Australian Government
Department of Infrastructure, Transport,
Regional Development, Communications and the Arts

INFRASTRUCTURE GROUP / INFRASTRUCTURE GROUP ASSURANCE AND ADVISORY BRANCH / INFRASTRUCTURE PROJECT ASSURANCE

Guidance Note 4 - Escalation

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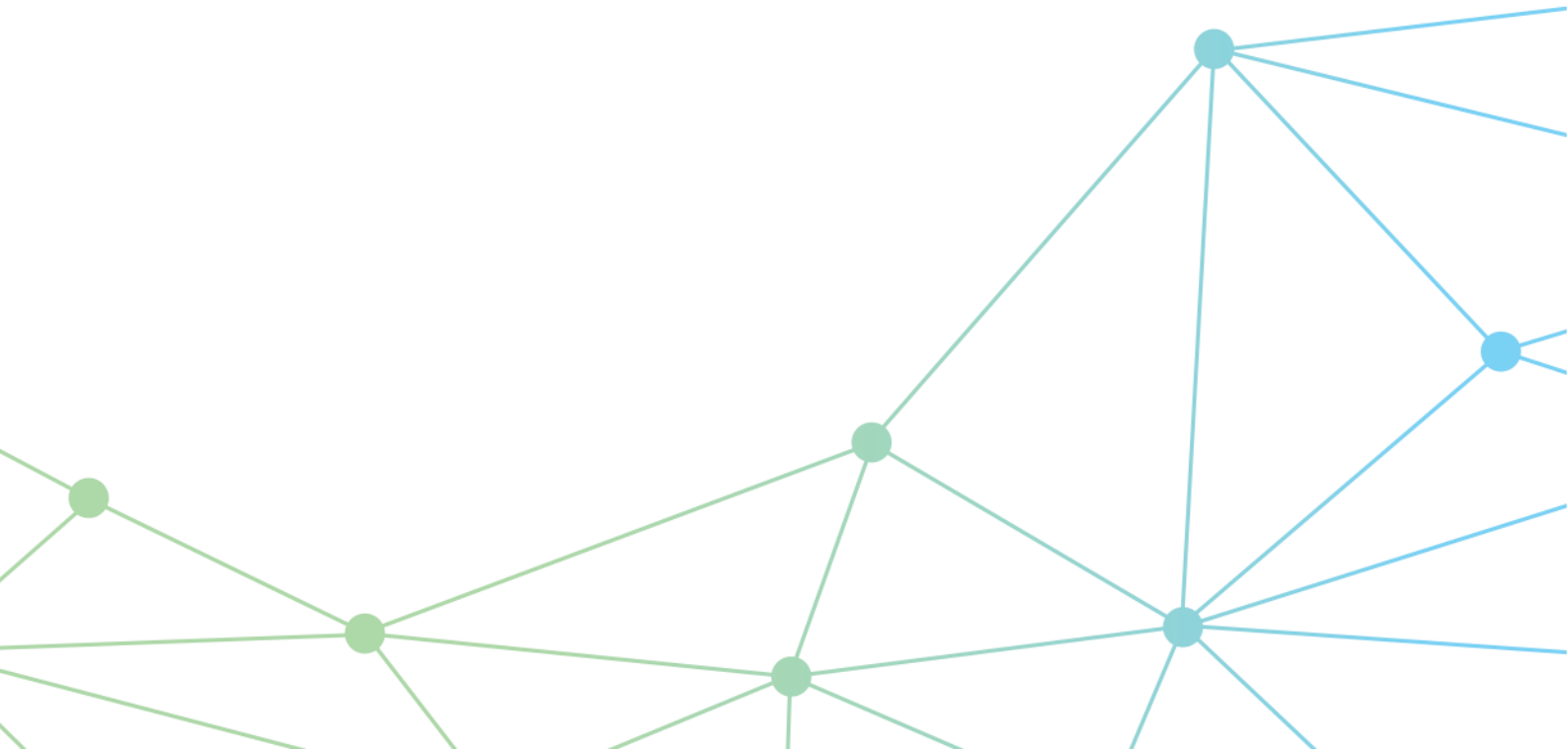

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1. Introduction

1.1. Context

The Department of Infrastructure, Transport, Regional Development, Communications and the Arts (the department) provides and maintains cost estimation guidance intended to inform and assist proponents in improving and establishing cost estimation practices for land transport infrastructure projects, the suite comprises the following volumes:

- Guidance Note – Overview
- Guidance Note 1 — Project Scope
- Guidance Note 2 — Base Cost Estimation
- Guidance Note 3A – Probabilistic Contingency Estimation
- Supplementary Guidance Note to 3A
- Guidance Note 3B – Deterministic Contingency Estimation
- **Guidance Note 4 – Escalation**

1.2. Objective and scope

This guidance note is intended to ensure that the escalation rates used to outturn Infrastructure Investment Program (IIP) projects across Australian jurisdictions are derived using a robust and replicable methodology which will enable effective forecasting of project cash flows and more efficient infrastructure investment.

This guidance note:

- Defines escalation and its components.
- Outlines the methodology for developing escalation rates.
- Outlines how to apply escalation rates to cost estimates for projects seeking funding under the Infrastructure Investment Program (IIP).

It is expected that the primary users of this document are jurisdictional public sector organisations (agencies), including Local Government Authorities that prepare submissions for funding through the IIP. However, the guidance may also be relevant to contractors and members of the public with an interest in major infrastructure projects.

2. Overview

2.1. Defining escalation

Escalation is the price movement of a resource over time, it is not inflation, however, inflation is one of the factors that can contribute to escalation. For simplicity:

- Inflation refers to the movement of prices of the goods and services that a typical household buys.
- Escalation refers to a movement of prices of the good and services that are required to construct of road or rail project.

Escalation is the component of a project's total cost that reflects the changes in prices and costs since the project was estimated (or the date that the rates used for the estimate were sourced, 'base estimate date'),

to when the cost is expected to be incurred. Escalation is added to the total project cost to obtain the outturn cost.

Measuring escalation allows for the rebasing of costs which means we can look at what a road cost in the past, and apply the escalation to determine what the price would be to build that same road today. This is useful in cost estimation as it allows past rates to be rebased to current prices for use on cost estimates.

