Suffolk County Council

IPSWICH NORTHERN ROUTE

Economic Case Costs Methodology and Calculations Technical Note

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Appendix E - Economic Case Costs Methodology and Calculations Technical Note

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Introduction

This technical note has been produced to explain how base cost estimates for the scheme have been converted into Present Value of Costs (PVC) – described below, which were used in the economic appraisal for the project.

The method follows TAG UNIT A1.2 Scheme Costs (July 2017) guidance. It should be noted that the costs in the Economic Case are not the same as those in the Financial Case. They should not be the same. The two sets of costs are used for different purposes within a business case. The figures in the Financial Case provide the value of the investment sought. These figures will be used by both the scheme promoter (in this case Suffolk County Council) and any funding body in their decision-making process to determine whether the scheme is "affordable".

In addition, the base costs for this scheme are nominal (unadjusted). When inflation is not taken into account values are said to be in nominal prices, and when values are adjusted they are said to be real prices. The base cost values require adjustment to consider the effects of inflation to determine the likely outturn cost of the scheme. When applying values to impacts over a long appraisal period, it is important to take into account inflation as failing to do so would distort the results by placing too much weight on future costs, where values would be higher simply because of inflation.

The costs in the economic case are used purely for the economic appraisal, i.e. to determine whether the scheme offers Value for Money. In this economic analysis we establish if the benefits of the scheme outweigh the costs by a certain pre-determined ratio, which is set by the DfT in their Value for Money Framework[1]. As economists consider that the value of money changes depending upon whether expenditure occurs now, in the past or in the future, and because the Department for Transport requires scheme costs and benefits to be provided in 2010 prices and values, so that a range of schemes presented to them can be compared against each other, the costs and benefits used within the economic case are subject to a number of adjustments (described below), which result in what are termed Present Value of Costs (PVC) and Present Value of Benefits (PVB). These values are then used within the cost-benefit analysis to derive the Benefit Cost Ratio (BCR). These numbers should never be used when presenting the costs of the scheme to decision-makers, the public or other stakeholders, they are just for use in the value for money calculation.

The steps required to produce the scheme costs for the economic appraisal are follows:

[1] https://www.gov.uk/government/publications/dft-value-for-money-framework

- Derive a base cost estimate
- Convert to real prices to account for inflation
- Adjust for risk and optimism bias
- Re-base to the price base of the DfT's base year (2010)
- Discount to the Department's base year; and then
- Convert to the market prices unit of account.

These technical definitions are explained in more detail below, and the cost adjustments are summarised in the worked example. For the purpose of this technical note, the costs for the Outer route option were used.

Base cost estimate

The costs of the INR scheme were estimated by WSP Quantity Surveyors / cost consultants with inputs from discipline specialists (highway and structural engineers). Land costs were provided by land agents – Ardent.[2] The estimate included:

- Investment costs including construction costs, land and property costs, preparation and administration
- Operating, maintenance and renewal costs to estimate the whole life costs for the scheme

These costs provided the base cost estimate. Base costs are the first component of a scheme cost estimate. The base cost / nominal costs represent the basic costs of the scheme made up of investment (or capital), maintenance and operating costs, estimated in today's (2019) prices. Nominal costs are those that do not account for inflation.

Table 1–Outer Route Base Costs (£k,2019)

		2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030-2086	Total (60 years)
Scheme base costs	**Investment costs**	3,968	5,290	5,290	9,257	14,547	70,313	85,082	61,252	2,551	589	0	258,138
	Maintenance cost (over 60 years)	0	0	0	0	0	0	0	710	710	710	40,470	42,600
Total Scheme Base Costs		3,968	5,290	5,290	9,257	14,547	70,313	85,082	61,962	3,261	1,299	40,470	300,738
Real adjustment factor		1.03	1.06	1.09	1.13	1.16	1.19	1.23	1.27	1.30	1.34	-	-
Investment Cost. w/real adjustment		4,087	5,612	5,781	10,419	16,863	83,957	104,641	77,593	3,329	791	0	313,071

Table 1 shows costs as investment and operating costs. Base costs have been estimated separately for investment and operating costs in a 2019 price base (ie the costs in today's prices), taking account of real increases in costs. Inflation is the general increase in prices over time which reduces what a given amount

[2] Some of the land costs could be incurred after the scheme opens in 2027.

of money can buy. A real adjustment factor was applied to the base costs to take into account the effects of inflation.

