

Project Appraisal Guidelines

Unit 6.13 CBA Audit Checklist

August 2011

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1 Introduction

- 1.1. Auditing and checking of the COBA output is an essential element of the cost-benefit analysis process and due consideration, in terms of resources allocated to the task and the time allowed, should be given in the project management of the scheme.
- 1.2. The CBA software provides a detailed analysis of the scheme appraisal. Although the software performs a wide range of data and consistency checks, it is not possible for the program to detect all possible errors. It is, therefore, important that the output be reviewed to determine whether or not the appraisal is robust.
- 1.3. This PAG Unit provides a checklist for the undertaking of CBA assessments and the validation of CBA reports and outputs.

2. Responsibilities

- 2.1. The responsibility for undertaking the auditing and checking occurs at three levels
 - Firstly, the Appraisal Team Leader undertaking the CBA should satisfy him/herself that the assessment has been carried out in a robust manner prior to submitting the appraisal report to the DOPM;
 - Secondly, the DOPM or his/her team should undertake a review of the work themselves; and
 - Lastly, the NRA Strategic Planning Unit will conduct a review of each CBA produced
- 2.2. CBA Team and Design Office audits should take place at each project phase that CBA is required.
- 2.3. Persons involved in the appraisal process must have had some prior experience or attended an approved formal training course on either project appraisal or CBA. This holds true for both members of the Appraisal Team and for the person responsible for reviewing the appraisal work in the Design Offices
- 2.4. The Appraisal Team comprises an Appraisal Team Leader and Appraisal Team Members. The required experience within the Appraisal Team and the Design Office is defined below. Note that the requirements for the Appraisal Team are relevant regardless of whether the team is drawn from the Design Office, or employed as an external consultant. The Design Office Project Manager is responsible for the approval of the CBA Team.

Appraisal Team Leader:

The Appraisal Team Leader must be able to demonstrate knowledge of the appraisal process, including the use of standard computer programmes used in traffic modelling and economic assessment. The Team Leader must have been on an approved training course and have detailed experience of appraisal on at least three highway projects.

Appraisal Team Member: The Appraisal Team member must have been on an approved training course or seminar and/or have practical experience in undertaking appraisal. At least one Appraisal Team member should be included on each Appraisal Team

3. Key Audit Areas

- 3.1. The DMRB Volume 13, Section 1, Part 3, Chapter 11 provides guidance on what to check when validating a COBA printout; reference should be made to this document when undertaking the validation. The key areas that require checking are described below. Where modelled networks are large, a sampling approach to the checking may be adopted. For example, for networks consisting of over 100 links, it would be appropriate to check in detail the coding of 10% of the links and junctions

Basic Variables

- 3.2. If local rather than default values have been used for parameters such as traffic growth, traffic proportions, seasonality index, E- and M-factors, flow groups and accidents, then the basis for the derivation of these values should be examined and any calculations confirmed.

Coded Network Structure

- 3.3. There should be a direct correspondence between the coded network, the node link diagram and scheme plans for both the Do-Minimum and Do-Something schemes.

Link Data

- 3.4. A check should be made on the data pertaining to each link, such as the link length and other geometric characteristics, speed and accident rates, with those values falling outside the range of typical values for the link type being investigated further.

Junction Data

- 3.5. The audit should check that flow patterns and turning matrices are reasonable. Maximum delay coding can be compared against timed runs.

Traffic Flows

- 3.6. Flows entered for non-neutral months should be queried and the flows should be cross-referenced against those contained in any Local Model Validation Report. There should be no links with zero flow.

Scheme Costs

- 3.7. The audit should confirm that all items (construction, land, preparation and supervision costs) have been included and the cost estimates input are in

accordance with the most recent estimates agreed with the NRA Cost Estimation Unit.

- 3.8. The auditor should check whether the appropriate scenario testing / sensitivity analysis has been undertaken on costs as well as in terms of traffic growth forecasts (see PAG Unit 6.1: Guidance on Conducting CBA for more detail).
- 3.9. Any indices used to take historical costs to the price base year, such as the CPI and RPF should be reviewed for appropriateness. The Auditor should also consider whether the assumed timing of the scheme costs is correct.

