Department for Transport

TAG Unit A5.3

Rail Appraisal

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Department for Transport

Transport Analysis Guidance (TAG)

https://www.gov.uk/transport-analysis-guidance-tag

This TAG Unit is guidance for the **Appraisal Practitioner**

This TAG Unit is part of the family **A5 - Uni-Modal Appraisal**

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

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1. Introduction

1.1.1 This Unit provides guidance on how the general transport appraisal approach (see The Transport Appraisal Process for a summary) should be applied to rail schemes. It is applicable to the appraisal of all initiatives with rail elements that are submitted to DfT for funding with the following exception:

- railways closures and minor modifications[1].

1.1.2 Section 2 provides further detailed guidance and information on the principals of appraisal within the context of TAG. Sections 3 and 4 look specifically at measuring the impacts of a proposal on both wider society and the impact on government within the appraisal framework.

2. Principles of Rail Appraisal

2.1 Basic Appraisal Principles

2.1.1 TAG Unit A1.1 – Cost Benefit Analysis sets out the basic principles of cost-benefit analysis in transport appraisal. Rail appraisals should follow these principles, including presenting results in discounted, real prices (in the Department's base year) and in the market price unit of account (business passengers, private sector providers and government all perceive costs in the factor cost unit of account so all impacts on these groups should be converted to the market price unit of account using the conversion described in TAG Unit A1.1).

2.1.2 It is the analyst's responsibility to ensure all impacts are presented in the market price unit of account, and that adjustments are made where required. However, the following elements of a rail appraisal typically require adjustment to market prices (using the market price adjustment of 1+t), as described in TAG Unit A1.1:

- capital costs;
- rolling stock lease costs;
- operating costs; and
- rail revenues.

[1] Railways Closures Guidance, October 2006https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/266296/railwaysclosuresguidance.pdf

2.1.3 Other elements of the appraisal are typically already in market prices. Examples include work and non-work travel time savings (provided the 'market price' values have been used) and all impacts calculated with the marginal external congestion cost method (see TAG Unit A5.4), including indirect tax impacts (both the MEC method and the formulae given in Appendix A: calculate indirect tax impacts in the market price unit of account, and require no further adjustment).

2.1.4 Similarly, all appraisals must be documented in a standard manner, for ease of assessment within DfT and to enable comparison of rail projects with projects on other modes. In particular, appraisals must include:

- an Appraisal Summary Table (AST), summarising the impact of the project against all of the criteria included in the appraisal. This is a key output of an appraisal, as it is used by the Department when coming to a view on the value for money of a scheme;
- supporting worksheets for each impact, except where promoters can demonstrate there will be no impact. Detail on what is required for each impact can be found in the relevant guidance units for practitioners;
- Transport Economic Efficiency (TEE), Public Accounts (PA) and Analysis of Monetised Costs and Benefits (AMCB) tables. More detail on completing these tables can be found in TAG Unit A1.1 – Cost Benefit Analysis;
- an assessment of the extent to which the project addresses the problem and contributes to local and regional objectives;
- distributional analysis (TAG Unit A4.2 –Distributional Impact Appraisal); and
- analysis of the scheme's financial impact (Supplementary Guidance on completing Affordability and Financial Sustainability tables is not applicable to rail schemes and promoters should contact the Department regarding what analysis is required).

2.2 Project Development

2.2.1 The Transport Appraisal Process, Guidance for the Senior Responsible Officer and Guidance for the Technical Project Manager provide guidance on the approach that should be taken to project development. Problems and objectives should be clearly identified and all modes considered in possible solutions.

2.2.2 The appraisal must include an assessment of a range of options that would, as far as possible, broadly meet these objectives. The testing of alternatives is not an add-on to the appraisal but an integral part of the process of determining the preferred option. Any scheme for which the appraisal of alternative options is considered inadequate may not be accepted for funding.

2.2.3 The assessment of alternatives should start from an initial wide base of possible options. The Department requires a clear understanding of why some particular options are preferred to others and must be sufficiently robust to allow a detailed comparison between the preferred scheme and its alternatives. The Department may wish to see ASTs and worksheets (including TEE tables)

for the rejected alternatives, though the level of detail should be proportionate to the stage at which the rejected alternative was considered.

2.2.4 After a thorough justification has been given for the rejection of some of the initial set of options, the Department requires that all major schemes move toward a final appraisal of the preferred option and a 'fully worked up' lower cost alternative. A scaled down version of this may be acceptable for smaller schemes, however only after prior agreement with the Department. A 'next best' alternative may also need to be carried through the appraisal process. In these cases promoters should enter into discussion with the Department to determine the exact requirements for their scheme.

2.3 Demand and Revenue Forecasting and the Final Forecast year

2.3.1 The Department recommends a standard approach is taken to determine the final forecast year when using models underpinned by the exogenous elasticities recommended in TAG Unit M4 section 8. These elasticities have been derived from outturn data for approximately the past twenty years, and are therefore only recommended for use over a similar period into the future.

2.3.2 On this basis, models using the standard approach should be used to ensure that one of the modelled years is forecast twenty years from the appraisal year (e.g. an appraisal carried out in 2022/23 would be on the basis of a 2042/43 forecast). Beyond this point, and for the remainder of the appraisal period, the magnitude of impacts associated with the level of demand may be extrapolated using a simple forecast model, in line with projected population growth (applied to all ticket types and journey purposes).