Therefore, the first step was to incorporate real cost increases to the base investment costs. To convert nominal prices to real prices, an inflation index of 3% was used. The real price in any given year is the nominal price adjusted by the change in the inflation index between that year and the base year. This adjustment is needed because costs estimates should include realistic assumptions about real cost changes.

The construction costs were forecast to increase by 3% per annum over the duration of the scheme, where the previously accumulated interest (3%) was added to the initial construction cost of the current period, which also includes all of the accumulated inflation of previous periods. This was calculated by multiplying the initial costs by the annual inflation rate factor (1.03) and this factor is applied on a compound basis per year.

The maintenance cost total is provided over a 60-year period (which is termed the appraisal period). This is a standard period in which all schemes for the DfT are assessed. This runs from scheme opening in 2027 to 2086. In all tables within this note, the operational costs beyond 2030 are outlined in a separate column, as this is the point at which there are expected be no more investment/capital costs[3].

The total scheme costs in the final row of Table 1 were the costs presented in the financial case of the SOBC for the Outer route option.

Real adjustment factor calculation

1 x 1.03 for the first-year that inflation in 2020 was applied gives 1.03.

1.03 (which is the first-year inflation total) x 1.03 to give the second-year real adjustment factor of 1.06. This same calculation was applied to future investment and maintenance costs for the rest of the appraisal period.

Risk Adjustment

For schemes which are at a more developed stage of design and costing than this scheme, which sits at Strategic Outline Business Case (SOBC) stage (the earliest stage - later stages include Outline Business Case and then Full Business Case), a Quantified Risk Assessment (QRA), using Monte Carlo analysis is often employed to the costs as part of a risk-adjustment process. This process has not been undertaken yet for this scheme as it is not considered appropriate or proportionate given the current stage of design. In lieu of a full QRA risk-adjustment process being undertaken, a factor of 10% has been applied on top of construction costs. This is based on the notional route design, and it is to be considered robust at this early stage of the project. This will be considered in conjunction with the Stage 1 Optimism Bias value applied to calculate the Present Value of Costs.

[3] Where tables include rows showing the factors used to adjust costs, it is not possible to show these factors in the beyond 2030 column. However the method to calculate these factors and apply them is the same for each calendar year.

Table 2 – Scheme Risk Adjustment (£k, 2019)

	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030-2086	Total (60 years)
Investment Cost. w/real adjustment	4,087	5,612	5,781	10,419	16,863	83,957	104,641	77,593	3,329	791	0	313,071
Risk allowance (10%)	409	561	578	1,042	1,686	8,396	10,464	7,759	333	79	0	31,307
Risk adjusted investment costs	4,495	6,173	6,359	11,460	18,550	92,353	115,105	85,352	3,662	870	0	344,378

Optimism Bias Adjustment

The next stage was to apply an Optimism Bias-adjustment to the costs. Optimism Bias is the demonstrated systematic tendency for appraisers to be overly optimistic about key parameters in the estimation of scheme costs. The following steps were used to apply optimism bias (as of the DfT guidance - TAG unit A1.2):

- Step 1: Determine the nature of the project
- Step 2: Identify the stage of scheme development
- Step 3: Apply the DfT recommended uplift factors to the risk-adjusted transport cost estimate
- Step 4: Provide sensitivity analysis around the central estimate

In line with the guidance in TAG Unit A1.2, an optimism bias-adjustment of 44% was applied. This is the recommended uplift for a road scheme at Strategic Outline Business Case stage (Stage 1).