Costs and Benefits

- 3.10. The items listed above all relate to data input by the user and are relatively straightforward to check. A more complex task is the interpretation of the costs (and thereby benefits) that these data give rise to in the context of travel time, vehicle operating costs and accidents, and the changes thereof over the appraisal period.
- 3.11. The process should seek to confirm that the cost and benefit stream relating to each is realistic and also in line with the aims of the proposed scheme. For example:
 - Travel time – the audit should investigate links and junctions going over capacity and when this occurs during the appraisal period. The audit should also confirm whether changes in total vehicle kilometres accord with expectation, and should examine the resulting changes to time spent on each link and at each junction.
 - Vehicle Operating Costs – fuel and non-fuel related Vehicle Operating Costs will change as a result of the general increase in vehicle kilometres aggregated over the entire network over time. The auditor should confirm that the changes in vehicle operating costs accord with expectation.
 - Accidents – are large accident reductions realistic? Can they be reconciled with the problems for which the scheme is designed to address?

Audit Checklist

- 3.12. A checklist that summarises the key elements to be considered during the audit process is outlined below. This list is based on the information contained in DMRB Volume 13, Part 1, Chapter 11, and includes the more important items in each output phase that should be reviewed and commented upon if necessary. It is recommended that auditors use this list, or similar, to ensure that all costs and benefits attributed to a scheme have been checked.
- 3.13. If the audit is being undertaken by an independent consultant, any findings, comments and recommendations may be expanded upon in a separate audit report, with the summary checklist. All raw data used during the assessment, as well as the draft CBA Report itself, should be delivered to the NRA SPU for review.

Table 6.13.1: COBA Audit Checklist

Phase	Details	
REQUIRED REFERENCE DOCUMENTATION FOR VALIDATION	<ul style="list-style-type: none"> Scheme Plans <i>(plans of option at appropriate scale – tick if provided)</i> 	<ul style="list-style-type: none"> Do Nothing
	<ul style="list-style-type: none"> COBA Node Link Diagrams 	<ul style="list-style-type: none"> Do Minimum Do Something
	<ul style="list-style-type: none"> Input Reports <i>(reports detailing inputs for COBA– tick if provided)</i> 	<ul style="list-style-type: none"> Do Nothing Do Minimum Do Something
	<ul style="list-style-type: none"> Cost Estimates <i>(cost estimates with accompanying spreadsheets for each option - tick if provided)</i> 	<ul style="list-style-type: none"> COBA TUBA
	<ul style="list-style-type: none"> Full COBA Printouts <i>(printouts for both high, medium and low traffic growth for all options – tick if provided)</i> 	<ul style="list-style-type: none"> Do Minimum Do Something
	COBA OUTPUT PHASES (2&3) – BASIC VARIABLES	<ul style="list-style-type: none"> Traffic Growth <i>(Tick where appropriate. If zone-based values derived, is it reasonable?)</i>
<ul style="list-style-type: none"> Traffic Proportions <i>(Tick where appropriate. If local values entered, are the proportions representative of the network throughout the year? How do they compare against default data?)</i> 		<ul style="list-style-type: none"> Zone Based Default Local
<ul style="list-style-type: none"> First Scheme Year <i>(Enter first scheme year. Is this realistic?)</i> 		
<ul style="list-style-type: none"> Seasonality Index <i>(Tick where appropriate. If local values entered have details of derivation, including calculations been provided?)</i> 		<ul style="list-style-type: none"> Default Local
<ul style="list-style-type: none"> M-Factor/E-Factor <i>(Tick where appropriate. If local values entered have details of derivation, including calculations been provided?)</i> 		<ul style="list-style-type: none"> Default Local
<ul style="list-style-type: none"> Flow Groups <i>(Tick where appropriate. If local values entered have details of derivation been provided?)</i> 		<ul style="list-style-type: none"> Default Local

