency in the analysis methodologies adopted. Furthermore, few schemes linked collective observed changes in indicators (e.g. journey times) to forecast changes, making a qualitative assessment of value for money difficult.

Finally, as a consequence of few schemes reporting updated BCRs little evidence was available on the forecast BCRs derived at Full Approval. Only five schemes reported forecast BCRs within ex-post documentation. It is therefore not possible to provide a commentary on the robustness, reliability or variance in value for money from the evaluation reports reviewed.

5.4 How do LMS impact on traveller experience?

The scope of this evaluation question has been limited to those elements outside of the main objectives/benefits questions presented above, namely:

- Public transport service quality, including comfort, security etc.;
- Bus service overall satisfaction; and
- Improvements in connectivity and accessibility, including specifically for pedestrians and cyclists.

Eleven LMS presented some level of evidence on these issues, consisting of three public transport, seven highway and one integrated transport scheme. In terms of bus service improvements, the Weymouth Transport Package sought to improve the overall ride quality, comfort (including reduced vibration) and satisfaction of passengers, alongside enhanced punctuality. The results of a passenger satisfaction survey concluded that overall quality ratings improved, although the average age of the bus fleet increased between the business case and ex-post periods; this is commonly used as a proxy for passenger comfort. The Cambridgeshire Guided Busway passenger survey also identified an improvement in overall ratings, with 92% of passenger reporting that the service was comfortable.

A different approach to assessing the traveller experience was undertaken as part of the Metrolink track renewal scheme, as this scheme involved the temporary closure of the line and the provision of replacement bus and train services. The ex-post passenger satisfaction survey recorded a 10% increase in overall satisfaction (79-89%) reportedly due to the reduced noise and vibration.

A number of schemes sought to represent road users and improvements in traveller experience through stakeholder consultation and feedback. Examples of this included the M4 Junction 11 improvements and the West Midlands Red Routes Package One. Both schemes reported very positive perceptions among consultees, with both schemes reportedly improving the quality of travel across all modes.

Highways based LMS also presented anecdotal evidence, through stakeholder consultation or observation, of improved connectivity and accessibility following implementation. This included the Burnt Three, Owen Street and Burgh Le Marsh schemes. Improvements included reduced severance, improved comfort for all road users, reduced vibrations for local businesses and residents, improved quality of life and health benefits. The latter was not commonly presented, although many schemes implicitly linked reduced air quality pollution with breathing and health benefits.

Overall, this evaluation question was not a direct focus for the majority of scheme promoters, with most benefits being secondary impacts of reduced congestion, replacement public transport services and enhanced transport choice. Walking and cycling benefits were not analysed and consequently health, quality of life and social inclusion evaluation was largely based on qualitative assessments.

5.5 What is the evidence of LMS impacting on modal choice?

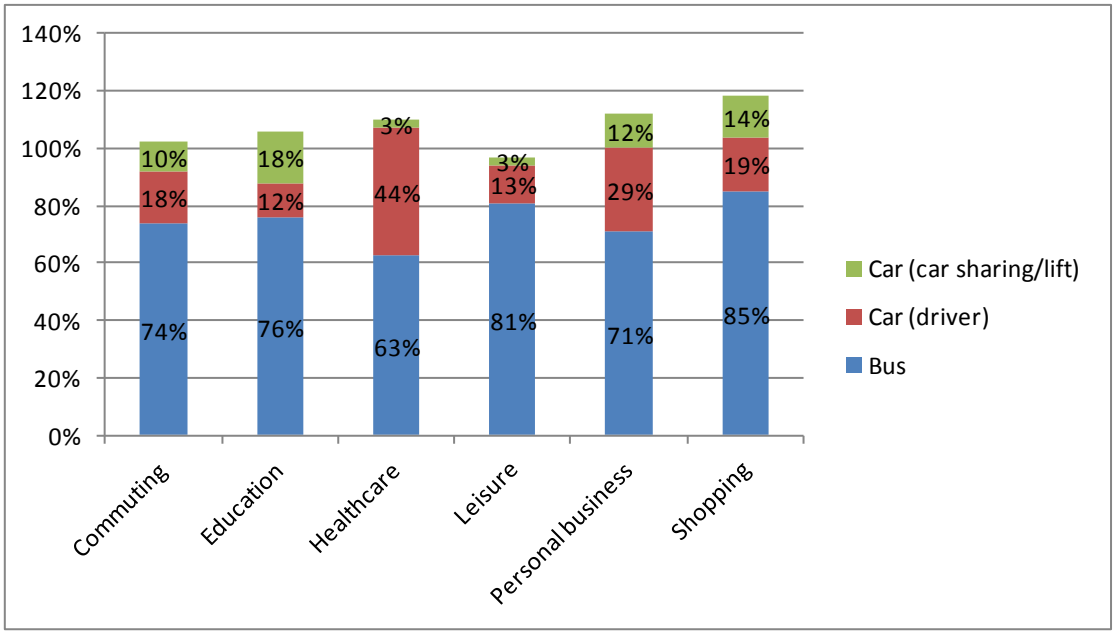
The level of evaluation evidence relating to modal choice and changes in traveller behaviour was very limited; two schemes presented detailed evidence of modal choice; a further two schemes presented some qualitative evidence; and six schemes presented some evidence of change in mode counts. It is noteworthy that only two of the 23 schemes had stated objectives that explicitly