2.3.3 This assumes that the magnitude of impacts per capita remain fixed at the levels observed in the final forecast year, but that journeys (and therefore total impacts) continue to increase as population increases. Before applying such extrapolation, analysts are expected to consider whether capacity limitations are likely to constrain the impacts not just within the standard twenty year modelling horizon but also over the remainder of the appraisal period, for example because of over-crowding in the do-something. Analysts are expected to present the justification for their approach in which consideration should be given to the following:

- The trajectory of benefits before the final modelled year and, in particular, whether there is evidence to suggest demand exceeds capacity constraints before the final modelled year. This might be demonstrated through analysis of load factors in the final modelled year. In some cases it may be prudent to test a forecast year before the final forecast year in line with recommendations from section 2.4 of TAG Unit A1.1;
- A forecast year beyond the final forecast year could be modelled to understand loadings. Understanding the likelihood and incidence of crowding dis-benefits is important in understanding if the future extrapolation of benefits is appropriate for an individual scheme (see Section 2.4 of TAG Unit A1.1 – Cost Benefit Analysis for guidance on this principle); and

- If extrapolated demand reaches a capacity limit during the extrapolation period, then demand should be capped from that point onwards. Consideration should be given to the appropriate metrics to use within the analysis of capacity constraints, for example, additional weight may be placed on capacity at peak times.

2.3.4 For the purposes of extrapolation, the relevant population projections should be used which are available in the TAG databook[2].

2.3.5 Where population-based extrapolation is used, it is expected that a series of sensitivity tests will be presented. These include:

- A sensitivity test in which no growth in demand is assumed after the final forecast year or, where the final forecast year is more than 20 years after scheme appraisal year (see para 2.3.7 below), zero growth is assumed after 20 years, in line with guidance in TAG Unit A1.1. This will allow identification of the proportion of impacts that is attributable to the long-term demand assumptions (whether forecast or extrapolated);
- Sensitivity tests with a final forecast year ten and thirty years after the appraisal year. These will test the impact of changing the period over which the exogenous relationships are assumed to hold to establish the potential impacts on costs, benefits and revenues[3]. This is recommended to understand the impact of uncertainty around the period over which we can have confidence that elasticities within TAG Unit M4 section 8 will hold; and
- If using standard elasticities, a forecast more than 20 years after the appraisal year will be necessary where the scheme opening year is after this period, since specific behavioural responses to the scheme at this time will be important. In this case, it is recommended that background growth in demand from year 20 to the appropriate forecast year should be in line with population growth.

2.3.6 Demand and revenue forecasts should be based on current fares policy (usually a nominal increase of RPI+X%). Nominal fare increases should be converted to real terms using the GDP deflator. TAG Data Book Table A5.3.1 provides the relevant GDP deflator and RPI series. No fares policy should be assumed after 20 years from the scheme appraisal year (so fares should be assumed to remain constant in GDP deflator real terms). Where the population extrapolation is used, the level of real revenue should then grow in line with population after the final forecast year.

2.3.7 In some circumstances, where the standard elasticities are not used, it may be appropriate to extend the complex model to a forecast year beyond 20 years after the appraisal year. In these instances, particular care should be given to demonstrating the robustness and strength of the model parameters, inputs and forecasts over the appraisal period.

[2] The population projection used should be consistent with the OBR's GDP forecast.
[3] For each sensitivity test, beyond the respective forecast year, demand should grow in line with population growth.

2.4 Cost assumptions

2.4.1 As noted in TAG Unit A1.2, it is important to consider how real costs will change over the appraisal period. Scheme appraisals should take into account both inflation as measured by the GDP Deflator and realistic real construction cost inflation.

TAG Data Book Table A5.3.1: Operating cost and revenue forecasting series

2.4.2 These forecasts are over a 20-year period. Where longer forecasts are required, the long-term growth rates for the final year should be extrapolated (and applied to further increases in the related indices).

2.4.3 Rolling stock lease contracts can be complex and unique. For appraisals, where analysts may not have access to specific current and future costs, it is useful to distinguish between the different elements of cost described in Table 1, below, as they are driven by different factors and change over time at different rates[4].

Table 1 Main elements of rolling stock costs

Rolling stock cost element	Description
Capital lease costs	Costs of the lease agreement relating to stock purchase. Implicitly includes build and financing costs (and profit margins for the rolling stock provider) but not maintenance costs. Typically expressed in £/vehicle/month (or year) and fixed in nominal terms from commencement of the lease agreement.
Non-capital lease costs	Contracted monthly/annual payments over the life of the stock to cover maintenance, ranging from 'heavy' and 'light' maintenance to potentially include items such as cleaning. More common for older (pre-1996) stock.
Mileage-based maintenance costs	Payments made by the operator to the rolling stock provider for maintenance on a '£/vehicle mile basis', based on annual mileage as deployed in service. More common for newer stock and, in some cases, rolling stock may be subject to both non-capital lease costs and mileage-based maintenance costs.