Escalation can also be used to forecast future prices. As land transport infrastructure projects are all different, it is more effective to measure the usual core components that form part of every land transport project and determine what causes the prices of each component to change over time. After identifying these major cost drivers and how they affect each component, forecast of escalation can occur. This is an important aspect of forecasting cashflows for land transport infrastructure projects.

Given its economic nature, it is recommended that the development of escalation forecasts is undertaken by specialists (i.e. economists with specific expertise in this area). That is because escalation is driven by macro-economic conditions and trends, the study of which is a core skill and knowledge area of economists rather than engineers.

2.2. Limitations of escalation forecasts

Escalation forecasts are informed predictions of future events and are approximations intended to represent the average trends for a large group of projects in a broad region. Judgement must be applied in the application of escalation in any given situation.

- Escalation should not be included within project contingency. Escalation and contingency are determined using different methodologies and used for different purposes[1].
  Guidance Note 3A – Probabilistic Contingency Estimation provides information on contingency.
- Major technology or regulatory changes directly impacting a project should be covered within contingency.

2.3. Escalation within the context of the IIP

The department requires escalation to be included with the cost estimates for projects seeking Australian Government funding through the IIP. The department requires escalation to be applied from the date of the cost estimation, noting that the base date of the cost estimate may not be the date the estimate was prepared rather it is the date in which the rates used to build the estimate were current. Escalation is not required to be included if the project will be completed within 12 months of the base date.

In volatile economic conditions, escalation may form a large component of total project cost and can have a large impact on stakeholders if allowances are not made for it. Escalation can be positive or negative but generally follows a positive trend (i.e. increasing prices).

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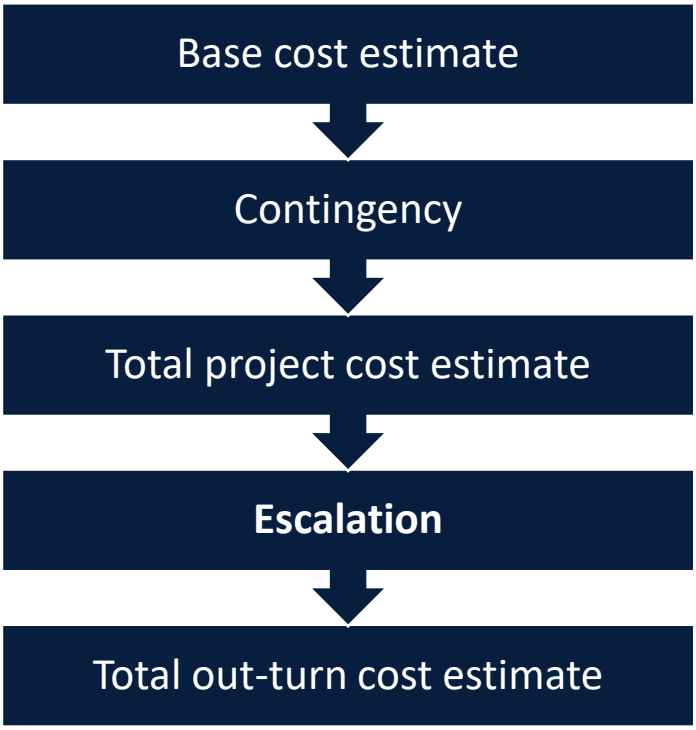
[1] AACE International (2012) Recommended Practice 68R-11: Escalation Estimating Using Indices and Monte Carlo Simulation, AACE International, Morgantown, WV

Figure 1: Escalation as part of an out-turn cost estimate



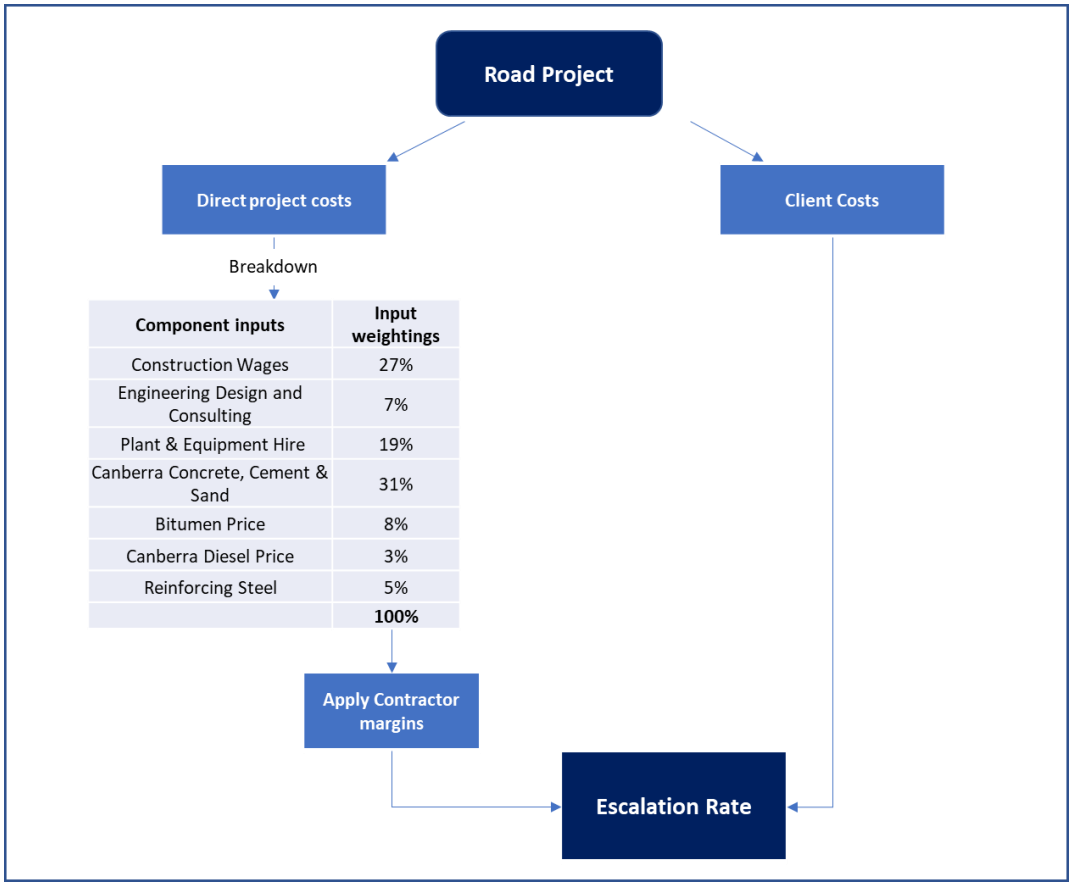
Escalation for IIP projects is normally calculated using the department's Project Cost Breakdown (PCB) template with the department's escalation rates. The PCB template provides the escalated project cashflow and contains the total escalated costs (outturn cost) calculated using the departments seven-year escalation forecast. The department will consider alternative escalation rates if provided with sound methodology and reasoning.