targeted a change in mode use. 14 schemes had objectives to either reduce traffic and/or congestion, but did not define the change in road user modal choice as a core outcome.

The coverage of top-down objective is likely to have influenced both the data collection methodologies and the scope of evaluation analysis; the coverage and depth of analysis for individual objectives, such as reducing traffic flows, is more robust as outlined in **Section 3**. An example of this is the almost complete lack of baseline evidence of modal share across all schemes. Pre-delivery baseline data on individual modes was common, leading to a good coverage of before and after analyses. However, these were constrained to direct mode specific comparisons, supported by assumed impacts on area-wide mode share. As a consequence, there was no evidence presented of direct attribution of mode share changes to LMS.

The Cambridge guided busway presented ex-post passenger survey data, including evidence of trip generation and modal choice. Of those passengers who were undertaking a regular journey, seventy-five percent stated that they had always used the bus. Of the remaining twenty-five percent, the vast majority had switched from the car (Figure 10 shows the previous mode of travel by journey purpose).

Figure 10: Evidence of modal change following Cambridge Guided Busway
(multiple responses allowed, percentages calculated on the total number of respondents therefore totals will be over 100%)



5.6 How do LMS impact on the environment?

The potential scope of environmental impacts of LMS includes:

- Air quality: covering NO2 and PM10;
- Greenhouse gases: CO2;
- Noise;
- Landscape;
- Biodiversity; and
- Water.

11 of the 23 LMS evaluated included evidence of environmental impacts, varying from directly observed data to model derived estimates; ten of the schemes were highway improvements and

one was an integrated transport scheme. Six of these schemes presenting data had defined environment-related objectives. Furthermore, four schemes that did not present any evidence of environmental impacts had defined environmental related objectives as part of the Business Case. The outturn impacts of schemes is summarised below under the main evidence types of air quality, greenhouse gases and noise.

5.6.1 Air Quality

The level of NO_2 was the most commonly reported environmental impact, with six schemes presenting quantitative evidence (**Table 14**). The national air quality objective (annual mean) is 40µg/m3, whilst the daily mean is 50µg/m3 and most schemes remained below these thresholds post implementation. The majority of these data were collected from direct monitoring sites; the exception was the Weymouth Relief Road which used a traffic based dispersion model to estimate air quality impacts. The Taunton Third Way scheme was located within an Air Quality Management Area and the data presented was the average of over 20 independent monitoring sites; there was significant variability between sites reported at both the baseline and ex-post periods.

Table 14 - NO2 Before and After Comparisons

Scheme	Before Opening (µg/m^3)	After Opening (µg/m^3) (Change)
Weymouth Transport Package (results shown for two key monitoring corridors)	49.6 35.5	38.9 (-10.7) 26.5 (-9)
Owen Street (results shown for two monitoring sites)	28.6 23.0	24.67 (-3.9) 20.48 (-2.5)
Taunton Third Way	26	29 (+3)
Darlington Eastern Transport Corridor	26.6	23 (-3.6)
Weymouth Relief Road	8 out of 10 sites saw a reduction of between 5% and 24%. Two sites saw an increase of approximately 2%.	
M4 Junction 11 Mereoak	Levels increased at all sites but remained below the national threshold. Levels were lower than forecast at Business Case.	