2.4.4 The following considerations should be taken into account when forecasting increases in non-staff-based operating cost elements over time:

- TAG Data Book Table A1.3.7 provides forecast gas oil (diesel) and electricity prices. These series should be applied over the whole appraisal period, with no capping of cost growth when demand and revenue are capped. With forecasting gas oil (diesel) costs it is necessary to include the impact on fuel consumption rates of the expected future increase in biofuel use, which are

[4] These distinctions may have *accounting* – and tax – implications but these are not of concern here where the focus is on *economic* aspects.

provided in TAG Data Book Table A1.3.10. The rail gas oil series should be used to uplift forecasts of future fuel consumption and costs;

- The default expectation is that capital lease costs (prior to the build year), maintenance and non-capital lease costs should be capped in real terms[5] in the same year that demand and revenue are capped; and
- Annual capital lease costs for a particular unit of rolling stock once built typically fall in real terms over time due to depreciation and because capital lease contracts are often set in nominal terms. Therefore, unless there is specific evidence to the contrary, real annual capital lease costs for stock after it is built should be assumed to decrease by the long-term GDP deflator rate given in TAG Data Book table A5.3.1, until refurbishment is required or the stock's asset life expires. If specific contractual information regarding the capital leases of new stock is not available, the following approach should be used:

  – for stock built in the future but before the demand cap, current year cost estimates should be assumed to increase with RPI until 2030, then GDP deflator + 0.7p.p[6] until the stock is built and then, from that point, to fall in real terms as described above; or
  – for stock which will not be built until after the demand cap, current year cost estimates should be increased with RPI until 2030, then GDP deflator + 0.7p.p until the cap year; held constant in real terms until the stock is built; and then to decrease in real terms (i.e., be held constant in nominal terms) once built, as described above.

- Unless specific contractual information is available to suggest otherwise, maintenance and non-capital lease costs should be assumed to increase with RPI until 2030, then GDP deflator +0.7p.p until the cap year (after which they are held constant in real terms over the remainder of the appraisal period).

2.4.5 Staff-related operating costs are treated differently to ensure consistency with the treatment of other impacts which increase with forecast income growth over the appraisal period. These costs should be assumed to increase in real terms in line with forecasts of average earnings produced by the OBR and given in TAG Data Book table A5.3.1. Staff-based costs (based on wages) should not be capped, and for years beyond the final year shown, extrapolated at the long-term rate given in the final year of the TAG Data Book table.

[5] Where 'real terms' is defined throughout this section, as with all other elements of the appraisal, against the GDP deflator and not any other measure of inflation, such as RPI.

[6] The ONS has announced RPI will be effectively discontinued in 2030. As a result, between 2030 and the demand cap year, GDP deflator + 0.7p.p should be used, this assumption being based upon the OBR's long term forecast difference between RPI and GDP deflator.

2.5 Risk, Uncertainty and Optimism Bias

2.5.1 TAG Unit A1.2 – Scheme Costs contains guidance on estimating scheme costs, including how to adjust for risk and optimism bias (OB). This guidance contains a list of standard optimism bias adjustments specific to rail schemes. For rail schemes that would benefit from more disaggregated/ bespoke project types, the NIC report (2020) is a possible alternative data source. Scheme promoters should seek to follow the criteria of quality cost estimation set out in Table 8 of TAG Unit A1.2.

2.5.2 If there is evidence (for example, if a scheme is novel or complex or from evidence resulting from an early stage Quantitative Risk Analysis (QRA)) that a particular scheme is riskier than these levels of optimism suggest, alternative higher values may be used. In these circumstances the Department should be contacted.[7]

2.5.3 For new proposals there is usually a difference between the projections of costs and benefits envisaged in appraisal and what happens after implementation. Table 2 below illustrates the two main sources of this error and suggests how these can be accounted for.

Table 2 Sources of Error in Cost Estimation

Source	Description	How to address this in appraisal
Risk	Events associated with known probabilities, measurable	Quantified Risk Assessment (QRA) - calculating probability weighted costs
Optimism Bias	Historically observed tendency to underestimate costs	Add optimism bias adjustment to the base cost to correct for this bias (see Table 3)

2.5.4 Table 3 provides standard adjustments to base cost estimates at different stages of project development (equivalent to Network Rail's Project Acceleration in a Controlled Environment (PACE) stages) to account for these sources of error. These adjustments should be applied to base cost, following

[7] Major and especially complex rail route enhancement schemes which fail to meet the recommendations of the Bowe Review specifically, "Being subject to integrated governance frameworks, such as those already used on Crossrail and Thameslink, which are contractual and reflect the whole-system requirements of such upgrades (including greater involvement of operators)….Leading project, programme and portfolio management practices should be introduced throughout the process; noting in particular the key issues of assurance, integration, and risk management" will require the application of bespoke higher OB rates. Indicative analysis by DfT suggests that a 120% uplift at PACE stage 1 provides a starting point, but the appropriate rate to apply should be assessed on a scheme by scheme basis in consultation with the Department. Link to Bowe Review: https://www.gov.uk/government/publications/bowe-review-into-the-planning-of-network-rails-enhancements-programme-2014-to-2019

the formulae below. Risk over benefits should be treated with the use of sensitivity analysis on key benefit drivers (e.g., patronage forecasts).