Application of optimism bias cost-adjustment essentially reduces the BCR by increasing the costs, providing a more conservative / robust estimate of the Value for Money.

Optimism bias-adjustments reduce as scheme progress through the business case stages SOBC, OBC, and FBC, as the level of design and cost detail increases, as there will usually be an increased level of certainty in the costs.

Optimism bias was also applied to the maintenance costs at 3%.

Table 3: Optimism Bias (£k,2019)

	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030-2086	Total (60 years)
Risk adjusted investment costs	4,495	6,173	6,359	11,460	18,550	92,353	115,105	85,352	3,662	870	0	344,378
Optimism Bias (44%)	1,978	2,716	2,798	5,043	8,162	40,635	50,647	37,555	1,612	383	0	151,529
Investment costs W/ 44% OB	6,473	8,890	9,156	16,503	26,712	132,988	165,751	122,907	5,274	1,254	0	495,907
Maintenance cost	0	0	0	0	0	0	0	710	710	710	40,470	42,600
Optimism Bias (3%)	0	0	0	0	0	0	0	21	21	21	1214	1,278
Maintenance cost W/ 3% OB	0	0	0	0	0	0	0	731	731	731	41,684	43,878
Total Scheme Base Costs W/OB	6,473	8,890	9,156	16,503	26,712	132,988	165,751	123,638	6,005	1,985	41,684	539,785

Rebasing

The costs up to this point have been in real prices in today's prices (2019). For economic appraisal purposes, the costs should be presented in the Department's for Transports (DfT) base year, 2010. The nominal costs were then rebased to the Department's base year of 2010 using the latest available WebTAG Databook's (May 2019) GDP deflators, which used ONS data[4]. The GDP price deflator expresses the extent of price level changes, or inflation, within the economy.

The table below shows that the GDP deflator factor for each year. This is calculated by the percentage change in the GDP deflator from the previous year compared to the GDP deflator of the year in which cost occur.

[4] https://www.gov.uk/government/statistics/gdp-deflators-at-market-prices-and-money-gdp-september-2019-quarterly-national-accounts

Example

GDP deflator factor calculation

101.92 (annual parameters WebTAG 2018) divided by 100 (2010 GDP deflator), minus 1 equates to 1.92%.

1.92% (2020 deflator YOY change) multiplied by 1.18 (GDP deflator factor nominal) which equates to 0.02. The sum of 0.23 + 1.19 (GDP deflator nominal) will provide the GDP deflator factor nominal for the next year (2021), 1.21.

This same calculation was applied for the rest of the appraisal period.

Where:

YOY change: A year-over-year calculation compares a statistic for one period to the same period the previous year from TAG databook.

Table 4: Rebasing (£k, 2010 prices)

	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030-2086	Total (60 years)
Total Scheme Base Costs W/OB	6,473	8,890	9,156	16,503	26,712	132,988	165,751	123,638	6,005	1,985	41,684	539,785
Deflator YOY change	1.92%	1.94%	1.92%	1.92%	2.20%	2.20%	2.20%	2.20%	2.20%	2.20%	-	-
GDP deflator factor nominal	1.18	1.21	1.23	1.25	1.28	1.31	1.34	1.37	1.40	1.43	-	-
Investment costs w Defl	5,465	7,362	7,440	13,156	20,836	101,503	123,787	89,814	3,771	877	0	374,011
Maintenance cost w Defl	0	0	0	0	0	0	0	629	629	629	35,866	37,753
Total scheme cost (2010 prices)	5,465	7,362	7,440	13,156	20,836	101,503	123,787	90,443	4,400	1,506	35,866	411,764

Discounting

Discounting is used to compare costs and benefits occurring over different periods of time – it converts costs and benefits into present values. It is based on the concept of time preference, that generally people prefer to receive goods and services now rather than later. If a projects A and B have identical costs and

benefits but Project A delivers benefits a year earlier, time preference means Project A is valued more highly. This is different to rebasing which is the process of adjusting what year the costs are priced in, so in this case from 2019 to 2010, whereas discounting adjusts the economic value of the costs in the future compared to a 2010 base year.