2.4. Measuring escalation for land transport infrastructure

Escalation is the measure of total cost changes over time. Due to the complexity of cost changes it is necessary to define the scope of the activity being measured (such as a road project or rail project) and identify cost components that move independently from each other. The department has developed an index series to measure escalation using the following steps:

- Identification of the key components which usually drive direct road (or other applicable sector) construction costs.
- Applying the appropriate component weightings.
- Inclusion of contractor margins or selling prices (see **Appendix C - Definitions**).
- Inclusion of client costs (see **Appendix C - Definitions**).
- Develop the overarching outturn price index.

Figure 2: Steps to develop an escalation rate



A project is separated into two independent sections, direct project costs and client costs. Changes in client costs will only affect the percentage of the project which is determined to be client costs and changes to direct project costs and contractor margins will only affect the remaining percentage of the project. Once the percentage of client costs is determined the escalation rate is calculated as follows.

Escalation Rate = Percentage of Direct Project Costs x Direct Project Cost Index x Contractor margins index + Percentage of Client Costs x Client Costs Index

The department uses the above methodology to measure escalation rates. Should alternate rates be proposed the department requires that the index series, as best as possible, reflect movements in costs faced by the jurisdictions.

Escalation drivers for forecasting

To forecast escalation, the reasons for price movement (cost drivers) need to be identified and a method to determine how they interplay must be determined. Cost drivers include a wide array of economic factors, including:

- General price inflation.
- Changes to market conditions.
- Technology
- Regulation
- General industry or regional-wide productivity.
- Other economic factors that generally affect an economic sector or segment.

- Geographical regions[2]

Cost drivers can be complex and it can take considerable time and effort to determine what the drivers are and how they influence infrastructure construction. Escalation comes from the interplay of changes in input costs (such as actual changes in the cost of materials like concrete and steel), the supplier's perceptions of the risks they may need to bear, and the perceptions of the competition and whether or not there is an expectation that suppliers are increasing or decreasing their prices[3].

Grouping cost drivers

Observations of past data can assist in determining aspects of construction that have tight relationships and how they best fit into categories. If certain aspects of a project follow the same cost trends it may be due to shared cost drivers. For example, the price of reinforcing steel is the same if it is in a bridge or a culvert, and an increase in the price of steel will affect both, therefore reinforcing steel forms a category.

Once categories are formed, the forecasted escalation can be made based on consideration of the cost drivers. For a simplified example, forecasts of construction wages should consider underlying trends and domestic market capacity as there is a relationship between the two, whereas reinforcing steel has consistently had a tight relationship with its primary input prices which are the price of iron ore and metallurgical cooking costs.

However, categories should not be viewed in isolation and there is a positive correlation between construction activity and construction costs because high (and rising) levels of demand (construction activity) not only places pressure on the existing supply of inputs, boosting input prices, but also allows construction suppliers to raise their prices (and possibly margins). Where capacity constraints exist, rising construction activity can lead to strong increases in input prices due to the lag between the balance of supply and demand. This could have effects on multiple inputs and careful consideration of how drivers interact is essential.

Input weightings

To measure escalation for a land transport project, each component needs to be weighted according to the influence they have on the project cost. The input weightings are the average cost of each component relative to the whole project. Input weightings will change over time due to the varying price movements as well as changes in future input quantities, therefore the weightings will need to be reassessed and adjusted when necessary[4]. The department has standard input weightings for road and rail projects based on historical projects and uses an index system to measure the relative price movements and adjust forecasts between geological locations. See **Appendix A and B** for the input weightings used by the department for road and rail projects. As client costs and direct project costs are measured using separate indices, a relative weighting needs to be determined.

Client costs

Client costs are the costs incurred by delivery agencies in delivering road and rail construction that are not driven by the construction process itself. These typically include costs related to the development and implementation phase of a project as well as the Principal's pre-delivery obligations such as service investigations and alterations. Movements in these costs should be included in an escalation calculation.

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[2] AACE International (2011) Recommended Practice 58R-10: Escalation Estimating Principles and Methods Using Indices, AACE International, Morgantown, WV

[3] Morris, P & Willson, W (2006) AACE International Transactions: Measuring and Managing Cost Escalation, AACE International, Morgantown, WV

[4] Bureau of Infrastructure, Transport and Regional Economics (BITRE), 2013, BITRE Road Construction and Maintenance Price Index and Sub-Index— 2013 update, Information Sheet 49, BITRE, Canberra.

Client costs also vary depending upon the delivery method chosen. In general, "Design and construct" project delivery entails a much greater degree of outsourcing to the private sector than the "Construct only" approach for a construction project. This means that the contractor takes on the workload of design and the client's costs are reduced.

Through analysis of projects, the department has determined the average proportions of client costs and direct project costs for road and rail projects for design and construct and construct only projects. A single rate has been used for rail construction due to the smaller sample of project.

Table 1: Client cost weightings

	Road project		Rail project	
Procurement method	Direct project costs	Client costs	Direct project costs	Client costs
Design and construct	92%	8%	77.6%	22.4%
Construct only	82%	18%		

This means that on a construct only road project, price changes in the client cost index will only influence 18% of the total project.

Direct project costs

The index used for direct project cost is the weighted average of all its inputs, four main input cost drivers for the Australian infrastructure construction sector are[5]:

- Input materials costs: materials such as aggregates, concrete, cement and steel are universal inputs into almost all types of infrastructure construction activity.
- Labour costs: labourers, tradespersons, management resources, engineering design and consulting are required to execute infrastructure construction projects.
- Machinery and equipment costs: the costs of purchasing or leasing machinery, equipment and spare parts are part of the normal costs of undertaking infrastructure construction.
- Oil-based costs: fuel for heavy machinery, equipment and other vehicles that are used in the process of building infrastructure, and oil-based input materials such as bitumen will form part of most road pavements/wearing courses.