5.6.2 Greenhouse Gases

Two schemes reported changes in CO_2 following scheme implementation, with both using traffic based forecasting techniques (following WebTAG Unit 3.3.5). Both schemes reported assumed reductions in emissions based on observed reductions in traffic flows and improved journey times (a reported proxy for congestion). A further scheme reported CO_2 levels for the baseline period, stating that the five year post opening assessment would re-evaluate environmental impacts.

5.6.3 Noise

Two schemes presented information on changes in noise levels, one using observed data from monitoring sites (the M4 Junction 11 at which 8 of the 15 sites showed a marginal <3db reduction) and the other relying on assumed impacts due to changes in traffic movements (Glasshoughton).

The level of attribution reported was very low or non-existent for each of the above environmental objectives and indicators. The assessment of scheme contribution was therefore largely absent, particularly where changes in journey times were used as a proxy for reduced congestion, which in turn were used to imply environmental benefits.

5.7 How do LMS impact on the local economy?

The wider economic impacts of LMS remains a challenging area of assessment, primarily for two reasons:

- The scale of schemes relative to the factors influencing wider economic conditions and characteristics; and
- The time lag associated with key economic changes, making analysis within the year one post opening Impact Assessment almost impossible.

Despite this, ten schemes provided a commentary on the assumed or forecast level of economic change; nine of the schemes were highway improvements and one scheme was an integrated transport package. All schemes were focused on identifying the economic regeneration benefits of schemes, rather than the direct or associated employment impacts. This emphasised the second challenge identified above, given the timeline for regeneration investment to materialise post scheme completion. Reference was also made in many of the remaining 13 LMS evaluations to enhancing accessibility to town centres, with the implied benefit of increasing employment, reducing social exclusion and promoting agglomeration.

A summary of the main regeneration impacts of schemes is presented in **Table 15**. This shows that whilst many promoters sought to link regeneration and development projects to schemes, little direct attribution or indeed contribution was determined. Various analytical methods were also adopted, from consultation with scheme stakeholders through to the use of secondary datasets on employment, house prices and wages.

Table 15: Summary of Wider Economic Impacts

Scheme	Wider Economic Impacts
Weymouth Relief Road	• Employment forecast to increase by ~4000 2008 and 2016. • Actual change 2008 to2010 was a reduction, due to wider recession. • Tourism numbers increased post implementation, but average and total spend reduced. • Wages increased since implementation. No real-terms assessment undertaken nor attribution/commentary on scheme contribution.
Owen Street	• Employment and businesses reduced between 2006 and 2011. • Closure of key route into the town for scheme implementation was stated to have contributed to this impact.
Taunton Third Way	• Reduction in businesses and employment in both Taunton and Somerset between baseline and year one ex-post. No attribution of impact of scheme determined.
Brierley Hill Sustainable Access Network	• >£40m development facilitated by the scheme • 200 job increase 2009 to 2010 but no attribution or net benefit of scheme determined. • Stated benefit of company moving into central Weymouth does not represent net benefit to the area.
Walsall Transport Package	• Key developments stated but no attribution to scheme presented.
Hemsworth-A1 Link	• The assessment of the scheme promoter stated that 1200 homes and >29,000m^2 of B2 and B8 development was contributed to by the scheme.