To present scheme costs in present values, scheme costs were then discounted back to 2010 values.

As discussed in TAG Unit A1.1, costs should be discounted and presented in present values. TAG Data Book table A1.1.1 provides the schedule of discount rates that should be applied from the year the appraisal is taking place. Therefore, for this scheme a discount rate of 3.5% per year was applied for the first 30 years from 2019 with a 3% discount rate applied thereafter. As per HM Treasury Green Book guidance, the 3.5% discount rate applied in the appraisal should decline over the long term due to uncertainty about future values of its component, hence why a rate of 3% was then applied[5].

Table 5 shows the effect of applying discount factors to the GDP deflated investment and operational costs from Table 4.

Example

To discount back to a 2010 base year from 2019, the discount factor of 3.5% that should be applied to costs in 2019 is:
$1 / (1.035)^{9)} = 0.73$
Where:
The power represents the number of years to be discounted E.g. 9^{th} power represents 9 years.
For 2020 it is:
$1 / (1.035)^{10} = 0.71$
To discount back to a 2010 base year from 2049, which is the 31st year from 2019 appraisal year therefore a discount factor of 3% should be applied to cost in 2049 and beyond, it is:
$1 / (1.035)^{38} \times (1.03) = 0.26$
For 2050 it is:
$1 / (1.035)^{38} \times (1.03)^{2)} = 0.26$

This same methodology follows for the rest of the appraisal period.

Table 5 – Present Value Scheme Costs (£k, Discounted to 2010)

	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030-2086	Total (60 years)
Total scheme cost (2010 prices)	5,465	7,362	7,440	13,156	20,836	101,503	123,787	90,443	4,400	1,506	35,866	411,764
Discount Rate	3.5%	3.5%	3.5%	3.5%	3.5%	3.5%	3.5%	3.5%	3.5%	3.5%	-	-
Discount Factor	0.71	0.68	0.66	0.64	0.62	0.60	0.58	0.56	0.54	0.52	-	-

5 https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/685903/The_Green_Book.pdf

Investment costs discounted	3,874	5,042	4,923	8,412	12,872	60,586	71,389	50,045	2,030	456	0	219,630
Maintenance cost discounted	0	0	0	0	0	0	0	351	339	327	8,316	9,333
Total scheme cost discounted	3,874	5,042	4,923	8,412	12,872	60,586	71,389	50,395	2,369	783	8,316	228,963

Market price adjustment

The final stage in preparing the costs for appraisal was to convert them from the factor cost which are the costs incurred on the factors of production without tax to the market price, which is the price once government imposed tax is applied, using the indirect tax correction factor contained within the most recent TAG databook (May 2019). Table 6 shows the results of applying market price adjustment factor of 1.19 to deflated and discounted scheme costs. The final row of this table are the values used to calculate Net Present Value and Benefit Costs Ratio for the Outer route option in the economic case.

Table 6 – Present Value Scheme Costs in Market Price (£k, 2010)

	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030-2086	Total (60 years)
Total scheme cost discounted	3,874	5,042	4,923	8,412	12,872	60,586	71,389	50,395	2,369	783	8,316	228,963
Investment costs/ market price adjustment	4,610	6,001	5,859	10,011	15,318	72,098	84,952	59,553	2,416	543	0	261,360
Maintenance cost / market price adjustment	0	0	0	0	0	0	0	417	403	389	9,896	11,106
Present Value of Costs	4,610	6,001	5,859	10,011	15,318	72,098	84,952	59,970	2,819	932	9,896	272,466

Conclusion

This technical note displays the step by step method used to convert base cost estimates into Present value of Costs for the Outer route option. The exact same methodology and calculations were applied to the cost estimates for the Middle and Inner route options.