The main input cost drivers may be further separated on a road project:

- Site based labour: this refers to labour used on site, in conjunction with capital equipment and materials in the construction phase of projects.
- Office-based labour: engineering design and consulting services used during all project phases.
- Bitumen: bitumen is obtained from refining crude petroleum oils and is commonly used as an economical binder for sprayed seals and aggregate mixtures used in road pavements.
- Cement and Concrete: together with reinforcing steel are used for components such as culverts, kerbs, pipes, and other road structures, and may form part of the road pavement itself.
- Quarry products: primarily used to form layers of unbound pavement, and usually form part of the pavement wearing course.
- Reinforcing steel: widely used in concrete pavements as well as road structures as a tension device to form reinforced concrete.
- Plant hire/ownership: includes plant, vehicles, appliances and other equipment such as scaffolding and formwork, used in road construction processes.

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[5] GHD Meyrick 2011 Final Report for Infrastructure Australia – Evidence Based Comparative Analysis of Major Infrastructure Costs in Australia and internationally

- Diesel fuel: is commonly used to power diesel engine mobile plant and equipment during road construction projects.

The department has determined relative weightings through the analysis of many projects noting that the input weightings are different between road and rail projects, with further differences between aboveground and belowground rail projects.

For rail construction projects, the following input cost drivers are identified:

- Labour: required at every stage of the construction process, including trade-based construction, site labour (electricians) and professional labour (engineers and project managers).
- Plant and equipment hire: required for the laying of ballast, rail tracks and installation of heavy concrete or steel products.
- Diesel: required for transportation and operation of plant and equipment.
- Concrete products: required for sleepers on rail tracks, construction of box culverts underneath the tracks, girders and precast for bridges and tunnel segments.
- Steel Products: required for tracks, fasteners, clamps and electrification (masts, cantilevers).
- Ballast or quarried products: required for earthworks such as supporting track foundation.
- Electrical equipment: required for signalling and communication, including circuits, relays, balises and encoders for communication between train and trackside components, switches and signals.
- Electrical cable and wires: required for electrification (overhead wires – contact, messenger, span, dropper).
- Bitumen: used as binder in asphalt for roads and paving for carparks and footways.
- Imported machinery and equipment: required for tunnelling, including tunnel boring machines.
- Buildings: includes railway stations, single or multi-storey.

Contractor margins

Contractor margins are the difference between the cost price of a project contract and the sale price. Contractor margins move independently of the other inputs. However, data suggests that they are correlated with the level of engineering construction activities.

3. The department's index series

The primary econometric measures of price change over time used by economists are price indices. Examples include stock market indices, consumer price indices and even the Big Mac Index which expresses the adjusted cost of a Big Mac anywhere in the world as a percentage over or under the cost of a Big Mac in the United States. An index is usually expressed as a relative factor with a value of 100 representing the price at a given base time. If the index 12 months later was 105, this would represent a 5 percent increase since the base time period. It is self-evident that, depending on economic trends, an index will fluctuate and at times, may decrease.

For the purposes of calculating escalation for infrastructure projects, the department defines the annual (financial year) escalation rate as the average of the quarterly indexes (i.e. the September, December, March and June quarters) in a given financial year divided by the average of the quarterly indexes in the previous financial year. This is because the department treats project cash flows for each financial year as a single dollar aggregate amount, and hence a single escalation rate applicable to the financial year as a whole is required.

The use of quarterly composite index series permits historical escalation rates to be calculated, which in turn provides a robust basis for updating (uplifting or rebasing) estimates prepared several years ago.

3.1. Escalation Model

In 2015 the department engaged then BIS Shrapnel to develop a suite of state and territory jurisdiction composite road construction indices, with associated forecasts, for standard road projects from which escalation rates can be derived.

BIS Shrapnel, drawing on Aquenta Consulting Pty Ltd to identify the key road construction cost drivers, initially developed escalation forecasts from 2015-16 to 2021-22 and provided historical data back to 2006-07. The forecast is updated annually by the department. With forecasts informed by extensive macroeconomic modelling documented in comprehensive reports for each jurisdiction.

These cost escalation reports address price movements in road construction components such as construction wages, materials and plant and equipment hire rates. Movements in contractor margins are incorporated into the analysis, as well as non-construction jurisdictional ("client") costs to arrive at an overall composite Road Construction Outturn Cost Index (RCOCI). In turn, forecast movements in the RCOCI provide a logically-built, jurisdiction-specific escalation (cost growth) factor for road construction projects. By making explicit the weighting of the composite indices, and the forecasts for key inputs, refinements can be made to the composite index forecasts by making appropriate adjustments to the input weights or input price forecasts.

In 2020 the department engaged Oxford Economics Australia to develop an index series for rail construction, with forecasts up to 2026-27 (Rail-COCI) and has since updated and extended the national composite rail construction indices, with forecasts, for above and below-ground rail projects. Rail-COCI has separate sets of component weightings to represent above-ground and below-ground options and has been tailored to represent the unique nature of rail.

To address concerns regarding actual and forecast negative escalation rates, the department has decided that a "zero floor" escalation policy will apply. Departmental escalation rates will not be below 0% in any financial year and the underpinning composite index series will be adjusted as necessary to account for this in the following year. As a consequence, the escalation rate for the year following the zero percent escalation would be slightly lower to adjust previous negative escalation.

Property acquisition and rolling stock

Owing to the high variability in the proportion of costs relating to property acquisition and rolling stock from one project to the next, property acquisition and rolling stock costs were not considered in the analysis of road and rail component inputs. However, applying the departments escalation rates to a project that includes property acquisition costs is unlikely to make a material difference to the total project outturn cost, unless property acquisition is a significant proportion of the un-escalated project cost. In the event that jurisdiction's expresses a concern regarding escalation of property acquisition costs, it should provide their rationale for using a property acquisition escalation rate. The jurisdiction is required to provide supporting information to the department if requested.