Optimism bias adjusted cost = (Base Cost excluding QRA) * (1+Optimism bias)

2.5.5 For Project Development at all levels any measure of QRA and contingency should be excluded from the definition of costs and be used as a complimentary valuation technique to the optimism bias adjusted measure of costs, rather than a substitute. Realistic assumptions on the changes in real costs over time should be incorporated (for example, where costs increase above inflation). Guidance on how to deal with inflation rates in the transport sector including construction inflation is given in TAG Unit A1.2.

2.5.6 Table 3 below shows the recommended standard uplifts for optimism bias in rail projects. Any rail risk and OB adjustments are expected to be generally consistent with the principles in TAG Unit A1.2.

2.5.7 Table 3 provides uplifts for both capital and operational expenditure (opex). For opex, analysts should consider what application of OB is likely to be most effective at testing and demonstrating the robustness of the economic case to potential overruns (i.e greater costs than forecast). Applying OB only to opex directly relating to the investment, leaving opex impacts across the wider network unadjusted, may be a good starting point. If large-scale opex impacts are forecast across the wider network, applying OB to net operating costs (the difference between the 'with and without scheme scenarios') may be a better test of economic case robustness. The analyst should consider the importance of network-wide cost savings to the intervention in question in choosing how to apply OB to opex, and be aware that the 'net' approach implies an expectation of 'overruns' in any cost reductions occurring across the wider network (i.e. greater reductions than the unadjusted forecast). Where it would be material to the appraisal, they should seek to avoid inflating forecast cost reductions, as this is not supported by the available empirical evidence on OB. Sensitivity tests and ranges can be used to further demonstrate uncertainty in opex estimates.

Table 3 Recommended standard risk and optimism bias adjustments

Project Development Level (Equivalent to Network Rail's PACE stages)*	Level 1	Level 2	Level 3	Level 4	Level 5
Activity	Project Definition	Pre-feasibility	Option Selection	Single Option Refinement	Design Development
Equivalent HMT stage for determining OB rate	SOBC	SOBC	OBC	OBC	FBC
	Capital Expenditure				
Optimism Bias uplift to the base cost (% of present value capex)	New build rail: 56% Rolling stock: 61%** Stations and Terminal buildings: 70%		New build rail: 33% Rolling stock: 38%** Stations and Terminal buildings: 48%		New build rail: 30% Rolling stock: 35%** Stations and Terminal buildings: 44%
	Operational Expenditure				
Optimism Bias	41%	41%	21%	21%	1%

Sources: OGP (2020). Review of Large Public Procurement in UK (HM Treasury website), SRA and Network Rail research

* Definition of project development levels is consistent with Network Rail's project development milestones in PACE (Project Acceleration in a Controlled Environment)

** The Rolling Stock refers to procurement of new rolling stock, rather than existing stock sourced through lease deals.

2.5.8 These OB values are only intended for appraisal purposes. It may be appropriate to use a different way of taking into account potential cost overruns for financial or accounting purposes, such as the use of contingency.

2.5.9 Scheme promoters should note that in Table 3, the Rolling Stock optimism bias uplift should only be applied to new rolling stock that has been procured. For schemes that will lease the rolling stock or buy an already available stock, the operational expenditure optimism bias uplift should instead be used.

2.5.10 The Department recommends using the capex OB uplift values from the OGP study (2020), which were produced for the HMT stages SOBC/OBC/FBC. For appraisal purposes, the SOBC rate applies at PACE 1-2, the OBC rate at PACE 3-4 and the FBC rate at PACE 5.

2.5.11 For opex OB uplift, schemes may use the FBC rate at earlier stages if their opex estimates include the following activities we would expect at FBC stage:

(a) Full circulation, stabling and rostering plan

(b) The exact class of rolling stock to be leased is known and there is a plan to lease it including where it will be cascaded from

(c) Signaller and maintenance resourcing implications known

(d) Driver training is reflected

(e) Rationale for non-driver crew size

2.5.12 The rail capex OB rates above are primarily derived from major new build rail projects, and should be used for any project costing in excess of £7 million (2021 prices), which is approximately the 90th percentile of costs within the UCL (2015) reference class of Network Rail projects. For rail schemes that would benefit from more disaggregated/ bespoke RCFs, research published by NIC (2020) provides up to date OB rates for a range of P-values. Scheme promoters may use alternative data sources if they are sufficiently robust, in such circumstances they would be expected to justify the use of alternative data.

2.5.13 For smaller rail enhancement or renewals projects with a lower cost, the OB rates calculated by UCL (2015) are more appropriate. Table 4 below presents the OB rates recommended for enhancement and renewals projects. Due to the underlying reference class data, OB uplift values relating to Project Development Levels 3 to 5 should be applied to the mean QRA value, whereas uplift values for Levels 1 and 2 should be applied to the base cost point estimate as per the values in Table 3.