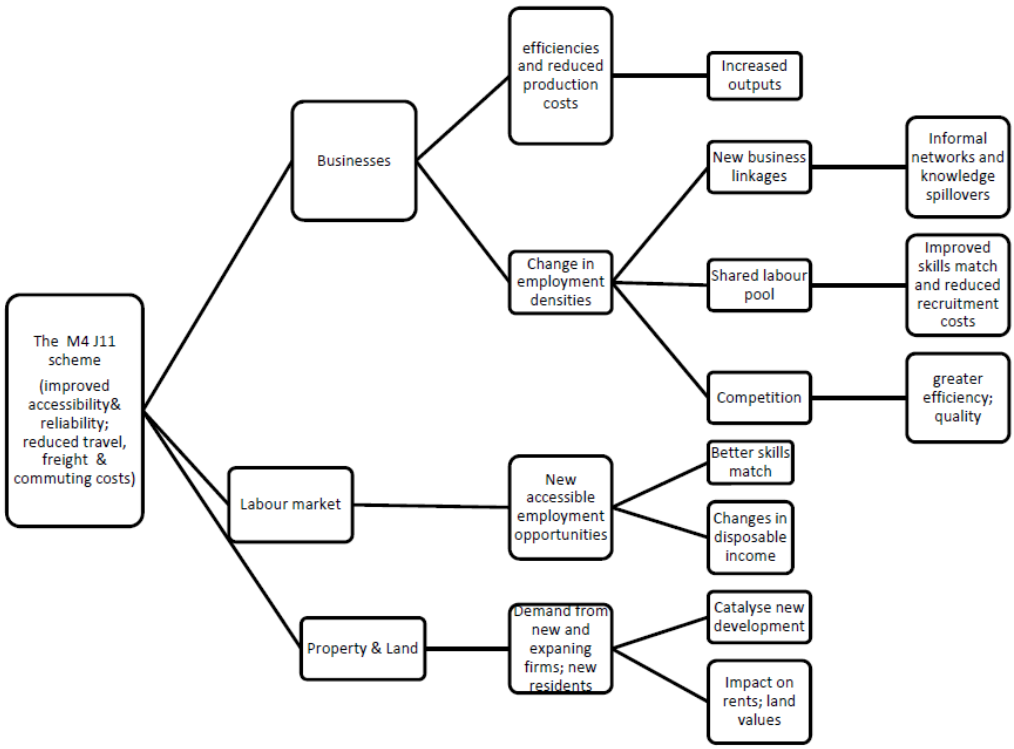
A good example of a more qualitative approach was adopted on the M4 Junction 11 Mereoak scheme assessment (**Figure 11**). Because of the challenges in determining absolute change, and more importantly attributing this to the scheme, the following stakeholder consultation evaluation methodology was adopted (the logic map (**Figure 11**) for this approach is also shown overleaf):

- **Businesses:** what impact has the J11 scheme had on local businesses? Are the businesses benefiting from additional agglomeration economies as predicted by the theoretical

evidence? In the short term there was no statistical evidence to suggest that productivity in the locality had improved. This was reported to be largely due to the macro economy and the recession which has had profound effects on all firms and particularly on the high value firms such as those found in the Junction 11 locality. The qualitative evidence indicated that the J11 improvement scheme had had a short term influence on the efficiency of business inputs and the perceived attractiveness of the locality.

- **Labour market:** has/will the J11 scheme had any impact on the supply of labour and the move to more or less productive employment? The qualitative evidence indicated a perceived benefit of the scheme in terms of journey time and reliability, thereby opening up the potential labour market.
- **Property and land:** has the J11 scheme brought forward new development and attracted new employers to the local area? The qualitative evidence from stakeholders such as local estate agents indicated that the Junction 11 improvements are pivotal in realising future development opportunities by increasing the probability of planning applications being accepted (e.g. the removal of transport constraints such as capacity and congestion).

Figure 11: M4 J11 Logic Chain Analysis



5.8 How do LMS have an impact on local bus operations?

The evaluation of LMS impact on local bus operations focused on three areas of performance:

- Bus punctuality, measured against the timetable;
- Bus journey times, improvements in absolute values; and
- Bus journey time reliability.

Five of the 23 LMS evaluated included objectives specific to the above bus operational characteristics, with schemes having a combination of one, two or all of the above. Other schemes also included reference to improving bus reliability, but presented this as a consequence of reduced traffic congestion and improved network performance. The schemes presenting evidence of changes in bus operations included:

- The Cambridgeshire Guided Busway;
- The West Midlands Red Routes (package one);
- The A638 Quality Bus Corridor (Doncaster); and
- Integrated transport packages in Weymouth, Taunton and Scarborough.