3.2. Considerations when developing forecasts

For the purposes of forecasting future movements in road or rail construction prices, three main factors must be considered:

- Forecasts for the various construction inputs (labour, plant, material as described at section 2.4).
- Forecasts of contractor margins.
- Forecasts of client cost changes, mainly as a result of movements in delivery agency wages.

To forecast any of the above factors it is necessary to know what the primary drivers of cost change are. Growth in input costs for Australian road and rail construction is driven by domestic and international markets or pressures. In the long run, underlying cost trends (such as the underlying trends of wage growth, or other

input categories) tend to be the dominant factor impacting price movements. However, when considering the length of a typical project life cycle through its phases, market strength or weakness can be the dominant driver of price trends. Examples include disruption of supply chains such as Covid-19, or changes in steel prices due to international pressures.

A further concept to consider when forecasting escalation is that of lag, or sticky prices. Suppliers, and thus contractors, are unlikely to change their bidding prices immediately in step with underlying trends. They may hold off on increasing their prices for a short time until they feel that the trends are real. However, with increasing costs, suppliers will generally not lag the market too long. Conversely, when costs decrease suppliers will attempt to capitalise on improved profits for as long as possible. That is, prices are sticky on the downside as suppliers hold off on passing on savings. An escalation forecasting methodology will need to consider this lag effect.

For short-term forecasts, quantity surveyors or other procurement and contracting specialists, are likely to be the source of the most reliable forecasts. However, such individuals may under-appreciate relevant macroeconomic trends outside of their specific niche, and may also lack long term insight.

On the other hand, economists tend not to be specialists in specific capital project costs or sub-markets. They are also unlikely to have bespoke indices for specific cost items or specialised equipment. Cost estimators and economists should work together to find an adjusted combination of indices that can serve as proxies for elements of project or product costs that the estimator can then apply.

4. Outturning a project

Outturning a project requires the following input variables[6]:

- Cost estimate, including contingency.
- Base date of the cost estimate.
- Cash flow pattern and dates (spending forecast throughout the project).
- Escalation rates.

The indices are used to calculate escalation of costs from the base date of the cost estimate to each financial year that project spending has been forecasted. The summation of each year's escalation forms the total project escalation and is added to the cost estimate (which includes contingency) to form the outturn cost.

In general, the length of the project (schedule) and the indices are the two main variables impacting escalation. However, the cash flow profile can have an impact, particularly for projects that have significant expenditure early or late in the project schedule.

4.1. Outturning projects using the department's PCB template

Each year the department provides each jurisdiction with a PCB template pre-loaded with the jurisdiction-specific road index series and the national rail index series. The PCB template allows escalation rates to be automatically calculated, taking into account the effective date of costing of the base estimate and the procurement type ("Design & Construct" or "Construct Only").

The steps in the process are further explained and shown below with screenshots from the 2021-22 NSW Road PCB template. Note that these steps relate only to using the PCB template to outturn a project cost estimate. The remaining fields in the PCB template must be appropriately completed by proponents

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[6] AACE International 2012 Recommended Practice 68R-11: Escalation Estimating Using Indices and Monte Carlo Simulation, AACE International, Morgantown, WV

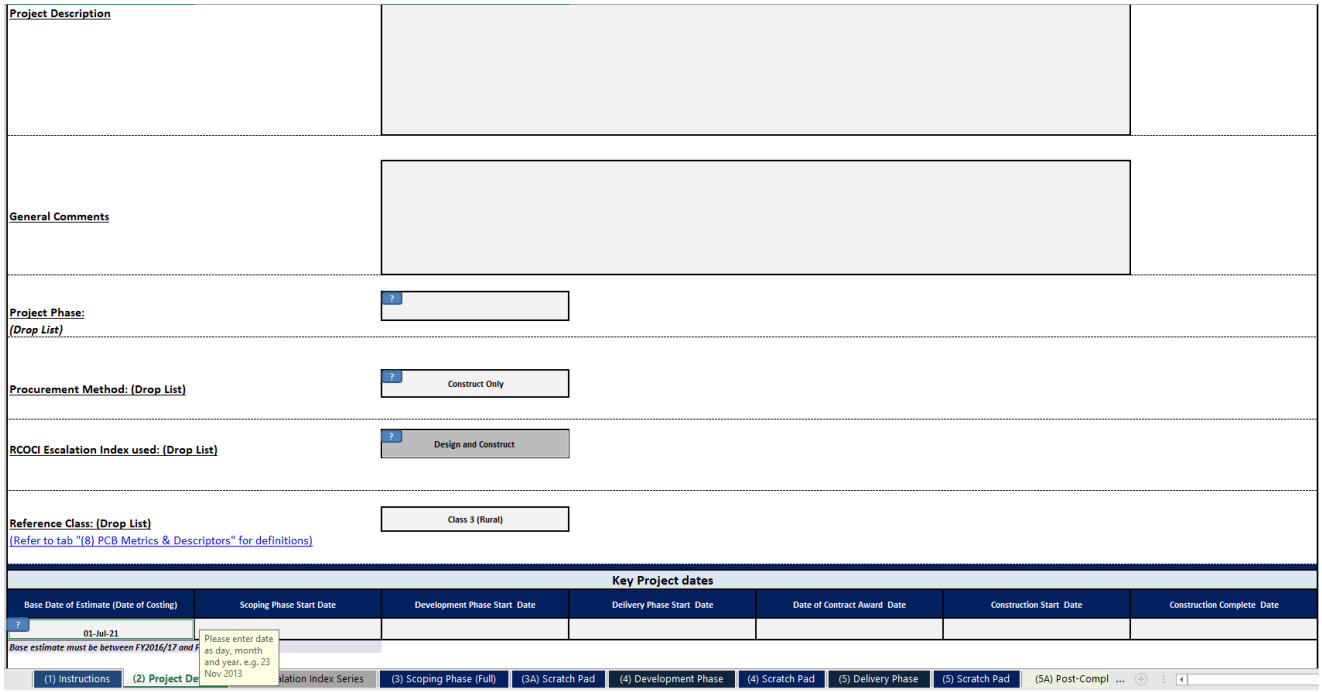
submitting PCB templates in conjunction with a Project Proposal Report (PPR) when seeking Commonwealth funding.

Step 1

Select the appropriate escalation index at on tab 2 using the drop-down arrow.