Table 4 - Recommended optimism bias adjustments for small enhancement and renewals projects

Project Development Level (Equivalent to Network Rail's PACE stages)	Level 1	Level 2	Level 3	Level 4	Level 5
Activity	Project Definition	Pre-feasibility	Option Selection	Single Option Refinement	Design Development
Equivalent HMT stage for determining OB rate	SOBC	SOBC	OBC	OBC	FBC
OB uplift applied to	Base cost point estimate		Mean QRA value		
Optimism Bias - Renewals	66%		18%	13%	3%
Optimism Bias - Enhancements	60%		17%*		8%

** Level 3 Enhancements uplift applied for Levels 3 and 4 to ensure monotonic decreases in uplift values as schemes progress through Project Development Levels.*

2.6 Appraisal Period and Discounting

2.6.1 TAG Unit A1.1 distinguishes between projects for which determining an exact life is difficult (projects with indefinite lives) and projects with finite lives. For the former, the appraisal period should end 60 years from the opening year of the scheme and no residual value should be used beyond year 60. For projects with finite lives, project sponsors should provide evidence to justify a shorter appraisal period (e.g. asset lives, franchise expiry etc.). In these cases residual values will reflect any benefits generated by assets beyond the selected appraisal period up to year 60 or will be based on their resale or scrap values. More guidance on how to calculate residual values can be found in TAG Unit A1.1.

2.6.2 For appraisals of policies that only involve fare changes, standard appraisal period guidance will not apply as there is no asset, and therefore no asset lifespan on which to base the appraisal period. In these cases a 10 year appraisal period should be used (based on Impact Assessment Guidance) unless there is evidence to support an alternative appraisal period.

2.6.3 Rarely, a scheme may involve a large capital expenditure towards the end of the 60 year appraisal. If this expenditure continues to generate large benefits for a significant time after the end of the appraisal period there may be a case to include a residual value for this capital stock. If this situation applies, please contact the Department for advice.

2.6.4 Appraisals should use the standard discount rates given in the TAG Data Book: A1.1.1 – HMT Green Book discount rates

3. Impacts on Wider Society (Present Value Benefits)

3.1.1 This section discusses the Department's approach to calculating the present value benefits and dis-benefits of a scheme to wider society. The net value of benefits and dis-benefits (the Present Value Benefits, or PVB) forms the numerator in the Benefit Cost Ratio (BCR). Present values of benefits and costs are covered in TAG Unit 1.1, particularly section 2.8.2 for the Present Value of Benefits.

3.2 Non-Marketed Impacts

3.2.1 An appraisal should include all the marketed (i.e. where a good is traded and market prices exist to form the basis of valuation) and non-marketed (i.e. where such prices do not exist) impacts of a scheme. Where robust methods exist to do so, non-marketed impacts should be expressed in monetary terms. Table 5 provides sources for parameters for this purpose.

3.2.2 In Table 5 there are references to PDFH, the Passenger Demand Forecasting Handbook. The Passenger Demand Forecasting Handbook (PDFH) is owned by a rail industry consortium including most train operating companies (TOCs). Advice about PDFH-based estimates of the impact of crowding on patronage and revenues should be sought from the relevant TOC or funding authority. References to PDFH are provided for the convenience of promoters – they do not imply that the Department endorses the values and assumptions in PDFH. Project promoters may be required to justify the use of these or any other, values in studies, alongside evidence of their appropriate application to the modelling and appraisal undertaken[8].

3.2.3 In line with guidance in TAG Unit A4.1 – Social Impact Appraisal, monetised benefits from crowding relief, station improvements and rolling stock improvements should be reported under the 'Journey Quality' heading in the Analysis of Monetised Costs and Benefits and Appraisal Summary Table. The evidence in this area is fairly limited. Analysts should use judgment, or potentially a 'sliding scale' approach to value journey quality impacts depending on the perceived quality of an intervention, using published research figures as a guide to the maximum value for an improvement. Given the evidence base underpinning these values, appropriate sensitivity testing is encouraged to demonstrate the robustness of appraised impacts, in line with the principles set

[8] TAG Unit M4 – Forecasting and Uncertainty contains further guidance on the application of demand uplifts for station improvements.

out in TAG Unit M4 – Forecasting and Uncertainty and the TAG Uncertainty Toolkit.

3.2.4 As these journey quality benefits are perceived by users, the calculation of benefits should be subject to the 'rule of a half', with existing users deriving the full benefit and new users deriving half the benefit. The work values of time given in TAG Data Book Tables A1.3.1 & A1.3.2 should be used when calculating crowding and interchange penalties for business users.

Table 5 Source of values and assumptions for non-marketed impacts

		Source	Comments
Journey Time Savings			
Values of time for in-vehicle time (IVT)	Work Commuting Other non-work	Data Book table A1.3.2	
Value of wait time relative to IVT	Work Other non-work	TAG Unit A1.3 or the weight in GJT as specified in PDFH 6.0 section B4 table B4.10	
Value of walk and cycle relative to IVT	Work Other non-work	TAG Unit A1.3 and for access and egress PDFH6.0 section B9)	
Uplift factor applied to unexpected delay time	Work Other non-work	PDFHv5.1, Section B5.5 (note PDFH 6.1 used for forecast but multipliers in PDFH5.1 required for appraisal) (and see TAG Unit A1.3)	
Journey Purpose Spits			
Journey purpose / ticket type splits by flow category	Work Commuting Other non-work	Data Book table A5.3.2	
Diversion factors			
Car diversion factors by flow category	All passengers	Data Book table A5.4.5	
Crowding			
Value of Crowding Relief	All passengers	PDFHv6.0, SectionB6 formula on page 2	
Interchanges			
Interchange Penalty	All passengers	PDFHv6.0, Section B4 table B4.15. However when B4.13 has been used in forecasting and it is not proportionate to adjust these it is permissible to use B4.13 in appraisal as well.	