	<ul style="list-style-type: none"> Accident Data <i>(Tick where appropriate. If local values entered have details of derivation been provided? Compare against default values.)</i> 	<ul style="list-style-type: none"> Default Local
COBA OUTPUT PHASE (4) – NETWORK STRUCTURE AND RESTRUCTURING	<ul style="list-style-type: none"> Does node-link structure of Do Minimum and Do Something agree to scheme plans? 	<ul style="list-style-type: none"> (i) Do Minimum <ul style="list-style-type: none"> Yes No (ii) Do Something <ul style="list-style-type: none"> Yes No
COBA OUTPUT PHASES (5&6) – LINK AND JUNCTION DATA	<ul style="list-style-type: none"> Link Data – check the following are reasonable 	<ul style="list-style-type: none"> (i) Geometric parameters <ul style="list-style-type: none"> Yes No (ii) Traffic flows <ul style="list-style-type: none"> Yes No
	<ul style="list-style-type: none"> Junction Data – check the following are reasonable 	<ul style="list-style-type: none"> (i) Turning matrices <ul style="list-style-type: none"> Yes No (ii) Maximum delay <ul style="list-style-type: none"> Yes No
COBA OUTPUT PHASE (8) – AVERAGE LINK SPEED AND AVERAGE JUNCTION DELAY PER NODE	(i) Do link and junction speeds/times by flow group compare well with observed journey times?	<ul style="list-style-type: none"> Yes No
	(ii) Are there any unusual variations (or lack of) in speeds and times by flow group?	<ul style="list-style-type: none"> Yes No
COBA OUTPUT PHASE (9) – OVERCAPACITY REPORTS	<ul style="list-style-type: none"> Is there overcapacity in early years, or outside flow group 4? <i>(if YES this should be investigated further.)</i> 	<ul style="list-style-type: none"> Yes No
COBA OUTPUT PHASE (10) – CHANGES IN TOTAL VEHICLE KILOMETRES	<ul style="list-style-type: none"> Does the change in total vehicle kilometres accord with common sense given the nature of the scheme? 	<ul style="list-style-type: none"> Yes
		<ul style="list-style-type: none"> No

<p>COBA OUTPUT PHASE (11) – LINK TRANSIT COSTS & LINK TOTAL VEHICLE HOURS</p>	<ul style="list-style-type: none"> • Check the following are reasonable: 	<ul style="list-style-type: none"> (i) Links that have high link transit benefits <ul style="list-style-type: none"> • Yes • No (ii) Changes in vehicle hours spent on each link <ul style="list-style-type: none"> • Yes • No
<p>COBA OUTPUT PHASE (12) – JUNCTION DELAY COSTS & JUNCTION TOTAL VEHICLE HOURS</p>	<ul style="list-style-type: none"> • Check the following are reasonable: 	<ul style="list-style-type: none"> (i) Junctions with large benefits <ul style="list-style-type: none"> • Yes • No (ii) Changes in vehicle hours spent at each junction <ul style="list-style-type: none"> • Yes • No
<p>COBA OUTPUT PHASE (13) – LINK ACCIDENT NUMBERS AND COSTS; JUNCTION ACCIDENT NUMBERS AND COST; SUMMARY OF ACCIDENT NUMBERS AND COSTS; & ANALYSIS OF ACCIDENT BENEFITS BY YEAR</p>	<ul style="list-style-type: none"> • Check the following are reasonable: <i>(i.e. relate to problems to which scheme is designed to solve)</i> 	<ul style="list-style-type: none"> (i) Large accident reductions <ul style="list-style-type: none"> • Yes • No (ii) Cost and Benefit streams over time realistic <ul style="list-style-type: none"> • Yes • No
<p>COBA OUTPUT PHASE (14) – LINK TRANSIT AND JUNCTION DELAY COSTS BY VEHICLE CATEGORY; LINK TRANSIT AND JUNCTION DELAY COSTS BY FLOW GROUP; LINK AND JUNCTION VEHICLE HOURS BY FLOW GROUP; LINK</p>	<ul style="list-style-type: none"> • Check the following are reasonable: <i>(i.e. concurs with main aims of scheme)</i> 	<ul style="list-style-type: none"> (i) Split of benefits per vehicle category <ul style="list-style-type: none"> • Yes • No (ii) Split of benefits per flow group <ul style="list-style-type: none"> • Yes • No (iii) Split of vehicle hours by flow group <ul style="list-style-type: none"> • Yes • No