Step 2

Ensure that the base date of the estimate is entered in tab 2 and it reflects the date in which the rates used in the cost estimate were sourced not the date in which the estimate was conducted. The base date will allow the cost estimate to be rebased to the current financial year using a rebase factor. Failure to enter the base date of estimate into Cell B46 will not permit the escalation calculations to proceed.



Step 3

Once the base date is entered, the template will automatically populate the annual escalation rate (%) and cumulative escalation factor in tabs 3, 4, and 5. Part-year pro-rata adjustments will also be performed automatically based on the month of the base date and is included in the rebasing factor, seen in Table 5 in the below image. Users should enter the cashflow for the base estimate, P50 and P90, in the green shaded cells for each financial year of the project's duration. Only the tab representing the current project phase (*(3) Scoping Phase, (4) Development Phase, (5) Delivery Phase)* needs to be populated, however the cashflow should represent the total expected cost of the project for all phases:

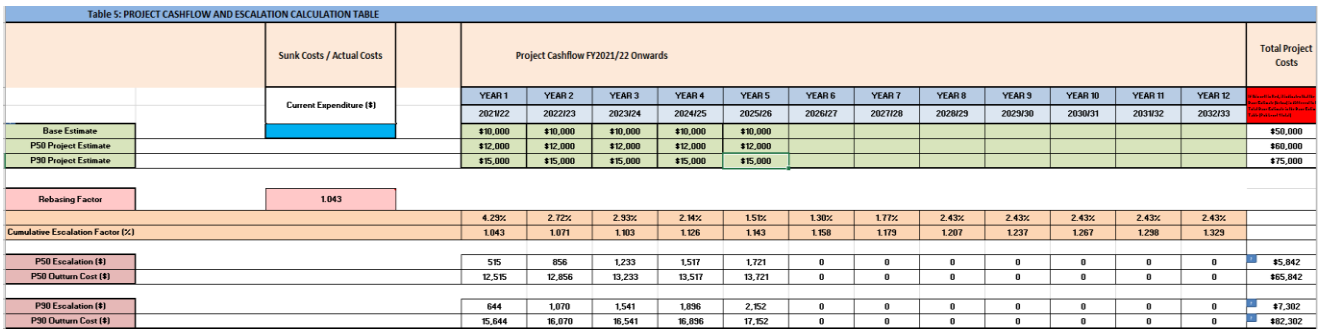


Table 5: PROJECT CASHFLOW AND ESCALATION CALCULATION TABLE

	Sunk Costs / Actual Costs		Project Cashflow FY2021/22 Onwards												Total Project Costs
	Current Expenditure ($)		YEAR 1	YEAR 2	YEAR 3	YEAR 4	YEAR 5	YEAR 6	YEAR 7	YEAR 8	YEAR 9	YEAR 10	YEAR 11	YEAR 12	
			2021/22	2022/23	2023/24	2024/25	2025/26	2026/27	2027/28	2028/29	2029/30	2030/31	2031/32	2032/33	
Base Estimate			$10,000	$10,000	$10,000	$10,000	$10,000								$50,000
P50 Project Estimate			$12,000	$12,000	$12,000	$12,000	$12,000								$60,000
P90 Project Estimate			$15,000	$15,000	$15,000	$15,000	$15,000								$75,000
Rebasing Factor		1.043													
			4.29%	2.72%	2.93%	2.14%	1.51%	1.38%	1.77%	2.43%	2.43%	2.43%	2.43%	2.43%	
Cumulative Escalation Factor (%)			1.043	1.071	1.103	1.126	1.143	1.158	1.179	1.207	1.237	1.267	1.298	1.329	
P50 Escalation ($)			515	856	1,233	1,517	1,721	0	0	0	0	0	0	0	$5,842
P50 Outturn Cost ($)			12,515	12,856	13,233	13,517	13,721	0	0	0	0	0	0	0	$65,842
P90 Escalation ($)			644	1,070	1,541	1,896	2,152	0	0	0	0	0	0	0	$7,302
P90 Outturn Cost ($)			15,644	16,070	16,541	16,896	17,152	0	0	0	0	0	0	0	$82,302

The PCB template will automatically calculate the outturned cashflow and the total outturn cost, with values shown in table 2 of tabs 3, 4 and 5.

Table 2: OVERALL PROJECT SUMMARY TABLE (incl sunk costs)		
	P50	P90
BASE ESTIMATE	$50,000	$50,000
CONTINGENCY	$10,000	$20,000
PROJECT ESTIMATE	$60,000	$70,000
ESCALATION	$4,285	$4,999
OUTTURN COST	$64,285	$74,999

4.2. Example of calculations

A simple example is shown below that shows how the calculations are built up and performed within the PCB template. The example is for information purposes only - none of the calculations below need to be performed manually by users.

Table 2: Manual calculation of annual escalation rate

Year	Quarter	Index	Financial year average quarterly index	Annual escalation rate
1	September	103.65		
	December	104.38	104.75	-
	March	105.11		
	June	105.84		
2	September	106.57		
	December	107.30	107.67	= (107.67/104.75) – 1
	March	108.03		=2.79%
	June	108.76		
3	September	109.49		
	December	110.22	110.59	= (110.59/107.67) – 1
	March	110.95		=2.71%
	June	111.68		

For a hypothetical cashflow, the escalation rates derived above are used to outturn the cashflow as per **Table 3**:

Table 3: Example of outturning cashflows using escalation rates

		A	B	C	
		Year 1	Year 2	Year 3	Totals
1	Annual Escalation Rate (%)	-	2.79%	2.71%	
2	Escalation (%)	= 1 + A1	= 1 + B1	= 1 + C1	
		= 100%	= 102.79%	= 102.71%	
3	Cumulative Factor	1	= B2 x A3	= C2 x B3	
			= 1.028	= 1.055	
4	P50 Project Estimate ($)	10,000,000	30,000,000	20,000,000	**60,000,000**
5	Escalation ($)	= (A4 x A3) – A4	= (B4 x B3) –	= (C4 x C3) – C4	**1,940,000**
		= 0	= 840,000	=1,100,000	
6	P50 Cashflow ($)	= A4 + A5	= B4 + B5	= C4 + C5	**61,940,000**
		= 10,000,000	= 30,840,000	= 21,100,000	

The PCB template will automatically rebase the cost estimate to the start of the current financial year using the rebasing factor.