		Source	Comments
Rolling Stock and Stations			
Rolling Stock Improvements	All passengers	PDFHv6.0, Table B7.1 (apart from layout see M4)	Values for selected rolling stock enhancements
Station Improvements	All passengers	PDFHv6.0 Table B8.1[9]	Some values are available by market segment. Values should only be applied to passengers impacted by the specific improvements in question.
Safety			
Value of casualty prevention (fatality)	Apply to car and rail casualties	Data Book table A4.1.5	Includes lost output, medical and ambulance costs and human costs
Value of casualty prevention (serious accident)	Apply to car and rail casualties	Data Book table A4.1.5	Includes lost output, medical and ambulance costs and human costs
Safety Benefits to remaining car users	Apply to car accidents	Data Book table A5.4.2	These values apply to remaining car users, they should be added to the figures above

3.3 External Costs of Car Use Estimates

3.3.1 Mode switch from car to train as a result of a scheme will result in benefits from reduced congestion for existing road users and reductions in the externalities (such as accidents and emissions) relating to car use. TAG Unit A5.4 – Marginal External Costs provides a method to estimate the monetised external impacts of changes in road traffic, with the Marginal External Cost (MEC) values provided in the TAG Data Book. This approach should be used for schemes that are not appraised using multi-modal models.

3.4 Changes in Train Operating Company's Revenue

3.4.1 Where a proposal is expected to impact on rail fares (levels or structures) and therefore result in welfare changes for rail passengers please consult DfT for

[9] Evidence on a wider set of enhancements available in TRC-ITS-Systra (2018) and Accent-PJM Economics (2020): The Railway Consultancy, ITS Leeds and Systra (2018) *Station Facilities Valuation: Final Report*; Accent and PJM Economics (2020) *Valuation of Station Enhancements: York Station Final Report*

advice. Fare proposals can have implications for decisions about the longer term provision of services and capacity that would need to be taken into account.

3.4.2 Where a proposal leads to a change in revenue for a train operating company (TOC), revenue transfer (through changes to subsidy or premium payments) may be an issue when the change occurs within the terms of a franchise contract. Under these circumstances the amount of revenue that accrues to the public sector needs to take into account the revenue sharing and allocation aspects of the franchise contract and the likely outcome of an in-franchise contract change. An assumption should therefore be made on the best available evidence and sensitivity tests should be carried out around the assumption. If these sensitivity tests suggest that this is an important element of the appraisal then advice should be sought from DfT.

3.4.3 Following refranchising it should be assumed in the central case that all the extra revenue accrues to Government. This should be shown in the Transport Economic Efficiency (TEE) table as a change in revenue to the private sector provider, negated by a change in the revenue transfer line. This should then be reflected in the central government revenue transfer line in the Public Accounts (PA) table.

3.4.4 Where a proposal leads to a predicted change in Network Rail net revenues it should be assumed that this change is taken into account in the Office of Rail and Road periodic review process. Therefore, at the next periodic review process TOC operating costs can be assumed to change via track access charges - and these changes passed on to public accounts in the same way as explained above. So, an increase in Network Rail operating costs should be recorded as a positive number in the 'Operating costs' row of the Central Government section of the PA table; related increases in track access charges should be recorded as a negative number in the 'Operating costs' row of the Private Sector Provider section of the TEE table and in the 'Revenue' row of the Central Government section of the PA table. Unless there is evidence of a net negative or positive private sector impact, in the central case, subsidy payments should be set so as to ensure that sub-total 3 in the TEE table is equal to zero.

3.4.5 The profits made by TOCs are influenced by a franchising scheme or initiative. The terms and assumptions economists use to define profit are not equivalent to defining profit in the accountancy sense. Economists split profit into:

- normal profit which is the amount a company needs to earn in profit to enter or stay in a market in order to offset their cost of capital as well as their cost of risk; and
- supernormal profit which is defined as any profit received in addition to normal profit.[10]

[10] For further guidance on presenting profits as part of the benefit cost ratio, please contact TASM: tasm@dft.gov.uk.

3.4.6 For analysing a re-franchising project and initiatives, it is possible to model revenue, cost and premium/subsidy impacts. There is not a directly observable estimate of the impact on normal profit as it is not possible to estimate the extent to which an initiative will impact on the capital the TOC will need to hold and/or the risk that the TOC faces.

3.5 Disruption Costs

3.5.1 Where the construction of a new rail project causes disruption to rail users and/or non-rail users the disruption costs of the new project should be taken into account. Payments due under schedule 4 of the Office of Rail and Road's Track Access Contract[11] due to the disruption should be included as an additional cost to Government. The rail industry is assumed to be fully compensated for lost revenue by these payments, but rail users and possibly non-rail users still experience a dis-benefit. Therefore, the welfare impacts on rail users and non-rail users should be calculated.

3.5.2 If no schedule 4 payments are going to be paid then the loss of revenue, and any additional costs experienced by the rail industry, should be calculated and included in the PVB, as should, any welfare impacts.

3.5.3 For smaller schemes with mild disruption impacts, a proportionate approach should be taken to estimating these costs.

3.6 Indirect Tax Impacts

3.6.1 As discussed in TAG Unit A1.1, because they do not form part of the Broad Transport Budget, indirect tax revenues should be included in the numerator of the BCR.