However, the evidence presented does not allow a comparison to be made between segregated, online bus priority and wider traffic management interventions. In respect of service punctuality, two schemes presented a direct before and after comparison. The Weymouth Transport Package for the 2012 Olympic Games reported a baseline range of 17-57% of buses departing more than five minutes late, across three survey sites. The one year ex-post results were a range between 29-54%; however, poor weather conditions were experienced during the ex-post survey period and this was reported as potentially influencing results. The Taunton Third Way scheme saw an increase from 25% to 50% of surveyed buses departing on time.

Three schemes presented data on the change on absolute bus journey times: the Weymouth Transport Package saw a 29% reduction in route end-to-end journey time; the A638 QBC reported 22-28% reductions on the north and south approaches respectively; and the West Midlands Red Routes package one reported an 18% reduction in bus journey times. Changes in the reported journey time reliability were of a similar magnitude to absolute times (**Table 16**). The review of evaluation reports from across 23 LMS indicated assumed improvements in bus journey time and reliability as a consequence of reduced traffic congestion and flows. However, town centre bypass and transport package schemes presented little direct evidence to support such conclusions and no direct link or contribution analysis was demonstrated.

Table 16: Comparison of Absolute and Reliability change in Bus Journey Times

Scheme	Reduction in Absolute Journey Time	Improvement in Journey Time Reliability
Weymouth Transport Package	29%	28%
A638 QBC	22-28%	28-57%
West Midland Red Routes	18%	33%

5.9 How well have the impacts of LMS been forecast and what are the reasons for differences between forecasts and outturn impacts?

These two research questions have been considered together, with the findings of the meta evaluation presented by impact type rather than by question. The main comparisons made were relevant to:

- Travel demand;
- Journey times;
- Journey time reliability;
- Safety; and

- Environment.

5.9.1 Travel Demand

Ten of the 23 LMS presented evidence comparing pre-scheme forecasts with observed outturn travel demand. This was predominantly reported using traffic count comparisons, with forecast movements being derived from a range of standard transport planning modelling platforms (e.g. SATURN). Seven of the ten schemes were highway improvements, two were highways dominated integrated transport packages and one public transport scheme reported forecast patronage on temporary replacement bus services.

Table 17 presents a summary of a selection of scheme comparisons, focusing on those that presented consistent forecast (modelled) and outturn data across the scheme. In general, forecast levels of traffic were higher than observed post implementation flows, although significant variation across count sites/scheme areas was observed. The main reported reason for these variations was the economic recession, and associated downturn in development and background traffic growth. There were also selected examples of traffic routing variance compared with modelled forecasts, particularly on the Weymouth Transport Package; the latter was in part due to the different phasing of the scheme and anticipated traffic calming not progressing on defined links.

Table 17: Comparison of Forecast and Outturn Traffic Flows

Scheme	Difference between Forecast and Observed Traffic Flows
Weymouth Transport Package	-3% overall -56% - +31% on select links
Glasshoughton Coalfields Link Road	-28% - +18% on select links GEH average <10
Hemsworth-A1 Link	-3% overall -63% - +3% on select links
Walsall Town Centre Package	-50%-80% on select links

It is also noteworthy that two schemes updated transport modelling to reflect the revised background growth, and re-ran the do-something scenario. This was undertaken to test the robustness of the transport model, permitting a direct comparison between updated modelled flows with observed flows. Significant variance was observed, particularly on the Glasshoughton Coalfields Link Road scheme, where traffic flows varied substantially from modelled values.

5.9.2 Journey Times and Reliability

Only two schemes presented a comparison of forecast and outturn journey time data; a number of schemes presented target levels of outturn data but such levels were not substantiated with detailed modelling or forecasting. The Taunton Third Way presented modelled/forecast improvements in journey times of 4.8% and 11% for the AM and PM peaks respectively. The comparable outturn values were 5% and 11%. The variance in the AM peak was reportedly linked to the lower than forecast traffic flows, a consequence of the economic recession and suppression of overall travel demand. The Walsall Town Centre Package also forecast longer journey times compared with the observed year one post opening surveys; in this case 30 seconds higher on average journey times of 6 minutes. However, both the forecast and observed times were lower than the baseline, reflecting the improved journey times post implementation.