4.3. Rebasing and part-year adjustments

The department uses the average annual escalation rate as the average of the composite quarterly indexes for a financial year divided by the average of the composite quarterly indexes for the previous financial year.

Since FY 2019-20 update of the PCB, part year adjustments will involve a simple monthly adjustment based on the annual escalation rate, rather than the quarterly escalation series. All calculations will be performed automatically within the PCB template.

Below is an example of part year escalation based on a 2% annual escalation rate, these formulas are based on the compound interest formula

$$A = P\left(1 + \frac{r}{N}\right)^{NT}$$

A= escalated amount at the end of the FY

P= principle amount

r_{annual}= annual escalation rate which is provided in the PCB

$r_{monthly}$ = monthly escalation rate that if compounded will be equivalent to the annual rate

N= number of times compounded in a year

t= 1 (time period in years)

Monthly periods have been used for the part-year rebasing making N=12. The monthly escalation rate needs to be determined, as this is a compounded figure it does not have a linear relationship to the annual rate. This

will be less than 1/12 of the annual rate but if compounded 12 times will give the same end of year final value as the annual escalation rate.

To determine this, assume P = 1

$$P = 1$$

$$N = 12$$

$$A = P \times (1 + r_{annual})$$

Rearranged the compound interest formula to determine the equivalent compounded interest rate and divided by 12 to determine the monthly interest rate.

$$r_{monthly} = \left(N \times A^{\left(\frac{1}{Nt}\right)} - N\right) \div 12$$

As N = 12, and t = 1

$$r_{monthly} = \left(12 \times A^{\left(\frac{1}{12}\right)} - 12\right) \div 12$$

Substitution for A

$$r_{monthly} = \left((1 + r\_annual)^{\left(\frac{1}{12}\right)} - 1\right)$$

For part-year escalation, the PCB template rebases the base estimate to the start of the FY and then applies the full annual escalation rate. Part-year escalation is only needed in the year the base estimate was conducted, full annual escalation is applied for all years following this. To rebase the base estimate to the start of the FY of the base estimate date the following method is used.

1. B is known as it is the value of the base estimate
2. Find P
3. Find A

The table below shows the month values used to determine part-year escalation. These numbers represent the number of months before the next FY, also indicating how many months of escalation is required.

July	Aug	Sep	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	June
12	11	10	9	8	7	6	5	4	3	2	1
P		**B**									**A**

The following values are used

B = 1 (This represents the base estimate value as an index, B is entered into the table in the month the base estimate was made.)

M = 10 (Month value from table in this example, this will vary depending on the base estimate date)

$$B = 1 = P \times \left(1 + r_{monthly}\right)^{12-M}$$

Solve for P

$$P = \frac{1}{(1 + r_{monthly})^{12-M}}$$

Find A

$$A = P \times (1 + r_{annual})$$

Substitution for P

$$A = \frac{1}{(1 + r_{monthly})^{12-M}} \times (1 + r_{annual})$$

Substitution for $r_{monthly}$ and cancelation of +1-1

$$A = \left(\frac{1}{\left((1 + r\_annual)^{\left(\frac{1}{12}\right)}\right)^{12-M}} \right) \times (1 + r_{annual})$$

'A' equals the end of year escalated value, the part-year escalation process rebases the base estimate to the start of the FY in which it was made based on the month the base estimate was made within that year. The formula then applies the observed annual escalation rate to rebase this value to the current financial year, and then applies the forecasted escalation rates to determine the escalated project cashflow.

$$A = \left(\frac{1}{\left((1 + r\_annual)^{\left(\frac{1}{12}\right)}\right)^{12-M}} \right) \times (1 + r_{annual}) \times \left(1 + r_{year\ 2}\right) \times \left(1 + r_{year\ 3}\right)$$

5. Conclusion

This guidance note has outlined the basic principles and a methodology for developing an index series, noting some of the key factors to take into consideration. It is stressed that these factors should not be regarded as definitive or fully inclusive.

The department provides a PCB template that has the jurisdiction-specific index series pre-loaded to enable proponents to outturn road projects based on the Oxford Economics Australia derived escalation rates. The department also provides a PCB template for rail projects which uses national escalation figures. The department has a zero-floor policy, where it will not include negative escalation rates in the forecast. It is expected that these escalation rates will also be useful, and indeed their use is encouraged, for jurisdictions to manage their own portfolios of projects for which Commonwealth funding is not being sought.

Appendix A – Recalibration of road input weightings

As part of the development of the RCOCI in 2015, Oxford Economics Australia engaged in-market expert Aquenta to provide a matrix of input shares across all jurisdictions, as well as Australia as a whole.

Table 4: Component weightings for road construction projects across Australia used between 2015-2019

State	Construction wages	Engineering Design and Consulting Services	Plant & Equipment Hire	Concrete, Cement & Sand	Bitumen	Diesel	Reinforcing Steel	Project Base Cost
AUST	29%	14%	14%	22%	12%	4%	6%	100%
NSW	27%	14%	13%	26%	14%	3%	4%	100%
VIC	29%	14%	14%	22%	12%	4%	6%	100%
QLD	27%	15%	15%	19%	15%	4%	5%	100%
SA	25%	18%	11%	22%	14%	3%	7%	100%
WA	26%	17%	13%	21%	14%	5%	3%	100%
TAS	29%	14%	14%	22%	12%	4%	6%	100%
ACT	26%	16%	13%	20%	15%	4%	5%	100%
NT	29%	14%	14%	22%	12%	4%	6%	100%

The matrix was derived through the examination of 17 major road construction projects. Given the small sample size, in 2019 the department engaged MIEngineers to analyse a random sample of 50 projects to validate the weightings.

Since 2019 the component weightings do not differentiate between jurisdictions. It was accepted that assuming the weightings apply across all jurisdictions is a limitation to the accuracy of forecasts. Work to derive jurisdiction-specific weightings from a suitably large sample of projects may be considered in future.

The revised weightings, used from 2019/20 onwards, are shown in the table below[7].