<p>TRANSIT AND JUNCTION DELAY COSTS FOR ALL VEHICLES BY FLOW GROUP AND VEHICLE CATEGORY BY FLOW GROUP</p>		<p>(iv) Time of day and vehicle type to which most benefit attributed</p> <ul style="list-style-type: none"> • Yes • No
<p>COBA OUTPUT PHASE (15) – TIME COSTS AND BENEFITS BY YEAR; VEHICLE OPERATING COSTS AND BENEFITS BY YEAR; FUEL CONSUMPTION BY VEHICLE TYPE BY YEAR; AND FUEL CONSUMPTION BY VEHICLE TYPE AND FLOW GROUP</p>	<ul style="list-style-type: none"> • Are the following realistic? Are there any anomalies over time? 	<p>(i) Profile of time costs and benefits over time</p> <ul style="list-style-type: none"> • Yes • No <p>(ii) Vehicle operating cost and benefit stream</p> <ul style="list-style-type: none"> • Yes • No <p>(iii) Fuel consumption cost and benefit stream by vehicle type</p> <ul style="list-style-type: none"> • Yes • No <p>(iv) Fuel consumption by vehicle type and flow group</p> <ul style="list-style-type: none"> • Yes • No
<p>COBA OUTPUT PHASE (16) – MAINTENANCE ANALYSIS; ANALYSIS OF EXPENDITURE AND BENEFITS BY YEAR; CONVERSION OF TRAVEL COSTS TO MARKET PRICES BY VEHICLE CATEGORY; AND ECONOMIC EFFICIENCY OF ROAD SYSTEM IN MARKET PRICES</p>	<p>(i) Are assumptions made about future maintenance costs reasonable?</p>	<ul style="list-style-type: none"> • Yes
	<ul style="list-style-type: none"> • No 	
	<p>(ii) Does Cost and benefit profile over the appraisal period appear reasonable?</p>	<ul style="list-style-type: none"> • Yes
	<ul style="list-style-type: none"> • No 	
	<p>(iii) Is timing of expenditure and first year of benefits correct?</p>	<ul style="list-style-type: none"> • Yes
<ul style="list-style-type: none"> • No 		
<p>(iv) Is spend profile appropriate to specific scheme?</p>	<ul style="list-style-type: none"> • Yes 	
<ul style="list-style-type: none"> • No 		
<p>(v) Is benefit profile as expected?</p>	<ul style="list-style-type: none"> • Yes 	
<ul style="list-style-type: none"> • No 		

Table 6.13.1: TUBA Audit Checklist

Phase	Details	
REQUIRED DATA FOR AUDIT	<ul style="list-style-type: none"> Scheme Plans <i>(plans of option at appropriate scale – tick if provided)</i> 	<ul style="list-style-type: none"> Do Nothing
		<ul style="list-style-type: none"> Do Minimum
		<ul style="list-style-type: none"> Do Something
	<ul style="list-style-type: none"> Traffic Model Network Plans 	<ul style="list-style-type: none"> Do Nothing
		<ul style="list-style-type: none"> Do Minimum
		<ul style="list-style-type: none"> Do Something
	<ul style="list-style-type: none"> Input Reports <i>(reports detailing inputs for TUBA – tick if provided)</i> 	<ul style="list-style-type: none"> TMR
		<ul style="list-style-type: none"> TUBA
	<ul style="list-style-type: none"> Cost Estimates <i>(cost estimates with accompanying spreadsheets for each option - tick if provided)</i> 	<ul style="list-style-type: none"> Do Minimum
		<ul style="list-style-type: none"> Do Something
	<ul style="list-style-type: none"> Full TUBA Printouts <i>(printouts for high, medium and low traffic growth for all options – tick if provided)</i> 	<ul style="list-style-type: none"> Yes
	<ul style="list-style-type: none"> Traffic Models <i>(Given the link between the traffic model and the TUBA input, the integrity of the model will be the most significant factor influencing the TUBA results. Robust checking of the base model and forecast assignments should provide a degree of assurance that TUBA results are valid)</i> 	<ul style="list-style-type: none"> No
BASIC VARIABLES	<ul style="list-style-type: none"> Economics Input File <i>(Tick if appropriate file used based on PAG Unit 6.11)</i> 	<ul style="list-style-type: none"> Yes
		<ul style="list-style-type: none"> No
	<ul style="list-style-type: none"> Scheme Input File <i>(A check should be made to confirm that the parameters defining the scheme are correct, in particular the input matrices i.e. demand, distance, travel time and other costs)</i> 	<ul style="list-style-type: none"> Yes
		<ul style="list-style-type: none"> No
	<ul style="list-style-type: none"> User Classes <i>(Have sufficient user classes been specified?)</i> 	<ul style="list-style-type: none"> Yes
		<ul style="list-style-type: none"> No
	<ul style="list-style-type: none"> First Scheme Year <i>(Enter first scheme year. Is this realistic?)</i> 	<ul style="list-style-type: none"> Yes
		<ul style="list-style-type: none"> No
	<ul style="list-style-type: none"> Modelled Years 	<ul style="list-style-type: none"> Yes