3.6.2 There are three mains sources of indirect tax effects in rail: (a) when rail revenue changes between the with and without scheme scenarios, expenditure shifts from/to goods or services attracting the average level of indirect taxation to/from rail fares – this has an indirect tax effect as there is no VAT on rail fares; (b) when people switch modes from road to rail (or vice versa), they stop (or start) paying the level of indirect taxation on fuel, which is higher than the average level of indirect taxation. This element of the indirect tax impact for uni-modal model appraisals is generally calculated as one of the elements of Marginal External Costs (see TAG Unit A5.4); (c) if the quantity of rail diesel vehicle kms changes as a result of the scheme, there will be an indirect tax effect as rail diesel is subject to duty.

3.6.3 The detailed method for calculating indirect tax impacts is given in Appendix A:.

3.7 Freight Appraisal

3.7.1 A scheme expected to change the amount of freight taken on the rail network is likely to lead to a change in the amount of freight taken by road and it is

[11] see http://www.rail-reg.gov.uk/upload/pdf/model_passenger_contract_051011.pdf

recommended to account for the benefits and disbenefits of this modal shift. For this purpose a set of heavy goods vehicle (HGV) specific Marginal External Costs (MECs) have been developed, which can be accessed by contacting the Department. The MECs should only be applied where rail freight will replace road freight and the MECs should be applied to the number of road kilometres replaced (which may not be equivalent to the number of rail kilometres generated).

3.7.2 Scheme promoters should consider which road journeys would be replaced by rail freight, for example using online journey planning tools to calculate the estimated change in road freight distance.

3.7.3 Which type of HGV MEC to use should depend on the type of HGV (i.e. Articulated or Rigid) which would have been used in the without scheme scenario. If possible this should be evidenced (hauliers or rail freight companies may be able to advise). In the absence of other information, for containers the Articulated figure should be used, for aggregates the Rigid figure should be used and for other freight the combined HGV figure should be used.

3.7.4 Freight user benefits in transport appraisal should be based on operating cost savings (and those operating costs savings should include the wage costs of freight train drivers, guards and other staff). This treatment is consistent across modes.

3.8 Stock Lifespan

3.8.1 For appraisal purposes, in absence of other evidence, the following new rolling stock minimum-lifespan assumptions should be used: new Diesel Multiple Unit (DMU) and diesel locomotives lifespan of 30 years; new Electric Multiple Unit (EMU) and electric locomotives lifespan of 35 years. Appropriate allowance for refurbishments during the lifespan of the stock should be made. However, where specific evidence exists that justifies alternative rolling stock lifespan assumptions, the Department should be consulted about its use.

3.9 Economic Impacts

3.9.1 Wider economic impacts should be included in rail appraisals if proportionate and relevant. This should be based on the A2 series of TAG. In some cases, it might not be feasible or appropriate to develop multi-modal models suitable for monetising wider economic impacts in rail appraisal. In those cases, it is permissible to use external data on the number of journeys and user costs of other modes.

3.9.2 For highway generalised travel costs, base year data can be sourced using journey times from an open-source journey planner API.[12] TAG Unit M2.1 sets out how to calculate generalised cost for private car. Ratios of demand between highway trips of different purposes (commuting and business) from

[12] Open-source services include Openrouteservice, API-enabled Bing Maps queries, Open Source Routing Machine and the r5r R package.

the TAG Data Book can also be used. However, consideration should be given to how these costs are likely to change in future. In the absence of scheme specific assumptions or modelling, the car journey time indices from TAG Data Book Table M4.2.3 may be used to uplift base year road travel costs for future years.

3.9.3 The Department has developed a tool for use in conjunction with rail model outputs to prepare them for the guidance in the A2 series. For advice on this please contact the Department.

4. Impacts on Government (Present Value Costs)

4.1.1 This section discusses the Department's methodology for calculating the present value cost of a scheme to government. This PVC represents the denominator in the BCR. Following the decision to reclassify Network Rail as a Central Government Body[13], Network Rail spending (and revenue) should be considered to impact directly on the Broad Transport Budget.

4.1.2 As noted in TAG Unit A1.2, the appraisal should include the whole-life costs of the scheme. Therefore, all Network Rail investment, renewal, operating and maintenance expenditure should be included and treated as 'in-year' costs, reported in the central government section Public Accounts (PA) table and directly enter the PVC.

4.1.3 As noted in section 3.4, the PVC should also include changes to TOC support or premium payments arising from forecast changes in revenue that result from the scheme and changes to Network Rail track access charge revenues.