5.9.3 Safety

Only one scheme presented a detailed analysis of forecast accidents with outturn observed values (the Hemsworth – A1 Link Road). This forecast a reduction of 131 accidents across the 60 year appraisal period. Using the three year post implementation data for extrapolation, an estimated 240 accidents would actually be saved. A number of other highway schemes reported extrapolated year one post opening accident data to compare with a three/five year baseline period. However,

good practice indicates that a minimum of three years of accident data is required to undertake statistically reliable analysis, and so such comparisons were not considered within the meta evaluation.

5.9.4 Environment

Two schemes presented comparisons of forecast and outturn environmental outcomes; the M4 Junction 11 Mereoak improvements; and the Weymouth Relief Road. This covered air quality, greenhouse gas and noise predictions for the ex-post period, using traffic modelling platforms and following WebTAG. For example, the Weymouth Relief Road presented detailed noise forecasting, including modelled values of noise annoyance and consequential impacts of house prices. This included the use of over 120 road traffic noise surveys. An example comparison for the Dorchester Road reported forecast reductions of between 6db and 7db, compared with measured outturn reductions of between 1db and 4db depending on specific site location. Overall, six monitored routes saw an increase in absolute traffic noise levels but all were lower than the forecast increase. Similarly, four routes reported a reduction in traffic noise levels, with each being greater reductions than forecast. The Weymouth Relief Road scheme was also assessed for forecast and outturn NO_2, PM10 and CO_2 levels.

The M4 Junction 11 schemes undertook a detailed monitoring programme for environmental impacts, including noise monitoring at key receptors, diffusion tubes for air quality and modelling analysis for greenhouse gases. Noise forecasts varied between -6.8db to +10.1db from the measured outturn values, although across the scheme area noise levels remains within +/- 1db. In terms of NO2, six of the seven monitored sites had outturn values lower than forecast, with variance ranging from -10db to +6.3db.

6. Conclusions and Lessons Learnt

6.1 How well do schemes deliver their stated objectives?

LMS have been successful in delivering a range of short term objectives, particularly focused on reducing congestion and improving journey times. Public transport schemes have also delivered objectives on reliability, punctuality and service quality, albeit for a small number of schemes. However, there was little evidence presented to demonstrate the delivery of longer term objectives, such as economic, environmental and social impacts.

6.2 What are the main benefits of LMS (does this vary by scheme type/context?)

A most commonly reported benefit realised across scheme types was improved network efficiency (reduced congestion), leading to improvements in journey time reliability. Reductions in town/village congestion and associated air quality impacts were also well evidenced across a range of scheme types and locations. However, demonstrable benefits were commonly focused on the immediate scheme vicinity, with wider impacts not reported or evidenced.

6.3 Do LMS delivery value for money?

Only three LMS reported updated Benefit Cost Ratios, with all three reporting lower outturn values compared with Business Case forecasts. The economic recession suppressing travel demand was commonly reported as a factor in reduced outturn values. Another factor was undertaking ex-post monitoring too soon following scheme opening, with traffic not re-routing back to pre-scheme travel behaviour. However, the majority of schemes achieved short term objectives or were able to demonstrate they were travelling in the right direction for achievement.

6.4 Are LMS delivered on budget and on time? (if not, why not?)

Reasons for cost and programme variances have been found to be diverse and often unique to specific scheme circumstances. Although seemingly obvious, future promoters should consider the likelihood of the following risks at the earliest possible opportunity (doing so will improve cost and programme expectations for all stakeholders and delivery partners):

- The implications of weather conditions/environmental constraints and archaeology on construction scheduling;
- Stakeholder objections/delivery partner responsibilities/statutory undertakings/land acquisitions and legal issues; and
- Contractual arrangements that may affect where risks are carried, start of works dates and works specifications.