	<p><i>(Have models been prepared for both the first year and future year (preferably 30 years)?)</i></p>	<ul style="list-style-type: none"> No
	<ul style="list-style-type: none"> Annualisation Factors <i>(Tick where appropriate. Is basis for annualisation factors provided? Is use of model periods reasonable?)</i> 	<ul style="list-style-type: none"> Yes No
	<ul style="list-style-type: none"> Cost Inputs <i>(Have costs been input correctly in terms of profile, cost types, mode, sector etc? Market or Factor prices?)</i> 	<ul style="list-style-type: none"> Yes No
WARNINGS IN OUTPUTS	<ul style="list-style-type: none"> Warnings <i>(TUBA undertakes a number of checks on the consistency of the input matrices, have any warnings been checked and rationale for why these warnings are occurring been provided within the report?)</i> 	<ul style="list-style-type: none"> Yes No
HAVE ACCIDENTS BEEN TAKEN INTO ACCOUNT USING AN ALTERNATIVE METHOD?	<ul style="list-style-type: none"> How have accident benefits been calculated – is this acceptable? Check the following are reasonable: <i>(i.e. relate to problems to which scheme is designed to solve)</i> 	<ul style="list-style-type: none"> (i) Large accident reductions <ul style="list-style-type: none"> Yes No (ii) Cost and Benefit streams realistic <ul style="list-style-type: none"> Yes No
TIME COSTS AND BENEFITS BY YEAR; VEHICLE OPERATING COSTS AND BENEFITS BY YEAR; FUEL CONSUMPTION BY VEHICLE TYPE BY YEAR; AND FUEL CONSUMPTION BY VEHICLE TYPE AND FLOW GROUP	<ul style="list-style-type: none"> Are the following realistic? Are there any anomalies over time? 	<ul style="list-style-type: none"> (i) Profile of time costs and benefits over time <ul style="list-style-type: none"> Yes No (ii) Vehicle operating cost and benefit stream <ul style="list-style-type: none"> Yes No (iii) Fuel consumption cost and benefit stream by vehicle type <ul style="list-style-type: none"> Yes No (iv) Fuel consumption by vehicle type and flow group <ul style="list-style-type: none"> Yes No

MAINTENANCE ANALYSIS; ANALYSIS OF EXPENDITURE AND BENEFITS BY YEAR; CONVERSION OF TRAVEL COSTS TO MARKET PRICES BY VEHICLE CATEGORY; AND ECONOMIC EFFICIENCY OF ROAD SYSTEM IN MARKET PRICES	(vi) Are assumptions made about future maintenance costs reasonable?	<ul style="list-style-type: none"> • Yes • No
	(vii) Does Cost and benefit profile appear reasonable?	<ul style="list-style-type: none"> • Yes • No
	(viii) Is timing of expenditure and first year of benefits correct?	<ul style="list-style-type: none"> • Yes • No
	(ix) Is spend profile appropriate to specific scheme?	<ul style="list-style-type: none"> • Yes • No
	(x) Is benefit profile as expected?	<ul style="list-style-type: none"> • Yes • No