5. References

Accent and PJM Economics (2020) Valuation of Station Enhancements: York Station Final Report

DfT (December 2005) Final Guidance on LTP1 delivery

DfT (March 2006) Network Rail Discretionary Fund schemes: Appraisal guidance

[13] http://www.ons.gov.uk/ons/dcp171766_345415.pdf

DfT (October 2006) Government Response to the Consultation on the Implementation of the Railways Act 2005 Provisions on Closures and Minor Modifications

Mott MacDonald (July 2002): Review of Large Public Procurement in the UK

NIC (2020): Rail Needs' Assessment Reference Class Forecast, https://nic.org.uk/app/uploads/RNA-Reference-Class-Forecast.pdf

Rail Delivery Group (July 2013), Passenger Demand Forecasting Handbook (version 6.0)[14]

SRA (April 2003) Appraisal Criteria

The Railway Consultancy, ITS Leeds and Systra (2018) Station Facilities Valuation: Final Report

UCL (2015), Optimism Bias Study, https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/576976/dft-optimism-bias-study.pdf

OGP (2020), Updating the Evidence Behind the Optimism Bias Uplifts for Transport Appraisals, https://www.gov.uk/government/publications/tag-updated-evidence-for-optimism-bias-uplifts

[14] The Passenger Demand Forecasting Handbook is available to members of the Passenger Demand Forecasting Council see https://www.raildeliverygroup.com/pdfc.html for more information

6. Document Provenance

This TAG Unit forms part of the restructured WebTAG guidance, taking previous TAG unit 3.13.1 – Guidance on Rail Appraisal as its basis. That Unit was first published in August 2007; updated in 2012 to incorporate PDFH v5.0 for crowding, rolling stock improvements and station facilities, a clarification of guidance on optimism bias and changes to treatment of demand caps; and updated again in 2013 to introduce new rolling stock lifespan assumptions and clarify appraisal periods for projects or policies focusing on fare changes.

This TAG Unit was updated in November 2014 to provide clarifications on assumptions for cost and revenue forecasting; reflect the Department's adoption of parts of PDFH v5.1; and set out how Network Rail costs should be treated in appraisal following the decision to reclassify Network Rail as a Central Government Body.

This TAG Unit was updated in November 2015 to clarify how indirect tax impacts should be calculated in rail appraisal.

This TAG Unit was updated in December 2016 to update the standard OB values, clarify OB assumptions for non-standard projects, clarify the treatment of profit, clarify the requirements around calculating wider economic benefits and incorporate new journey purpose/ticket type splits and rail diversion factors.

In May 2018 this document was updated to reflect PDFH 6 and the RDFE study.

In November 2023 this document was updated with additional guidance on wider economic impacts.

In May 2024, the unit was updated to align station enhancement guidance with the latest evidence, and refresh references to Network Rail's PACE framework (formerly GRIP).

In May 2025, the unit was updated to reflect the latest advice on the application of optimism bias uplifts to operational expenditure.

Appendix A: Calculating Indirect Tax Impacts for Rail Schemes

A.1.1 Changes in indirect tax due to changes in car and public transport expenditure should be calculated using the expressions below. The left-hand part of each expression addresses the indirect tax impact of people switching from/to road use whilst the right-hand part of the expression addresses indirect tax impacts from changes in public transport demand and revenue. Indirect tax impacts calculated with these expressions will be in the market price unit of account.

A.1.2 In appraisals conducted with results from a uni-modal model, the indirect tax impact associated with people switching from/to road (the left-hand part) should be calculated as one of the elements of Marginal External Costs, following the method described in TAG Unit A5.4.

Work trips:

$$\frac{(K_c F'_c) t'_F (1+t)}{1+t'_F} + \frac{M t'_M (1+t)}{1+t'_M}$$

Non-work trips:

$$\frac{(K_c F_c)(t_F - t)}{1+t_F} + \frac{M(t_M - t)}{1+t_M}$$

Where:

K_C = Change in car kilometres from the without scheme to the with scheme scenario;

F_C = Average cost of road fuel per km as a final consumption good;

F'_C = Average cost of road fuel per km as an intermediate good;

M = Change in expenditure on public transport fares from the without scheme to the with scheme scenario;

t_F = rate of indirect tax on fuel as a final consumption good (i.e. including duty and VAT);

t'_F = rate of indirect tax on fuel as an intermediate good (i.e. including duty only);

t_M = rate of indirect tax on fares as final consumption goods;

t'_M = rate of indirect tax on fares as intermediate goods.

t = Average rate of indirect tax;

Note that (1+t) gives the indirect tax correction factor (see TAG Unit A1.1)

A.1.3 A further calculation for changes in diesel train use needs to be calculated:

Change in fuel duty received = $(K_r * C_r * \tau_r)$ (1+t)

Where:

K_r = Change in diesel train kilometres/train vehicle kilometres

C_r = Average rail fuel consumption rate (litres per train/vehicle km)

τ_r = Rail fuel duty (£ per litre) (exc. VAT)

Table A1 Suggested sources to calculate the indirect tax change

Variable	Symbol	Source
Change in car kilometres	K_C	Original appraisal or use evidence in TAG Unit A5.4 – Marginal External Costs
Change in diesel train kilometres/train vehicle kilometres	K_r	Original appraisal
Average cost of road fuel (£ per km) as a final consumption good	F_C	TAG Data Book table A1.3.13
Average cost of road fuel (£ per km) as an intermediate good	F'_C	TAG Data Book table A1.1.3.12
Rates of indirect tax	t_F / t'_F / t_M / t'_M	TAG Data Book table A1.1.3.7
Rail fuel duty (£ per litre)	τ_r	TAG Data Book table A1.3.7
Average rail fuel consumption rate (litres per train/vehicle km)	C_r	Contact the Department

A.1.4 Calculating the average cost of road fuel in £/km requires information on the speed of traffic.

A.1.5 The user (work and non-work) and rail duty adjustments should be added together to calculate the total indirect tax impact.