Cost and programme forecasting certainty improves significantly between Programme Entry Stage and Full Approval Stage. Looking ahead, scheme promoters should be actively encouraged to develop their ‘Management Business Cases’ at the earliest possible opportunity to mitigate against programme and cost over-runs. If done at the scheme prioritisation stage, this also gives the added benefit of ensuring the right schemes are taken forward for delivery.

6.5 How do LMS impact on traveller experience?

Public transport LMS demonstrated strong performance and positive movements in passenger satisfaction (improved ride quality, vibrations, comfort). A lack of end user data for non public transport schemes made commentary on traveller experience difficult. However, reduced congestion and increased journey time reliability were reportedly benefiting network users.

6.6 Is there evidence LMS impact on modal choice?

There was a general lack of evidence presented on mode choice with the majority of schemes presenting scheme specific data. There were reported positive changes in public transport patronage, but little evidence of wider travel behaviour impacts.

6.7 How do LMS impact on the environment?

Associated with reduced congestion and improved network performance were evidenced improvements in air quality and, to a lesser extent, noise. Evidence of greenhouse gas reduction was less commonly reported, but modelled outcomes presented a positive movement in post implementation periods. Very little evidence was presented on wider environmental impacts such as biodiversity.

6.8 How do LMS impact on the local economy?

Limited evidence on regeneration and wider economic impacts was reported, primarily due to the majority of evaluation reports being year one post opening in scope. There was good use of stakeholder consultation to fill in quantitative evidence gaps, which indicated positive directional change in economic indicators and trends. A commonly reported benefit was reduced congestion and improved journey times leading to enhanced accessibility to employment and business customers.

6.9 How do LMS impact on local bus operations?

Public transport schemes reported positive benefits in both absolute journey time and reliability, alongside punctuality improvements. Highways and integrated transport schemes reported assumed public transport operational benefits resulting from reduced congestion and improved network efficiency.

6.10 How well have the impacts of LMS been forecast? What are the reasons for differences between forecast and out-turn?

Outturn traffic flows were generally lower than forecast, reportedly due to the economic recession suppressing travel demand. The presentation of forecasts within year one post opening reports was very limited for other outcomes, so no comparisons were available.

6.11 Lessons Learnt for Evaluation Approaches

The evaluation standard for LMS implemented has been found to be highly varied. This has limited the opportunities to identify constructive lessons for promoters of future LMS.

The review of the data presented shows that the scope for robust meta 'analysis' as defined in **Section 1** is heavily constrained. With the exception of detail available on cost and programme, there are substantial gaps in the overall dataset that need to be filled before a robust meta analysis can be undertaken. The main obstacles to meta analysis are summarised as follows:

- Evaluation analysis is inconsistent across the programme and between research questions, this severely limits the scope for cross programme level analysis;
- Further evaluation is not at all feasible without additional engagement with scheme promoters;
- Adequate detail regarding technical assumptions used in evaluations is regularly missing, inconsistent or require further challenge such that immediate comparison between schemes is not appropriate without substantial additional work; and

- Most schemes have been evaluated just one year after opening, whilst this is sufficient for assessing shorter term impacts this is not the case for impacts on the local economy, modal share and environment.

Such data inconsistencies make it only feasible to prepare qualitative statements of the scheme outcomes and impacts at the programme level – supported in a minority of cases by quantitative data. Consequently these issues result in difficulties relating to the identification of useful learning points for both the DfT and future scheme promoters.

However in completing the meta evaluation it has been possible to consider thematic areas of evaluation quality, identify examples of good practice and areas of methodological weakness. A summary of these findings is presented below, structured according to the main stages of scheme evaluation.

The DfT may wish to consider these issues as it continues to develop its 2012 Framework for LMS evaluation.

6.11.1 Baseline Data

The level of baseline data varied significantly between LMS, particularly in the following areas:

- **Data scope:** traffic count data was commonly presented, but little baseline data was presented for public transport, walking and cycling modes;
- **Data coverage:** the geographical area of monitoring and data collection was commonly tightly defined around the scheme location. The coverage of data was also often defined by the transport modelling undertaken during Business Case preparation, with little obvious consideration given to the wider potential impacts;
- **Data quality:** the number of days, duration of collection by time period and particularly background trend data was inconsistent between schemes and often very limited (one or two days of data for peak periods was common).