Table 5: Component weightings for road construction projects across Australia used from 2019/20

	Construction wages	Engineering Design and Consulting Services	Plant & Equipment Hire	Concrete, Cement & Sand	Bitumen	Diesel	Reinforcing Steel	Project Base Cost
Weighting	27%	7%	19%	31%	8%	3%	5%	100%

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[7] Source: MIEngineers

Appendix B – Rail input weightings

In 2020, Oxford Economics Australia obtained survey data from Fission used to inform rail input weightings, which consisted 17 rail projects. Whilst the project sample mostly accounted for rail projects in Queensland and does not include underground projects, the following component weightings have been developed:

Table 6: Component weights for rail construction projects across Australia

Component	Aboveground Weighting	Belowground Weighting
Labour	34.1%	38.0%
Plant & Equipment Hire	19.4%	9.7%
Diesel	1.4%	0.7%
Concrete Products	7.8%	6.5%
Steel Products	7.4%	3.7%
Ballast/Quarried Products	5.5%	2.8%
Electrical Equipment	7.4%	3.7%
Electrical Cable & Wires	1.4%	0.7%
Bitumen	1.4%	0.0%
Building	3.6%	19.9%
Imported Machinery & Equipment	0.0%	11.2%
Other	10.7%	3.2%

Appendix C – Definitions and abbreviations

Term	Definition
Agency	A state or territory government body that generally will deliver an infrastructure project.
Assumption	A documented, cost-related factor that, for the purpose of developing a base cost estimate is considered to be true, real or certain.
Base Date	A base date is a reference date from which changes in conditions, (including rates and standards) can be assessed. In the context of a base estimate it is the date for which the rates included in the cost estimate reflect current market conditions.
Base Estimate	The sum of the construction costs and client's costs at the applicable base date. It represents the best prediction of the quantities and current rates which are likely to be associated with the delivery of a given scope of work. It should not include any allowance for risk (contingency) or escalation.

Term	Definition
BCR	The Benefit Cost Ratio (BCR) is the ratio that represents the benefits over costs and is represented as a single number. Further guidance on BCR can be found on the Australian Transport Assessment and Planning (ATAP) website.
Client Costs	In this guidance note, 'client' is taken to mean the project proponent. Client costs are the costs incurred by the proponent (for example, public sector delivery agency) to develop and deliver a project.
Construction Costs	The costs required to complete the activities or tasks associated with the construction elements of a project.
Contingency	An amount added to an estimate to allow for items, conditions, or events for which the state, occurrence, or effect is uncertain and that experience shows will likely result, in aggregate, in additional costs[8]. As per Appendix B of NoA: *"The component of a Project's cost in excess of the Project Base Estimate that accounts for, or reflects, risk*". For further information on contingency refer to guidance notes 3A and 3B.
Contractor Direct Costs	All contractor's costs directly attributable to a project element including, but not limited to, plant, equipment, materials, and labour.
Contractor Indirect Costs	Costs incurred by the contractor to perform work but which are not directly attributable to a project element. These generally include costs such as preliminaries, supervision, and general and administrative costs.
Escalation	The component of a project's total cost at any point in time that reflects changes in prices and costs since the base cost estimate date. Escalation is added to the project cost to obtain the outturn cost. Escalation aspects do not form part of the scope of this document. For further information refer to Guidance Note 4 - Escalation.
Escalation Rate	The department derives escalation rates from actual or forecast composite index series that reflect the characteristics of infrastructure projects, where the escalation rate in any financial year is calculated from the average of the composite quarterly indexes for that financial year divided by the average of the composite quarterly indexes for the previous financial year.
Estimator	The person or organisation that prepares a cost estimate.
First Principles Estimate	The method of preparing a cost estimate by breaking down the project into a work breakdown structure and determining rates and quantities for each component. The cost estimate is the summation of each component.
Jurisdiction	An Australian state or territory.
Labour	Effort expended by people for wages or salary.
Margin	An allowance that includes the construction contractor's corporate overheads and profit.

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[8] AACE International, Recommended Practice 10S-90, Cost Engineering Terminology, accessed 19 October 2022 <https://web.aacei.org/docs/default-source/rps/10s-90.pdf>

Term	Definition
Material	An article, material, or supply brought to a construction site by the contractor or a subcontractor for incorporation into the work. Also includes any items brought to the site preassembled from articles, materials or supplies.
NoA	The Notes on Administration for Land Transport Infrastructure Projects 2019-2024 (NoA), provide administrative detail to support the National Partnership Agreement (NPA) and apply to all Projects funded, or proposed to be funded under Part 3 (Investment Projects) and Part 7 (Black Spot Projects) of the National Land Transport Act 2014 (NLT Act).
NPA	National Partnership Agreement on Land Transport Infrastructure Projects (NPA).
Outturn Cost	Outturn cost is the summation of the base cost, contingency and the total escalation, it is the nominal total project cost. The department's Project Cost Breakdown (PCB) template can be used to calculate escalation and outturn costs. In economic terms non-escalated costs are often referred to as real costs while outturn costs are often referred to as nominal costs.
Overhead(s)	A cost or expense inherent in the performing of an operation, (e.g., engineering, construction, operating, or manufacturing) which cannot be charged or identified with a part of the work, product or asset and, therefore, must be allocated on some arbitrary basis believed to be equitable, or handled as a business expense independent of the volume of production. These costs are considered when determining the cost of business.
Project Cost Breakdown (PCB)	A PCB template is provided by the department and is updated annually to reflect the latest escalation rates for road and rail projects.
Project Cost	The base estimate cost plus an allowance for contingency and generally prefixed by P50 or P90 to represent the level of contingency included. The project cost reflects costs as of the base estimate date.
Plant	All plant, motor vehicles, appliances and things (for example, scaffolding and formwork) of whatsoever nature used or in use in or about the execution of the work, but does not include materials, plant, equipment intended to form or forming part of the works.
Project Proposal Report (PPR)	A statement detailing the scope and benefits of the project submitted by proponents as part of the project approval process.
Project Scope	The work that must be performed to deliver a product, service or result with the specified features and functions.
Subcontractor	A contractor that enters into a subcontract and assumes some of the obligations of the primary contractor.
Sunk Costs	Costs which have already been incurred, such as investigation, research, and design costs. Sunk costs are included in an outturn cost.
Work Breakdown Structure (WBS)	A way of organising a project using a hierarchical breakdown of the activities required to complete the project. The WBS organises and defines the total scope of the project.