The often extended period of Business Case preparation, and iterations of submission, review and re-working resulted in a gap between the most recent baseline data and actual scheme implementation. Many schemes used data collected for Business Case appraisal activities as the default baseline, although up to five years passed in some instances before scheme build commenced. Baseline data was therefore often a poor representation of the network conditions immediate prior to scheme implementation. To ensure that future evaluations are as robust as possible, scheme promoters should give consideration to the merits of undertaking data collection at latest possible opportunity before commencement of works.

6.11.2 Forecasting

As noted above, the quality of forecasting varied between schemes, with the majority of evaluation reports not presenting comparisons of outturn and forecast outcomes. Where comparisons were presented it highlighted the challenge of such analysis in complex transport networks. The re-routing of traffic for example made the comparison of site specific outturn flows with forecasts particularly problematic. A requirement to present baseline, target and outturn data for each outcome would enhance the quality of future post opening evaluations.

6.11.3 Scheme Implementation and Delivery

The 2006 DfT evaluation guidance to which all 23 schemes were working did not stipulate the requirement to undertake a process evaluation. Consequently, the level of evidence presented on this area in the evaluation reports was limited. Some evidence was presented on key reasons for programme slippage or cost changes, but little evidence was presented on changes in scheme designs; a summary of the final delivered scheme was common but no commentary on variance

from the Business Case. The 2012 evaluation guidance presents a more structured requirement to articulate scheme designs, and the need to highlight variance from original proposals.

6.11.4 Year One Impact Assessments

Although the majority of the 23 LMS produced year one post opening evaluation reports, the quality of evidence and analysis therein was highly varied. As noted, the coverage and quality of comparisons between forecast and outturn data was poor, as was the updating of the value for money assessment. Few schemes presented directly comparable BCRs for the before and after periods. The nature of the observed counterfactual scenario was also limited, commonly using the observed 'pre scheme' data collected Business Case stage. No attempt was made to consider an updated counterfactual, incorporating alternative investment options and thereby the net impacts of the LMS; it is recognised that for many of the schemes this would not have been a proportionate approach.

There was little direct analysis of the contextual conditions in which the schemes were implemented, although qualitative statements regarding the economic downturn influencing travel demand were common. As a consequence, the true net impacts of schemes were not presented, accounting for variance in background datasets and trends. Furthermore, although the majority of scheme evaluations presented traffic flow and journey time analysis, evidence of public transport, walking and cycling demand was limited. Little multi-modal and network wide analysis was therefore evident.

The level of attribution or contribution analysis presented in the evaluation reports was also very limited. Conclusions regarding scheme impacts were often derived from single datasets, and changes assumed to be linked to scheme implementation. Associated with this, little attempt was evident to triangulate evidence sets through which to draw more robust and meaningful conclusions. There was an over reliance on single datasets, often consisting of single data points for each of the before and after periods; the lack of continuous or trend data should also be noted.

Finally, there was limited evidence from end users, with the exception of selected public transport schemes. Although it is recognised that undertaking end-user research for highways schemes is often prohibitive on cost grounds, understanding cause and effect of observed behaviour change would significantly enhance the quality of scheme outcome attribution.

6.11.5 Year 3-5 Economic Evaluation

As stated above, the majority of the evaluation reports reviewed were year one post opening assessments. Consequently the coverage of wider economic evaluation evidence was limited. However, there were good examples of stakeholder consultation to support quantitative analysis, to establish early post-scheme consensus on emerging scheme impacts.

6.11.6 Evaluation Design

The majority of LMS adopted an outcomes-based evaluation design, building on traditional monitoring activities supported by transport modelling. There was no evidence of quasi-experimental (comparison or control area/routes) or theory-based evaluation designs being adopted, and the quality of attribution was consequently very low. Within the analysis presented there was evidence of poor intervention logic, resulting in assumed changes and linkages being reported, which could not be evidenced by data. The use of logic mapping and the more common adoption of combined methods incorporating elements of theory-based techniques will help to address this issue. It was also noteworthy that the content and purpose of the evaluation reports reviewed also varied significantly, making the originally planned meta analysis impossible.